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TAXONOMIC IDENTIFICATION OF BEES AND WASPS (HYMENOPTERA) FAUNA

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Abstract

Hymenoptera is the biggest order that belongs to class insecta, aculeata, apocrita and symphyta. Bees and wasps are the members of sub-order apocrita and are essential pollinators, play an important role in natural and managed ecosystems as well as helpful to control the pests and insects. The present study was conducted for taxonomic identification of different species of bees and wasps in Quetta. A figure of 602 individuals was collected of 12 genera and 5 families. Families related to species of bees include apidae, halictidae and megachilidae, whereas the species of wasps were related to the families like vespidae, sphecidae and crabonidae. The most plentiful genus of bees were found to be Ceratina binghami (n= 84) afterwards is the genus amegilla (n=55), thyreus Panzer (n=46) and genus Halictus (n=49). While in wasps genera vespa orientalis (n=155) and polistes (n=94) were found numerously. The members of the family apidae were found to be the most abundant in the environment among the insects and The area of Quetta cantt was found to be a rich habitat of these invertebrates.

Keywords: *Bees, Hymenoptera, Identification, Taxonomy, Wasps*

INTRODUCTION

Insects are present excessively in number as 80 to 95% of species are not yet collected and described. Among them most of the insect species are present in the tropical regions (1). Specie identification must be performed accurately concerning environmental examination because it depends upon various factors like conservational assessment that includes population tendency, enforcement, evaluation of population administration plans, health and extinction analysis. According to an estimation, there are about 8.5 million species of insects are present at the globe (2). Hymenoptera is the biggest order that includes the class insecta. The taxa of hymenopteran comprises of two sub-orders called as symphyta and apocrita. The bees and wasps are the members of sub-order apocrita (3).

The populations of bees are at a decline at worldwide due to human interventions (4). The wasps are advantageous for agricultural crops, since the crops have invading invertebrate pests that affect the crop production and the wasps are predators of these invertebrates (5). Agriculture and bee population are directly dependent on each other; if agriculture is disorganized, bees become homeless and can't survive for longer. Moreover, the extensive use of pesticides cause serious decline in the population of bees and other beneficial insects (6). The richness ratio of wasps and bees differs with weathers and different geographical areas (7). Hence, the current study was conducted in the Quetta region; situated in north-west of Balochistan, Province. The city is situated above the sea level at an altitude of 1700-1900 meters (8). Various species of bees and wasps are present because the city is included in the tropical agro-ecological zone. The

city is also famous for production of several fruits and important crops that promote for habitat of beneficial insects.

Previously, new records of the different insect species have been presented in different regions of the world in several studies. In this context, 23 species of wasps were identified belonging to sub-family Eumainae (9). In a study, pollinator species were studied in Dera Ghazi Khan, Punjab wherein bees were found to be the utmost plentiful visitors of flowers among the identified insects including with 1294 individuals followed by wasps (n=208), flies (n=10) and butterflies (n=37) entities (10). Similarly, new species of wasps were identified in Murree hills of the Northern Punjab, Pakistan (11). Different species of family vespidae (Hymenoptera) were studied in America (12). Two species in two genera were listed from Bangladesh and 23 species in 08 genera were registered in Pakistan (13). Sub-family microtypinae was identified in Khyber Pakhtunkhwa (14). An investigation was conducted in the search of vespidae family in Gilgit Baltistan (Northern area of Pakistan) during 2010-2011 and 14 new species of vespidae family including eumeninae, polistinae and vespinae were identified (15). Similarly, a study was conducted in Balochistan during 2016 to 2017 wherein, two species Scaeva albomaculata macquart and Scaeva selenitica Meigen were identified and described for the first time in Balochistan province and Pakistan, respectively on the basis of body color, morphology and genitalia from different areas of Balochistan (16).

The identification and description of novel species of invertebrates serve as an important contribution in the insect fauna since these invertebrates are leading actors of the eco-system that are an army of mini-workers that serve as pollinators, clean the environment, aerate the soil, become food for birds, fish and mammals and thus maintain the balance of eco-system.

MATERIALS AND METHODS

Four locations were selected for the collection of bees and wasps such as Kuchlak, Wali Tangi, Benazir Bhutto Park and Quetta Cantt. The research was performed from the season of spring to the start of winter. The samples were collected by hand netting and pan traps. The entomological pins were used for pinning the bees and wasps and the collected samples were pinned to the right side of Scutum. The identification details including date, location, and plant name and collection method were recorded. Proper labels were placed beneath each pinned specimen. The bees and wasps were identified with the help of pictorial keys, available literature at internet and with the help of experts. The specimens which were unable to be identified due to damaged body parts they were not included in the study. Similarly, the specimens which were not identified at any taxonomic level was pinned in the separate insect box. The identified species were later confirmed by comparing the available record of insect species at National Agriculture Research Center (NARC), National Insect Museum and Insect Pest Informatics (NIMIPI). Further diversity indices were calculated by the software PAST (version 4.04).

RESULTS AND DISCUSSION

Throughout the investigation of bees and wasps identification, a total 602 individuals were collected and identified. Among which, 11 bee's species and 6 wasps species (total 17 species) were collected which were distributed in 12 genera and 5 families (Table I and II). Some of the specimens were unable to be identified because of the damaged body parts hence, could not be included in the study. The identification was accomplished under the families: apidae, megachilidae, halictidae, vespidae and sphecidae and the diversity indices of the data from the four locations were calculated (Table III). The identified species of bees were *Apis florae Micrapis*, *Ceratina binghami Cockereli*, *Thyreus ramosus Lepeletier*, *Xylocopa fenestrate Fabricus*, *Amegilla quadrifasciata Anthophorini*, *Xylocopa aestuans Gribdo*, *Halictus vishnu Cameron*, *Seladonia lucidipennis smith*, *Icertanthidium*, *Megachile sp*, *Megachile coelioxys Latreille*. The identified wasps species includes *Vespa orientalis Linnaeus*, *Vespula germanica Fabricius*, *Polistes indicus Stolfa*, *Polistes watii Cameron*, *Sceliphoron caementarium Klug*, *Chalybion californicum Saussure.* The abundance of the collected invertebrates was calculated according to the family (Fig. 1) and the collection area (Fig. 2) and it was found that members of the family apidae were the most abundantly found in the environment and Quetta cantt was found to be most important habitat of these insects (Fig. 2).

Table I. Specie abundance (relative percentage) of collected insect species

Sr. no.	Species	No. of species with location	Per specie abundance	Relative percentage
Family Apidae				
1	*Apis florae*	L1=4 L2=5 L3=3 L4=3	15	2.49
2	*Ceratina binghami*	L1=9 L2=29 L3=26 L4=20	**84**	**13.95**
3	*Thyreus ramosus*	L1=5 L2=16 L3=13 L4=16	46	7.60
4	*Xylocopa fenestrate*	L1=7 L2=11 L3=5 L4=12	35	5.81
5	*Amegilla sp*	L1=11 L2=18 L3=15 L4=11	55	9.13
6	*Xylocopa aestuans*	L1=1 L2=2 L3=1 L4=1	05	0.83
Family Halictidae				
7	*Halictus Vishnu*	L1=11 L2=2 L3=17 L4=13	49	8.13
8	*Seladonia lucidipennis*	L1=0 L2=2 L3=1 L4=1	15	2.49
Family Megachilidae				
9	*Icertanthidium sp*	L1=2 L2=1 L3=1 L4=1	5	0.83
10	*Megachile sp*	L1=5 L2=6 L3=3 L4=2	16	2.65
11	*Megachile coelioxya*	L1=1 L2=3 L3=3 L4=3	10	1.66
Family Vespidae				
12	*Vespa orientalis*	L1=11 L2=39 L3=26 L4=49	**125**	**20.76**
13	*Vespula germanica*	L1=6 L2=9 L3=11 L4=9	35	5.81
14	*Polistes wattii*	L1=9 L2=17 L3=9 L4=11	44	7.30
15	*Polistes indicus*	L1=7 L2=4 L3=0 L4=0	50	8.30
Family Specidae or Crabonidae				
16	*Sceliphoron caementarium*	L1=0 L2=0 L3=3 L4=4	7	1.16
17	*Chalybioancali fornicum*	L1=2 L2=2 L3=1 L4=1	6	0.99

Ceratina binghami and *Vespa orientalis* were the most abundant species that were collected from four different locations

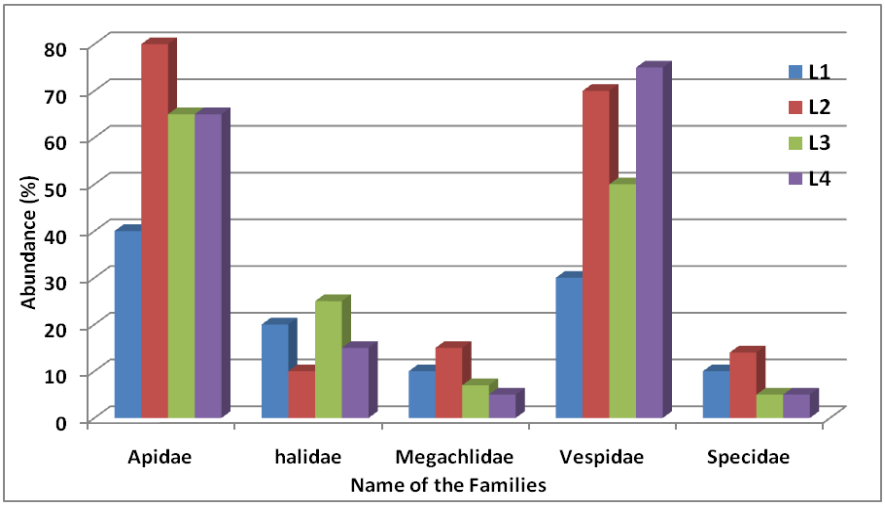

Fig. 1. Variation in abundance between four different locations. The members of the family apidae were found to be the most abundant in the environment among the insects

L1 = Benazir Bhutto Park Quetta, L2 = Quetta Cantt, L3 = Kuchlak, L4 = Wali Tang

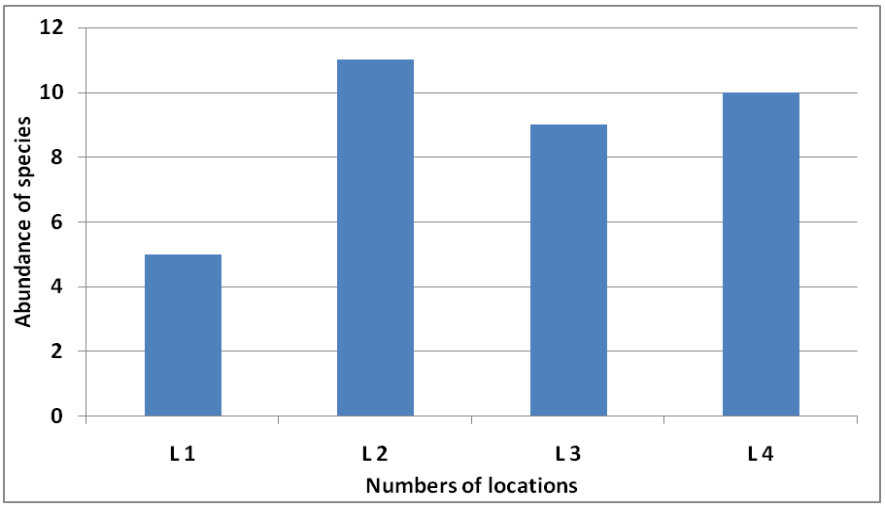

Fig. 2. The abundance of species in four Locations. Quetta cantt was found to be a rich area for invertebrates.

L1 = Benazir Bhutto Park Quetta, L2 = Quetta Cantt, L3 = Kuchlak, L4 = Wali Tangi

Table II. Combined rank list with taxa

Sr. no	Taxa name	L1	L2	L3	L4	Total abundance
1	*Apis florae*	4	5	3	3	15
2	*Ceratina binghami*	9	29	26	20	84
3	*Thyreus ramosus*	5	16	13	16	46
4	*Xylocopa fenestrate*	7	11	5	12	35
5	*Xylocopa aestuans*	1	2	1	1	5
6	*Halictus*	11	8	17	13	49
7	*Seladonia luccidepennis*	0	2	6	5	15
8	*Icertanthidium sp*	2	1	1	1	5
9	*Amegilla sp*	11	18	15	11	55
10	*Megachile sp*	5	6	3	2	16
11	*Megachile (c)*	1	3	3	3	10
12	*Vespa orientalis*	11	39	26	49	125
13	*Vespula germanica*	6	9	11	9	35
14	*Polistes wattii*	9	17	9	11	44
15	*Polistes indicus*	7	12	23	8	50
16	*Sceliphoron (c)*	3	4	0	0	7
17	*Chalybion (c)*	2	2	1	1	6
	Total	94	183	163	165	602

Most abundant number of individuals was collected from the Quetta cantt (locality # 2) and least number of individuals were evident from the Benazir Bhutto Park (location # 1).

Table III. Diversity indices of data from the four locations

Parameters	L1	L2	L3	L4
Taxa	16	17	16	16
Individuals	94	183	163	165
Dominance_D	0.0842	0.1112	0.1075	0.1398
Simpson_1D	0.9158	0.8888	0.8925	0.8602
Shanon_H	2.582	2.442	2.404	2.298
Eveness_e H/s	0.8263	0.6762	0.6914	0.6221
Brillouin	2.325	2.285	2.243	2.142
Menhinick	1.65	1.257	1.253	1.246
Margelf	3.302	3.071	2.945	2.938
Equiltability_J	0.9312	0.8619	0.8669	0.8288
Fisher_alpha	5.539	4.579	4.396	4.377
Berger_Parker	0.117	0.213	0.159	0.297
Chao_1	16.33	17	19	17.5

The identification process classified the collected species into families, namely apidae, megachilidae, halictidae, vespidae, and sphecidae, and further explored the diversity indices across four locations (Table III). Notably, the family apidae stood out as the most abundantly found in the environment, with Quetta Cantt identified as the most significant habitat for these insects (Fig. 2).

The abundance of each species was examined, revealing that Ceratina binghami and Vespa orientalis were the most prevalent species across the four locations (Table II). The relative percentages of these species were calculated, providing insights into their distribution and dominance in different areas.

The diversity indices, including Dominance_D, Simpson_1D, Shanon_H, Eveness_e H/s, Brillouin, Menhinick, Margelf, Equiltability_J, Fisher_alpha, Berger_Parker, and Chao_1, were calculated for each location (Table III). These indices contribute to understanding the ecological diversity and evenness of the identified species in the studied locations.

The taxonomic identification of each species was detailed in Table IV, presenting information on distribution, remarks, and relevant references. This comprehensive taxonomic breakdown enriches the understanding of the geographical presence and characteristics of each identified bee and wasp species.

Table IV. Family wise distribution of species

Family	Genus	Distribution	Remarks	References
Apidae	**Apis, (Linnaeus, 1758). Apis florae Fabricus, 1787:** The red dwarf honey bee. Found at Balochistan: Quetta, Benazir Park, 15.iv.2021, 1 adult, Quetta cantt, 21.vi.2021, 1 adult, Kuchlak, 9.v.2021,1 adult, L4, 29.v.2021, 1 adult.	Apis florea is distributed in Vietnam, China, across mainland Asia. Southern flanks of Himalaya's, Iran, Oman, Saudi Arabia, Sudan, java, Indonesia.	Species were identified from Sri Lanka, Southern India, Iran, Oman, Pakistan and Thailand.	17, 18
	Ceratina Latreille, 1802. Ceratina binghami Cocereli, 1908: The small carpenter bee. Found at Balochistan: Quetta, Benazir park, 15.v.2021, 4 adults, Quetta cantt, 5.v.2021, 6 adults, Kuchlak, 7.iv.2021, 6 adults, Wali Tangi, 11.iv.2021, 1 adult.	Africa, Asia, Indonesia, Hawaii	These species has been raised in California, Florida and Utah, Hawaii, Pakistan	19, 20
	Genus *Thyreus* Panzer, 1806 ***Thyreus ramosus* Lepeletier, 1841** - The cuckoo bee. Found at Pakistan: Balochistan: Quetta, Benazir Park, 15.v.2021, 3 adults, Quetta cantt, 23.vii.2021, 3 adults, Kuchlak, 10.vi.2021, 5 adults, Wali Tangi, 27.iv.2021, 27.iv.2021, 1 adult.	Pakistan, Afghanistan, Arabia, India, Europe, South Africa, Egypt, Sri Lanka, Myanmar	These species were informed in Pakistan	21, 22
	Genus Xylocopa Latrellie, 1802 ***Xylocopa fenestrata* Fabricius, 1798** - The large carpenter bee. Found at Balochistan: Quetta, Benazir Park, 15.iv.2021, 3 adults, Quetta cantt, 21.iv.2021, 1 adult, Kuchlak, 7.iv.2021, 1 adult, Wali Tangi, 27.iv.2021, 1 adult.	India, Pakistan, Sri Lanka, Nepal, Myanmar, Iran, Brazil, China, Madagascar, Israel, Afghanistan	Studied these species from Pakistan	23, 24
	***Xylocopa aestuans* Gribodo, 1884** **Found at Balochistan:** Quetta, Benazir park, 20.vi.2021, 1 adult, Quetta cantt, 23.v.2021, 1 adult, Kuchlak, 23.iv.2021, 2 adults, Wali Tangi, 13.v.2021, 1	India, UAE, Southeast Asia, Egypt, Nepal, Myanmar (25).	Reported these species from different cities of Pakistan (23).	23, 25

	adult.			
	Genus AmegillaVillers, 1789 ***Amegilla quadrifasciata* de Villers, 1789** - The white banded digger bee. Found at Balochistan: Quetta, Benazir park, 15.iv.2021, 1 adult, Quetta cantt, 21.iv.2021, 3 adults, Kuchlak, 23.iv.2021, 3 adults, Wali Tangi, 29.v.2021, 2 adults.	Pakistan, India, Afghanistan, Egypt, Japan, Southern Europe, Central Asia, North Africa, Australia	Reported this specie from Bahawalpur, Pakistan	25, 26
Halictidae	**Genus Halictus Latreile, 1804** ***Halictus Vishnu* Cameron, 1897** - The mining bee. Found at Balochistan: Quetta, Benazir Park, 15.v.2021, 3 adults, Quetta cantt, 21.iv.2021, 4 adults, Kuchlak, 7.iv.2021,1 Adult, Wali Tangi, 11.iv.2021, 1 adult.	Pakistan.	Stated these species from Pakistan	27
	***Seladonia lucidipennis* Smith, 1853** **Found at Balochistan:** Quetta Benazir park, 15.v.2021, 1 adult, Quetta cantt, 21.iv.2021, 3 adults, Kuchlak, 7.iv.2021, 2 adults. Metallic green body, below the eye and sub-genal area white plumose pubescence is seen, legs have ochraceous pubescence.	Sri lanka, Multan, Quetta	Examined these species from Pakistan	27, 28
Megachilida	**Genus *Iceteranthidium* Michener, 1948** - *Icertanthidium sp.* Found at Balochistan: Quetta ,Quetta cantt, 26.viii.2021,1 adult, Kuchlak, 25.v.2021,1 adult WaliTangi, 13.v.2021, 1 adult.	Pakistan, Quetta, India.	Reported this specie from Pakistan	29
	Genus Megachile Latrrielle, 1802 ***Megachile sp.* - The leaf cutter bee**. Found at Balochistan: Quetta, Benazir Park, 2.iv.2021, 1 adult, Quetta cantt, 21,iv,2021, 1 adult, Kuchlak, 23.iv.2021,2 adults, Wali Tangi, 11.iv.2021, 2 adults.	Sri Lanka, Pakistan, India	Stated this specie from Pakistan	28

	Genus CoelioxysLatreille, 1809 ***Megachile coelioxys* - The Cuckoo bees**, sharp tailed bees. Found at Balochistan: Quetta, Benazir park, 20.viii.2021, 1 adult, Quetta cantt, 7.ix.2021, 3 adults, Kuchlak, 11.vii.2021, 3 adults, Wali Tangi, 2.viii.2021, 1 adult.	South America,Australia, Africa, Arctic regions, Florida, and wide variety of habitats	Reported these species from America and Australia	30
Vespidae	**Genus *Vespa* Linnaeus, 1758** - *Vespa orientalis* Linnaeus, 1771. Found at Balochistan: Quetta, Benazir park, 2.vi.2021, 4 adults, Quetta cantt, 21.iii.2021,6 adults, Kuchlak, 23.iii.2021, 6 adults, Wali Tangi, 27.iv.2021, 1 adult.	Presence of the specie is found in Pakistan, India, Tajikistan, Nepal, Libya, U.A.E, and Afghanistan	these species from Kashmir, Islamabad, Hajira, Gilgit, Chillas, Peshawar, Quetta, Kohat, Mansehra, Abbotabad, Kohistan, and Mardan and listed this specie from Pakistan (31).	31, 32
	Genus *Vespula* Thomson ***Vespula germanica Fabricus*, 1793**. Found at Balochistan: Quetta, Benazir park, 2.iv.2021, 1 adult, Quetta cant, 23.vii.2021,2 adults, kuchlak, 23.iv.2021, 2 adults, WaliTangi, 11.iv.2021, 1 adult.	Mongolia, China, India, Kashmir, Afghanistan, Pakistan, Turkmenistan, Tajikistan, Kazakhstan, Israel, Iran, Syria, Georgia, Armenia, Norway, Switzerland, Australia, Germany, Romania, Albania	listed this specie from Pakistan	33
	Genus Polistes Latreille, 1802 ***Polistes indicus* Stofla, 1934**. Found at Balochistan: Quetta, Benazir park, 3.v.2021, 3 adults, Quetta cantt, 21.iii.2021, 7 adults, Kuchlak, 26.vi.2021, 3 adults, WaliTangii, 13.v.2021, 1 adult.	U.A.E, Oman, Iran, Pakistan, Afghanistan, Iraq	described these species from Pakistan	22
	***Polistes wattii* Cameron, 1900** Found at Balochistan: Quetta, Benazir Park, 15.iii.2021, 1 adult, Quetta cantt, 3.iv.2021, 1 adult, Kuchlak, 23.iii.2021.1 adult, WaliTangii, 27.iii.2021.2 adult,2 adults.	India, China, Oman, Iraq, Saudia Arabia, Afghanistan, Iran	Stated this specie from Pakistan	34
Sphecidae	**Genus *Sceliphron*, Klug 1801**. *Sceliphron*	America, Asia, Europe, Australia, New		35

caementarium. Found at Balochistan: Quetta, Kuchlak, 24.ix.2021, 2 adults, Wali Tangi, 16.vii.2021, 1 adult.	Zealand, Hawaii, Fiji, Samoa, Madeira, United States ,Canada, Mexico, Pakistan	
Genus *Chalybion*, Saussure, 1867 ***Chalybion californicum***. Found at Balochistan: Quetta, Benazir park, 15.x.2021, 1 adult, Quetta cantt, 24.x.2021, 1 adult, Kuchlak, 12.viii.2021,2 adults, Wali Tangi, 2.x.2021,2 adults.	Mexico, Canada, Hawaii, Bermuda, America (35).	35

The investigation provides a robust foundation for understanding the taxonomic composition, distribution, and ecological diversity of bees and wasps in the studied regions. The identified species and their abundance contribute valuable insights into the local insect fauna, with potential implications for ecological conservation and management strategies.

CONCLUSIONS

During the examination of bees and wasps, an identification of 602 collected insects were conducted, among which 11 species were of bees and 6 were species wasps . These species were distributed in 12 genera and 5 families. Identification was accomplished under the families: Apidae, megachilidae, halictidae, vespidae and sphecidae. Batesian mimicry was seen in some of the flies such as hover or drone flies, also in some beetles and moths which considerably resemble bees, those are considered also as important pollinators so these species could also be studied. Further studies are required to identify these insects at molecular level for absolute confirmation. Moreover, the studies should be conducted on behavioral and structural adaptations, physiology, seasonal variations in abundance and genetics of these bees and wasps. Since these insects also have medical benefits due to their products like honey, wax, royal jelly, propolis and bee venom, hence could be raised at commercial basis.

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