



Nectar resource use by Butterflies in Gir Wildlife Sanctuary, Sasan, Gujarat

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ABSTRACT: Butterflies are known to be the most fascinating creatures existing on this earth and have a great aesthetic value. They are in close relation with the plant species as they procure nectar from flowering plants to meet their energy requirements while butterflies serve to be pollinators for various plant species which is the only means of their propagation. Hence in order to understand the butterfly-flower interactions, the present study was conducted in Gir Wildlife Sanctuary, Sasan, Gujarat to determine the numerous host plants associated with these beautiful butterflies. An extensive entomological survey for a period of two years in the forest area of Gir was undertaken. Out of the 50 butterfly species recorded in Gir, 27 species (54%) used nectar while other species obtained their food from non-floral resources such as mud, wet soils and cow dung. Highest number of butterflies were recorded in *Lantana camara* (19), followed by *Asclepias syriaca* (10), *Tamarindus indica* (6), *Diospyros melanoxylon* (5) and *Ixora arborea* (5) respectively.

Key words: Butterflies, Nectar, Pollinators, Gir wildlife sanctuary, Host plants, Food

INTRODUCTION

Plants are a food source for many insects and animals; some plants play host to caterpillars whereas other plants provide sustenance for butterflies. Butterflies help to pollinate plants in return. Insects visit flowers to obtain food, usually in the form of pollen or nectar. The plants obtain the services of pollinators in carrying pollen from one flower to another (Proctor *et al.*, 1996). Butterflies are often considered opportunistic foragers that visit a wide variety of available flowers. However their choice of flower is not random and they exhibit distinct flower preference which can differ between species (Jennersten, 1984). The choice of plants as nectar sources by butterflies depends on various factors including innate color preference, corolla depth, clustering of flowers from which nectar can be extracted (Porter *et al.*, 1992). The flower scent is an important signal for butterflies initially to identify and subsequently to recognize and distinguish among rewarding plants. The life cycle of plants, caterpillars and butterflies has closely evolved to ensure the continuation of various plant and animal species. Butterflies are generalists, able to exist in a wide variety of habitats. Most butterflies however are far more specialised, each species having its own particular requirements regarding habitats, temperature, humidity, larval food plants and adult food sources. Most species of caterpillars and butterflies only populate specific plant families. Host plants are the types of plants that butterflies choose to populate with their larvae. When a caterpillar changes

into a butterfly, it will populate various types of other plants for food. Each category of pollinator is associated with a syndrome of dependent floral characteristics (size, shape, and reward).

The flora of Gir comprises of many flowering and non-flowering plants which appear during rains. The vegetation changes along with west to east axis. The various plant consists of herbs (40.43%), trees (21.12%), shrubs (16.67%), climbers (14.19%) and grasses (7.59%) (Kumar and Meena, 2012). Many of these plants serve as hosts for various stages of butterfly life cycle. The consideration of Gir came into picture because of the fact that it has become a very stable ecosystem with tremendous regenerating, self supporting and self sustaining capacity due to its rich and diverse flora and fauna. Also, it is a potential place to be a centre for creating environmental awareness and imparting nature education (Kumar and Meena, 2012). It supports a varied topography means a corresponding variety of microclimates, rainfall patterns, plant distributions, wetlands and therefore the butterfly distributions. The majority of species occur in fair close proximity to their larval food plants. Shahabuddin (1997) has worked on butterfly visitors to 20 plant species in Palni hills, Western Ghats. The environmental conditions of Gir Wildlife Sanctuary differ from it. Hence, the present study gives a picture of the butterfly attracting plant species in Gir that may be helpful in future afforestation programmes.

MATERIALS AND METHODS

The study area: A systematic study was carried out to find out the food resources of butterflies in Gir Wildlife Sanctuary. Various nes, thana and rivarine sites were selected from eastern and western Gir ranges that come under Wildlife Sanctuary areas *i.e.* between Latitude 20° 40' N to 21° 50' N and Longitude 70° 50' E to 71° 15' E (Krishnan and Guha, 2006). The present study covered an area of 678.45 sq. km in West Gir Wildlife Sanctuary. The study area has rich flora and wild life. The major vegetation consists of *Tectona grandis*, *Wrightia tinctoria*, *Acacia catechu*, *Zizyphus mauritiana*, *Acacia nilotica*, *Anogeissus latifolia*, *Acacia leucophloea*, *Terminalia crenulata*, *Diospyros melanoxylon*, *Bauhinia purpurea*, *Grewia tiliaefolia*, *A. ferruginea*, *Boswellia serrata*, *Lannea coromandelica*, and *Butea monosperma* (Sharma and Johan Singh 1995).

Study method: The natural vegetation consisting of trees, shrubs, herbs, climbers and grasses were observed to find out the food resources of butterflies, in different seasons. Recording of flower visiting insect species, their foraging behavior, length of the visits and number of flowers visited in unit time was done. All the above data were recorded between 0600 and 1800 hrs. Butterfly species were collected and identified by using standard books of Kehimkar 2008; Gay *et al.* 1992 and Wynter Blyth 1957.

RESULTS

Butterfly Diversity: A total of 50 species of small and large butterflies belonging to four families within an area of 678.45 km² of Western Gir Wildlife Sanctuary encompassing eighty localities were recorded (Table 1). The most dominant family was Nymphalidae followed by Pieridae, Lycaenidae and Papilionidae. The data indicated that the smallest butterfly recorded was *Castalius rosimon* (Lycaenidae) and the largest was *Pachliopta aristolochiae* (Papilionidae). Among the butterflies sampled, *Castalius rosimon* is enlisted in Schedule-I, *Hypolimnas misippus* is enlisted in Schedule-I and II and *Euploea core* is enlisted in Schedule-IV of the Indian Wildlife Protection Act, 1972 (Evans, 1932; Gaonkar, 1996; Kunte, 2000 & 2008; Larson, 1987 & 1988; Talbot, 1939; Wynter-Blyth, 1957).

The faunal diversity of butterflies was greatly influenced by season, monsoon to late winters being the preferred seasons. However, butterflies of some families were also visible during summers. The most commonly observed species were *Danais chrysippus*, *Junonia lemonias*, *Junonia hierta*, *Junonia orithya*,

Catopsilia pyranthe, *Eurema hecabe* and *Papilio demoleus*. They were noticed in all the seasons.

Lycaenidae butterflies were dominant during monsoon. Papilionidae were always encountered flying at heights in pair or singly.

Nectar resources: Plant species associated with these butterflies were identified as their host plants. Out of the 50 butterfly species recorded, 27 species used nectar while other species obtained their food from non-floral resources such as mud, wet soils and cow dung. Floral nectar of 50 plant species was used as food. The food plants comprised of 27 species of trees, 10 species of grasses, 9 species of shrubs and 4 species of herbs respectively. Highest number of butterflies were recorded in *Lantana camara* (19), followed by *Asclepias syriaca* (10), *Tamarindus indica* (6), *Diospyros melanoxylon* (5) and *Ixora arborea* (5). Five plant species namely *Terminalia arjuna*, *Balanites aegyptica*, *Bauhinia variegata*, *Commiphora wightii* and *Lannea coromandelica* were not observed visited by butterflies (Table 2). The flower color and size also influence the visiting insects, therefore majority of butterflies were attracted to white flowers (36.36%). This was followed by yellow (29.09%), red (20%) and green (14.55%) respectively (Fig. 1). Also small sized flowers charmed maximum butterflies (Table 2). Foraging behavior and timings varied among different species. Most of the species remain active in the forenoon (Selvarathinam *et al.*, 2009). *Junonia lemonias* visited many flowers and spent long durations for collecting nectar. *Danais chrysippus* was observed the whole day siphoning nectar. On the contrary, swallowtail butterflies like *Graphium sarpedon*, *Pachliopta aristolochiae* occasionally visited flowers and spent only 1-2 seconds in a single flower and flew away. The major flower visitors were *Euploea core*, *Phalantha phalantha*, *Eurema blanda*, *Anaphaeis aurota* and *Catopsilia pomona*.

Non-floral food source: Species of Pieridae and Papilionidae are generally seen mud puddling (Sreekumar and Balakrishnan, 2001). *Catopsilia pyranthe*, *C. crocale*, *Anaphaeis aurota*, *Eurema blanda*, *Papilio demoleus* and *Graphium sarpedon* were observed mud puddling on wet soil in the monsoon season. Alongside, two species of Nymphalidae *viz.* *Euploea core* and *Phalantha phalantha* were also observed mud puddling at times. Males seem to benefit from the sodium uptake through mud-puddling behavior with an increase in reproductive success. The collected sodium and amino acids are often transferred to the female with the spermatophore during mating as a nuptial gift. This nutrition enhances the survival rate of the eggs (Pivnik and McNeil, 1987; Medley and Eisner, 1996; Molleman *et al.*, 2004).

Table 1: Butterflies recorded in Western Gir Wildlife Sanctuary, Sasan, Gujarat (2011 to 2013).

S. No.	Common Name	Scientific Name	Family	Legal Status
1.	The Lemon Pansy	<i>Junonia lemonias</i>	Nymphalidae	-
2.	The Blue Pansy	<i>Junonia orithya</i>	Nymphalidae	-
3.	The Yellow Pansy	<i>Junonia hierta</i>	Nymphalidae	-
4.	The Peacock Pansy	<i>Junonia almanac</i>	Nymphalidae	-
5.	The Danaid Eggfly	<i>Hypolimnas misippus</i>	Nymphalidae	Schedule I & II
6.	Blue Tiger	<i>Tirumala limniace leopardus</i>	Nymphalidae	-
7.	Plain Tiger/African Monarch	<i>Danais chrysippus</i>	Nymphalidae	-
8.	The Monarch Butterfly/ The Milkweed Butterfly	<i>Danais plexippus</i>	Nymphalidae	-
9.	The Baronet	<i>Euthalia nais</i>	Nymphalidae	-
10.	The Common Indian Crow	<i>Euploea core</i>	Nymphalidae	Schedule IV
11.	The Common Leopard	<i>Phalantha phalantha</i>	Nymphalidae	-
12.	The Common Nawab	<i>Charaxes athamas</i>	Nymphalidae	-
13.	Common evening brown	<i>Melanitis leda</i>	Nymphalidae	-
14.	Common threering	<i>Ypthima asterope</i>	Nymphalidae	-
15.	Dark evening brown	<i>Melanitis phedima</i>	Nymphalidae	-
16.	Spotted joker	<i>Byblia ilithyia</i>	Nymphalidae	-
17.	Angled castor	<i>Ariadne ariadne</i>	Nymphalidae	-
18.	Painted lady	<i>Vanessa cardui</i>	Nymphalidae	-
19.	Tawny coster	<i>Acraea terpsicore</i> Syn. <i>A. violae</i>	Nymphalidae	-
20.	The common pierrot	<i>Castalius rosimon</i>	Lycaenidae	Schedule I
21.	Common guava blue	<i>Virachola Isocrates</i>	Lycaenidae	-
22.	Forget-me-not	<i>Catochrysops Strabo</i>	Lycaenidae	-
23.	Babul blue/ Topaz spotted blue	<i>Azanus jesous</i>	Lycaenidae	-
24.	Indian red flash	<i>Baspa melampus</i>	Lycaenidae	-
25.	Stripped pierrot	<i>Tarucus nara</i>	Lycaenidae	-
26.	Common silverline	<i>Cigaritis vulcanus</i>	Lycaenidae	-
27.	Bright babul blue	<i>Azanus ubaldus</i>	Lycaenidae	-
28.	The Lemon Emigrant	<i>Catopsilia pomona</i> Syn. <i>Catopsilia crocale</i>	Pieridae	-
29.	The Mottled Emigrant	<i>Catopsilia pyranthe</i>	Pieridae	-
30.	Yellow Orange Tip	<i>Ixias pyrene evippe</i>	Pieridae	-
31.	White Orange Tip	<i>Ixias Marianne</i>	Pieridae	-
32.	The Pioneer White	<i>Belenois aurota</i> Syn. <i>Anaphaeis aurota</i>	Pieridae	-
33.	The Black veins	<i>Aporia hippie</i>	Pieridae	-
34.	Small orange tip	<i>Colotis etrida</i>	Pieridae	-
35.	Plain orange tip	<i>Colotis eucharis</i>	Pieridae	-
36.	Crimson tip	<i>Colotis danae</i>	Pieridae	-
37.	The Common Jezebel	<i>Delias eucharis</i>	Pieridae	-
38.	The Common Grass Yellow	<i>Eurema hecabe</i>	Pieridae	-
39.	Three spot Grass yellow	<i>Eurema blanda</i>	Pieridae	-
40.	Spotless grass yellow	<i>Eurema laeta</i>	Pieridae	-

41.	Broad bordered grass yellow	<i>Eurema brigitta</i>	Pieridae	-
42.	Common gull	<i>Cepora nerissa</i>	Pieridae	-
43.	Small white	<i>Pieris rapae</i>	Pieridae	-
44.	Large white	<i>Pieris brassicae</i>	Pieridae	-
45.	Common Lime Butterfly/ Chequered Swallowtail	<i>Papilio demoleus</i>	Papilionidae	-
46.	The Swallowtail	<i>Papilio veiovis</i>	Papilionidae	-
47.	Common Rose Swallowtail	<i>Pachliopta aristolochiae</i>	Papilionidae	-
48.	The Common Mormon	<i>Papilio polytes romulus</i>	Papilionidae	-
49.	Zebra butterfly	<i>Graphium nomius</i>	Papilionidae	-
50.	Common bluebottle	<i>Graphium sarpedon</i>	Papilionidae	-

Table 2 : Butterfly attracting plant species (flowers) recorded in Gir Wildlife Sanctuary, Sasan, Gujarat (2011 to 2013).

1.	<i>Lantana camara</i> (Shrub)	Lantana, red sage, shrub verbena	Verbenaceae	Small	white, pink, or yellow, changing to orange or red	19
2.	<i>Asclepias syriaca</i> (Herb)	Common Milkweed	Asclepiadaceae	Small	Pinkish-purple	10
3.	<i>Zizyphus mauritiana</i> (Shrub)	Ber, Indian plum, Jujube	Rhamnaceae	Small	Yellow	4
4.	<i>Zizyphus xylopyrus</i> (Shrub)	Ghatbor	Rhamnaceae	Small	Yellow-green	2
5.	<i>Terminalia bellirica</i> (Tree)	Baheda	Combretaceae	Small	Greenish-yellow	3
6.	<i>Terminalia crenulata</i> (Tree)	Aina, sadad	Combretaceae	Small	Cream	1
7.	<i>Butea monosperma</i> (Tree)	Flame of forest, dhak, palash, khakhar	Fabaceae	Large	Red	2
8.	<i>Tectona grandis</i> (Tree)	Teak	Verbenaceae	Large	White	2
9.	<i>Cassia tora</i> (Herb)	Charota or Chakod. Guj. Kawaria, kuvadio	Fabaceae	Large	Yellow	1
10.	<i>Cassia fistula</i> (Tree)	Golden shower tree, Garmalo	Fabaceae	Large	Yellow	2
11.	<i>Nerium oleander</i> (Shrub)	Oleander	Apocynaceae	Large	White, pink to red	2
12.	<i>Acacia catechu</i> (Tree)	Khair, catch tree, Kumath	Fabaceae	Small	White to pale yellow	1
13.	<i>Acacia nilotica</i> (Tree)	Babul, gum Arabic tree	Fabaceae	Small	Yellow	2

14.	<i>Acacia senegal</i> (Shrub)	Gum Arabic tree, gum acacia, gorad	Fabaceae	Small	Creamy white	3
15.	<i>Acacia leucophloea</i> (Tree)	Safed kikkar, safed babul, hermo	Fabaceae	Small	White	1
16.	<i>Ficus benghalensis</i> (Tree)	Banyan tree, Vad	Moraceae	Small	Pinkish-red	1
17.	<i>Syzygium cumini</i> (Tree)	Jamun	Myrtaceae	Small	White	3
18.	<i>Diospyros melanoxylon</i> (Tree)	Tendu, timru	Ebenaceae	Small	White	5
19.	<i>Pongamia pinnata</i> (Tree)	Karanj	Fabaceae	Small	White	3
20.	<i>Ficus racemosa</i> (Tree)	Cluster fig tree, Umro	Moraceae	Small	White	2
21.	<i>Mitragyna parvifolia</i> (Tree)	Kalam, Kaim	Rubiaceae	Small	Yellow	3
22.	<i>Holoptelia integrifolia</i> (Tree)	Indian elm, Charal	Ulmaceae	Small	Greenish-yellow	1
23.	<i>Albizia lebbek</i> (Tree)	Sirus	Fabaceae	Large	White	1
24.	<i>Tamarindus indica</i> (Tree)	Amlı	Fabaceae	Large	Red & yellow	6
25.	<i>Prosopis juliflora</i> (Shrub)	Vilayati babul, Gandobaval	Fabaceae	Small	Greenish-yellow	2
26.	<i>Casuarina equisetifolia</i> (Tree)	Sheoak, saru	Casuarinaceae	Small	Brown	1
27.	<i>Wrightia tinctoria</i> (Tree)	Duhi, dudhlo	Apocynaceae	Small	White	3
28.	<i>Aegle marmalos</i> , (Tree)	Stone apple, bili	Rutaceae	Large	White	3
29.	<i>Carissa carandus</i> (Shrub)	Karonda	Apocynaceae	Small	White	2
30.	<i>Emblica officinalis</i> (Tree)	Amla	Euphorbiaceae	Small	Green	1
31.	<i>Vitex negundu</i> (Shrub)	Five leaved haste tree, nirgundi	Verbenaceae	Large	White to blue-purple	1
32.	<i>Anogeissus latifolia</i> (Tree)	Dhawa, dhavdo	Combretaceae	Small	Yellow	1
33.	<i>Sterculia urens</i> (Tree)	Gum karaya, kada	Malvaceae	Small	Green	3
34.	<i>Bauhinia racemosa</i> (Tree)	Bidi leaf tree, Asundharo	Fabaceae	Large	White	2
35.	<i>Bombax ceiba</i> (Tree)	Cotton tree, semal, semlo	Malvaceae	Large	Red	1
36.	<i>Boswellia serrata</i> (Herb)	Salai, saaledi	Burseraceae	Small	Cream	1

37.	<i>Ixora arborea</i> (Shrub)	Torch tree	Rubiaceae	Small	White	5
38.	<i>Grewia tiliaefolia</i> (Tree)	Dhaman, dhamani	Malvaceae	Small	Yellow	3
39.	<i>Mangifera indica</i> (Tree)	Mango	Anacardiaceae	Small	White	1
40.	<i>Ricinus communis</i> (Herb)	Castor oil plant	Euphorbiaceae	Small	Red	1
41.	<i>Sehima nervosum</i> (Grass)	Rat's tail grass, white grass	Poaceae	Small	-	1
42.	<i>Sehima sulcatum</i> (Grass)	Shaniyar	Poaceae	Small	-	1
43.	<i>Dicanthium annulatum</i> (Grass)	Sheda grass, zinjoo	Poaceae	Small	-	1
44.	<i>Bothriochloa ischaemum</i> (Grass)	Yellow blue stem, jinjavo	Poaceae	Small	-	1
45.	<i>Cymbopogon jwarancusa</i> (Grass)	Lemongrass, gandharu	Poaceae	Small	-	1
46.	<i>Cymbopogon martini</i> (Grass)	gingergrass and rosha or rosha grass, rosa	Poaceae	Small	-	1
47.	<i>Chrysopogon</i> (Grass)	Guria grass	Poaceae	Small	-	1
48.	<i>Apulda mutica</i> (Grass)	Mauritian Grass, Bhongla, bhangaru	Poaceae	Small	-	1
49.	<i>Aristida adscensionis</i> (Grass)	Common needle grass, lapdu	Poaceae	Small	-	1
50.	<i>Heteropogon contortus</i> (Grass)	black spear grass, dabhasaliu	Poaceae	Small	-	1
51.	<i>Terminalia arjuna</i> (Tree)	Arjun tree	Combretaceae	Small	Yellow	0
52.	<i>Balanites aegyptica</i> (Tree)	Soap berry tree	Zygophyllaceae	Large	Yellow-green	0
53.	<i>Bauhinia variegata</i> (Shrub)	Orchid tree	Fabaceae	Large	Pink	0
54.	<i>Commiphora wightii</i> (Tree)	Gugal	Bursaceae	Large	Red-pink	0
55.	<i>Lanena coromandelica</i> (Tree)	Indian ash tree, Moledi	Anacardiaceae	Small	Green	0

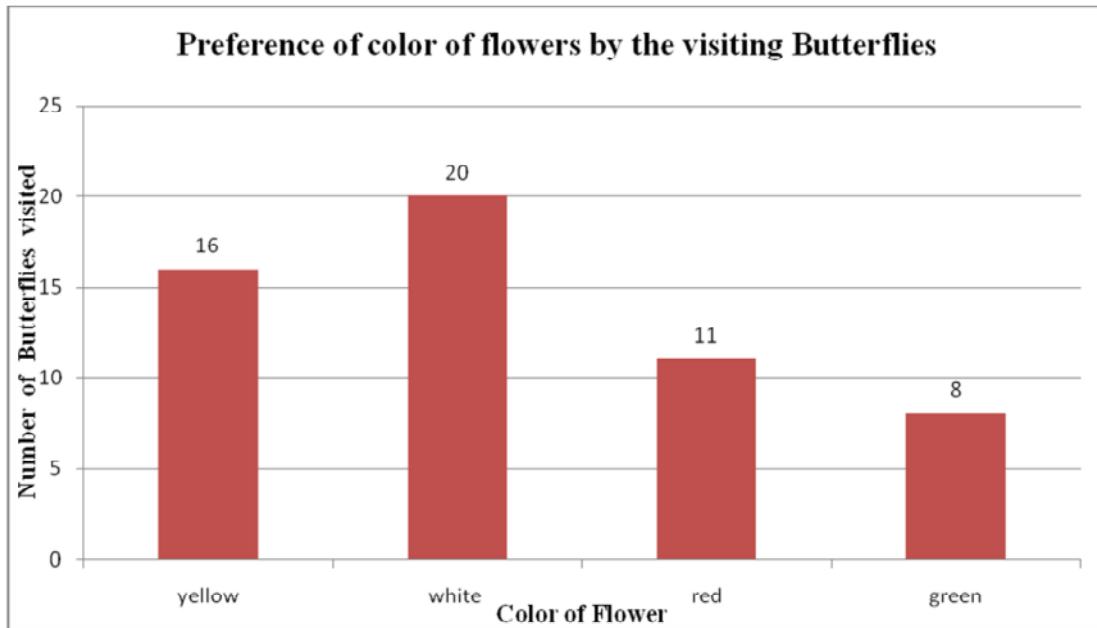


Fig. 1. A graph depicting the preference of color of flowers by the visiting butterflies.

DISCUSSION

Most butterflies have specific habitat and food requirements. Although adult butterflies are sensitive to their choice of flowers for feeding, most species never visit some flowers (Feltwell, 1986). All the butterflies are not flower visitors, only the highly evolved species whose mouth parts are represented by a long, thin proboscis, is adapted for feeding on liquid diet known as nectar (Wynter-Blyth, 1957). The amount of nectar present in a flower is related to foraging visits of a butterfly. When little nectar is available, visits are short and a butterfly visits many flowers. While when large amounts of nectar accumulate, the butterflies need to spend more time to extract nectar and hence they visit few flowers (Cruden, 1976). This study indicates that Gir proves to be a flourishing habitat for butterflies various life cycle stages (egg to adult). Since butterflies are in close relationship with vegetation, they indicate the floral diversity of a habitat. This diversity, in turn, determines the survival of herbivores and hence the dependent carnivores of that particular habitat. The nature of vegetation is an important factor that determines the survival of herbivores in a particular habitat. Being highly sensitive to changes in environment, butterflies are easily affected by minor changes in the habitat. To maintain a healthy habitat, it is essential to sustain the biodiversity.

Hence, to attract butterflies, butterfly attracting plant species listed here may be included in the afforestation programmes. Therefore, protecting butterflies confers protection of coexisting organisms as well. The checklist of host plant species provides suitable route for mass scale breeding of beautiful butterflies species in order to develop a butterfly garden in future studies. Due to various developmental activities, most of the natural habitat of butterflies is under threat. There is need to identify the threats and survival chances of various species by which the conservation programme can be develop. There is a need to further survey work in the other parts of Gir to get the entire spectrum of butterflies and their host plants in this region. It also reiterates the need to have more such unadulterated areas such as National Parks and Wildlife Sanctuaries for long term conservation of rare and endangered flora and fauna.

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