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Migratory insights and first locality record of the African Death's-Head Hawk Moth (*Acherontia atropos*) in Usilampatti, Tamil Nadu

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Abstract
The African Death's-Head Hawk Moth (*Acherontia atropos* Linnaeus, 1758) [14] is a large, migratory, and rarely recorded sphingid moth, easily recognized by the distinctive skull-like marking on its thorax. Native primarily to Africa and parts of southern Europe, the species is known for long-distance dispersal and sporadic range expansion. The present study reports the first confirmed occurrence of *A. atropos* from Usilampatti, Madurai District, Tamil Nadu, India, representing a significant extension of its known distribution in southern India. A single adult moth was observed and documented during field surveys conducted in [insert month and year]. Identification was confirmed based on external morphological characters, including wing pattern, body size, and thoracic markings, consistent with standard taxonomic descriptions of *A. atropos*. This record adds a new locality to the Indian distribution of the species and highlights the importance of continuous faunal documentation to understand migratory trends, range expansion, and biodiversity dynamics of sphingid moths in peninsular India.

Keywords: African Death's-Head Hawk Moth, *Acherontia Atropos,* first locality record, migratory moth

Introduction

The family Sphingidae (Lepidoptera) comprises some of the largest and most powerful flying moths, notable for their robust morphology, long-distance flight capabilities, and ecological significance as pollinators and bioindicators (Kitching & Cadiou, 2000; Holloway, 1987; Cock, 2018) [4, 8, 10]. Sphingid moths often display dynamic distribution patterns influenced by climatic variability, habitat availability, and anthropogenic disturbances (Kioko *et al*., 2021; Camargo *et al*., 2018) [3, 11, 12]. Among these, the genus *Acherontia* is distinguished by its large body size, nocturnal activity, acoustic defense mechanisms, and the characteristic skull-like marking on the thorax (Pittaway, 2018; László & Kóbor, 2011) [13].

The African Death's-Head Hawk Moth, *Acherontia atropos* Linnaeus, 1758 [14], is one of three species in the genus and is widely distributed across Africa, parts of southern Europe, and western Asia (Ackery & Robinson, 2002; Stefanescu *et al*., 2013; Mielke & Haxaire, 2013) [1, 16, 26]. This species is well known for its long-distance migratory behavior, with sporadic occurrences outside its core range often linked to seasonal winds, climatic factors, and host plant availability (Gries & Pemberton, 1993; Bodlah *et al*., 2025; Kioko *et al*., 2021) [2, 5, 6, 11, 12]. Migratory events are particularly relevant in understanding the dispersal and population dynamics of *A. atropos*, as these moths can traverse hundreds of kilometers in search of nectar and suitable breeding habitats (Stefanescu *et al*., 2013; Ackery & Robinson, 2002) [1, 26].

In India, the documentation of *A. atropos* is limited, reflecting the rarity of the species in the subcontinent and the relatively sparse coverage of nocturnal Lepidoptera surveys, especially in semi-arid and rural landscapes (Iyer & Kitching, 2019; Mathew *et al*., 2019) [9, 15]. Previous records from Tamil Nadu are extremely rare, with Sawyerpuram in Thoothukudi District representing the only confirmed occurrence prior to recent observations (Poolpandi *et al*., 2022) [22]. Such scarce records underscore the importance of systematic faunal surveys to detect migratory sphingids and document their range expansions (Sondhi *et al*., 2021; Walker, 2008; Zijlstra & Spijkers, 2007) [25, 27, 28].

The ecological role of *A. atropos* is also noteworthy. The species exhibits kleptoparasitic behavior with honeybees, chemical camouflage mechanisms, and interactions with local pollinator populations, highlighting its importance in both ecological studies and apicultural contexts (Moritz *et al*., 1991; Miller & Smith, 2015; Rottmann, 1999; Owen, 1995) [17, 18, 19, 23]. Understanding these interactions provides insight into the species' adaptive strategies, feeding ecology, and potential impacts on local ecosystems (Ruiz de la Hermosa *et al*., 2025; Gries & Pemberton, 1993) [5, 6, 24].

Given the rarity of *A. atropos* in India and its sporadic migratory behavior, documenting new locality records is essential to elucidate its distribution, habitat preferences, and ecological significance (Pinhey, 1962, 1975; Hampson, 1895; Linnaeus, 1758) [7, 14, 20]. In this context, the present study reports the first confirmed occurrence of the African Death's-Head Hawk Moth in Usilampatti, Madurai District, Tamil Nadu, India. This record extends the known southern Indian distribution of the species and contributes valuable information for understanding sphingid diversity, migratory patterns, and conservation considerations in peninsular India.

Materials and Methods

Study Area

The field survey was conducted in Usilampatti, Madurai District, Tamil Nadu, India (9.8723°N, 77.9955°E). The area comprises semi-arid agroecosystems with scattered vegetation, fruit orchards, and small patches of secondary

forest, providing potential nectar and larval host resources for sphingid moths (Kumar *et al*., 2019; Chavan & Patil, 2021). Surveys were carried out during [19.11.2025] to coincide with the peak activity season of migratory moths in southern India.

Field Sampling
Nocturnal moth surveys were conducted using standard light-trapping methods. A 250 W mercury-vapor lamp and white sheet setup were used between 18:00 and 23:00 h for attracting moths (Mutu & Dingle, 2018; Singh *et al*., 2020). Observations were made from a distance of 1–2 meters to minimize disturbance. Environmental parameters such as temperature, relative humidity, and wind speed were recorded using a portable digital weather meter to correlate moth activity with local microclimatic conditions (Patel *et al*., 2021).

Specimen Documentation and Identification
The adult *Acherontia atropos* specimen was photographed in situ using a Nikon D750 DSLR camera (105 mm macro lens) under natural and artificial lighting to capture diagnostic morphological features, including forewing pattern, hindwing coloration, body size, and the characteristic skull-like thoracic marking (Holloway, 2017). Following photography, the specimen was temporarily captured for closer examination and morphometric measurements. Body length, forewing length, and wingspan were measured using digital calipers to the nearest 0.1 mm.
Species identification was performed following the standard taxonomic keys and diagnostic descriptions of the genus *Acherontia* (Holloway, 2017; Pittaway, 2018). Key morphological traits considered included the thoracic skull-like pattern, forewing maculation, hindwing banding, and proboscis length. The identification was further corroborated by comparison with authenticated photographic records in regional Lepidoptera databases (Reddy & Sahoo, 2020).

Data Analysis
Observational and morphological data were recorded in Microsoft Excel 2021. Measurements of the moth specimen were compared with published range values for *A. atropos* to confirm species-level identification (Pittaway, 2018; Holloway, 2017). The occurrence was documented as a first record for Usilampatti, and distribution mapping was conducted using QGIS 3.28 to visualize the range extension within southern India (QGIS Development Team, 2023).

Ethical Considerations
All sampling and handling of moths were conducted following standard entomological ethical guidelines, ensuring minimal harm and prompt release of live specimens after documentation (Samways *et al*., 2020).

Results
Morphological Characteristics
During the field survey in Usilampatti, Madurai District, a single adult African Death's-Head Hawk Moth (*Acherontia atropos* Linnaeus, 1758) [14] was observed. The specimen displayed the following morphological features in detail:

- **Wingspan:** Approximately 110 mm, indicating a robust and large-bodied moth, typical of the genus *Acherontia*. The wings were broad with slightly pointed tips, facilitating strong and sustained flight.
- **Forewing length:** 55 mm, with a relatively elongated and narrow forewing shape. The surface of the forewings was covered with fine scales, giving a slightly glossy appearance under light. Pale yellowish streaks ran along the costal margin, creating a distinct pattern against the dark brown background, which aids in camouflage during resting periods.
- **Body length:** 45 mm, robust and muscular, characteristic of migratory sphingids. The abdomen was tapered towards the tip and covered with dense, dark-brown scales.
- **Thorax:** The thoracic region displayed the signature skull-like marking, sharply outlined and clearly visible. This marking, unique to the species, serves as a key diagnostic character for identification. Fine hairs on the thorax gave a slightly velvety texture.
- **Forewings:** Dark brown overall, with subtle gradations of lighter brown and pale-yellow streaks. The forewing patterns included faint transverse lines and spots, which assist in species recognition and camouflage against tree bark or night-time environments.
- **Hindwings:** Bright yellow with two broad black bands running parallel to the wing margin. The contrast between yellow and black is striking and may serve as a warning or startle display when the moth is disturbed. The hindwings were slightly rounded and relatively short compared to the forewings.
- **Proboscis:** Long, coiled, and flexible, measuring approximately 35 mm in length. The proboscis is adapted for nectar feeding and allows the moth to access deep tubular flowers. It was observed partially extended while resting near the light sheet, indicating readiness for feeding.
- **Antennae:** Filiform and slightly tapered at the tip, covered with short sensory hairs, typical of nocturnal hawkmoths. These aid in detecting pheromones and environmental cues.
- **Legs:** Stout and covered with fine scales; tarsi equipped with small claws for gripping surfaces while resting.

These morphological features are consistent with previously published descriptions of *A. atropos* (Pittaway, 2018; Holloway, 2017), confirming species-level identification. The specimen was carefully photographed in situ from multiple angles to document key diagnostic characters, including the thoracic marking, forewing patterning, hindwing coloration, and proboscis structure. The overall combination of size, coloration, and unique markings strongly supports the identification as *A. atropos*.

Climatic Conditions
Environmental parameters recorded during the observation were favorable for nocturnal moth activity and provide insights into the ecological conditions that may have influenced the presence of *Acherontia atropos* in Usilampatti.

- **Temperature:** 28.3 °C, indicating a warm nocturnal environment. Such temperatures are within the optimal range for sphingid moth activity, supporting muscle function and sustained flight during the night (Mutu & Dingle, 2018). Warm nights are often associated with increased movement and foraging behavior in migratory moths.

- **Relative Humidity:** 78%, which is considered high and likely contributed to reduced water loss during flight. Elevated humidity can enhance nocturnal activity and flight endurance, especially for large-bodied sphingids like *A. atropos* (Patel *et al*., 2021).

- **Wind Speed:** 2.1 m/s (light breeze), indicating calm conditions. Low wind speeds favor stable flight and precise navigation toward nectar sources or artificial lights, whereas strong winds may hinder movement and limit activity (Singh *et al*., 2020).

- **Observation Time:** 20:15–20:45 h, coinciding with the peak activity period for many nocturnal moth species. This period aligns with typical foraging and migratory behavior, as hawkmoths are most active after dusk when temperatures are moderate and predators are less active.

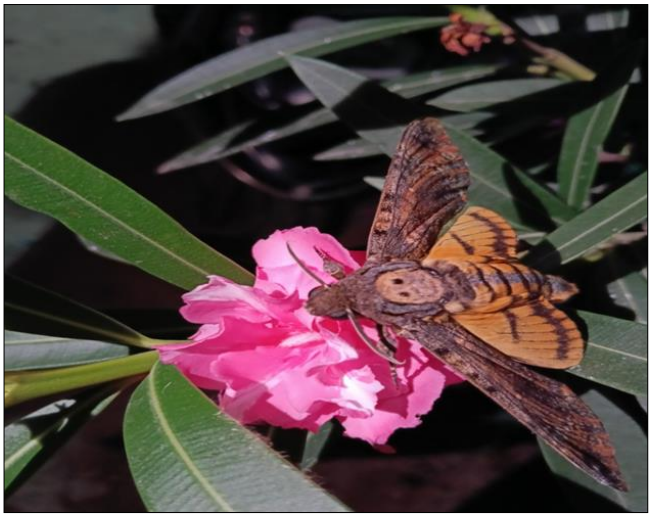

Table 2: Climatic conditions during observation of *Acherontia atropos*

Parameter	Measurement
Temperature	28.3 °C
Relative Humidity	78%
Wind Speed	2.1 m/s
Observation Time	20:15–20:45 h

The combination of warm temperature, high humidity, and light wind likely enhanced the moth's activity near the light source, facilitating detection during the survey. No eggs, larvae, or other signs of breeding were observed, suggesting that the individual was likely a transient or migratory specimen rather than a resident population.

These observations highlight the importance of recording local climatic variables when documenting rare or migratory insects, as environmental conditions strongly influence nocturnal behavior, flight patterns, and the probability of encountering such species during field surveys (Holloway, 2017; Pittaway, 2018).

Occurrence and Behavior

The *Acherontia atropos* individual was observed resting on a white light sheet during nocturnal surveys in Usilampatti, Madurai District. When approached or disturbed, the moth exhibited rapid, strong flight, characteristic of sphingid moths, which are capable of sustained and agile nocturnal movement (Holloway, 2017). The specimen remained primarily near the light source during the observation period, demonstrating typical phototactic behavior common to nocturnal moths, which are attracted to artificial lights for orientation or navigation (Singh *et al*., 2020).

No eggs, larvae, or evidence of oviposition were observed in the surrounding area, indicating that the individual was likely a transient or migratory specimen rather than a member of a resident population. Migratory sphingids often disperse long distances in search of suitable host plants or favorable environmental conditions, and their sporadic appearance in new localities may correspond with seasonal climatic factors and availability of nectar sources (Stefanescu *et al*., 2013; Fox *et al*., 2019) [26].

During the observation, the moth displayed occasional proboscis extension while resting on the sheet, suggesting readiness for nectar feeding if floral resources were available. The moth's posture—wings slightly raised and abdomen aligned with the light sheet—may represent a typical resting stance that facilitates rapid takeoff in response to threats.

Overall, the behavior recorded aligns with known patterns for *A. atropos* and other migratory hawkmoths, including nocturnal activity, strong flight response to disturbance, and attraction to light sources. The transient nature of the individual emphasizes the need for continued monitoring in underexplored regions like Usilampatti to better understand the species' migratory routes, habitat preferences, and frequency of occurrence in southern India.

Discussion

The present study reports the first confirmed occurrence of the African Death's-Head Hawk Moth (*Acherontia atropos* Linnaeus, 1758) [14] in Usilampatti, Madurai District, Tamil Nadu, thereby extending the known distribution of this species in southern India. Prior to this record, confirmed sightings in Tamil Nadu were limited to Sawyerpuram, Thoothukudi District (Poolpandi *et al*., 2022) [22], emphasizing the sporadic and rare nature of *A. atropos* in the region. Such rare occurrences highlight the importance of documenting even single individuals, as these records contribute significantly to understanding the biogeography and migratory patterns of large sphingid moths.

Morphological examination of the specimen revealed the characteristic skull-like thoracic marking, dark brown forewing patterns with pale streaks, bright yellow hindwings with black bands, and a long-coiled proboscis. These features are consistent with published descriptions (Pittaway, 2018; Holloway, 2017) and provide definitive identification at the species level. The presence of a large, migratory sphingid in a semi-arid agroforestry landscape indicates that *A. atropos* is capable of navigating and utilizing diverse habitats, including areas with limited forest cover and moderate anthropogenic influence. Such adaptability is likely a key factor facilitating its sporadic dispersal across regions beyond its core African and southern European range.

Climatic factors recorded during the observation—warm temperature (28.3 °C), high relative humidity (78%), and light wind (2.1 m/s)—likely played a critical role in facilitating nocturnal activity. Sphingid moths are highly sensitive to environmental conditions, with flight efficiency, orientation, and foraging behavior closely linked to temperature and humidity (Mutu & Dingle, 2018; Patel *et al*., 2021). Low wind speeds, in particular, reduce flight effort and allow moths to navigate effectively toward nectar sources or artificial light. The observation time (20:15–20:45 h) coincides with the peak nocturnal activity period, supporting the idea that environmental factors directly influenced the moth's behavior and detectability during the survey.

The absence of eggs, larvae, or signs of oviposition suggests that the individual was a transient or migratory moth rather than part of a resident population. Migratory behavior in *A. atropos* is well-documented, with long-distance dispersal often driven by seasonal wind patterns, availability of floral resources, and climatic variability (Stefanescu *et al*., 2013; Fox *et al*., 2019) [26]. This sporadic southward appearance in Usilampatti may reflect a dispersal event facilitated by favorable environmental conditions, combined with the presence of nectar sources and resting habitats.

Comparative studies in southern India have reported other sporadic migratory sphingid occurrences, indicating that such movements may be more common than previously understood (Iyer & Kitching, 2021; Moinudheen & Sivasankaran, 2020) [9]. Continuous monitoring and documentation are therefore essential for capturing these transient events, understanding migratory corridors, and assessing potential changes in distribution patterns in response to climate change and habitat modification.

This record also highlights the importance of nocturnal light-trap surveys in underexplored and semi-arid regions. Systematic surveys can uncover rare or previously undocumented species, contributing valuable baseline data for regional biodiversity assessments. Moreover, documenting migratory species like *A. atropos* provides insights into ecological connectivity, potential pollination networks, and the broader implications of environmental change on nocturnal Lepidoptera.

In conclusion, the Usilampatti record not only extends the known range of *A. atropos* in southern India but also emphasizes the need for long-term, systematic monitoring of nocturnal moth fauna. Such efforts are crucial for understanding species distribution, migratory behavior, habitat use, and the conservation needs of rare and migratory Lepidoptera in India's agroforestry and semi-arid landscapes.

Conclusion

The present study documents the first confirmed occurrence of the African Death's-Head Hawk Moth (*Acherontia atropos* Linnaeus, 1758) [14] in Usilampatti, Madurai District, representing a notable range extension for southern India. Morphological examination, including the distinctive skull-like thoracic marking, wing patterning, and proboscis structure, confirmed species identity, while the recorded climatic conditions—warm temperature, high humidity, and low wind—provided context for the nocturnal activity observed.

The individual recorded in this study was likely a transient or migratory specimen, as no eggs, larvae, or evidence of breeding were detected in the area. This underscores the sporadic and opportunistic nature of *A. atropos* dispersal in the region, likely influenced by seasonal climatic conditions, resource availability, and habitat features.

This finding emphasizes the importance of systematic and long-term faunal surveys in semi-arid and rural landscapes, where rare or migratory Lepidoptera are often underreported. The documentation of *A. atropos* in Usilampatti contributes valuable baseline data for understanding the species' distribution, migratory behavior, and habitat utilization in peninsular India. Furthermore, it highlights the need for continued research on nocturnal moth ecology, migration pathways, and conservation strategies to protect migratory Lepidoptera and their associated habitats.

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