



First record of the rare moth *Amana angulifera* Walker, 1855 (Lepidoptera: Epicopeiidae) from India since the 19th century

Primer registro de *Amana angulifera* Walker, 1855 (Lepidoptera: Epicopeiidae) en la India desde el siglo XIX

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ABSTRACT

Amana angulifera Walker, 1855, a diurnal moth belonging to the family Epicopeiidae, was described from India based on a previously collected specimen. Though type locality was omitted in the original description, in the last decade of the 19th century, the habitat of the moth was mentioned to be Khasi Hills of the present Meghalaya state of India. It is also recorded from Yunnan in southern part of China. After a gap of more than a century, this paper reports the presence of the species again from India, this time in the Himalayan state of Arunachal Pradesh, bordering China, filling a sampling gap within its distribution range. Further study of the moth in this region is recommended to fill the sampling gaps and assess its life cycle, population trends, abundance, phenological responses and inter-specific interactions with plants so that conservation measures may be taken up accordingly.

Keywords: *Epicopeiidae*; *Geometroidea*; *Himalay*; *Moth*; *Talle Valley*

RESUMEN

Amana angulifera Walker, 1855, polilla diurna perteneciente a la familia Epicopeiidae, fue descrita en la India a partir de un espécimen anterior, a mediados del siglo XIX. Aunque la localidad tipo se omitió en la descripción original, en la última década del siglo XIX, se estableció que el hábitat de la polilla se situaba en las colinas Khasi del actual estado indio de Meghalaya. No obstante, durante esta década también fue registrada en Yunnan, al sur de China. Tras un intervalo de más de un siglo sin registros en la India, este trabajo presenta evidencias de la existencia de esta polilla en el estado himalayano de Arunachal Pradesh, fronterizo con China, llenando así un vacío de muestreo de décadas en su área de distribución. A partir de este hallazgo, se están llevado a cabo estudios en esta región con el fin de evaluar el ciclo vital, tendencias poblacionales, abundancia, respuestas fenológicas e interacciones interespecíficas de esta polilla con las plantas, de modo que puedan tomarse las consecuentes medidas de conservación.

Palabras clave: *Epicopeiidae*; *Geometroidea*; *Himalaya*; *Polilla*; *Valle de Talle*

INTRODUCTION

Eastern Himalaya is a part of the Indo-Burma global biodiversity hotspot (Myers *et al.*, 2000). Talle Valley Wildlife Sanctuary of Eastern Himalaya is situated in Lower Subansiri district to the east of the district headquarters Ziro. The altitude of the park ranges from 1600m to 2750m (Talukdar *et al.*, 2014). Pange and Talle rivers flow through the sanctuary. The pristine primary forest in the sanctuary can be classified into four types: East Himalayan sub-tropical forest, East Himalayan wet temperate forest and East Himalayan coniferous forest (Champion *et al.*, 1968). This observation of *Amana angulifera* in mid-elevation of the sanctuary has been observed in the wet temperate forest region (Figure 1, left). The species was hitherto recorded from 'Khasis' (present Meghalaya state of India) (Hampson, 1895). There is no further report of the species from Indian subcontinent. A museum specimen from China (Wei *et al.*, 2017) provides evidence of its distribution there.

Epicopeiidae is a small family of diurnal moths belonging to only twenty-five species from nine genera (Zhang *et al.*, 2020). Once placed in superfamily Drepanoidea on the basis of morphology (Minet, 1991), it is recently classified under superfamily Geometroidea on the basis of phylogeny (Regier *et al.*, 2009), with Pseudobistonidae as its sister group (Rajaei *et al.*, 2015; Zhang *et al.*, 2020). Minet

(1986) transferred the genus *Amana* Walker, 1855 along with others from Epipleminae (now Uraniidae: Epipleminae) to Epicopeiidae. All but one genera of the family mimic species from other Lepidopteran families such as Papilionidae, Pieridae, Riodinidae, Nymphalidae, Erebidae and Geometridae (Zhang *et al.*, 2020). *Amana angulifera* Walker, 1855 mimics the male of sexually dimorphic *Numenes siletti* Walker, 1855 (Erebidae: Lymantriinae).

Since the family Epicopeiidae, as well as this particular study area, is vastly understudied, this study attempts to fill in sampling gaps, thereby reducing Wallacean shortfall, which is essential to understand the biogeography of the species, without which conservation attempts cannot be initiated.

METHODS

While going through an opportunistic field visit, primarily for butterflying, the first author found and photographed a moth on 25 September 2018 at 08:36 hours amidst torrential rain. The photograph was taken in Shutter Priority Mode using Nikon D5300 camera with Nikkor Af-p 70-300mm lens at f/6.3 aperture with 1/200 second shutter speed. The ISO speed was increased to ISO-640 to compensate for the low light. Compulsory flash with strobe return was used to generate the light for photographing the moth. The authors later identified the moth with the help of existing literature (Walker, 1855; Hampson, 1895; Minet, 2002).



Figure 1: Wet temperate forest habitat of the location where *Amana angulifera* was observed (left). Pange river with Pange Antio-Poaching Camp in backdrop providing a view of the landscape (right) (Photographs by: Aniruddha Singhamahapatra).



Figure 2 : *Amana angulifera* resting on a frond of *Diplopterygium blotianum* (Photograph by: Aniruddha Singhamahapatra)

RESULTS

The authors of the present paper identified the photographed moth as *A. angulifera*. The moth was resting on a fern (Figure 2) which was identified to be *Diplopterygium blotianum* (C. Chr.) Nakai. This fern is known to be widely distributed in south-east Asia. The individual of *A. angulifera* was found in the Pange Range of the sanctuary, around 2 km north of the Pange anti-poaching camp (Figure 1, right), on the dirt road leading to Talle valley. The co-ordinates of the observation were 27.550693°N, 93.914217°E at an altitude of around 2040m asl. Wet temperate vegetation, predominantly of thick pine forest, dominates the gentle slopes in the region, which descend to the Pange river. The soil is clayey loam and rich in humus, containing thin peat beds of the Pleistocene era (Behera *et al.*, 2000). Tropical dry sub-humid climatic conditions prevail in the study area, which is classified as Zone Aw according to Köppen-Geiger climatic classification (Peel *et al.*, 2007). The average maximum and minimum temperatures are 28.3 °C and 17°C: The average annual rainfall is 6637 mm: July is the wettest (1299 mm) month of the season (Anonymous, 2021).

DISCUSSION

Amana angulifera was described from the collection of Mr. Samuel Stevens. The triangular forewings have three yellow bands which almost converge on the hind angle (Walker, 1855); with a fascia from the costa, a narrow submarginal line and a broad oblique band from the costa beyond the middle (Hampson, 1895). *Deuveia banghaasi* and *Amana angulifera* are the only Epicopeiids with the distinctive forewing pattern of three yellow stripes converging towards the tornus. The former species, known only from higher elevations in central China differs from the latter in its smaller size and yellow hindwings, while those of *A. angulifera* are dark brown with orange marginal markings (Minet, 2002). Unlike these, the model *Numenes silletti*, which shares the same habitat and is mimicked by *A. angulifera*, has two oblique blackish brown bands (Walker, 1855).

In spite of the fact that the study area (and North-eastern part of India, in general) and this particular family of moths, both being vastly understudied, the rarity of the occurrence of *A. angulifera* seems significant enough to be assessed for conservation, and to control unauthorised and/or reckless collection spree of specimens of such rare species, which may jeopardise the population. The Eastern Himalayan region is also threatened by climate change. Further sampling efforts from Eastern Himalayas (in India), southern part of China and also in adjoining parts of South-East Asia (Myanmar, Thailand, Vietnam, Laos) needs to be initiated to overcome the Wallacean, as well as the Eltonian shortfalls for this species, which are essential to assess its population and to prepare a conservation strategy. International Union for Conservation of Nature (IUCN) assessment is thus recommended to bring this rare species under the purview of international conservation.

While most identifications and subsequent publications related to entomofauna are done through dissection and/or spreading wings after collection of

specimens, the present example is one of the very few cases where species level identification can be easily done from a photo. While photo-identification is a common practice for Papilionoidea (butterflies), it is difficult, often impossible, and hence rarely used for most other Lepidopterans (moths). However, there are several previous instances of photograph-based identification of moths resulting in significant new distribution reports (Vaidya *et al.*, 2015; Sondhi *et al.*, 2016; Sheikh *et al.*, 2021; Thapa, 2021) in India. With no type locality mentioned in the collection neither in the description, the habitat of *A. angulifera* was mentioned to be 'Khasis' (present Meghalaya state, India) (Hampson, 1895). Currently, *A. angulifera* is known to be distributed in parts of India and China (Wei *et al.*, 2017). The observations of the species are very scarce and the current observation represents the second record from India, after at least around hundred years or more, and the first from the state of Arunachal Pradesh. This particular observation has also been posted through peer-reviewed identification in the citizen science-based Moths of India (Anonymous, 2022) repository. Though Sondhi *et al.* (2021) had extensively surveyed the moth fauna of Talle Valley Wildlife Sanctuary, but this species eluded them too.

Being collected previously from Yunnan (South China) in the north and Meghalaya state of India in the south, the presence of this enigmatic moth from Arunachal Pradesh, an Indian state bordering China, fills in the sampling gap within its distribution range. Extensive survey needs to be conducted to understand its entire distribution and life cycle in order to assess its population trends, abundance, biogeography, inter-specific interactions with plants, phenological responses and thus plan proper conservation strategy for this species.

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