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The stinging Apidae and Vespidae (Hymenoptera: Apocrita) in Iranian islands, Qeshm, Abu–Musa, Great Tunb and Lesser Tunb on the Persian Gulf

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PEER REVIEW

Peer reviewer

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Comments

The Persian Gulf and its coastal areas are the world's largest single source of crude oil and have about 35% of the world natural gas reserves. Persian Gulf has also many tourist islands. Therefore these districts have economic and tourist attractions importance and many trips from different parts of the world are done to Persian Gulf costal and islands. Wasp and Bee stings can cause many problems for local people and tourists. This research can provide relative information about the status of stings Hymenoptera in 4 Persian Gulf islands and introduce many stings species. Details on Page S261

ABSTRACT

Objective: To study the stinging flying Hymenoptera (Apidae and Vespidae) fauna in four Iranian Islands, Qeshm, Greater Tunb, Lesser Tunb and Abu–Musa on the Persian Gulf.

Methods: The flies were captured by used of Malaise trap, fly trap, bottle trap and insect net-hashing from March 2011 to July 2012.

Results: In this study, 11 species of stinging Hymenoptera were reported for the first time in Persian Gulf region.

Conclusions: Some of this species such as *Vespa orientalis* and *Polistes olivaceus* are more common in the Persian Gulf islands and can cause clinical problem to islands resident and travelers.

KEY WORDS

Stinging Hymenoptera, Bee, Wasp, Persian Gulf, Iranian islands, Middle East

1. Introduction

The Hymenoptera, comprising the sawflies, wasps, bees and ants are one of the largest and important orders of insects.

The flying Hymenoptera has two pairs of membranous wings and an ovipositor specialized in female workers for stinging or piercing^[1]. These holometamorphosis insects have an important role in pollination and some of them in wax and

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honey production^[1,2]. Many species of Hymenoptera, especially wasps are predators or parasitoids of pest arthropods; therefore it is important to natural and biological control of pests^[2,3]. Recently, antimicrobial potential of solitary and social Hymenoptera venoms is considered^[4].

Despite the benefits of Hymenoptera, some of them including many species of wasp, bee and ants can have a painful sting and injected venom to human and can cause severe systemic reactions^[5]. Sensitivity to the Hymenoptera stings can go into anaphylactic shock, perhaps leading to death or disability^[3,5]. The severity of a previous reaction, adult age, male gender and honeybee sting are risk factors for severe systemic reactions after Hymenoptera stings^[5]. Among Hymenoptera, many social species including Apidae, Vespidae, Formicidae and a few of solitary families have the ability to induce allergic reactions^[6].

So far, over 130 000 species of this order have been recognized and described with many more remaining to be described^[2]. The Hymenoptera was classified into the two suborders, Apocrita (bees, wasps and ants) and Symphyta (sawflies and wood wasps)^[3]. All stinger in Hymenoptera, comprising wasp, bee and ants are in the Apocrita suborder^[1,3].

The Vespidae is a large family of Hymenoptera with over 5000 known species belonging to 6 subfamilies around the world^[7]. The stinging wasp occurred in three subfamilies including Vespidae, Polistinae and Eumeninae^[8]. The Vespidae and Polistinae are composed solely of eusociality, while Eumerinae are all solitary^[9]. The solitary wasps of the subfamily Eumeninae are another subfamily of Vespidae which has 3000 species belonging to 180 genera in the world^[10]. The Apidae is a large family of bees. The stinging bee mainly occurred in Apidae (honeybees and bumblebees) and Xylocopinae (carpenter bee) subfamilies^[1,2].

In recent years, the species of stinging Hymenoptera and the risk of exposure to insect's bite or sting were studied in southern Afghanistan by the North Atlantic Treaty Organization (NATO) and US army^[11]. Diversity of Vespidae was also determined in some other countries in this region such as Pakistan and Jordan^[12,13].

In the survey of North America Vespidae, 22 species from 3 genera, *Vespa*, *Vespula* and *Dolichovespula* were reported^[14]. Among the six subfamilies of Vespidae, 4 of them including Vespidae, Polistinae, Eumeninae, Masarinae, comparing 51 genera and 182 species occur in Iran^[15]. The checklist of Vespidae of Iran introduced 9 vespine species from three genera including two species of *Vespa* (L, 1758), 3 of *Vespula* (Thomson, 1869) and 4 of *Dolichovespula* (Rohwer, 1916)^[8]. Also the more complemented information of the geographical distribution of this nine vespine species in Iran and its identification key was provided by Dvorak, *et al*^[16]. A survey of bee in Fars province in the southeast of Iran was done and 177 species of all bees (sting and non-sting) were reported^[17]. The checklist of Vespidae species and distribution pattern of two hornet *Vespa orientalis* (*V. orientalis*) and *Vespa crabro* (*V. crabro*) were previously provided in Iran^[8,18]. A faunistic study of vespid wasps was done in Zanjan province in the north of Iran^[19].

Persian Gulf region in terms of traffic such as oil tankers, supertankers, commercial and military ships and many others has an international importance. In recent years, some studies

about medically important insect fauna such as mosquitoes, flies and sting ants in Persian Gulf Islands were done^[20–22], but there is poor knowledge on Persian Gulf islands about stinging wasp and bee faunas.

The aim of this study was to collect and identify the information about the venomous and stinging species of Apidae comparing two subfamilies of Apinae (honeybees and bumblebees) and Xylocopinae and also Vespidae (including Vespidae, Eumeninae and Polistinae) in Iranian islands, Qeshm, Greater Tunb, Lesser Tunb and Abu–Musa on Persian Gulf.

2. Material and methods

This is a faunistic study which was done from March 2011 to July 2012 in four Iranian islands on Persian Gulf. The islands under investigation, Qeshm (26°32'–27°06' N, 55°15'–56°30' E, with an area of 1491 km²), Greater Tunb (26°30' N–55°16' E, 10.3 km²), Lesser Tunb (26°14' N–55°08' E, 2.1 km²) and Abu–Musa (25°51'–26°19' N, 54°26'–55°19' E, 68.8 km²), were located in the Persian Gulf and belonged to Hormozgan province in the southeastern of Iran (Figure 1). Qeshm is the biggest Persian Gulf island and others are mostly small. The climatic conditions in these islands are warm and humid.

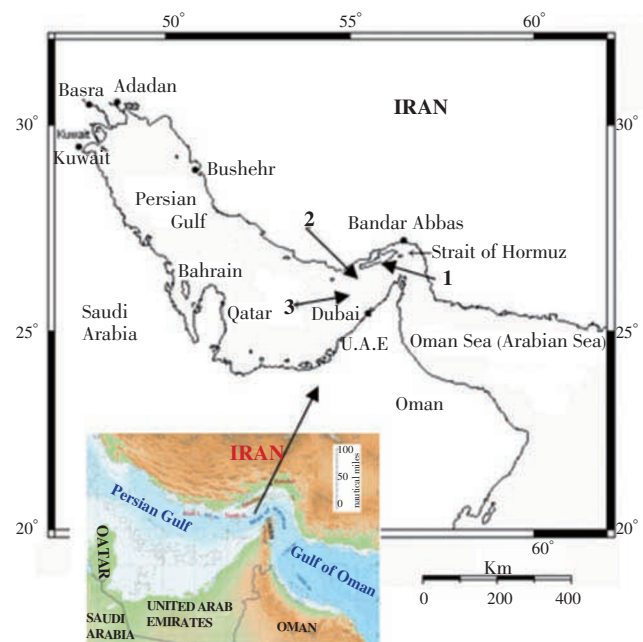


Figure 1. The geographical location of studied Iranian islands in the Persian Gulf on the map.

1: Qeshm; 2: Tunbs; 3: Abu–Musa.

Hymenoptera (Bee and wasp) collections were conducted on 4 above mentioned islands among 8 months during the year. Collection operation stopped in 2 months (July and August) during summer and 2 months (Jan and Feb) in the winter because of overheating and cold weather, respectively. At that time insect activity is highly decreased due to severe changes in temperature and humidity^[2].

Adult bee and wasp were captured by Malaise trap, fly trap, bottle trap and hand catching by used insect net–hashing (butterfly net). According to other studies, we also used flowers

and their pollen, protein (mainly meat) and sweet things such as baking soda and crystal sugar as baits in traps^[23,24]. Hand catching of bee and wasp was done by sweeping up insect net-hashing on flowers, waste and garbage. The collector's safety was provided by using of full dress, head net and gloves. It is necessary to mention that in some cases the relatively strong wind destroyed Malaise trap and therefore capture of this trap was low.

Collected bees and wasps were immediately killed in cyanide bottle and mounted. The specimens were identified by using the Hymenoptera morphology-based keys including: the world bees and wasps catalogs^[25,26], the key of the reported Vespidae of Iran^[16], checklist of Iranian Vespidae^[8], and some other Hymenoptera taxonomic description and illustration^[18,19]. The confirmations of some specimens were done by Professor E. Ebrahimi in the Iranian Institute of Plant Protection, Tehran, Iran.

Adult voucher specimens were deposited in the Health Research Center of Baqiyatallah University of Medical Sciences, and Iranian Institute of Plant Protection, Tehran, Iran. To determine Hymenoptera stinging prevalence, Health Center's recorders were reviewed in all 4 islands.

3. Results

In this study, a total of 702 adult Hymenoptera were captured in 8 months from the four Iranian Persian Gulf islands. Only 455 (65%) of them belonged to stinging Hymenoptera (wasp and bee) and 247 (35%) of them were from non-stinging Hymenoptera including parasitoids wasp and others species of Apocrita and Symphyta.

A total of 455 adult stinging Hymenoptera belonging to 6 genera and 11 species were collected from four islands including Qeshm ($n=152$), Greater Tunb ($n=128$), Lesser Tunb ($n=59$) and Abu-Musa ($n=116$). Out of total twelve species, nine were identified on Abu-Musa Island, nine on Greater Tunb Island and seven on the Lesser Tunb Island (Table 1). All twelve species were found on Qeshm Island (Table 1).

From the total of 455 stinging bees and wasp captured, 232 (51%) individuals (9 species) were collected by net-hashing (butterfly net) on flowers, waste and around nest. 188 (41% and 6 species) of them captured in fly trap and bottle trap and only 35 (8%, 3 species) in Malaise trap.

Two hundred and two (82%) of all 247 non-stinging Hymenoptera were captured in fly trap and bottle trap.

Among the stinging wasp and bee, the large bee such as bumblebee and carpenter bees (the genus *Xylocopa*) was more common species in three islands, Greater Tunb, Lesser Tunb and Abu-Musa. Some wasps including the yellow oriental paper wasp, *Polistes olivaceus* (*P. olivaceus*) and oriental hornet, *V. orientalis* was more prevalent in Qeshm Island (Table 1).

The stinging Hymenoptera was more abundant and more easily captured in traps in the spring ($n=268$), which is followed by the autumn ($n=119$).

In a garrison of Qeshm Island, the prevalence of wasp stinging was recorded of 2 cases per day, which was mainly caused by *P. olivaceus*. In other Islands, except of the oral reports about Hymenoptera stinging, there was no written records in the

hospitals and health centers.

Table 1

The bee and wasp collected from four Persian Gulf islands, Qeshm, Greater Tunb, Lesser Tunb and Abu-Musa during December, 2011.

Species	Collected No. on island				Sex ratio		Total
	Qeshm	Greater Tunb	Lesser Tunb	Abu-Musa	Male	Female	
<i>V. orientalis</i> (L., 1771)	23	19	5	11	14	44	58
<i>Rhynchium oculatum</i> (Fab, 1781)	12	3	4	2	8	13	21
<i>V. germanica</i> (Fab, 1793)	4	11	3	1	8	11	19
<i>P. olivaceus</i> (De Geer, 1773)	56	18	8	15	28	69	97
<i>Delta campaniforme</i> (Fab, 1775)	12	0	0	1	4	9	13
<i>Eumenes</i> spp. (Latreille, 1802)	4	1	0	0	2	3	5
<i>Bombus agrorum</i> (Fab, 1785)	11	38	10	41	29	71	100
<i>Bombus impatiens</i> (Cresson, 1863)	3	16	12	22	10	43	53
<i>Xylocopa violacea</i> (L., 1758)	2	19	17	19	33	24	57
<i>Apis florum</i> (Fab, 1787)	5	3	0	0	0	8	8
<i>Apis mellifera</i> (L., 1758)	18	0	0	4	4	18	22
<i>Bembix oculata</i> (Panzer, 1801) Crabronidae	2	0	0	0	0	2	2
Total	152	128	59	116	140 (31%)	315 (69%)	455

Fab: Fabricius, L: Linnae.

4. Discussion

In this study we collected 11 stinging Hymenoptera species of bee and wasp and also 1 species from Crabronidae in four Iranian islands on Persian Gulf. This is the first report of stinging Hymenoptera in Persian Gulf region. Stinging Hymenoptera is found worldwide except Antarctica, but is more abundant and diverse in tropical and subtropical regions^[1,2]. South of Iran has subtropical climate. Therefore it is suitable for Hymenoptera distribution and diverse fauna of Vespidae and Apidae is expected.

According to Iran Vespidae checklist, there are 9 species of this subfamily in Iran^[8]. In the present study we reported 2 species of them including *V. orientalis* and *Vespula germanica* (*V. germanica*) on Persian Gulf Islands.

Previous studies showed the two species of hornets including *V. orientalis* and *V. crabro* are more present in Iran. The *V. orientalis* has a widespread distribution in many parts of Iran, except for the Caspian coast in northern Iran, but *V. crabro* (European hornet) is present only on the Caspian coast^[18]. The *V. crabro* sting seems to be a new risk factor for life-threatening reactions after Hymenoptera sting^[5].

V. germanica has been reported from many areas of Iran, except south of the country and Persian Gulf Islands^[8]. Also the *Vespula vulgaris* has been previously reported from Kermanshah and Khorasan province in the West and North East of Iran, respectively^[16,27].

In southern Afghanistan, Iran's eastern neighbor, the stinging flying Hymenoptera are commonly three species including *V. orientalis*, *Polistes wattii*, and *V. germanica*. In this area, based on US electronic medical record, prevalence of insect bite or sting visit was determined as 0.2% (1 in 500)^[11]. Also *V. orientalis* is a severe problem in Jordan especially for beekeepers^[28]. This species has a wide distribution in the world and it is a health problem due to venomous stinging in many areas of world^[29].

Based on the survey in Jordan, 21 species of stinging vespid wasp (Vespidae) comprise two species of social wasps

(Vespidae), two species of paper wasps (Polistinae) and 17 species of Eumeninae solitary wasps were recognized^[13]. Also in the North America, 22 species Vespidae including six species of *Dolichovespula*, three species of *Vespa* and 13 species of *Vespula* were reported^[14].

After studying these islands, *P. olivaceus* and *V. orientalis* from Vespidae and *Bombus agrorum*, *Bombus impatiens* and *Xylocopa violacea* from Apidae family were more common stinging species.

The previous studies has reported 56 species of Apidae from Fars province in the south of Iran and also 26 species of bumblebees including sting and non–sting bee in the Alborz mountains area in centre and North West of Iran^[17,30].

The other faunistic study of vespidae wasps in Zanjan Province (northwest of Iran), have reported 5 species and subspecies of *Polistes* genera including *Polistes dominula*, *Polistes dominulus bucharensis*, *Polistes gallicus*, *Polistes iranus* and *Polistes nimpha irakensis*^[19]. *Polistes nimpha irakensis* (Gusenleitner, 1976) is a new record for the fauna of vespidae wasps of Iran^[31].

Among 23 reported species belonging to eight genera of Vespidae, *Polistes olivaceus* with other 6 species are newly recorded from Pakistan^[12]. In Europe, *Vespula* stings predominates over the others vespidae wasp genera such as *Vespa*, *Dolichovespula* and *Polistes*, but in Mediterranean areas, *Polistes* are mainly as a specific clinical problem^[32].

Among reported species, *V. orientalis* and *Polistes olivaceus* are more common than others and can cause clinical problems to islands resident and travelers. Therefore we propose to Persian Gulf islands tourists and travelers, especially in spring to using personal protection techniques such as wearing permethrin or repellents impregnated clothes and topical application of repellents comprise DEET (N, N–Diethyl–meta–toluamide), Picaridin and Citronella^[33,34]. Avoiding the bees and wasps colony and Hymenoptera attractants materials including aftershave, deodorant, hair spray and also avoiding wearing light–colored clothing, can provide an effective protection against stings^[35].

In this study, 11 species of stinging Hymenoptera were reported from four Iranian islands on Persian Gulf. This is the first report of this region and it seems that there are more species of stinging Vespidae and Apidae in Persian Gulf. Therefore due to complete information about stinging Vespidae and Apidae, the study should be conducted in many others residential Persian Gulf islands.

Conflict of interest statement

We declare that we have no conflict of interest.

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University of Manitoba, Canada for his valuable guidance in Hymenoptera identification and to provide scientific resource and articles.

Comments

Background

Faunistic and taxonomic study of insect is one of the basic branches of biological science. Determination of stinging Hymenoptera distribution is very important in biomedicine, because most venomous species occur in this order and often most life–threatening stings is done by Hymenoptera including Vespidae and Apidae family, which have many stinging species. Faunistic study of stinging Hymenoptera in Persian Gulf's islands can be interesting, since there is no information about the distribution of Hymenoptera in this area.

Research frontiers

In this study, authors determined the distribution of stinging Hymenoptera in Persian Gulf areas, where there was no report on Hymenoptera.

Related reports

According to the scientific resources and data base, in recent years there are many articles and reports from Iran and other Middle East countries about stinging Hymenoptera distribution. Ebrahimi 2008, had other research and reports of Vespidae in all area of Iran, exception Persian Gulf areas. Monfared 2009, introduced 26 species of bumblebees including sting and non–sting bee in Alborz mountains' area in centre and North West of Iran. Bagriacik 2011, did the report of 9 vespine species from *Vespa*, *Vespula* and *Dolichovespula* genuses in Iran. Mahmood, 2012, reported 23 species from the Pakistan.

Innovations and breakthroughs

The study was conducted in an area where there was no previously reports about stinging Hymenoptera. I think the complement of species distribution in unknown areas can be innovation in bioscience.

Applications

The first line of vector and venomous insect control is determined by species identification and distribution. Therefore determination of stinging Hymenoptera and more common species in Persian Gulf islands is needed for its control. On the other hands, species identification has other more application in biology and biomedicine such as construction of Hymenoptera anti–venom serum.

Peer review

The Persian Gulf and its coastal areas are the world's largest single source of crude oil and have about 35% of the world natural gas reserves. Persian Gulf also attracts many tourists. Therefore these districts play an important role in economic and tourist attractions and many trips

from different parts of the world attribute to Persian Gulf coastal and islands. Wasp and bee stings can cause many problems for local people and tourists. This research can provide relative information about the status of stinging Hymenoptera in 4 Persian Gulf islands and introduce many species with stings.

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