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Original article

## A preliminary detective survey of hymenopteran insects at Jazan Lake Dam Region, Southwest of Saudi Arabia

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## ABSTRACT

A preliminary detective survey for the hymenopteran insect fauna of Jazan Lake dam region, Southwest Saudi Arabia, was carried out for one year from January 2018 to January 2019 using mainly sweep nets and Malaise traps. The survey revealed the presence of three hymenopteran Superfamilies (Apoidea, Vespoidea and Evanioidea) representing 15 species belonging to 10 genera of 6 families (Apidae, Crabronidae, Sphecidae, Vespidae, Mutillidae, and Evaniidae). The largest number of species has belonged to the family Crabronidae is represented by 6 species under 2 genera. While the family Apidae, is represented by 2 species under 2 genera. Family Vespidae is represented by 2 species of one genus. While, the rest of the families Sphecidae, Mutillida, and Evaniidae each is represented by only one species and one genus each. Eleven species are predators, two species are pollinators and two species are parasitics. Note for each family was provided, and species was provided with synonyms and general and taxonomic remarks and their worldwide geographic distribution and information about their economic importance are also included. All species were photographed with dorsal and lateral views.

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## 1. Introduction

Jazan region located in southwestern Saudi Arabia and at the north border of Yemen between 16°20'N to 17°40'N and 41°55'E to 43°20'E (Tounekti et al., 2019). Jazan region has a distinctive nature of landform, climate and water availability as it is characterized by high ambient temperature and humidity. Jazan recorded an average annual temperature of 86.2°F (30.1 °C). The average daytime temperature during January ranged from 88°F (31 °C) to 73°F (23 °C), while the average in July ranged from 104.4°F (38 °C) to 86°F (30 °C) around that previously recorded (Bosly and Kawanna, 2014). This region considered as one of the richest regions for genetic resources in Saudi Arabia by high species diversity because its variable geomorphological characteristics like

islands, sand dunes, sandy plains and low rocky hills (Al-Turki et al., 2019).

A recent vegetation survey study in three zones away from Wadi Jazan dam reservoir (Sayed et al., 2020) concluded that the dam reservoir changed the soil and flora, which significantly affected the fragile desert ecosystem. The study indicated plant distribution related species according to the reservoir existence. Which were, summer annuals and perennials as salt-tolerant and drought tolerant, also aquatic and wetland plant species were recorded that uncommonly existed within the normal regional desert flora.

Hymenoptera order of insects distributed all over the world and important as pollinators for wild and flowering plants, parasitics of destructive insects and honey makers, thy also nonparasitic, carnivorous, phytophagous, or omnivorous. The order includes sawflies, wasps, ants, bees. The order according to the updated classification is composed of 2 suborders, 27 superfamilies, 132 families, 8423 extant genera with an additional 685 extinct genera and thought as one of the most species-rich insects' orders comprising 153,088 extant species with 2429 nonextinct species have been described (Aguilar et al., 2013). The Hymenoptera fauna existed in the Arabian region as a mixture of Palearctic and Afrotropical elements with a large number of endemic species. The Hymenoptera tend to accumulate in a desert region around

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the green spot, possibly with available water sources as recorded in Jazan region (Gadallah et al., 2013).

Fauna in Jazan region showed little interest, no detailed studies about the diversity of insects, except very few works, carried out on certain insect groups. Studies such as on mosquito larval survey (Abdullah and Merdan, 1995), phlebotomus species in Asir region (Ibrahim and Abdoon, 2005), Dipterous flies (Bosly, 2010), Mosquitos (AlAhmed et al., 2010) and recently on Chloropidae (Diptera) (Dawah et al., 2020). Hence, because of the scarcity of knowledge regarding the insect fauna of Jazan Dam region, the present work interested in collecting information about the hymenopterous insect fauna survey in Jazan Lake dam region.

## 2. Material and methods

### 2.1. Description of the area of study

Wadi Jazan area is situated in the southwest part of Saudi Arabia on Red Sea coast. The Jazan Dam is a gravity on Wadi Jazan about 16 km (9.9 mi) northeast of Abu Arish in Jizan Province of southwest Saudi Arabia between series of the high mountains of western coastal plain descending gradually toward the Red Sea. Coordinates of Jazan Dam (17°02'56.84"N 42°57'27.54"E). The present survey was carried out at The Jazan Lake dam region (Plate 1 (Figures 1A) and (1B)). Wadi Jazan dam was built on a large depressed desert for storing summer runoff water for irrigation of desert agriculture and protection against flash floods. The soil type in this area changes from clay to clay-loam and sand-silt soil as the distance from the reservoir increased. Vegetation of area around reservoir revealed the existence of summer annual and perennial herbs and shrubs in addition salt-tolerant species and many showed good ethnobotanical potential (Tounekti et al., 2019; Sayed et al., 2020).

### 2.2. Samples collection:

The survey was carried out by sweeping net and Malaise traps, during one whole year (January 2018 up to January 2019). All species were collected between rocks and plants in the area surrounding the lake. Where, sweep net was suitable for quantitative estimation, and Malaise trap was ideal for a wider qualitative estimation and a combination of different methods is highly recommended for a comprehensive sampling of groups like parasitic Hymenopteran sampling where different genera vary in behaviour, ecological niche and their hosts (Darling and Packer, 1988; Campbell and Hanula, 2007). The captured insects were processed and preserved in 70% alcohol and examined under a Stereo Zoom Microscope (Meiji Techno Japan's High Quality -EMT-42321 Meiji Techno co., LTD -Tokyo, Japan), the collected species were identified and photographed.

The collected species were identified at Insect Identification and Classification Department (IICD), in the Plant Protection Research Institute (PPRI), Agricultural Research Center (ARC), Egypt, and the King Saud Museum of Arthropod (KSMA), Riyadh, Saudi Arabia. In addition to confirmation, identified species were sent to the Natural History Museum, London, United Kingdom (BMNH).

## 3. Results

The list of the collected hymenopteran insects from the area of study in the present survey results are represented (Table 1) showing the recent scientific names of the species in alphabetical order according to families, genera and species together with their economic status. Note for each family are provided, and each species

is reported with synonyms, available information about their economic importance and their worldwide geographic distribution. General and taxonomic remarks are also given where appropriate. In addition to photographs are presented of the dorsal and lateral views of the collected species (Plates 2–5).

Fifteen species belonging to ten genera representing order Hymenoptera in three superfamilies, Apoidea, Vespoidea and Evanioidea and six families, namely are Apidae, Crabronidae, Sphecidae, Vespidae, Mutillidae, and Evaniidae. Family Apidae, is represented by 2 species the first is *Apis florea* Fabricius, 1787 (Figure: 2A and 2B) representing the genus *Apis* Linnaeus, 1758 and the second is *Xylocopa aestuans* (Linnaeus, 1758) (Figures: 3A and 3B) representing the genus *Xylocopa* Latreille, 1802 (Plate 2). In table (1) data indicated that, the highest existing number of species belongs to the family Crabronidae represented by 6 species. The *Bembecinus iranicus* Schmid-Egger, 2004 (Figures: 4A and 4B), *Stizus vespoides* (Walker, 1871) (Figures: 5A and 5B) (Plate 3), *Liris* sp. (Figures: 6A and 6B), *Tachytes* sp. (Figures: 7A and 7B) *Tachysphex deserticola* de Beaumont, 1940 (Figures: 8A and 8B) and *Tachysphex* sp.1 (Figures: 9A and 9B), *Tachysphex* sp.2 (Figures: 10A and 10B) and *Tachysphex* sp.3 (Figures: 11A and 11B) (Plate 4). The aforementioned Crabronidae species are within 4 genera (*Bembecinus* A. Costa, 1859, *Stizus* Latreille, 1802, *Liris* Fabricius, 1804 and *Tachysphex* Kohl, 1883), respectively. Sphecidae family each is represented by only one species *Ammophila insignis* F. Smith, 1856 (Figures: 12A and 12B), belonging to, *Ammophila* W. Kirby, 1798 genus. While Vespidae is represented by 2 species *Delta dimidiatipennis* (Saussure, 1852) (Figures: 13A and 13B) and *Delta esuriens* (Fabricius) (Fabricius, 1775) (Figures: 14A and 14B) belonging to the genus *Delta* de Saussure, 1855. The last two families, Mutillidae and Evaniidae is represented by only one species belonging to one genus. Mutillidae family is represented by *Trogaspidia floralis* Klug, 1829 (Figures: 15A and 15B), species of the genus *Trogaspidia* Ashmead 1899. While, family Evaniidae is represented by *Evania* sp. (Figures: 16A and 16B) of *Evania* Fabricius, 1775 genus (Plate 5). From the economic points of view, it was found that, eleven species are predators, two species are pollinators and two species are parasitic insects. While, five species are identified at the genus level, which are: *Liris* sp., *Tachytes* sp., *Tachysphex* sp.1, *Tachysphex* sp.2 and *Tachysphex* sp.3 (family Crabronidae) and *Evania* sp. (family Evaniidae) due to uncertainty of the species name.

### 3.1. Family Apidae (Flower and honeybees)

The family containing up to thousand species including social bees as well as some solitary and primitively social forms with worldwide distribution and pollination were recorded for this family of bees. It is the largest family within the superfamily Apoidea, contained 3 subfamilies, Apinae, Nomadinae and Xylocopinae. Apinae contains four tribes Apini (honeybees), Meliponini (stingless bees), Bombini (bumblebees), and Euglossini Apidae are bees with long tongue without pygidial plate or basitibial plates and a rather small (orchid bees) (Engel, 2005; Goulet and Hubert, 1993; Oldroyd and Pratt, 2015).

#### 3.1.1. *Apis florea* Fabricius, 1787, (Figure: 2A and 2B)

**Taxonomy: Family:** Apidae; **Subfamily:** Apinae; **Tribe:** Apini Latreille, 1802; **Genus:** *Apis* Linnaeus, 1758; **Subgenus:** *Apis* (*Micrapis*) Ashmead, 1904; **Species:** *Apis florea* Fabricius, 1787.

*Apis florea* acquired common name, dwarf honeybee with special morphology, foraging behavior and defensive mechanisms as they are making a piping noise (Nagaraja, 2020).

**Habitat:** This type of bees is one of the smallest bees known to be able to withstand high temperatures that may reach 50 °C. In addition, characterized by good adaptation to the hot arid conditions of both urban and bucolical landscapes and not affected by competition with the local *Apis mellifera* (El Shafie et al., 2002). A.

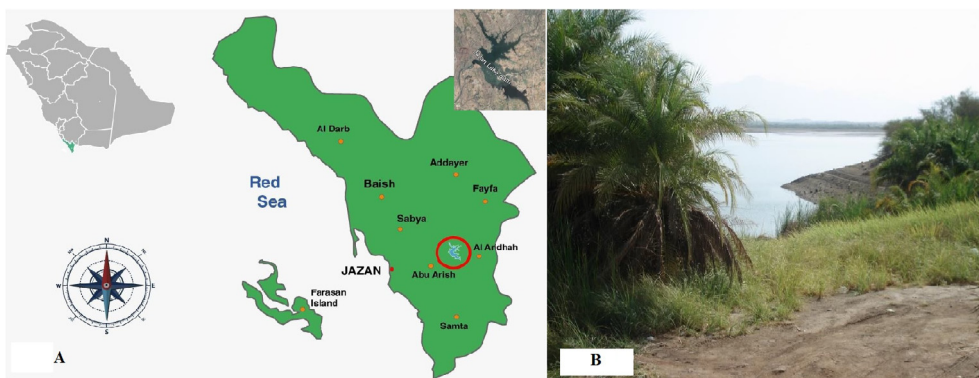


Plate 1. Figure 1A: Site location map and Figure 1B: Site of the study.

**Table 1**  
List of hymenopteran insects surveyed at the Jazan dam region, Southwest Saudi Arabia, during two successive years (Jan. 2018 - Jan. 2019) and their economic status.

Superfamily	Family	Subfamily	Genus	Species	Economic status	
<b>Apoidea</b>	<b>Apidae</b>	Apinae	<i>Apis</i> Linnaeus, 1758	<i>Apis florea</i> Fabricius, 1787	Pollinator	
		Xylocopinae	<i>Xylocopa</i> Latreille, 1802	<i>Xylocopa pubescens</i> Spinola, 1838	Pollinator	
	<b>Crabronidae</b>	Bembicinae		<i>Bembecinus</i> A. Costa, 1859	<i>Bembecinus iranicus</i> Schmid-Egger, 2004	Predator
				<i>Stizus vespoidea</i> (Walker, 1871)	<i>Stizus vespoidea</i> (Walker, 1871)	Predator
		Crabroninae		<i>Liris</i> Fabricius, 1804	<i>Liris</i> sp.	Predator
				<i>Tachysphex</i> Kohl, 1883	<i>Tachytes</i> sp.	Predator
					<i>Tachysphex deserticola</i> de Beaumont, 1940	Predator
<b>Vespoidea</b>	<b>Sphacidae</b>	Ammophilinae	<i>Ammophila</i> W. Kirby, 1798	<i>Ammophila insignis</i> F. Smith, 1856	Predator	
		Eumininae	<i>Delta</i> de Saussure, 1855	<i>Delta dimidiatipennis</i> (Saussure, 1852)	Predator	
	<b>Vespidae</b>			<i>Delta esuriens</i> (Fabricius) (Fabricius, 1775)	Predator	
				<i>Trogaspidia floralis</i> Klug, 1829	Predator	
<b>Evanoidea</b>	<b>Mutillidae</b>	Mutillinae	<i>Trogaspidia</i> Ashmead 1899	<i>Trogaspidia floralis</i> Klug, 1829	Parasitoid	
	<b>Evaniiidae</b>	-	<i>Evania</i> Fabricius, 1775	<i>Evania</i> sp.	Parasitoid	

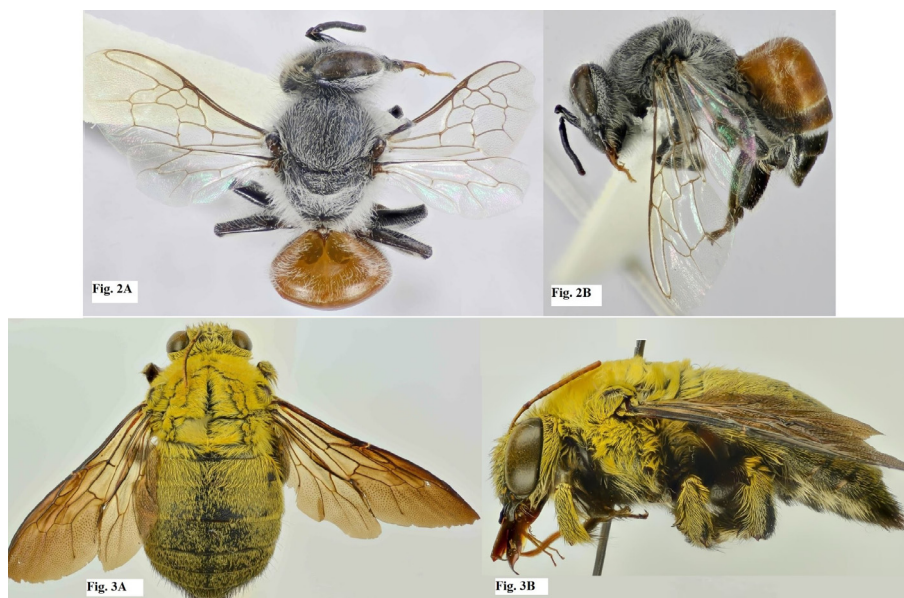


Plate 2. Figures: (2 A&B) *Apis florea* and (3 A&B) *Xylocopa aestuans*.

*florea* original native in Thailand, Malaysia, Indonesia and India with high invasive potential, it cohabited with the native *A. mellifera* in Sudan and genetic data indicated that its spreading based on a single colony (El-Niweiri et al., 2019).

**Importance:** They are pollinators of tropical fruit crops inhabiting forest and more susceptible to predation from cavity nesters with large numbers of defensive workers because of their open nests and small colonies (Beekman and Oldroyd, 2018).



**Plate 3.** Figures: (4 A&B) *Bembecinus iranicus* and (5 A&B) *Stizus vespoidea*.



**Plate 4.** Figures (6 A&B: *Liris* sp.), (7 A&B: *Tachytes* sp.), (8 A&B: *Tachysphex deserticola*), (9 A&B: *Tachysphex* sp.1, (10 A&B: *Tachysphex* sp.2) and (11 A&B: *Tachysphex* sp.3).

**Geographic distribution:** *A. florea* existed in Asia and Africa, and in forested regions of Saudi Arabia (Haddad et al., 2009; Hepburn et al., 2005).

**Remark:** The species was accidentally introduced into Saudi Arabia (Cardinal and Packer, 2007; Hepburn et al., 2005). This species was also previously recorded (El-Hawagry et al., 2016, 2013)

from El Baha region (Southeast Saudi Arabia) and in Riyadh (Hepburn et al., 2005). The workers body size and most morphometric characteristics recorded in the previous study within the species in the Jubail and Al-Ahsa provinces of Saudi Arabia were varied significantly according to their geographical origin. In addition to most measured characteristic values of the dwarf bees in



**Plate 5.** Figures (12 A&B: *Ammophila insignis*), (13 A&B: *Delta dimidiatipennis*), (14 A&B: *Delta esuriens*) and (15 A&B: *Evania* sp.).

Saudi Arabia were lower than that recorded from Pakistan, Nepal, Myanmar, Thailand, India, and Iran, while they were higher than that recorded from Sri Lanka (Al-Kahtani and Taha, 2014).

### 3.1.2. *Xylocopa pubescens* Spinola, 1838, (Figures: 3A and 3B)

(=*Xylocopa aestuans* subsp. *rubida* Gribodo, 1884; *Xylocopa pubescens* Eardley, 1987; *xylocopa rubida* Gribodo, 1884)

**Taxonomy:** Family: Apidae; **Subfamily:** Xylocopinae; **Tribe:** Xylocopini; **Genus:** *Xylocopa* Latreille, 1802; **Subgenus:** *Koptortosoma* Gribodo; **Species:** *pubescens* Spinola, 1838.

***Xylocopa pubescens* Spinola, 1838:** It is a large bee, measuring more than 20 mm in length. It has been confused with *Xylocopa aestuans*. They differ in their distribution areas as *Xylocopa aestuans* distributed in Southeast Asia while, *Xylocopa pubescens* occurs in Africa and eastward as far as the entire region of South Asia. A survey in Al-Baha Province, Saudi Arabia was recorded, *Xylocopa* (*Koptortosoma*) *pubescens* Spinola in three regions supporting the association of Al-Baha as Afrotropical Region in spite of Palearctic Region or the Eremic Zone (El-Hawagry et al., 2016). Previously in southern Saudi Arabia the large bees *Xylocopa* (*Koptortosoma*) *pubescens* Spinola was recorded and reported as *X. aestuans* (Linnaeus) (Hannan et al., 2012) and corrected later to *X. pubescens* (Engel et al., 2017). The species principally nest in deadwood (including the wood of human constructions), bamboo culms, and other similar substrates. Figure 4 (A and B).

**Habitat:** *Xylocopa pubescens* is found in the tropical and subtropical regions of the world, including primary forests, secondary forests, urban gardens, and urban parks and can even be found nesting in man-made structures such as garden sheds or wooden pillars and they tolerate high ambient temperatures during foraging (Keasar, 2010).

**Geographic distribution:** *Xylocopa pubescens* distributed in Saudi Arabia, United Arab Emirates, Iraq, Ethiopia, Sudan, Pakistan, India, Iran, North Africa (Morocco, Tunisia, Algeria, Libya, Egypt),

Sahel (Cape Verde, Senegal, Niger, Cameroon, Ethiopia, Eritrea) and expanded in distribution to Spain and Greece in Europe (Ascher and Pickering, 2020; Bodlah et al., 2015; Hannan et al., 2012; Özbek, 2013; Prashantha and Belavadi, 2017).

**Remark:** *Xylocopa pubescens* foraging behavior is characterized by a long season of activity, high diversity of foraging plants, tolerance of high temperatures not below 18 °C, activity under low illumination levels. They are able to perceive ultraviolet light and flowers that have UV floral patterns or reflect UV rays may attract more bees. The *X. pubescens* pollination increased fruit set threefold as compared to honeybee pollination that encouraged in greenhouse crops (Keasar, 2010; Sadeh et al., 2007).

### 3.2. Family Crabronidae (Sand wasps)

The family Crabronidae is by far the most diverse of the spheciform families belong to Apoidea superfamily. Recently, worldwide, fauna of this group is presented by 9005 species divided into 8 subfamilies and 243 genera with predation behavior. Many Crabronidae species prefer Saharan climate and they are active during high temperature (Pulawski, 2019).

**Remark:** This family was previously treated as a subfamily of the family Sphecidae. A study of the insect fauna of Al-Baha Province, Saudi Arabia (El-Hawagry et al., 2013) recorded 7 species within 4 genera. While in the present survey, seven species within 4 genera and two subfamilies were recorded. The family Crabronidae was represented by 54 genera and 383 species in the Arabian Peninsula (Gadallah and Brothers, 2020).

#### 3.2.1. *Bembecinus iranicus* Schmid-Egger, 2004 (Figures: 4A and 4B)

**Taxonomy:** Family: Crabronidae; **Subfamily:** Bembicinae Latreille, 1802; **Tribe:** Bembicini Latreille, 1802; **Subtribe:** Stizina A. Costa, 1859; **Genus:** *Bembecinus* A. Costa, 1859; **Species:** *Bembecinus iranicus* Schmid-Egger, 2004.

**Bembecinus iranicus** Schmid-Egger, 2004 is a species of sand wasps, family Crabronidae. A predator, its larvae fed on a variety of Homoptera (Hyodo et al., 2011).

**Geographical Distribution:** Distribution in Saudi Arabia (Gadallah et al., 2013) as *Bembecinus asiaticus*), United Arab Emirates (Schmid-Egger, 2014). In addition to distribution in Afghanistan, Iran, Iraq, Pakistan, Turkey, Turkmenistan, Turkey, Uzbekistan, Uzbekistan, Sudan, Niger, Lybia, Egypt. Morocco. Europe and Russian Far East (Rezaei and Fallahzadeh, 2015; Schmid-Egger, 2004).

**Remark: De Beaumont (1954)** recognized firstly *Bembecinus* as a valid genus and its knowledge is still poor and remains incomplete in the Arabian Peninsula (Schmid-Egger, 2014).

### 3.2.2. *Stizus vespoides* (Walker, 1871) (Figures: 5A and 5B)

(=*Larra argentea* Taschenberg, 1875; *Larra magnifica* F.Smith, 1873; *Larra vespoides* Walker, 1871)

**Taxonomy: Family:** Crabronidae; **Subfamily:** Bembicinae Latreille, 1802; **Tribe:** Bembicini Latreille, 1802; **Subtribe:** Stizina A. Costa, 1859; **Genus:** *Stizus* Latreille, 1802; **Species:** *Stizus vespoides* (Walker, 1871).

**Importance:** A predator, mainly mass provision its cells with grasshoppers, katydids, and mantids.

**Geographical Distribution:** Distributed in Saudi Arabia: Abu Arish, Jeddah). While generally distributed in Afrotropical region in Chad, Djibouti, Eritrea, Niger, Sudan, Yemen) and Palaearctic region in Algeria, Egypt, Libya, Morocco, Palestine, Saudi Arabia and the United Arab Emirates) (Gadallah & Assery, 2004a; Gadallah et al., 2013)

**Remark: Shalaby, (1961)**, firstly reported this species in Saudi Arabia.

### 3.2.3. *Liris* Sp. (Figures: 6A and 6B)

**Taxonomy: Family:** Crabronidae; **Subfamily:** Crabroninae Latreille, 1802; **Tribe:** Larrini Latreille, 1810; **Subtribe:** Larrina Latreille, 1810; **Genus:** *Liris* Fabricius, 1804; **Species:** *Liris* Sp.

**Liris** Sp. **Sample** from *Liris* genus is the 5th richest genus of the Crabronidae. Fabricius first published the species scientific name as valid in 1804. The species predominantly pan-tropical genus of solitary ground-nesting predatory wasps, worldwide existing more than 313 species (da Costa and Buschini, 2016).

**Habitat:** *Liris* species usually make nests by digging in the ground or using prior burrows (Krombein and Gingras, 1984). The nest made of a variety of materials like sand, small stones, wood chips or different plant materials with different architectures (Krombein and Gingras, 1984; Steiner, 1968).

**Importance:** A predator (Steiner, 1976).

**Geographical Distribution:** *Liris braueri* Kohl, 1884, distributed in Saudi Arabia without specific locality (Gadallah and Assery, 2004b), while generally distributed in Oman, UAE (Afrotropical region), Sri Lanka, Central Asia, Egypt, Iran, Kazakhstan, Palestine, Saudi Arabia (Palaearctic region). *Liris festinans praetermissus* (Richards, 1928), Newly distributed in Saudi Arabia and found in Tamim (180 Km south of Riyadh). Generally distributed in the Afrotropical region (Oman, UAE), Palaearctic region (Afghanistan, Algeria, Bulgaria, France, Greece, Italy, Kazakhstan, Malta, Portugal, Spain, Turkey). In addition, *Liris haemorrhoidalis* (Fabricius, 1804), distributed in Saudi Arabia in Hadasham (120 Km east Jeddah) and generally distributed in the Afrotropical region in Cape Verde Islands, Cameroon, Central African Republic, Eritrea, Ethiopia, Kenya, Mozambique, Oman, Socotra, Somalia, South Africa, Sudan, Tanzania, Zimbabwe, in Oriental region (India), in the Palaearctic region (Afghanistan, Canary Islands, Egypt, Iran, Iraq, Italy, Kazakhstan, Libya, Morocco, Palestine, Saudi Arabia, Spain, Western Sahara) (Gadallah et al., 2013; Gadallah, 2020a). In addition four species of genus of *Liris* Fabricius (subfamily; Larrinae) were stud-

ied in different regions of Iraq that were, *L. haemorrhoidalis* (Fabricius), *L. subtessellata* (Smith), *L. atratus* (Spinola) and *L. nigricans* (Walker) (Augul, 2015).

### 3.2.4. *Tachytes* sp. (Figures: 7A and 7B)

**Taxonomy: Family:** Crabronidae; **Subfamily:** Crabroninae Latreille, 1802; **Tribe:** Larrini Latreille, 1810; **Subtribe:** Gastrosericina André, 1886; **Genus:** *Tachytes* Panzer, 1806; **Species:** *Tachytes* sp.

The genus *Tachytes* is a genus of predatory, solitary wasps, containing about 300 species of medium-sized large-eyed digger wasps that nest in sandy soil (Back and Kim, 2014).

**Importance:** A predator of the immature grasshoppers in general (Bohart & Menke, 1976).

**Geographic distribution:** Distributed in the temperate and tropical world (Bohart & Menke (1976).

**Remarks:** Gadallah et al. (2013) recorded 12 species of the genus *Tachytes* from Saudi Arabia. Different *Tachytes* sp. have been recorded worldwide, Egypt, Jordan, Saudi Arabia, Yemen, Oman, United Arab Emirates, Jordan, Syria, Turkey, Mali, Lebanon, Mauretania, Pakistan, Tajikistan, India, Italy, Kazakhstan, Romania, Russia, Singapore, Slovakia, Spain, Turkmenistan, Ukraine, Yugoslavia (Gadallah, 2020a; Schmid-Egger, 2011).

### 3.2.5. *Tachysphex deserticola* de Beaumont, 1940 (Figures: 8A and 8B)

**Taxonomy: Family:** Crabronidae; **Subfamily:** Crabroninae Latreille, 1802; **Tribe:** Larrini Latreille, 1810; **Subtribe:** Gastrosericina André, 1886; **Genus:** *Tachysphex* Kohl, 1883; **Species:** *deserticola* de Beaumont, 1940.

**Tachysphex deserticola** is one of the sand wasps of the genus *Tachysphex* of the family Crabronidae (previously assigned in the family Sphecidae), which is a diverse genus of wasps, and is the largest in the Larrini with over 350 species (Bohart & Menke, 1976).

**Importance:** It is a polyphagous predator; provision its nests with various Orthoptera (Bohart & Menke, 1976).

**Geographical distribution:** Saudi Arabia, Sudan, Egypt, Libya (Gadallah, 2020a).

### 3.2.6. *Tachysphex* sp-1 (Figures: 9A and 9B)

**Taxonomy: Family:** Crabronidae; **Subfamily:** Crabroninae Latreille, 1802; **Tribe:** Larrini Latreille, 1810; **Subtribe:** Gastrosericina André, 1886; **Genus:** *Tachysphex* Kohl, 1883; **Species:** *Tachysphex* sp1.

### 3.2.7. *Tachysphex* sp-2 figure (Figures: 10A and 10B)

**Taxonomy: Family:** Crabronidae; **Subfamily:** Crabroninae Latreille, 1802; **Tribe:** Larrini Latreille, 1810; **Subtribe:** Gastrosericina André, 1886; **Genus:** *Tachysphex* Kohl, 1883; **Species:** *Tachysphex* sp2.

### 3.2.8. *Tachysphex* sp-3 (Figures: 11A and 11B)

**Taxonomy: Family:** Crabronidae; **Subfamily:** Crabroninae Latreille, 1802; **Tribe:** Larrini Latreille, 1810; **Subtribe:** Gastrosericina André, 1886; **Genus:** *Tachysphex* Kohl, 1883; **Species:** *Tachysphex* sp3.

**Remark:** Gadallah et al. (2013) recorded 27 species of *Tachysphex* from Saudi Arabia, giving their general distribution, and their distribution in Saudi Arabia, of them, the species, *Tachysphex deserticola* that is new for Saudi Arabia and the Arabian Peninsula's fauna. Al-Ahmadi and Salem (1999) mentioned only one species of the genus *Tachysphex* from Saudi Arabia, which is *T. aegyptius* (Morice). Different species of the Genus *Tachysphex* Kohl, 1883 were represented in the Arabian Peninsula especially in Saudi Arabia (Gadallah, 2020a).

### 3.3. Family Sphecidae (Mud-dauber and thread-waisted wasps)

The Sphecidae are a cosmopolitan family of wasps of the suborder Apocrita that includes mud daubers, and thread-waisted wasps. The family has five subfamilies (Ammophilinae, Chloriontinae, Sceliphrinae, Sphecinae and Stangeellinae) of a total of 787 extant species in 19 genera (Pulawski, 2019). Species of the family Sphecidae easily differentiated from other spheciform families by their petiolate metasoma and the large anal lobe of the hind wing (Bohart & Menke, 1976; Brothers and Finnamore, 1993; Goulet and Hubert, 1993).

**Remark:** The family Sphecidae is represented in the Arabian Peninsula, by 70 identified valid species in 10 genera and 4 subfamilies: Ammophilinae (4 genera, 35 species), Chloriontinae (1 genus, 6 species), Sceliphrinae (2 genera, 8 species) and Sphecinae (3 genera, 21 species). That representing 9% of the total number of the worldwide sphecid species and 6% of the recorded aculeate wasps of the region. Ammophilinae are the most diverse subfamily, comprising 50% of the total number of species (Gadallah, 2020b).

#### 3.3.1. *Ammophila insignis* F. Smith, 1856 (Figures: 12A and 12B)

(=*Ammophila egregia* Mocsáry, 1881; *Ammophila transvaalensis* Cameron, 1910; *Sphex egregia* Mocsáry, 1881)

**Taxonomy:** Family: Sphecidae; **Subfamily:** Ammophilinae André, 1886; **Genus:** *Ammophila* W. Kirby, 1798; **Species:** *Ammophila insignis* F. Smith, 1856.

*Ammophila insignis* is a species of hunting wasps from the thread-waisted wasp family (Sphecidae).

**Importance:** A predator mainly on moth and sawfly caterpillars.

**Habitat:** *A. insignis* occurs in the warmer regions and nesting by digging an unbranched tunnel in sandy soil or in old animal burrows and females nest primarily in shaded areas (Weaving, 1989).

**Geographical distribution:** Distributed in the Arabian Peninsula, in Oman as *Ammophila insignis egregia* Mocsáry, 1881, in Saudi Arabia, United Arab Emirates and Yemen as *A. insignis egregia* and its extralimital distribution in Africa, Iran, Jordan, Lebanon, Syria (Gadallah, 2020b)

**Remark:** This species was first recorded from Saudi Arabia by Guichard, (Guichard, 1988) previously two Ammophilid species were recorded from Al-Baha (Southeast Saudi Arabia, these are: *Ammophila arabica* Kirby, 1900 and *Ammophila erminea* Kohl, 1901 (El-Hawagry et al., 2013).

### 3.4. Family Vespidae

The family Vespidae is the largest family of superfamily Vespoidea (Goulet and Hubert, 1993). The family includes about 5465 species (of which 58 are fossils) in 255 recent genera and 13 extinct ones (Perrard et al., 2017). Vespidae are medium-sized, rare of them varied from small (2.5 mm) to very large (up to 50 mm) There are six existing subfamilies (Euparagiinae, Masarinae, Eumeninae, Stenogastrinae, Polistinae, and Vespinae) and two entirely fossil subfamilies (Priorvespinae and Protovespinae) (Aguiar et al., 2013; Antropov & Fatergya, 2017).

**Importance:** Most of them are solitary, and they play an important role as biocontrol agents, because their larvae feed on caterpillars and other insects (Fatergya, 2010).

**Remark:** The Vespidae of the Arabian Peninsula have been identified 163 valid species in 49 genera and four subfamilies are reported: Eumeninae (potter wasps, 41 genera, 130 species), Masarinae (pollen wasps, 4 genera, 14 species), Polistinae (paper wasps, 3 genera, 17 species) and Vespinae (yellow jackets and hornets, 1 genus, 2 species). They represent 3% of the extant vespid species worldwide, and 15% of the recorded aculeate wasps of the region. Eumeninae is the most diverse subfamily, comprising

80% of the total number of listed species. Fifty-three species (33%) are confined to the Arabian Peninsula, as are 15 subspecies (Carpenter and Gadallah, 2020).

#### 3.4.1. *Delta dimidiatipennes* Saussure, 1852 (Figures: 13A and 13B)

(=*Eumenes dimidiatipennis* de Saussure, 1852; *Eumenes transcaspicus* Morawitz, 1895; *Eumenes maxillosa* (De Geer, 1773; *Eumenes maxillosus* De Geer, 1773)

**Taxonomy:** Family: Vespidae; **Subfamily:** Eumeninae; **Tribe:** Eumenini; **Genus:** *Delta* de Saussure, 1855; **Species:** *Delta dimidiatipennes* Saussure, 1852.

*Delta dimidiatipennes* is a species specified in the caterpillars hunting defining them as caterpillar hunting wasp and due to their nest building behavior also named red potter wasp. The female uses saliva to form wet clay from sand or mud pellets and by mouthparts build a nest as small pot shaped vessel. It places nest on walls or rocks, usually suspended downwards and make a slight lip over the entrance and the clay dries to harden.

**Habitat:** In Palearctic warmer regions.

**Geographic distribution:** In the Arabian Peninsula: Saudi Arabia, Yemen, Kuwait, Oman and Qatar as *Eumenes dimidiatipennis*, United Arab Emirates as *Delta dimidiatipennes*. Distributed worldwide in Afghanistan, Algeria, Canary Islands, Chad, Djibouti, Egypt, Eritrea, Ethiopia, India, Iran, Jordan, Madagascar, Mauritania, Morocco, Nepal, Niger, Pakistan, Spain, Somalia, South Africa, Sudan, Syria, Tajikistan, Turkmenistan, Turkey and Uganda. (Carpenter and Gadallah, 2020; Gawas et al., 2020).

**Importance:** Predator wasps, hunting caterpillars.

#### 3.4.2. *Delta esuriens* (Fabricius 1787) (Figures: 14A and 14B)

(=*Vespa esuriens* Fabricius, 1787: 293; *Vespa pediculata* Olivier 1792: 671; *Eumenes boscii* de Saussure 1855: 132)

**Taxonomy:** Family: Vespidae; **Subfamily:** Eumeninae; **Tribe:** Eumenini; **Genus:** *Delta* de Saussure, 1855; **Species:** *esuriens* (Fabricius, 1787)

Most species of the subfamily Eumeninae are solitary wasps and known as potter wasps. They are predators of phytophagous insects. Their hunting activity increased due to their waking ability on wax bloom covered plants to get sheltered insects (Pham, 2015; Jones et al., 2002).

**Habitat and Distribution:** The genus predominantly distributed through tropical Africa and Asia and some species are present in Palearctic region. Distributed in Kuwait as *Delta campaniforme* (Fabricius, 1775), Oman and Qatar as *D. campaniforme esuriens* or as *D. campaniforme*. Saudi Arabia and United Arab Emirates as *D. campaniforme* and in Iraq. Distributed worldwide in India, Iran, China; Indonesia, Laos, Malaysia, Mauritius, Myanmar, New Caledonia, Pakistan, Sri Lanka, Thailand, Vietnam (Carpenter and Gadallah, 2020; Gawas et al., 2020).

**Importance:** A predator, hunting caterpillars (Pham, 2015).

### 3.5. Family Mutillidae (Velvet ants)

The Mutillidae (velvet ants) is a relatively large family, worldwide in distribution and the greatest diversity occurs in the tropical and subtropical regions. The family currently having 4603 described species (13 fossil) in 222 genera (of which *Protomutilla* Bischoff and *Cretavus* Sharov are fossil), placed in 13 tribes and eight subfamilies (Gadallah and Brothers, 2020). On the Arabian Peninsula, the family Mutillidae is represented by 64 identified valid species and 21 genera in five subfamilies: Dasylabrinae (2 genera, 16 species), Mutillinae (14 genera, 37 species), Myrmillinae (3 genera, 6 species), Pseudophotopsidinae (1 genus, 4 species), and Ticopliinae (1 genus, 1 species). Velvet ants have very tough and roughly textured integument, providing protection against

the stings of wasps and bees whose nests they invade (Invrea, 1964).

**Remark:** Al-Ahmadi and Salem (2000) represented the family in Saudi Arabia by four species.

### 3.5.1. *Trogaspidia floralis* Klug, 1829 (Figures: 15A and 15B)

(=*Mutilla interrupta* Olivier, 1811 (nec Latreille, 1792; *Mutilla floralis* Klug, 1829; *Mutilla divisa* Smith, 1855; *Mutilla aureiventris* Walker, 1871; *Trogaspidia divisa* Bischoff, 1920)

**Taxonomy: Family:** Mutillidae; **Subfamily:** Mutillinae Latreille 1802; **Tribe:** Trogaspidiini Bischoff 1920; **Genus:** *Trogaspidia* Ashmead 1899; **Species:** *floralis* (Klug 1829).

The species of *Trogaspidia* genus is most abundant in the Oriental region (133 species) and are not still revised. A few penetrate to the Australian region and 19 species are in the Palaearctic region (Lelej and Schmid-Egger, 2005).

**Importance:** Well known as ectoparasitoids (Brothers et al., 2000).

**Geographic distribution:** Africa (Egypt, Algeria, Libya, Sudan, Senegal, Mali, Nigeria, Cameroon, Chad, Eritrea, Djibouti, Ethiopia and Somalia); Asia (Saudi Arabia and Yemen) (Gadallah et al., 2020).

**Remark:** A first attempt to split the African members of the genus *Trogaspidia* Ashmead, 1899 was made by Bischoff, (1920). *Trogaspidia* (*Trogaspidia*) *floralis* (Klug, 1829) distributed in Saudi Arabia (Madl, 2018), Yemen (as *Mutilla divisa* or *T. divisa klugiana* (Lelej and Van Harten, 2006) and as *f. moslemita* and *f. klugiana*; (Madl, 2018)

### 3.6. Family Evaniidae

They known as the ensign wasps, night-shade wasps or hatchet wasps, a parasitic wasps and have 31 genera (11 of which are fossils) and 455 species (20 of which are fossils) (Deans, 2005).

**Habitat:** Evaniidae is abundant in tropical regions. A few species are cosmopolitan, living inside warehouses and other buildings with a cockroach population (Deans and Kawada, 2008).

**Remarks:** In spite of their feeding behavior on insects (pests) but their population achieves not enough size to be effective as biological control agents. Evaniidae usually accompanied with the human settlements where cockroaches are abundant so Evaniidae encountered in buildings looking for prey in absence of other wasps. Their adults drink the flowers nectar and adults or their larvae are not harmful for humans (Deans et al., 2006).

### 3.6.1. *Evania* sp. (Figures: 16A and 16B)

**Taxonomy: Superfamily:** Evanioidea (parasitic hymenoptera); **Family:** Evaniidae; **Tribe:** Evaniini; **Genus:** *Evania* Fabricius, 1775; **Species:** *Evania* sp.

*Evania appendigaster* and *Prosevania fuscipes* are two Evaniidae, species worldwide distributed nowadays. They have been introduced to many countries along with various Blattellidae species of genera *Blatta* and *Periplaneta*. The species *Evania appendigaster* is originated in Asia and nowadays it occurs in tropical and subtropical and in many temperate regions.

**Distribution:** Russia (Dagestan); Azerbaijan, Egypt, Ethiopia, Libya, Sudan, Syria, Turkmenistan (Belokobylskij, 2019; Deans, 2005; Deans and Kawada, 2008).

**Importance:** they are parasitoid wasps specially on cockroaches.

**Remarks:** According to Al-Ahmadi and Salem (1999), the genus *Evania* is represented in Saudi Arabia by only two species at time, these are *Evania appendigaster* Linne. and *E. dimidiata* Fabricius (first reported by Dabbour and Hammad, (1982).

## 4. Discussion

The list of the collected hymenopteran insects from the Jazan Lake dam region included seven families. The first family Apidae that represented by 2 subfamilies the first Apinae with one species, (*A. florea*), the second Xylocopinae with one species, *Xylocopa aestuans* a valuable pollinator able to withstand high temperatures (Al-Kahtani and Taha, 2014; Keasar, 2010; Nagaraja, 2020). The second family Crabronidae represented by 2 subfamilies Bembicinae (*Bembecinus iranicus* Schmid-Egger and *Stizus vespoides*) and Crabroninae (*Liris* Sp., *Tachytes* sp.; *Tachysphex deserticola* de Beaumont; *Tachysphex* sp1; *Tachysphex* sp2; *Tachysphex* sp3). Previous study recorded wasps from Crabronidae in Jizan province (Gadallah et al., 2013). The rest prevalent families (Species) were Evaniidae (*Evania* sp.), Mutillidae (*Trogaspidia floralis* Klug, 1829) and Sphecidae (*Ammophila insignis* F. Smith, 1856). Pollinators of the Apidae family with health, pharmaceutical, financial, cultural and human beneficial efficacy. Hence, the proper management of non-cropped areas will encourage wild pollinators that may add economical means to maximize the crop yield (Nicholls and Altieri, 2013). In addition to the important role of the biological control agents, mainly from parasitoids and predators for the conservation of plants that are found in Jazan region as economical and medicinal importance plants. The discovered hymenopteran species from the present study supporting the climatic conditions influence that are main distribution potential on the faunal composition of the region and confirming that Hymenoptera is one of the major constituents of the insect biodiversity in Jazan Lake dam region, Saudi Arabia. Meanwhile, other new taxa will probably be found from Jazan region in the future, and thus will need to be periodically updated by continued survey of the area.

## 5. Ethics approval and consent to participate

Not applicable.

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## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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