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Taxonomic assessment of sphingid agricultural pest (Sphingidae: Macroglossinae) from Nashik, Maharashtra

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Abstract
Taxonomic research serves as the cornerstone for understanding and mitigating the impact of biodiversity, especially in the context of insects, the most abundant class on Earth. Moths, the second-largest and most diverse group of insects, comprise approximately 12,000 species in India and a staggering 1.6 million species worldwide, with several emerging as significant agricultural pests.

The study focuses on an in-depth taxonomic investigation of sphingid pests of the subfamily Macroglossinae from the Nashik district, targeting five species across four genera: *Hippotion celerio*, *Hyles livornica*, *Nephele hespera*, *Theretra alecto*, and *Theretra clotho*- all recognised as major agricultural pests. The study prioritizes meticulous examination of morphological features, including wing patterns, wing venation, and external genitalia. By providing a detailed exploration of these critical characteristics, the research aims to enhance our understanding of the taxonomy and diversity of Macroglossinae moths from the Nashik district. Such comprehensive information would help in rapid and impeccable identification of pest that is of utmost importance for effective pest management strategies and sustainable agricultural practices amidst evolving agricultural conditions.

Keywords: Moth, pest, wing venation, external genitalia, sphingidae

Introduction

Biodiversity is a fundamental and dynamic force that shapes ecosystems and plays a crucial role in agricultural systems. In the vast realm of insects, moths stand out as the second-largest and highly diverse group [1]. India alone boasts approximately 12,000 species of moths, contributing to a whooping global count of 1.6 million species [2]. Moths play essential roles as pollinators and in food webs, although some species are considered pests due to their impact on crops and textiles. The family Sphingidae, or hawk moths, also known as sphinx moths, is a prominent group within Lepidoptera. Hawk moths vary in size and are characterized by their robust bodies, long, narrow wings, and often brightly coloured patterns. They are distributed worldwide, with a preference for tropical regions and a diverse range of habitats. Hawk moth larvae typically feed on trees and shrubs, while adults feed on nectar from flowers, fruits, and sap. Even though they are known for their strong flight capabilities and their role as important pollinators for many plant species, within this diverse community, a subset of moths has emerged as major agricultural pests, posing significant challenges to crop cultivation and ecosystem sustainability.

The present work is dedicated to a comprehensive taxonomic assessment of key sphingid agricultural pests in the Nashik district, Maharashtra, India. The primary focus lies on the sub-family Macroglossinae within the Sphingidae family, specifically targeting five species spread across four genera: *Hippotion celerio*, *Hyles livornica*, *Nephele hespera*, *Theretra alecto*, and *Theretra clotho*—all of which have been recognized as major agricultural pests (Table 1). The study places particular emphasis on a meticulous examination of morphological features, encompassing wing patterns, wing venation, and external genitalia. These features serve as key identifiers for species within the Macroglossinae subfamily and are crucial for accurate and rapid pest identification. Such taxonomic precision is indispensable for devising targeted and efficient pest control measures, ensuring the sustainable cultivation of crops in the Nashik district. The study aims to fill a crucial gap in the current understanding of Macroglossinae moths in the Nashik district. By providing a detailed examination of morphological features, the research seeks to uncover not only the diversity within this sub-family but also potential variations in the pest species that may impact agricultural practices differently.

Material and Methods

Study Area

The focus of this research was limited to Nashik District in the state of Maharashtra. Situated between 20.16ºN and 74.03ºE, Nashik District covers an expanse of 15,582 sq. km. and stands at an elevation of approximately 2300 ft. above sea level. It shares borders with Dhule district to the North, Jalgaon district to the North-East, Ahmednagar district to the South, Aurangabad district to the South-East, and Thane district to the South West. Additionally, it shares its western boundaries with the state of Gujarat. The Northern part of the Western Ghats ranges is situated within this district, with the Sahyadri Mountains in the western part and Wani & Chandwad hill ranges in the central part. The Western part of the district encompasses 3400 sq. km. of forests, with Surgana, Kalwan, Peint, Dindori, Nashik, and Igatpuri talukas having forested areas. These forests are characterized by the presence of Teak and Sissoo trees and fall under the categories of tropical moist deciduous, tropical dry deciduous, and tropical hill forest types. The temperature in the region ranges from 20º to 42º C.

According to the Koppen climate classification, the area experiences a tropical wet and tropical dry climate, with peak rainfall occurring in July [3]. The western part of the district falls under a rainfed region, while the eastern part lies in a rain shadow region, resulting in variations in rainfall and consequently affecting vegetation and the type of agricultural crops cultivated in these regions.

Collection, preservation, and identification

Moths were majorly collected using light spread sheet with help of mercury vapour bulb. Adult moths were collected and were taxonomically investigated. The collected moths were spread on insect spreading boards and dried in oven for approximately 5 days. All the taxonomic investigations were carried out upon preservation of the adult specimen.

The wing pattern of the adult moths was studied by simple observation and comparison with various identification keys [4-14]. A putative identification and description of all the adults was done by observing the wing patterns on the forewing and hindwing.

Wing Venation

The right forewing and hindwing of adult specimen was removed carefully from the base. The wings were kept immersed in 10% KOH for 3-4 hours. The wings were descaled with help of size zero camel hair brush. The scales were carefully dislodged to expose the venation.

External genitalia dissection

The abdomen of the preserved specimen is carefully removed and immersed in 10% KOH. It is then heated intermittently and carefully (to avoid bumping) till the abdomen looks soft and translucent. The softened abdomen is carefully removed from a petri plate and dissected under a stereo-zoom microscope.

Results and Discussion

The study yields critical insights into the biodiversity and the ecological dynamics of this region through meticulous examination of the sphingid pests. By elucidating the taxonomy of the sphingid moths, we contribute to a deeper understanding of identifying the pest moth species. Thus, aiming at better pest management strategies and conservation efforts in agricultural landscapes. Table 1 describes the Indian host plants for the moths from the present study. A total of five moth species were studied thoroughly in the present study representing four genera: *Hippotion Celerio* (Linnaeus, 1758), *Hyles livornica* (Esper, 1780), *Nephele hespera* (Fabricius, 1775), *Theretra Alecto* (Linnaeus, 1758), and *Theretra clotho* (Drury, 1773).

Table 1: Indian host plants for the moths under study [15].

Taxon	Host Plant	Pest Status
Hippotion Celerio (Linnaeus, 1758)	Impatiens, Beta vulgaris, Rumex vesicarius, Vitis	Minor
Hyles livornica (Esper, 1780)	Acacia, Fragaria, Pelargonium, Plantago, Rumex, Asphodelus, Asparagus, Vitis, Eremurus, Galium, Polygonum, Zygophyllum fabago, Antirrhinum, Fuchsia	Major
Nephele hespera (Fabricius, 1775)	Carissa carandas	Minor
Theretra Alecto (Linnaeus, 1758)	Morinda, Pisum sativum, Dillenia indica, Psychotria, Rubia cordifolia, Tectona grandis, Glochidion, Saurauia napaulensis, Vitis, Boerhavia, Vitis vinifera, Leea, Paederia.	Major
Theretra clotho (Drury, 1773)	Fuchsia, Cissus, Amorphophallus, Dillenia pentagyna, Hibiscus mutabilis, Dillenia indica, Dillenia pentagyna, Fuchsia, Ampelopsis, Begonia, Cissus, Ampelopsis, Dillenia indica, Vitis, Amorphophallus, Hibiscus mutabilis	Minor

Systematic Account

Family sphingidae latreille, 1802

Subfamily macroglossinae Harris, 1839

Genus Hippotion Hübner, [1819]

Type species: Sphinx celerio Linnaeus, 1819

1. Hippotion celerio (Linnaeus, 1758)

Material Examined: Male, 16.viii.2011, Igatpuri, Maharashtra, 651.9 m, ex. Light trap, coll. Aditi Sunil Shere Kharwar.

Adult Description: The body displays a brown hue with white patches near the eyes. The thorax exhibits a central brownish patch that extends from prothorax to metathorax and continues on the abdominal segments up to the last one. Silverish lines run along the lateral sides of this central brownish patch, while on the abdomen, they manifest as silverish specks. The forewing is of a light brown shade, featuring a silverish line that stretches from the base of the inner margin to the apex, followed by ochre and brownish lines. A white sub-marginal line is also evident. The hind wing is darker, with a pinkish colour at the base and anal angle. Just below the sub-marginal outer light brown line, there are light brown patches. Wingspan 77 mm.

Global Distribution: India; Sri Lanka; Africa; Europe; Indonesia; China; Thailand; Borneo; Hong Kong; Timor; Australia; Fiji; Arabia and Japan.

Genus *Hyles* Hübner, [1819]

Type species: Hyles gallii (Rottemburg, 1775)

2. *Hyles livornica* (Esper, 1780)

Material Examined: Male, 24.viii.2011, Kalwan, Maharashtra, 759.5 m, ex. Light trap, coll. Aditi Sunil Shere Kharwar.

Adult Description: The head and thorax exhibit a light brown hue, featuring white lines near the eyes that extend along the thorax's sides. The abdomen is olive with white patches adorn the lateral sides of each segment, accompanied by dorsal white specks and black segmental lines. The forewing olive green; wing base displays a combination of white and black patches, with a broad white band extending from the inner margin to the apex. The marginal band takes on a greyish colour, and the nervules are white. The hindwing is light red, complemented by a dark brown sub-marginal band. The anal area is characterized by a white colouration. Wingspan 72 mm.

Global Distribution: India; Sri Lanka; China; North Africa; Europe; Aden.

Genus Nephele Hübner, [1819]
Type species: Sphinx didyma Fabricius, 1775

3. Nephele hespera (Fabricius, 1775)
Material Examined: Male, 29.viii.11, Wani, Maharashtra, 1200.3 m, ex. Light trap, coll. Aditi Sunil Shere Kharwar.
Adult Description: The body displays an olive brown or green colouration. Black segmental bands are visible on the abdomen, and the wings are shorter and broader. The forewings exhibit a more greenish tone compared to the hind wings. The sub-marginal line is angled, and there are two silver spots at the end of the cell. The hindwings have a brownish colouration. Wingspan 66 mm.
Global Distribution: India; Sri Lanka; Burma; Nepal; China; Thailand; Vietnam; Malaysia; Sumatra; Hong Kong; Java; Australia.

4. Genus Theretra Hübner, [1819]
Type species: *Sphinx equestris* Fabricius, 1793
Theretra alecto (Linnaeus, 1758)
Material Examined: Female, 26.vi.12, Igatpuri, Maharashtra, 651.9 m, ex. Light trap, coll. Aditi Sunil Shere Kharwar.
Adult Description: Head, thorax and abdomen pale brown. The body exhibits a brown colour. White lines near the eyes extend along the sides of the thorax. Black lateral patches are present near the base of the abdomen. The forewing is light brown, featuring a dark speck at the end of the cell and faint oblique lines from the inner margin to the apex. The hindwing is red, with black colouring at the base and outer margins, and a slightly lighter shade at the anal angle. Wingspan 78 mm.
Global Distribution: India; Sri Lanka; Africa; Europe; Arabia; Turkey; China; Japan; Sunderland; Philippines; Hong Kong.

5. Theretra Clotho (Drury, 1773)
Material Examined: Male, 29.viii.11, Wani, Maharashtra, 1200.3 m, ex. Light trap, coll. Aditi Sunil Shere Kharwar.
Adult Description: The body showcases a colour range from light brown to greenish-brown. White lines near the eyes extend up to the thorax, while a black patch is located at the base of the abdomen. The forewing is light brown, distinguished by its relatively longer length and a more pointed apex. At the forewing's base, there is a black patch, and at the end of the cell, a black speck accompanied by a small black dot is present. A noticeable line runs from the inner side of the margin to the apex. The hindwing is primarily black, with the underside and anal angles exhibiting a light brown colouration. Wingspan 90 mm.
Global Distribution: India; Sri Lanka; Burma; Nepal; Thailand; Vietnam, China; Hong Kong; Borneo; Japan; Philippines; Australia; New Guinea.

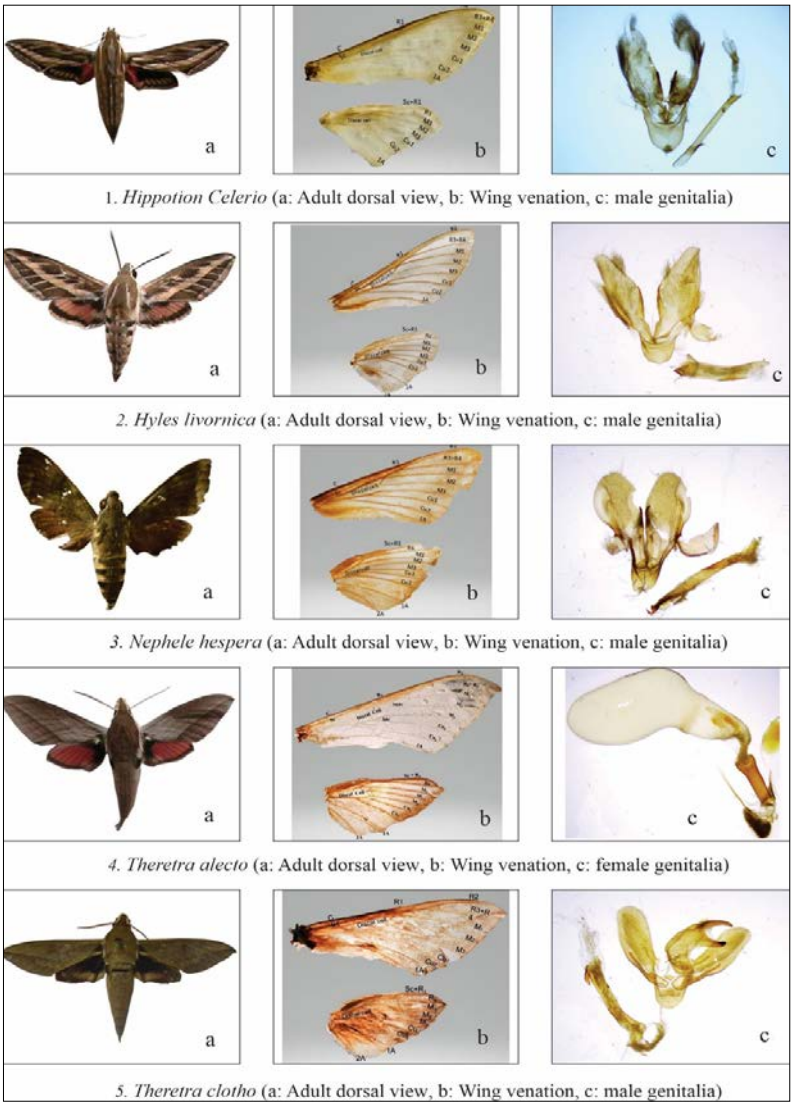

Fig 1

Conclusion

The present article strives to bridge the knowledge gap regarding the taxonomy and diversity of Macroglossinae moths, particularly those with significant agricultural implications. By conducting a comprehensive taxonomic assessment and providing detailed insights into morphological features, the study aims to offer a foundation for effective pest management strategies and sustainable agricultural practices. Furthermore, the research contributes to the broader scientific understanding of these moths, fostering a more comprehensive and holistic approach towards biodiversity conservation and agricultural sustainability in the face of changing environmental conditions.

References

1. Erwin Terry L. Biodiversity at its utmost: Tropical Forest Beetles. pp. 2740. In: Reaka-Kudla, M. L., D. E. Wilson & E. O. Wilson (Eds.). Biodiversity II. Joseph Henry Press, 1997, 2740.
2. Komal J, Shashank PR, Sondhi S, *et al*. Moths (Insecta: Lepidoptera) of Delhi, India: An illustrated checklist based on museum specimens and surveys. Biodivers Data J,2021;9:1-73. doi:10.3897/BDJ.9.e73997
3. Tom L. McKnight, Darrel Hess. Climate Zones and Types: The Köppen System. Physical Geography: A Landscape Appreciation. Published online, 2000, 200.
4. Barlow HS. An Introduction to the Moths of South East Asia, 1982.
5. Holloway JD. The Moths of Borneo: Part 3; Laciocampidae, Eupterotidae, Bombycidae, Brahmaedidae, Saturniidae, Shingidae, 1987.
6. Haruta T. Moths of Nepal, Part 1, Tinea. 13 (Supplement 2). Japan Heterocerists' Society, Tokyo, 122pp+ 109figs+ 32pls. Published online, 1992.
7. Haruta T, Saturniidae P, 159, pl. 93 in: Ha ru ta, T.(ed.), Moths of Nepal, Part 3. Tinea, Tokyo,1994:14:65-96.
8. Kendrick RC. Moths (Insecta: Lepidoptera) of Hong Kong. University of Hong Kong, 2002.
9. Srivastava A. Taxonomy of Moths in India. International Book Distributors, 2002.
10. Gurule SA, Nikam SM. The moths (Lepidoptera: Heterocera) of northern Maharashtra: a preliminary checklist. J Threat Taxa,2013:5(12):4693-4713. doi:http://dx.doi.org/10.11609/JoTT.o2555.4693-713
11. Gurule SA. Taxonomic study of Moths (Lepidoptera: Heterocera) from north Maharashtra, India. Ph.D. thesis submitted to Savitribai Phule Pune University; 2013. Accessed, 2023. http://hdl.handle.net/10603/98571
12. Shere Aditi Arun. Taxonomic Study of Family Sphingidae and Noctuidae (Lepidoptera: Heterocera) Using DNA Barcoding from Nashik District. Savitribai Phule Pune University; 2018. Accessed, 2023. http://hdl.handle.net/10603/228022
13. Shere Kharwar AS, Magdum SM, Khedkar GD, Singh Gupta S. DNA barcoding elucidates ecological dynamics regulating the diversity of Theretra, Hübner 1819 (Lepidoptera: Sphingidae) from northernmost Western Ghats. Ecol Genet Genom,2024:31:100240. doi:10.1016/j.egg.2024.100240
14. Shere Kharwar AS, Magdum SM, Khedkar GD, Singh Gupta S. Diversity patterns and seasonality of hawkmoths (Lepidoptera: Sphingidae) from northern Western Ghats of Maharashtra, India. J Threat Taxa,2022:14(11):22105-22117. doi:10.11609/jott.7511.14.11.22105-22117
15. Sphingidae host plant dataset. Accessed,2024. https://data.nhm.ac.uk/doi/10.5519/qd.6jwkfr65