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Insect pollinator's diversity in the Dangs district of Gujarat

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Abstract
The study on insect pollinator's diversity was carried out through survey of the Dangs district of Gujarat during 2018 and 2019. A total of 8411 insect pollinators were sampled; among them 7396 insects were reported under order Hymenoptera followed by Lepidoptera (484) Diptera (475), Coleoptera (30) and Hemiptera (26). A total of 67 species of different insect pollinators/foragers were recorded in the Dangs which was belonging five orders *viz*., Hymenoptera, Diptera, Lepidoptera, Hemiptera and Coleoptera. As far as order wise distribution was concerned Hymenoptera order found to be dominated with four families *viz*., apidae, megachilidae, xylocopidae and halictidae distributed into 41 species followed by Diptera order with two families *viz*., syrphidae and calliphoridae distributed into 10 species and Lepidoptera order with six families *viz*., nymphalidae, pieridae, licaenidae, papilionidae, and hesperiidae distributed into 12 species. Whereas, Hemiptera with two families *viz.*, pyrrhocoridea and coreidea distributed into 2 species and Coleoptera order with two families *viz.*, meloidea and chrysomelidae distributed into two species.

Keywords: Pollinators, Dangs, diversity

Introduction
Pollination is the process of transfer of pollen from the anther of one flower to the stigma of another or the same flower. Pollination can be either self-pollination or cross pollination. Pollination is achieved by abiotic and biotic means. Abiotic pollination occurs mainly by wind (anemophily) and water (hydrophily). Biotic pollination includes mainly vertebrate pollination (zoophily) and insect pollination (Entomophily). Bee, flies, butterflies, moths, wasps, beetles, thrips and some other insects play a major role in pollination process. Among the insects, hymenopterans (largest and diversified assemblages of beneficial insects with nearly 2,50,000 described species) are highly evolved and constitute the most important group of pollinating insects. Pollination, an essential ecosystem service provided by insect pollinators, is many times taken for granted and little attention is paid to the need of conserving and enhancing the pollinator diversity in crop ecosystem. Majority of insect pollinators belong to three orders viz. hymenoptera, lepidoptera and diptera. (Sreedevi *et al*., 2011) [8].
Pollinators are crucial in the functioning of almost all terrestrial ecosystems including those dominated by agriculture because they are in the front line of sustainable productivity through plant reproduction (Kevan, 1999). Worldwide an estimated 35 per cent of crop production is dependent on insect pollination (Klein *et al*., 2007).

Materials and methods
Weekly observations (rapid roving survey) in each season were made from the different crops, trees and weed plant of the Dangs district during 2018 and 2019. The various flower visitors were collected and identified. The number of specimens under each species in respective observation was used for further analysis and interpretation.

Results and discussion
The population of insect pollinators was found abundant in the Dangs district. The survey was made from the Dangs district during 2018-2020 and data thus obtained has been summed up and their relative abundance was worked out.

Hymenoptera
Among the Hymenoptera, *Apis dorsata* (1836) was found the most abundant with 24.44 per cent abundance in the Dangs district followed by *Apis florea* (1658) and *Apis cerana* (1224)

with 22.07 and 16.29 per cent abundance, respectively as very common species. Whereas, eleven species *viz*., *Tetragonula laeviceps* (241), *Tetragonula irridipenis* (224), *Megachile lanata* (174), *Megachile bicolor* (157), *Megachile disjuncta* (126), *Megachile* (*Eutricharaea*) *hera*, (137), *Megachile stirostoma* (168), *Xylocopa aestuans* (132), *Xylocopa amethystina* (112), *Xylocopa latipes* (124) and *Xylocopa fenestrate* (99) with 3.21, 2.98, 2.32, 2.09, 1.68, 1.82, 2.24, 1.76, 1.49,1.65 and 1.32 per cent abundance, respectively as common species of the Dangs district. Whereas, six species of Hymenoptera, *viz*., *Ceratina binghami* (89), *Ceratina hieroglyphica* (51), *Ceratina smaragdula* (63), *Halictus gutturosus* (54), *Hoplonomia elliotii* (62), *Xylocopa fenestrate* (99) with 1.18, 0.68, 0.84, 0.72, 0.83 and 1.32 per cent abundance, respectively.

Finally, 21 species *viz*., *Amegilla cingulate* (16), *Amegilla confuse* (11), *Anthidium orientale* (18), *Ceratina lieatincki* (11), *Ceratina similina* (28), *Coelioxys fuscipennis* (31), *Coelioxys sexmaculatus* (22), *Halictus constrictus* (39), *Halictus fimbriatellus* (42), *Halictus funebris* (27), *Halictus lucidipennis* (33), *Halictus rugolatus* (47), *Lasioglossum (Ctenonomia) serenum* (46), *Homalictus sp.* (28), *Nomia sp.* (14), *Eusera sp.* (23), *Lithurgus atratus* (18), *Nomia crassipes* (18), *Nomia iridescens* (26), *Pseudapis oxybeloides* (14), *Sphecodes fumipennis* (7) with 0.21, 0.15, 0.24, 0.15, 0.37, 0.41, 0.29, 0.52, 0.56, 0.36, 0.44, 0.63, 0.61, 0.37, 0.19, 0.31, 0.24, 0.24, 0.35, 0.19 and 0.09 per cent abundance, respectively were noticed as very rare species in the Dangs district.

The results of the present research work corroboration with the results of Zinzuvadiya (2020) [1] recorded that total of 63 species of insect pollinators belonging to 12 families and 37 genera of the three orders *viz*., Hymenoptera, Diptera and Lepidoptera. Among the Hymenoptera, *A. dorsata* (2830) was found the most abundant with 16.94 per cent abundance from South Gujarat followed by *A. florea* (2538) and *A. cerana* (1931) with 15.19 and 11.56 per cent abundance, respectively. Bashir *et al*. (2015) [2] at Southern Punjab (Pakistan) also recorded *A. dorsata*, *A. florea* and *Halictus* sp. as the most abundant from 68 different species among bees. Subhakar *et al*. (2011) [3] as among all insect visitors, Hymenoptera order constituted the major chunk of pollinators with 88.51 per cent followed by Diptera (5.81%) and Lepidoptera was the least (4.68%).

Diptera

Among Diptera, *Eristalinus megacephalus* (77) was found the most abundant with 16.2 per cent abundance in the Dangs district followed by *Eristalis obliquus* (61) and *Phytomia errans* with 12.8 and 12.8 per cent, respectively as very common species. Whereas, *Eristalinus quinquestriatus* (56), *Mesembrius quadrivitatus* (58) and *Paragus serratus* (56) with the abundance of 11.8, 12.2 and11.8 per cent, respectively as common species of the Dangs district. Whereas, four species *viz*., *Ischiodon scutalarris* (48), *Syritta orientalis* (36), *Paragus serratus* (56) and *Syritta orientalis* (36) with 10.1, 6.82 and 7.6 per cent abundance, respectively as rare species of the Dangs district. Finally, two species *viz*., *Asarkina ericetorum* (14) and *Chrysomya megacephala* (8) with 2.9 and 1.7 per cent abundance, respectively were noticed as very rare species in the Dangs district.

The present work is more or less similar with the work done by Zinzuvadiya (2020) [1] reported that *Ischiodon scutellaris* (184) was found the most abundant with 21.62 per cent abundance followed by *Eristalis obliquus* (175) with 20.56 per cent from South Gujarat. Stojnic *et al*. (2012) [4] at Vojvodina (Serbia) as they observed hover flies as the most abundant species, Devi *et al*. (2015) [5] at Solan (Himachal Pradesh) found significantly higher syrphids in the coriander crop at bloom.

Lepidoptera

Among Lepidoptera, *Lampides boeticus* (78) was found the most abundant with 16.1 per cent abundance in the Dangs district followed by *Tirumala limniace* (61) with 12.6 per cent as very common species. Whereas, six species *viz*., *Papilio demoleus* (39), *Junonia orthya* (46), *colotis danae* (47), *Junonia almana* (38), *Junonia lemonias* (44) and *Hypolimnas bolina* (36) with 8.1, 9.5, 9.7, 7.9, 9.1 and 7.6 per cent abundance, respectively as common species. Whereas, *Pelopidas mathais* (29) with 6.0 per cent abundance as rare species of the Dangs district. Finally, three species *viz*., *Delias eucharis* (16), *Catopsila pyranthe* (24), *Hyplolimnas misippus* (26) with 3.3, 5.0 and 5.4 per cent abundance, respectively were noticed as very rare species in the Dangs district.

The following scientists also reported pollinators/visitors from order Lepidoptera; Zinzuvadiya (2020) [1] reported that *Lampides boeticus* (223) was found the most abundant with 33.38 per cent abundance in followed by *Pelopidas mathias* (115) with 17.22 per cent as very common species. Whereas, five species *viz. Tirumala limniace* (61), *Amata passalis* (54), *Euploea core* (51), *Eurema hecabe* (49) and *Delias eucharis* (48) with 9.13, 8.08, 7.63, 7.34 and 7.19 per cent abundance, respectively from South Gujarat. Balachandran *et al*. (2014) [6] they observed lepidopteran foragers comprised of 39 butterfly species from 32 genera and five families. Nymphalidae was the most specious (19 species) family followed by pieridae (7 species), lycaenidae (6 species), papilionidae (5 species) and hesperiidae (2 species).

Hemiptera

Among Hemiptera, *Dysdercus cingulatus* (15) was found the most abundant with 57.7 per cent abundance in the Dangs district followed by *Clavigralla gibbosa* (11) with 42.3 per cent, respectively as very common species.

Painkra *et al*. (2015) [7] at Chhattisgarh reported 15 species of insect visitors visited niger flowers. Amongest the visitors, *Dysdercus cingulatus* Fabricius, *Leptocorisa acuta* Thunberg, *Amata passelis* Fabricius, *Chrysomya bezziana* Villeneuve, *Coccinella septumpunctata* Linnaeus, *Vespa cincta* Fabricius and *Sarcophagi* sp. They were found visiting on niger flower throughout the blooming period.

Coleoptera

Among Coleoptera, *Raphidopalpa foveicollis* (12) was found the most abundant with 40.0 per cent abundance in the Dangs district followed by *Mylabris pustulata* (18) with 60.0 per cent, respectively as very common species.

The present work is more or less similar with the work done by Sreedevi *et al*. (2011) [8] at Andhra Pradesh noticed twenty diurnal species and four nocturnal species visiting sunflower heads belonging to orders Hymenoptera, Lepidoptera, Diptera and Coleoptera.

Table 1: Population and relative abundance of pollinators in the Dangs district

Sr. No.	Species	Host/Ecosystem	Population (No.)	Abundance (%)
I	**Hymenoptera**			
1	*Amegilla cingulata*	Brinjal, Rose, Cucurbit	16	0.22
2	*Amegilla confusa*	Weed, Lucerne	11	0.15
3	*Anthidium orientale*	Ekdandi weed, Brinjal	18	0.24
4	*Apis cerana*	Bitter gourd, Mustard, Cucumber, Niger	1224	16.55
5	*Apis dorsata*	Bitter gourd, Mustard, Cucumber, Niger	1836	24.82
6	*Apis florea*	Bitter gourd, Mustard, Cucumber, Niger	1658	22.42
7	*Ceratina binghami*	Brinjal, Lucerne, Cucumber	89	1.20
8	*Ceratina hieroglyphica*	Pigeon pea, Niger, Milkweed	51	0.69
9	*Ceratina smaragdula*	Pigeon pea, Cucumber, Niger, Weeds	63	0.85
10	*Ceratina lieatincki*	Pigeon pea, Cucumber, Niger, Weeds	11	0.15
11	*Ceratina similina*	Pigeon pea, Cucumber, Niger, Weeds	28	0.38
12	*Coelioxys fuscipennis*	Cucurbit, Pigeon pea, Sun hemp	31	0.42
13	*Coelioxys sexmaculatus*	Cucurbit, Sun hemp	22	0.30
14	*Halictus constrictus*	Coriender, Niger, Cucurbit, Weed	39	0.53
15	*Halictus fimbriatellus*	Coriender, Niger, Cucurbit, Weed	42	0.57
16	*Halictus funebris*	Coriender, Niger, Cucurbit, Weed	27	0.37
17	*Halictus gutturosus*	Coriender, Niger, Cucurbit, Weed	54	0.73
18	*Halictus lucidipennis*	Coriender, Niger, Cucurbit, Weed	33	0.45
19	*Halictus rugolatus*	Coriender, Niger, Cucurbit, Weed	47	0.64
20	*Hoplonomia elliotii*	Morning glory, Brinjal, Pigeon pea	62	0.84
21	*Lasioglossum (Ctenonomia) serenum*	Cucurbit, Weed, Niger	46	0.62
22	*Homalictus sp.*	Weed, Niger, Cucurbit	28	0.38
23	*Nomia sp.*	Weed, Cucurbit, Sun hemp	14	0.19
24	*Eusera sp.*	Cucurbit, Pigeon pea, Weed	23	0.31
25	*Lithurgus atratus*	Pigeon pea, Weed, Niger, Sunflower	18	0.24
26	*Megachile (Eutricharaea) hera*	Pigeon pea, Niger, Cucurbit, Sun hemp	137	1.85
27	*Megachile (Callomegachile) lerma*	Pigeon pea, Niger, Cucurbit, Sun hemp	146	1.97
28	*Megachile bicolor*	Pigeon pea, Niger, Cucurbit, Sun hemp	157	2.12
29	*Megachile disjuncta*	Pigeon pea, Niger, Cucurbit, Sun hemp	126	1.70
30	*Megachile lanata*	Pigeon pea, Niger, Cucurbit, Sun hemp, Sesame	174	2.35
31	*Megachile stirostoma*	Pigeon pea, Niger, Cucurbit, Sun hemp, Sesame	168	2.27
32	*Nomia crassipes*	Pigeon pea, Niger, Cucurbit,	18	0.24
33	*Nomioides sp.*	Brinjal, Weed	26	0.35
34	*Pseudapis oxybeloides*	Weed, Carrot, Niger	14	0.19
35	*Sphecodes fumipennis*	Brinjal, Weed, Tomato	7	0.09
36	*Tetragonula laeviceps*	Cucumber, Bitter gourd, Rose, Niger, Mustard	241	3.26
37	*Tetragonula irridipenis*	Bitter gourd, Cucumber, Rose, Weed, Mustard, Niger	224	3.03
38	*Xylocopa aestuans*	Pigeon pea, Brinjal, Sesame, Indian bean, Sun hemp	132	1.78
39	*Xylocopa amethystina*	Pigeon pea, Brinjal, Sesame, Indian bean, Sun hemp	112	1.51
40	*Xylocopa fenestrata*	Pigeon pea, Brinjal, Sesame, Indian bean, Sun hemp	99	1.34
41	*Xylocopa latipes*	Pigeon pea, Brinjal, Sesame, Indian bean, Sun hemp	124	1.68
Total (A)			**7396**	**100**
II	**Diptera**			
42	*Asarkina ericetorum*	Khaki weed, Ekdandi, Niger	14	2.90
43	*Chrysomya megacephala*	Ekdandi weed, Niger, Mustard	8	1.70
44	*Eristalinus megacephalus*	Khahi weed, Niger, Cucurbit	77	16.20
45	*Eristalinus quinquestriatus*	Brinjal, Niger, Bitter gourd, Cucumber	56	11.80
46	*Eristalis obliquus*	Weed, Niger, Cucurbit	61	12.80
47	*Ischiodon scutalarris*	Turnera, Coriender, Mustard, Cucurbit	48	10.10
48	*Mesembrius quadrivitatus*	Weed, Niger, Brinjal, Indian bean, Mung bean	58	12.20
49	*Paragus serratus*	Brinjal, Niger, Tulsi, Weed	56	11.80
50	*Phytomia errans*	Weed, Niger, Coriender	61	12.80
51	*Syritta orientalis*	Weed, Coriender, Niger	36	7.60
Total (B)			**475**	**100.0**
III	**Lepidoptera**			
52	*Delias eucharis*	Pigeon pea, Lantana, Niger, Cucurbit	16	3.30
53	*Lampides boeticus*	Pigeon pea, Sun hemp, Weed	78	16.10
54	*Papilio demoleus*	Citrus, Niger, Cucurbit, Weed	39	8.10
55	*Pelopidas mathais*	Weed, Cucumber, Bitter gourd, Niger	29	6.00
56	*Tirumala limniace*	Brinjal, Niger, Sunflower, Weed	61	12.60
57	*Junonia orthya*	Pigeon pea, Niger, Cucurbit, Weeds	46	9.50
58	*Colitis danae*	Rose, Niger, Sun hemp, Weed	47	9.70
59	*Junonia almana*	Pigeon pea, Niger, Cucurbit, Weed	38	7.90
60	*Junonia lemonias*	Weed, Pigeon pea, Niger, Sunflower	44	9.10
61	*Hypolimnas bolina*	Rose, Ber, Niger, Cucurbit, Weed	36	7.40

62	*Catopsila pyranthe*	Weed, Senna, Niger, Cucurbit	24	5.00
63	*Hyplolimnas misippus*	Pigeon pea, Weed, Ber	26	5.40
Total (C)			**484**	**100.0**
IV	**Hemiptera**			
64	*Dysdercus cingulatus*	Cucurbit, Cotton, Okra	15	57.7
65	*Clavigralla gibbosa*	Cucurbit, Pigeon pea, Indian bean	11	42.3
Total (D)			**26**	**100.0**
V	**Coleoptera**			
66	*Raphidopalpa foveicollis*	Cucurbit, Weed	12	40.0
67	*Mylabris pustulata*	Rose, Hibiscus, Mung bean	18	60.0
Total (E)			**30**	**100.0**
Grand Total (A + B + C+D+E)			**8411**	**100.0**

Conclusion

The Dangs district being a forest dominated area is rich in pollinators' diversity. A total of 8411 insect pollinators were collected, among them 7396 insects were reported under order Hymenoptera followed by Lepidoptera (484) Diptera (475), Coleoptera (30) and Hemiptera (26). A total of 67 species of different insect pollinators/foragers were recorded in the Dangs which was belonging five orders *viz*., Hymenoptera, Diptera, Lepidoptera, Hemiptera and Coleoptera. The efforts should be made to conservation of the pollination diversity in forest area of the Dangs district.

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