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Photographic catalogue of dipteran and lepidopteran pollinators in agricultural landscape area of South Gujarat

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Abstract

The study was carried out in the different districts of South Gujarat *i.e.* Bharuch, Narmada, Surat, Tapi, Navsari, The Dangs and Valsad during September 2017 to December 2019. The pollinators of diptera and lepidoptera were observed, collected and identified upto species level. The photographic catalogue of dipteran and lepidopteran pollinators recorded in agricultural landscape area of South Gujarat was prepared and published.

Keywords: Pollinators, dipteran pollinators, lepidopteran pollinators, photographic catalogue

Introduction

Agricultural land use is an artificial ecosystem that fascinates several insects for nesting, resting, feeding, biological activities like pollination. 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 [8]. Pollination by insects often occurs on plants that have developed coloured petals and a strong scent to attract various insect pollinators have been observed to engage in flower fidelity, which means they are more likely to transfer pollen to other conspecific plants [1, 2, 3, 4, 9].

Among the insect pollinators, hymenopteran pollinators are highly grownup and constitute the most important group of pollinating insects. To our knowledge, this study is the first in the field of nonhymenopteran pollinators' study in South Gujarat. We show that insects other than hymenopterans are also efficient visitors of crop flowers for pollination drive. However, most studies to date have largely ignoring diurnal lepidopteran and dipteran pollinators. The information on diurnal lepidopteran and dipteran pollinators of South Gujarat with its key characteristics is not available. Looking towards the presence of insect pollinators without identifications is less meaningful to know its role and significance in crop pollination and its conservation practices. Therefore, the catalogue manual of diurnal lepidopteran and dipteran pollinators is designed with systemic order to guide adequately to entomologists, agriculturists, researchers, students, extension workers, and progressive farmers of the region. It is often the most overlooked pollinators' species that play an essential role in pollinating crop plants, which can be identified through the study of diversity of butterflies and flies influencing pollination.

Materials and Methods

Study area

The study was carried out in the different districts of South Gujarat *i.e.* Bharuch, Narmada, Surat, Tapi, Navsari, The Dangs and Valsad during September 2017 to December 2019. South Gujarat is situated in the south part of the Gujarat state in the coastal low land on the western part. The total geographic area of South Gujarat is 17,500 km². South Gujarat with coordinates: 21° 1702' N to 21° 4766' N (North latitude) and 72° 8013'E to 72° 8854'E (East longitude). It has a coastal line open to the Arabian Sea from West and is bounded by Middle Gujarat on the North and Maharashtra on Southern as well as Eastern parts. On the East, it is contagious to The Dang district with forest and hilly evergreen as well as deciduous forest, revarian forest, mountains, water reservoirs, dams, ponds, plains, wetlands, canal areas, having alkaline soils, saline soils, and black fertile soils, etc.

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Survey, collection, identification and photography

Survey and collection of diurnal lepidopteran and dipteran pollinators were made in South Gujarat (Narmada, Bharuch, Surat, Tapi, Navsari, Valsad and The Dangs districts) through the random selection of agricultural landscaped area under roving survey methods. The spot observations were followed by photography and collection from the different areas for their taxonomical studies based on morphological observations. After noting characteristics and observations the live pollinators were released in the environment from where they collected. The collected and preserved specimens of different dipteran and lepidopteran pollinators were identified by sending samples to GKVK, Bengaluru.

Close up photographs of all recorded insect species were captured with the help of SONY ALPHA 58 DSLR digital camera. Live specimens in the field condition were photographed so that natural colouration and specific behavioural postures can be documented. Photograph of preserved pinned insects was documented in the case of live specimens' photograph couldn't be captured. Photographic document of all the species with its comprehensive identification key was prepared. For the elimination of the lacuna in the identification of pollinators present in South Gujarat, the photographic catalogue was prepared as a tool for the identification of existing diurnal lepidopteran and dipteran pollinators of the region.

Verification of pollinators

Insect foraging on crop flowers was collected and examined for physical pollen loads (i.e. presence of pollen) on its body parts (i.e. legs, antennae, mouth parts, wings, abdominal tip, etc.) for its confirmation as a pollinator. For pollen observations, collected insects were observed under 10X magnifying glass for the presence of the pollen on its body, then insects were released in the same field from where they collected. At least 10 insects of all species were observed for presence of pollen on body and ≥ 30 per cent insects of the same species were found adequate pollen load on the body then that was considered as a pollinator. The habits, habitat and floral choice of pollinators were oversight in the study.

Result and discussion

The intensive study on the diversity of lepidopteran and dipteran pollinators in agricultural landscape area of South Gujarat was carried out during September 2017 to December 2019. During the course of present study, total 10 species of dipteran and nine species of lepidopteran pollinators were collected from seven districts of South Gujarat. The photograph taken of each species is depicted in photo 1 to 19 with natural condition and pinned photograph. Detailed description of each pollinator species of different families and photographs of pollinators are as under:

1. *Asarkina ericetorum* (Fabricius, 1781) (Plate 1)

Syrphus ericetorum Fabricius, *Spec. Insect.*, 2: 425. (Ref.: Mitra, 2005a) ^[5]

Diagnosis: A medium sized yellowish species; frons yellow, vertex black but both with black pubescence; thorax and scutellum covered with bright yellow pubescence; abdomen orange yellow with all the segments black banded at posterior margin; legs yellow.

Habitat: All districts of South Gujarat except Bharuch, Tapi and Surat



Plate 1: *Asarkina ericetorum* (Fabricius, 1781)

2. *Eristalinus megacephalus* (Rossi, 1794) (Plate 2)

Syrphus megacephalus Rossi, *Mantissa. insect.* 2: 3 (Ref.: Mitra, 2005a) ^[5]

Diagnosis: **Head:** Eyes mostly bare, spotted, both antennae and arista reddish yellow, later bare. **Thorax:** three narrow longitudinal stripes on anterior side of dorsum, scutellum honey-yellow in colour elongate-conical, large yellowish quadrate spots on anterior margin of 3rd abdominal tergite. **Leg:** black, tip of all femora yellowish, tarsi black, pubescence of all legs yellow in colour **Wing:** wings clear with yellow halteres.

Habitat: All districts of South Gujarat



Plate 2: *Eristalinus megacephalus* (Rossi, 1794)

3. *Eristalinus quinquestriatus* (Fabricius, 1794) (Plate 3)

Syrphus quinquestriatus Fabricius, *Ent. Syst.*, 4: 289. (Ref.: Mitra, 2005a) ^[5]

Diagnosis: A medium sized yellow and black species; frons and face with yellowish grey pubescence, antenna and arista brownish orange, thoracic dorsum with four black longitudinal stripes; scutellum yellowish; abdominal segments yellow and black patterned; all femora black except tip of fore and hind femora orange or yellow.

Habitat: All districts of South Gujarat



Plate 3: *Eristalinus quinquestriatus* (Fabricius, 1794)

4. *Eristalis obliquus* (Weidemann, 1824) (Plate 4)
Eumerus obliquus Verrall, 1898; *Transactions of the Entomological Society of London*, 422. *Analecta Ent.*: 38. (Ref.: Mitra, 2005b) ^[6]

Diagnosis: Abdomen without any yellow, translucent markings, but with dusted spots only. Scutellum with a clearly dusted rim, though sometimes only a thin line. Eyes clearly and densely haired. Scutellum with a very thin dusted rim. Fourth tergite with only a pair of dusted spots.



Plate 4: *Eristalis obliquus* (Weidemann, 1824)

5. *Ischiodon scutellaris* (Fabricius, 1805) (Plate 5)
Scaeva scutellaris Fabricius, *Syst Antliat.*, 252. (Ref.: Mitra, 2005a) ^[5]

Diagnosis: A medium sized blackish species with frons and face bright sulphur yellow; thorax shining black with side margins bright yellow from anterior margin of wing; abdomen black with a pair of yellow spots on second segment, third and fourth with a yellow band on each segment, fifth segment with greater part orange; legs yellow with a broad subapical black ring on hind femora.

Habitat: All districts of South Gujarat



Plate 5: *Ischiodon scutellaris* (Fabricius, 1805)

6. *Mesembrius quadrivittatus* (Wiedemann, 1819) (Plate 6)
Eristalis quadrivittatus Wiedemann, *Zool. Mag.*, 1: 17. (Ref.: Mitra, 2005a) ^[5]

Diagnosis: A large yellow and black species; eyes not touching at any point in male; thorax yellow with three longitudinal black stripes; abdomen orange with black patterns; femora black, brownish tinge at tip, anterior and middle tibiae orange yellow on basal half.

Habitat: All districts of South Gujarat



Plate 6: *Mesembrius quadrivittatus* (Wiedemann, 1819)

7. *Paragus serratus* (Fabricius, 1805) (Plate 7)
Mulio serratus Fabricius, *Syst. Antliat.*:186 (Ref.: Mitra, 2005a) ^[5]

Diagnosis: **Head:** Frons and face orange yellow, face with a narrow brownish-black stripe, antennae blackish, lower part of second and third joints are brownishorange, Thorax: thorax shining black with a pair of greyish median stripes, sides are shining black with a conspicuous stripe at greyish white long pubescence below humeri to sterno pleura, scutellum black and uniquely serrated, hind margin broadly yellow with about 13 teeth. Abdomen: highly variable in coloration, 3rd, 4th and 5th segments colour varying from brown or yellowish to

nearly wholly black, 3rd, 4th and 5th segments on anterior margin with a whitish dust band on each side, sixth segment orange brown to black, pubescence white at tip. Leg: coxae base of fore femora, above basal half of the middle and basal three fourth of hind femora black, hind tibiae nearly brown on apical half, rest of legs orange or yellowish. Wing: clear with halteres yellowish.

Habitat: All districts of South Gujarat



Plate 7: *Paragus serratus* (Fabricius, 1805)

8. *Phytomia errans* (Fabricius, 1787) (Plate 8)

Syrphus erralls Fabricius. Mantissa Insect: 2: 337. (Ref.: Mitra, 2005a) ^[5]

Diagnosis: Antenna entirely orange, arista orange, bare; mesonotum usually dull black anteriorly, with two broad stripes and broadly yellowish grey posteriorly; abdomen brownish orange. Segments 2, 3 and 4 each with a large blackish brown spot posteriorly.

Habitat: All districts of South Gujarat except Bharuch, Tapi and Surat



Plate 8: *Phytomia errans* (Fabricius, 1787)

9. *Syritta orientalis* (Macquart, 1824) (Plate 9)

Syritta orientalis Macquart, Dipt. Exot., 2(2): 76(136). (Ref.: Mitra, 2005a) ^[5]

Diagnosis: A medium blackish species; antennae orange with black arista; thorax black with humeri, lateral sides and pleura wholly yellow or whitish grey; second and third abdominal segments wholly with complete yellow bands; hind femora normally wholly yellow.

Habitat: All districts of South Gujarat except Surat and Valsad



Plate 9: *Syritta orientalis* (Macquart, 1842)

10. *Chrysomya megacephala* (Fabricius, 1794) (Plate 10)

Musca megacephala Fabricius, Syst. Ent., 4: 317. (Ref.: Mitra, 2005a) ^[5]

Diagnosis: A medium blue or green coloured fly with upper eye facets greatly enlarged, larger than lower third in male; wing hyaline, slightly dark at base; legs black.

Habitat: All districts of South Gujarat except Surat and Valsad



Plate 10: *Chrysomya megacephala* (Fabricius, 1794)

11. Blue Tiger (*Tirumala limniace* Cramer, 1775) (Plate 11)

Wynter -Blyth (1957). Butterflies of the Indian Region, p 67 ^[11].

Measurements: Expanse: 90-100mm Our measurements: ♀: 82.14±0.54mm, ♂: 78.59±0.99mm

Description: ♂♀: Upperside, black with large irregular white or pale blue markings. UPH cell almost entirely white, enclosing a narrow black streak. ♂: UNH with a pendulous pouch.

Habitat: All districts of South Gujarat



Plate 11: *Tirumala limniace* (Cramer, 1775)

12. Common Crow (*Euploea core* Cramer, 1780) (Plate 12) Wynter-Blyth (1957). *Butterflies of the Indian Region*, p 72 [11].

Measurements: Expanse: 85-96mm Our measurements: 75.63±6.07mm

Description: ♂♀: Above, glossy brown with marginal and terminal white spots. ♂: UPF with short brand. ♀: In interspace 1b UNF one short whitish-streak, UPF spots are more or less equal, or decrease in size.

Habitat: All districts of South Gujarat

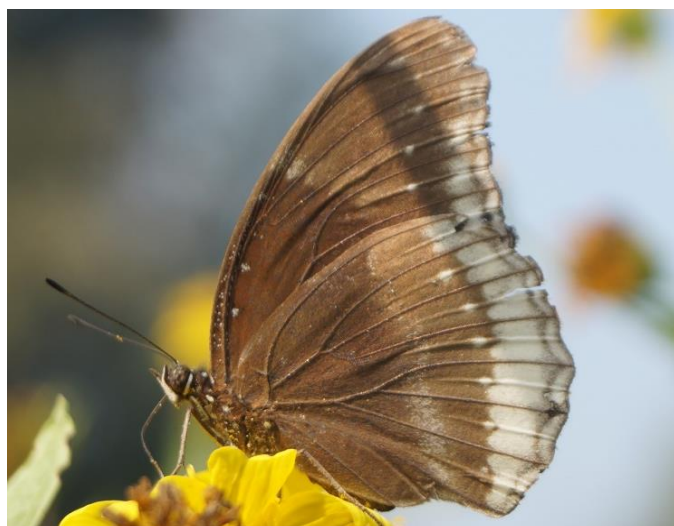


Plate 12: *Euploea core* (Cramer, 1780)

13. Common Grass Yellow (*Eurema hecabe* Linnaeus, 1758) (Plate 13)

Wynter -Blyth (1957). *Butterflies of the Indian Region*, p 453 [11].

Measurements: Expanse: 40-50mm Our measurements: 37.79±2.41mm

Description: ♂: Bright yellow. UPF apex and termen broadly black and usually excavated between vs. 2 and 4. UPH with

narrow black terminal border. ♀: Similar with broader black borders. ♂♀: Below, FW with two black spots in cell (one or both of which may be absent). Irregular ring spots at ends of cells on both wings.

Habitat: All districts of South Gujarat



Plate 13: *Eurema hecabe* (Linnaeus, 1758)

14. Common Gull (*Cepora nerissa* Fabricius, 1775) (Plate 14)

Wynter -Blyth (1957). *Butterflies of the Indian Region*, p 421 [11].

Measurements: Expanse: 40-65mm

Our measurements: ♀: 49.44±4.26mm, ♂: 46.40±0.77mm

Description: ♂: Above, white some veins blackened. FW with black terminal border, border at apex being broader and often bearing white spots; a black spot in middle of 3 separated from black border by a white spot. HW with black terminal border of varying extent. Below, HW pale or dark yellow with veins heavily out lined in dark green. ♀: above, black margins more extensive and veins mostly darkened, especially on margin of cells. FW with additional black spot in 1b; often with yellow spot on apex. HW black outer border bearing white or greyish white spots. Below as ♂.

Habitat: All districts of South Gujarat



Plate 14: *Cepora nerissa* (Fabricius, 1775)

15. Indian Jezebel (*Delias eucharis* Drury, 1773) (Plate 15)
Wynter-Blyth (1957). *Butterflies of the Indian Region*, p 420
[11].

Measurements: Expanse: 66-83 mm

Our measurements: ♀: 61.76±2.30mm, ♂: 62.80±0.75mm

Description: ♂: Above, white with black veins on the FW and a black outer discal band on both wings. UNH yellow with black veins and a black border containing large red spots that comes to a point at the margin, the border being black-edge inwardly. ♀: Above, white, tinged with yellow and pink. More heavily marked and with black veins UPH. Otherwise as ♂.

Habitat: All districts of South Gujarat



Plate 15: *Delias eucharis* (Drury, 1773)

16. Pea Blue (*Lampides boeticus* Linnaeus, 1767) (Plate 16)
Wynter-Blyth (1957). *Butterflies of the Indian Region*, p 289
[11].

Measurements: Expanse: 24-36mm

Our measurements: ♀: 30.40±0.54mm, ♂: 27.98±1.03mm

Description: ♂♀: Tailed. Below, pale brown or whitish with narrow brown bands, not spots, except for two black, orange-crowned tornal spots HW. ♀: Above dark brown, blue basally; generally with obscure. White marginal crescents HW which may be continued on to the forewing. Often an obscure white outer discal band HW. ♂: Above, violet-blue frosted over; two tornal spots HW.

Habitat: All districts of South Gujarat



Plate 16: *Lampides boeticus* (Linnaeus, 1767)

17. Lime Swallowtail (*Papilio demoleus* Linnaeus, 1758)
(Plate 17)

Wynter-Blyth (1957). *Butterflies of the Indian Region*, p 395
[11].

Measurements: Expanse: 80-100mm; Our measurements:
73.45±5.58mm

Description: ♂♀: A large tail less butterfly. Ground colour black. UPH with broad irregular yellow discal band, which is broken into large irregular spots and patches UPF. Marginal and terminal rows of yellow spots on both wings. Yellow spots toward end cell and at apex UPF. Tornal red spot and apical black and blue spot UPH.

Habitat: All districts of South Gujarat



Plate 17: *Papilio demoleus* (Linnaeus, 1758)

18. Small Branded Swift (*Pelopidas mathias* Fabricius, 1798) (Plate 18)

Varshney, R. K. and Smetacek, P. (2015). *A Synoptic Catalogue of the Butterflies of India*, p.57 [10]

Measurements: Expanse 41-45 mm

♀: Upperside olive brown: forewing with two small yellowish semi-transparent spots within end of cell, three before the apex, and in the male three oblique discal spots followed by a dark-bordered slender straight impressed glandular streak: hind wing with one or two very indistinct pale discal spots. ♂: five discal spots in the forewing, and four or five in the hind wing. Underside paler; markings more distinct; hind wing also with a spot at upper end of the cell.

Habitat: All districts of South Gujarat



Plate 18: *Pelopidas mathias* (Fabricius, 1798)

19. Wasp Moth, *Amata passalis* (Fabricius, 1781) (Plate 19) Sakhtivel *et al.* (2019). Mulberry pests current status and management practices^[7].

Measurements: Expanse 36-44 mm

Adult males are long with slender abdomen and females are stout bodied. The body brownish black wings. The forewings have seven transparent spots.

Habitat: All districts of South Gujarat

Description of various insect pollinators has been given by Wynter-Blyth (1957), Mitra *et al.* (2005a), Mitra *et al.* (2005b), Varshney and Smetacek (2015), Sakhtivel *et al.* (2019) was repeatedly utilized during the course of investigations for identification of different pollinators.

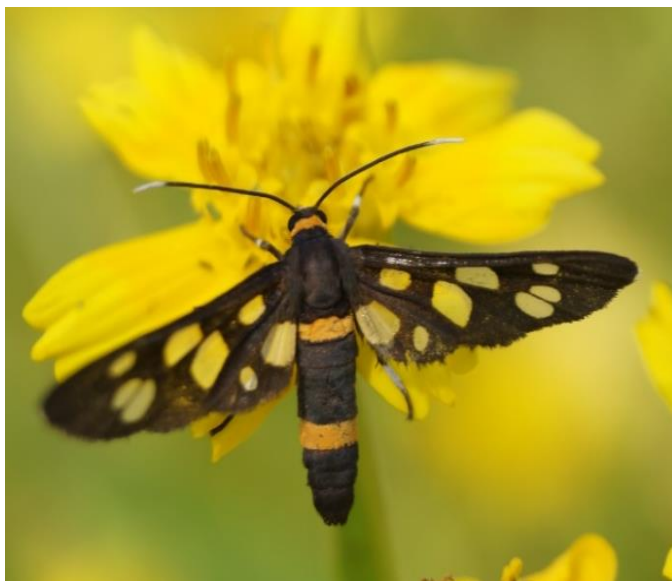


Plate 19: *Amata passalis* (Fabricius, 1781)

Conclusion: For the elimination of the lacuna in the identification of pollinators present in South Gujarat, the photographic catalogue was prepared as a tool for the identification and conservation of existing pollinators of the region.

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