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Butterfly diversity; district Gujrat, Punjab, Pakistan

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Key words: Hand net swiping method, Pieridae, Nymphalidae, Danaidae, Host availability, Systematics

Abstract

This entomological study was conducted at University of Gujrat to discover the butterfly species in Gujrat district of Province Punjab, Pakistan. During the study, about 232 specimens of adult butterflies were collected by hand net swiping method from the different localities of Gujrat district. Among these specimens, twelve species of butterflies were identified which belong to eight generas, four subfamilies and three families. The Pieridae family includes 78.44 %, family Nymphalidae includes 8.18 % and family Danaidae includes 13.36 % species of this study area. The family Pieridae is represented by six species that are *Anapheis aurota, Pieris canidia, Pieris brassicae, Catopsilia florella, Catopsilia pyranthe* and *Eurema hecabe*. The family Nymphalidae is represented by four species that are *Junonia orithya, Junonia almana, Vanessa carduiand Ergolis merione*. Whereas the family Danaidae is represented by two species that are *Danaus chryssipus* and *Danaus genutia*. The maximum population (74 numbers) of *Pieris canidia* was recorded throughout the season; whereas, *Danaus genuttia* and *Vanessa cardui* was least populated (01 numbers). The population of *Pieris brassicae* was moderate in the seasons that might be due to the host availability and preference. This is the first record of systematics and diversity of butterflies from Gujrat district of Province Punjab, Pakistan. In future the reconciliation of the systematics of the reported species through molecular biology is suggested.

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Introduction

Animal diversity means the number of different species along their relative frequency at a specific area (U.S. Congress Report, 1987). Currently 1.4 million species of organisms have been discovered on this planet earth (Miller and Harley, 2001), among them more than 53% are insects and 15000 to 16000 species of butterflies have been discovered (Hassan, 1994). In Pakistan, the number of insect species is exceeding than 5000 and butterflies and moths are 400 (Khan *et al*., 2000 and 2007).

Butterflies are master piece of art and beauty of Nature (Rafi *et al.* 2000). They are the source of happiness to every one due to their marvelous bright colors (Iqbal J., 1978). Butterflies are found on flowering plants in every habitat of the world except Antarctic, Arctic and mountains that are uttered with snow (Hassan, 1997). Due to continuous discovery of new species of Butterflies, this figure is not constant and it is increasing tremendously day by day (Roberts, 2001; khan *et al*., 2007) but the butterflies fauna of the area under study is not well documented and the diversity of the butterflies from area under study was never calculated before and this is the first attempt to discover the various species of butterflies (Lepidoptera) in district Gujrat, Punjab. Pakistan. So, the objective of present research is to study the diversity of butterflies (Lepidoptera) in district Gujrat, Punjab. Pakistan.

Butterflies belong to Lepidoptera which is included in one of those insect orders that are mostly recognized and distributed in the world. Carolus Linnaeus was first person who coined the term Lepidoptera in 1735 and derived the Lepidoptera from two Greek Words that is Lepis means scale and ptera means wings. Linnaeus divided order Lepidoptera in three divisions in his famous book "Systema Naturea "(1758) that are Papilo, Sphinx and Phalaena. Today, Lepidoptera is comprised of 174250 (moth, butterflies and skipper) species in 46 super families and 126 families. According to recent estimate the order may have more species than earlier and is categorized among the four most species order like Hymenoptera, Diptera and Coleoptera (Powell, 2009).Butterflies possess 2 pairs of large wings that are covered with colorful indecent scales arranged in overlapping rows. In cool weather, they take sun bath to warm up their bodies themselves. With growing age, the colour of wings fades and the wings become ragged. The speed of flight of butterflies is variable as it is evident that speed of poisonous butterflies is slower than non-poisonous butterflies. The speed of flight of faster butterflies (Some Skippers) is 30 miles/hour and slowest butterflies are 30 miles/hour. They show migration behavior to avoid adverse environmental conditions like cold weather. Often, they migrate for short distances for example the painted lady, *Vanessa cardui* (Linnaeus, 1758) etc. but a few of them migrate for thousands of miles like monarch (*Danaus plexipppus*) butterfly (Perveen *et al.* 2014). Butterflies show mimicry as a distinguishing character in different forms that is still a challenge for evolution. They show Batesian mimicry in between palatable and non-palatable species (of butterflies). In case of Mullerian mimicry, not only the mimics but many equally unpleasantly tasting species share a colour pattern and all species are mutually beneficial (Meyer, 2006) for example, seven species of clearwing butterflies like *Milinaea* and seven species of morphotypes of numeta, long wing *Heliconius* numeta are related in coloration, shape of wings and location of spots, strips and bars (Robbins, *et al.* 1981).

Butterflies show utmost economic importance. They act as remarkable pollinating agent. They are very important for the survival of man and animals as they play a role of helping agent in production of food crops, seeds and fruits (Maheshwari, 2003). They also possess well developed silk glands (Borror, 1975). They possess antennae either knobbed or slenderical at the tips or hooked at the tip in case of the family Hesperioidae (Skippers) but in some genera of butterflies like common snout butterfly, Libytheacarienta (Cramer) and Taractrothera, the knob is hollowed underneath (Evans 1923,1932 and 1933).

There are many diagnostic characters in butterflies that prove them good candidate as an indicator species. They are worldwide in distribution, comparatively easy to sample and recognize. They are

highly sensitive to environmental changes and are influenced by local weather conditions. So, due to changes in composition and structure of vegetation, composition of butterfly species also changes (Sawchick *et al*. 2005). Butterflies are showing decrease in species richness, abundance and diversity due to increased urbanization features in environment like construction of roads, buildings and mowed lawns, so they are more affected by urbanization than any other species (Clark, 2005). The objective of present research is to study distribution and diversity of butterflies in district Gujrat.

Materials and methods

The study of distribution and diversity of butterflies in Gujrat was imposed to answer following question; What is the diversity of butterflies in District Gujrat?

Study sites

The area of study, Gujrat is located between 32°40' north latitude and 74°02 east longitudes. Gujrat possess an eminent and archaic status in districts of province Punjab- a land of five rivers, in Pakistan. It is situated between Jhelum and Chenab (two famous rivers in Punjab). Because of its closeness to the rivers, its land is suitable for production of rice and sugarcane. On its northwest side river Jhelum sperates it from areas of district Jhelum, on the east and southeast side the river Chenab sperates it from the districts of Gujranwala and Sialkot, on the northeast Jammun and Kashmir are present and on its west side Mandi Bahaudddin district is situated. The area of Gujrat is more than 3192 square kilometers. Gujrat, Kharian and Sarai Alamgir are three tehsils of district Gujrat. fig. 1 is showing location map of sampling sites in district Gujrat.

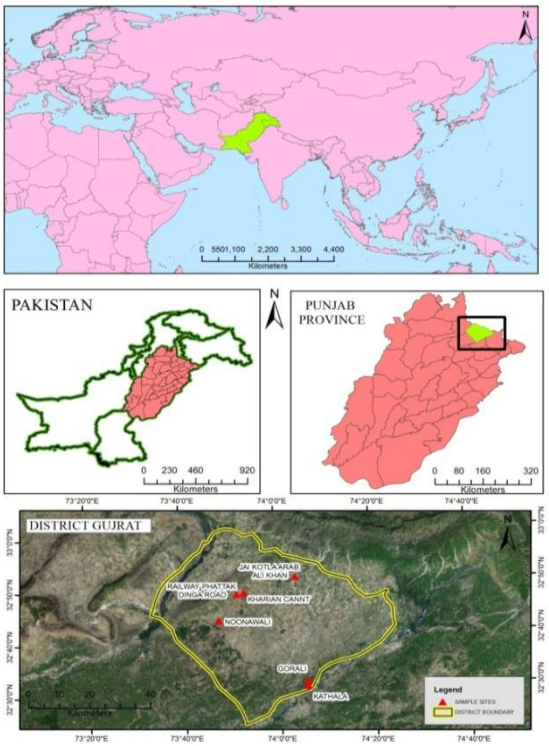

Fig. 1. Location map of sampling sites in district Gujrat, Punjab, Pakistan.

Materials

Hand swiping net, cyanide bottle, insect pins, a wooden board, Naphthalene balls wooden collection boxes, Camera (Cannon PC 1234), Ruler, Pencil and field notebook.

Collection and Preservation

Keeping in view the approach and presence of gardens, vegetation and forests areas, six locations; Kathali, Gorali, Railway Phatic Dinga road kharian, Noona Wali Chak, Kharian Cantt and Jai Pur Kotla were selected along the Great Trunk (G. T.) road in district Gujrat.

The selected sites were visited for several times for the collection of butterflies and about 232 specimens of adult butterflies were collected during October 2013 to November 2014 by hand net swiping method.

The collected specimens were exterminated in a cyanide bottle and subsequently were placed on a wooden board for setting wings with insect pins through the thoracic region.

As the specimens dried, they were arranged in wooden collection boxes. Naphthalene balls mounted on pins were kept in collection boxes for the protection of the specimens from different pests.

Identification

Every specimen was labeled with place and date of collection and later on scientific name was added after identification. The specimens were identified by using the Keys (Bingham, 1905; Talbot, 1939; Abbas *et al*, 2002; Perveen *et al.*, 2013) and the identified samples were reconfirmed by literature (Sabir *et al*, 2000). The photographs of all specimens were taken by using camera (Cannon PC 1234).

All the specimens have been deposited in the insectary of the Department of Zoology, Hafiz Hayat Campus, University of Gujrat, Gujrat, Punjab, Pakistan for future references.

Results

During the current studies, twelve species of butterflies were identified out of 232 specimens. Table 1 describes the overview of the identified species of butterflies in the selected sites. Table 2 shows area wise distribution of various species of butterflies, table 3 shows distribution of various species of butterflies during 2013-2014 and table 4 shows family wise distribution of butterflies in district Gujrat, Punjab, Pakistan.

Table 1. Overview of the identified species of the butterflies in district Gujrat, Pakistan.

SL	Species	Family	Subfamily	Genus	Species
1	1	Pieridae	Pierinae	Anapheis	*Anapheis aurota*
2	2	Pieridae	Pierinae	Pieris (SHRANK)	*Pieris canidia*
3	3	Pieridae	Pierinae	Pieris (SHRANK)	*Pieris brassicae*
4	4	Pieridae	Colidinae	Catopsilia (HUBNER)	*Catopsilia florella*
5	5	Pieridae	Colidinae	Catopsilia (HUBNER)	*Catopsilia pyranthe*
6	6	Pieridae	Colidinae	Eurema (HUBNER)	*Eurema hecabe*
7	7	Danaidae	Danainae	Danaus (KLUK)	*Danaus chryssipus*
8	8	Danaidae	Danainae	Danaus (KLUK)	*Danaus genutia*
9	9	Nymphalidae	Nymphalinae	Junonia	*Junonia orithya*
10	10	Nymphalidae	Nymphalinae	Junonia	*Junonia almana*
11	11	Nymphalidae	Nymphalinae	Vanessa (FABRICIUS)	*Vanessa cardui*
12	12	Nymphalidae	Nymphalinae	Ergolis (BOISDUVAL)	*Ergolis merione*

Table 2. Area wise distribution of various species of butterflies in district Gujrat, Pakistan.

SL	Name of species	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Total	%
1	*Anapheis aurota*	6	7	2	-	-	-	15	6.44
2	*Pieris canidia*	11	27	7	29	-	-	74	31.89
3	*Pieris brassicae*	-	12	-	15	-	15	42	18.10
4	*Catopsilia florella*	4	_	-	-	-	-	04	1.72
5	*Catopsilia pyranthe*	1	_	-	3	17	-	21	9.05
6	*Eurema hecabe*	1	12	-	11	2	-	26	11.20
7	*Danaus chrysippus*	5	20	-	1	4	-	30	12.93
8	*Danaus genuttia*	-	1	-	-	-	-	01	0.43
9	*Junonia orithya*	2	-	-	-	1	-	03	1.29
10	*Junonia, almanac*	-	2	-	-	-	-	02	0.86
11	*Vanessa cardui*	-	-	-	-	1	-	01	0.43
12	*Ergolis merione*	10	3	-	-	-	-	13	5.60
Total		40	84	9	59	25	15	232	
Total %		17.24	36.20	3.87	25.43	10.77	6.44		

Sign (-) indicates that species was not found.
Site 1: Gorali, Gujrat
Site 2: Khatala , Gujrat
Site 3: Noona Wali, Kharian
Site 4:Kharian Cantt
Site 5: Railway Phatic Dinga Road Kharian
Site 6: Jai Pur, Kotla Arab Ali Khan, Kharian

Table 3. Distribution of Various Species of Butterflies during 2013-2014 in District Gujrat, Pakistan.

S.#	Name of Species	Oct 2013	Nov 2013	Dec 2013	Jan 2014	Feb 2014	March 2014	April 2014	May 2014	June 2014	July 2014	Aug 2014	Sep 2014	Oct 2014	Nov 2014	Dec 2014	Total	%
1	*Anapheis aurota*			7	2				6								15	6.46
2	*Pieris canidia*			27	7	10	7	12	11								74	31.89
3	*Pieris brassicae*			12		2	4	9								15	42	18.10
4	*Catopsilia florella*	4															4	1.72
5	*Catopsilia pyranthe*								1	1	6	10	1	2			21	9.05
6	*Eurema hecabe*		9	3					1			1	1	5	6		26	11.20
7	*Danaus chrysippus*	1	8	12					4			1	3	1			30	12.93
8	*Danaus genuttia*		1														1	0.43
9	*Junonia orithya*								2					1			3	1.29
10	*Junonia, almana*		1	1													2	0.86
11	*Vanessa cardui*										1						1	0.43
12	*Ergolis merione*	7	1	2					3								13	5.60
	Total	12	20	64	9	12	11	21	28	1	7	12	5	9	6	15	232	
	Total %	5.17	8.62	27.58	3.87	5.17	4.74	9.05	12.06	0.43	3.01	5.17	2.15	3.87	2.58	6.46		

Table 4. Family wise distribution of butterflies in district Gujrat.

SL.	Family	Percentage
1	Pieridae	78
2	Danaidae	14
3	Nymphalidae	8

Moreover, fig. 2 shows site wise distribution of butterflies in district Gujrat. Fig. 3 shows graphically area wise distribution and density of various species of butterflies, fig. 4 shows the month wise population dynamics of the butterflies in graphically form and fig. 5 in Pie chart graph form shows family wise distribution of butterflies in district Gujrat, Punjab, Pakistan.

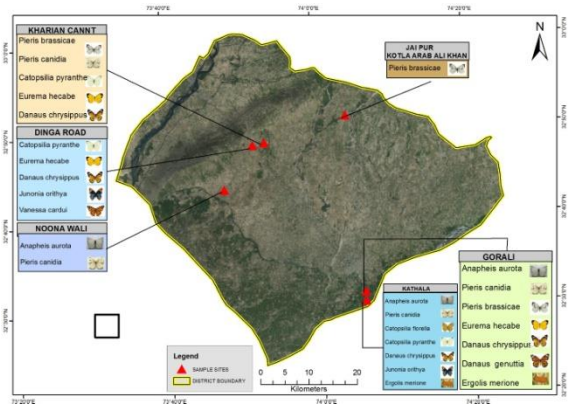

Fig. 2. Site wise distribution of butterflies in district Gujrat, Punjab, Pakistan.

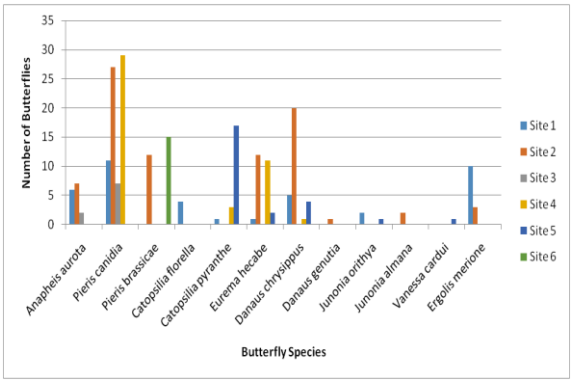

Fig. 3. Graph showing Area Wise Distribution & Density of Various Species of Butterflies in District Gujrat, Pakistan.

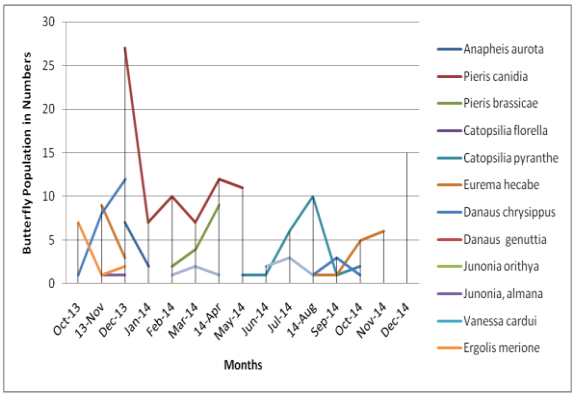

Fig. 4. Graph showing the month wise population dynamics of the butterflies in district Gujrat, Pakistan.

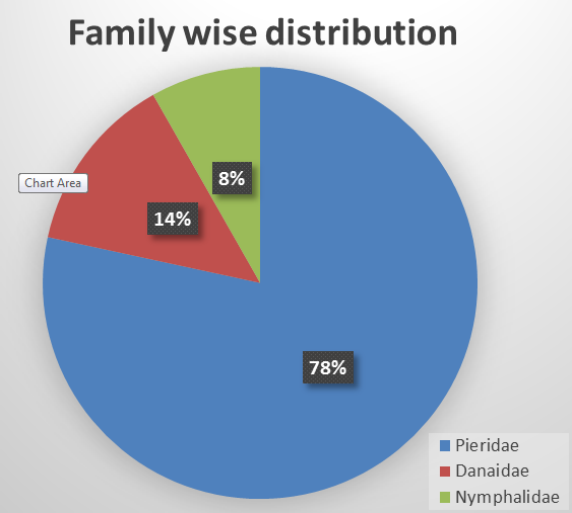

Fig. 5. Pie chart showing family wise distribution of Butterflies in district Gujrat, three partition's are not clearly shown.

Discussion

In nature, butterflies are considered as a symbol of beauty (Rafi *et al.* 2000). The bright colours, shapes and flight of butterflies are a source of pleasure for everyone. They act as a pollinator and environmental indicator (Perveen and Ahmed, 2012 a & b) as they give response to changes in habitat.

The larvae of butterflies play a role of pest that give economic loss to various crops (Gardiner *et al.* 2005) and adult butterflies show great commercial and aesthetic importance (Perveen and Ahmed, 2012a).

Much of the work has been done by taxonomists for study of butterflies in the Indian subcontinent but still there is very little information about the butterfly fauna of Pakistan and especially there is no scientific taxonomic report about the systematic studies of butterflies in the district Gujrat region, so literature references are relatively scarce.

In 1886, Doherty was the first taxonomist who first of all studied the butterfly fauna of Kashmir. In 1887, Swinhoe worked on butterflies of Karachi and neighboring areas. He reported 4 species of Papilionidae family, 18 species of Lycaenidae family, 17 species of Nymphalidae family and 7 species of Hesperioidae family.

Marshal and De-Niceville worked for seven (7) years from 1883 to 1890 on the variety of butterflies in the Indian subcontinent. Butterfly fauna of Chitral was reported by Leslie and Evans in 1903.

Bringham in 1905 also worked on the variety of the butterflies of Indian subcontinent. Rhe-Philipe discovered 5 families of butterflies in Lahore in 1917. He reported 3 species of Papilionidae family, 17 species of Pieridae family, 11 species of Lycaenidae family and 7 species of Hesperioidae family. Evans studied variety of butterflies in Indian region in 1923. Tytler published his work on the variety of butterflies in India and Barma in 1926.

Puri worked on the distribution of butterflies in Lahore in 1931. He explored 57 species which belong to 34 genera and 5 families. Butterfly fauna of Baluchistan was studied by Evans in 1931. Moreover distribution of butterflies in Indian subcontinent was also explored by Talbot in 1939 and Wynter-Blyth (1940 to 1957). Butterflies of Sind were reported by Menesse in 1950.

Malik explored 8 species of butterflies from Rawalpindi and Murree in 1970. In another study, Malik worked on the variety of butterflies in West-Pakistan. He reported 9 species of Papilionidae family, 21 species of Pieridae family, 21 species of Lycaenidae family, 9 species of Hesperioidae family, 19 species of Nymphalidae family, 1 species of Satyridae family, 1 species of Acaeridae family and 9 species of Danaide family. Ahsan and Iqbal explored 66 species of butterflies from Lahore which belongs to 44 genera and 7 families and 12 species out of 66 were discovered for the first time in Lahore in 1975. Iqbal in 1978 reported 51 species of butterflies from Rawalpindi and Islamabad which belongs to 35 genera and 8 families. He reported 3 species of Papilionidae family, 12 species of Pieridae family, 7 species of Lycaenidae family, 11 species of Nymphalidae family, 6 species of Satyridae family, 3 species of Danaide family, 3 species of Ercycinidae family and 5 species of Hesperioidae family. Arshad *et al.* explored 32 species of butterflies from Northern Western Frontier Province (NWFP) now Khyber Pukhtunkhwan (KPK) in 1983.

Hassan worked on the butterflies fauna of Islam Abad and Murree in 1994. He reported 4 species of Papilionidae family, 13 species of Pieridae family, 11 species of Lycaenidae family, 1 species of Libythcidae family, 17 species of Nymphalidae family and 3 species of Danaide family. In 1997, Hassan worked on the butterfly fauna of North West Himalaya, Gilgit and Azad Kashmir. He explored 80 species of butterflies which belong to 9 families. He reported 6 species of Papilionidae family, 15 species of Pieridae family, 17 species of Lycaenidae family, 1 species of Libythcidae family and 5 species of Hesperioidae family. In another study that was being conducted by Smith and Hassan in 1997 and they explored 50 species of butterflies from northern areas (Gilgit to khunjerab) of Pakistan. In 2000, Khan *et al.* worked on the distribution and diversity of genus *Papilio* in Rawalpindi and Islam Abad. In 2000, Rafi *et al.* published a guide to the Papilionidae family of butterflies of Pakistan. In 2001, Roberts explored 320 species of butterflies of Pakistan. Naz, also in 2001, studied 25 species from district Buner (KPK). Shah *et al.* in 2001 collected 10 species from Kohat which belongs to only one family Pieridae. Inyatullah, in 2002, studied 29 species of butterflies from KPK, Malakand agency and Lower Swat of Pakistan. Abbas *et al.* studied diversity of butterflies in 2002 and reported 16 species of butterflies from Skardu, Kamang, sadpare and Deosal plains. In 2007, Khan *et al.* explored 28 species of butterflies from district Muzafar Abad , Azad Kashmir and in another study, he explored 16 species of butterflies from district Kotaly, 20 species from district Mir Pur and 19 species of butterflies from district Bhimber.

Conclusion

During the studies twelve (12) species of butterflies were identified which belong to (eight genera and three families. Most of the butterflies population (78.44%) belongs to the family Pieridae; whereas, least population (8.18%) was recorded from family Nymphalidae. The population of family Danaidae was moderate (13.36%) in the experimental region.

The maximum population (74 numbers) of *Pieriscanidia* was recorded throughout the season; whereas, *Danausgenuttia* and *Vanessa cardui* was least populated (01 numbers). The population of *Pierisbrassicae* was modrate in the seasons that might be due to the host availability and preference.

Recommendations

In future the reconciliation of the identified and systematics of the reported unidentified specifies through molecular biology is suggested.

Acknowledgement

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