# Larvae of *Perixera illepidaria* (Guenée) (Lepidoptera: Geometridae), an emerging pest of mango, migrate to banana for pupation and to meet their nemesis

*Perixera illepidaria* (Guenée) (=*Anisodes illepidaria* Guenée)[1] (Lepidoptera: Geometridae) is known to be a pest of mango in Guam. In recent years, it has been reported from India also as a pest of litchi[2] and mango[3,4]. It is distributed in the north-eastern Himalayas, Hong Kong, Sundaland, the Philippines, Sulawesi, Guam[5] and Thailand[6]. It is an alien invasive species in Guam under the common name 'mango shoot looper'[7]. Larvae of *P. illepidaria* have been reported to feed on mango flowers and foliage in Guam[8]. It is a mango pest in the Federated States of Micronesia and Palau[9]. In India, *P. illepidaria* was first reported from Bihar as an outbreak pest on litchi during 2011–12 (ref. 2). The pest incidence in Bihar ranged from 34.1% to 84.5% in 2012 and foliage damage was 81–100%. The larvae were reported as feeding voraciously on the leaf lamina of litchi, leaving behind only the midribs and veins, and caused heavy canopy damage. Castor bean and mango were also recorded as additional host plants in Bihar[2]. Soumya[3] recorded it on mango in Karnataka. Verghese and Soumya[4] identified it as a major pest of concern on commercial cultivars of mango in the southern Indian states of Andhra Pradesh, Karnataka and Tamil Nadu in 2020–21. They reported that the larvae were active during the peak flowering season of mango (January–March) and found it feeding on mango inflorescence with set fruits, resulting in yield losses which were not quantified. The literature on this pest is limited, possibly because it has been reported only recently in India, and accounts of its diagnosis and biological information, including host plants and natural enemies in Indian conditions are lacking. We report the migration of larvae of *P. illepidaria* from mango, its host plant, to banana, a non-host, for pupation and the attendant parasitization of the looper pupae on banana with information on its parasitoids from Tamil Nadu, India. Natural enemies of *P. illepidaria* have not been reported from any part of the world until now.

During February–March 2021, we came across a large number of the larvae and pupae of a looper (Lepidoptera: Geometridae) on banana foliage at the research farm of the National Research Centre for Banana, Tiruchirappalli, Tamil Nadu. Totally 25 larvae and 30 pupae were collected on the local banana cultivar Karpuravalli. The larvae were of variable colouration – beige coloured with dark brown, somewhat diamond-shaped pattern or greyish with purplish-brown pattern (Figure 1 *a–f* ). The pupae were green and turned brown before adult emergence (Figure 1 *g*). Most of the larvae collected on bananas appeared to be mature and were medium to large in size. The pupae collected on banana foliage were reared to adults in the laboratory. Parasitoids emerging from the pupae were also identified and imaged.

The identity of the adult moths was confirmed as *P. illepidaria* based on the available literature and the genitalia[5] (Figure 1 *h*). When the larvae were offered banana leaves in the laboratory, they did not feed on them and pupated after 3–4 days, confirming that banana is not a host plant. On closer examination, we found a mango tree about 5 m away from the banana field where the larvae and pupae were collected. We found only a few early-stage larvae on mango. As there is no recent work with the illustrations of the genitalia and wing venation of *P. illepidaria*, they are provided here to facilitate identification.

The adult moth is pinkish fawn in both sexes with a characteristic sexual dimorphism in the antenna and wing venation. The female is uniform pink with a lenticular discal spot on the hindwing (Figure 1 *h*). The wing venation in the male moth is distinctive and characterized by the presence of a shallow fold at the centre of the


**Figure 1.** ***a–f***, Larva of *Perixera illepidaria* on banana; ***g***, Pupa; ***h***, Adult female.

forewing costa (Figure 2 *b*), with a tuft of scales over the discal spot in the upper side and lateral grey edging to the fold in the underside[5]. The genitalia are illustrated in Figure 2 *c* and *d*. The female wing venation (Figure 2 *a*) and the genitalia are also illustrated in Figure 2 *e*.

Interestingly, as many as five pupal parasitoids belonging to three families of Hymenoptera were reared from the pupae collected on banana. These were identified as *Xanthopimpla nana* Schulz (Hymenoptera: Ichneumonidae), three species of *Brachymeria* sp. (Hymenoptera: Chalcididae) and one species of *Eurytoma* (Hymenoptera: Eurytomidae). Out of 30 pupae collected on banana, 40% were parasitized (*Xanthopimpla nana* – 13.33%, *Brachymeria* – 26.67%; *Eurytoma* sp. – negligible). Until now, there have been no reports on the natural enemies of *P. illepidaria* from any part of the world. The parasitoids reared on *P. illepidaria* are discussed below.

***Xanthopimpla nana* Schulz (Figure 3 *a–f*):** This is commonly distributed in India, but there is not much information on its hosts at present. It can be identified by the following combination of characters: Body lemon yellow. Head yellow with only ocellar triangle black. Mesoscutum with a transverse basal black band (Figure 3 *e*) (sometimes obliterated with only two smaller black spots (Figure 3 *c* and *d*)) and a black macula in front of scutellum. Propodeum with posterior transverse carina entirely absent. Abdominal tergites 1, 3, 4, 5, and 7 with two black spots and tergite 8 with a median black spot (Figure 3 *f*); ovipositor sheath about 0.6–0.8× hind tibia[10]. The specimens reared from *P. illepidaria* showed some intraspecific variation in the size of mesoscutal maculae, as illustrated. Townes and Chiu[10] reported that where known, all species of *Xanthopimpla* are idiobiont endoparasitoids of the pupae of Lepidoptera.

***Brachymeria* spp. (Figure 4 *a–c*):** Three species of *Brachymeria* were found to parasitize the pupae of *P. illepidaria* (Figure 4 *e* and *f*). *Brachymeria* spp. are common pupal parasitoids of lepidopterans. They could not be identified to species level because the Indian species are numerous and difficult to identify. Most of the species of *Brachymeria* are characterized by a robust, black body having dense piliferous punctures, black and yellow legs having distinctly swollen and ventrally dentate hind femora, and the postmarginal vein of forewing is distinctly longer than stigmal vein. The species of *Brachymeria* are mostly primary parasitoids in pupae of holometabolous insects, especially of Lepidoptera, but some are hyperparasitoids of Hymenoptera or Diptera *attacking* Lepidoptera[11].

***Eurytoma* sp. (Figure 4 *d*):** A single specimen of an unidentified species of *Eurytoma* was reared from the pupae. Eurytomids are known to parasitize lepidopterans and are occasionally hyperparasitoids.

Interestingly, soon after, we also recorded the life stages of coconut defoliator, *Phalacra vidhisara* (Walker) (Lepidoptera: Drepanidae), hitherto unknown to feed on bananas, on the foliage of banana, albeit in very low numbers (2–3 larvae and pupae) (Figure 5). The natural host plant, coconut, was found in the vicinity at a distance of about 50 m.

Hagstrum and Subramanyam[12] reviewed the ecological role of immature-stage mobility among several insect taxa. They reported that most of the active feeding life in Lepidoptera is spent on the larval host plants, and mature larvae of Lepidoptera wander in search of a shelter or a pupation site; the maximum larval movement occurs just before pupation. They mentioned that lepidopteran larvae begin wandering before reaching fourth instars and are known to have daytime resting sites such as litter at the base of a tree or other sheltered locations, and return to the foliage for feeding at night. Baker[13] and Wagner[14] reported that >230 species of Lepidoptera (25 additional families) leave their feeding sites to find pupation sites. Of these, 68% are from five families (23 Geometridae, 22 Lycaenidae, 30 Noctuidae, 56 Notodontidae, and 41 Sphingidae). Larvae of >361 insect species in 59 families leave their feeding sites to find a pupation site[12].

Many lepidopterans, including major pests of crops such as *Helicoverpa armigera*, *Spodoptera litura*, cutworms, etc. are known to pupate in the soil and leaf litter, which offer protection[15]. Leaving the feeding habitat can increase the risk of predation and/or parasitism on the wandering larvae but reduce the mortality of pupae from predators or parasitoids at the feeding site. According to Riemann *et al.*[16], daytime wandering may have originated as a defence against predation. The movement

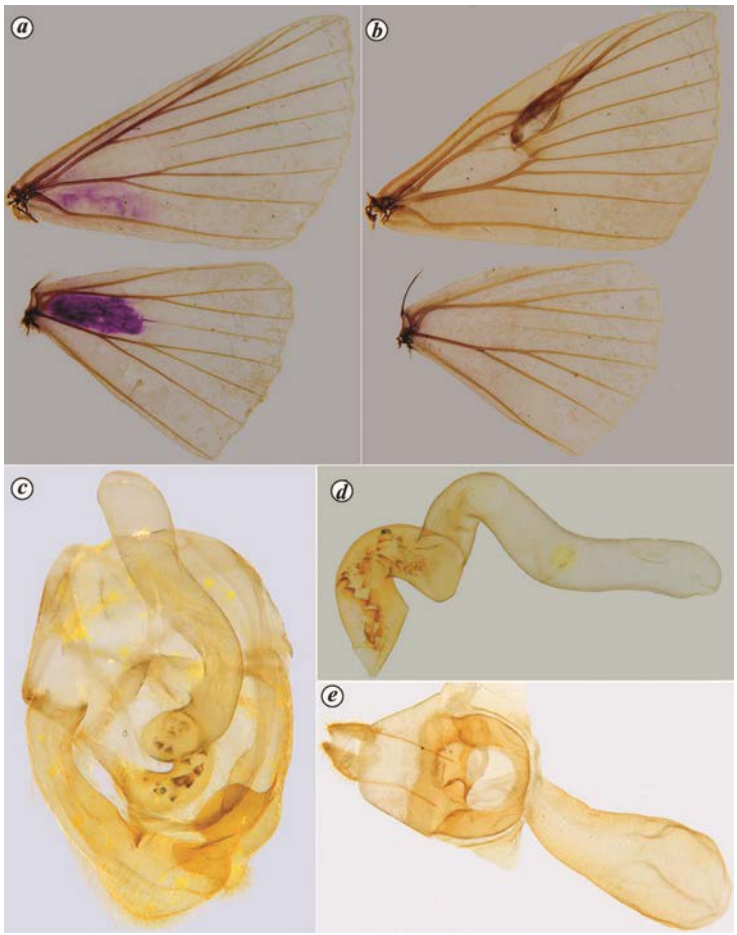


**Figure 2.** Diagnostic characters of *P. illepidaria*: ***a***, Wing venation, female; ***b***, Wing venation, male; ***c***, Male genitalia; ***d***, Male genitalia: aedeagus; ***e***, Female genitalia.

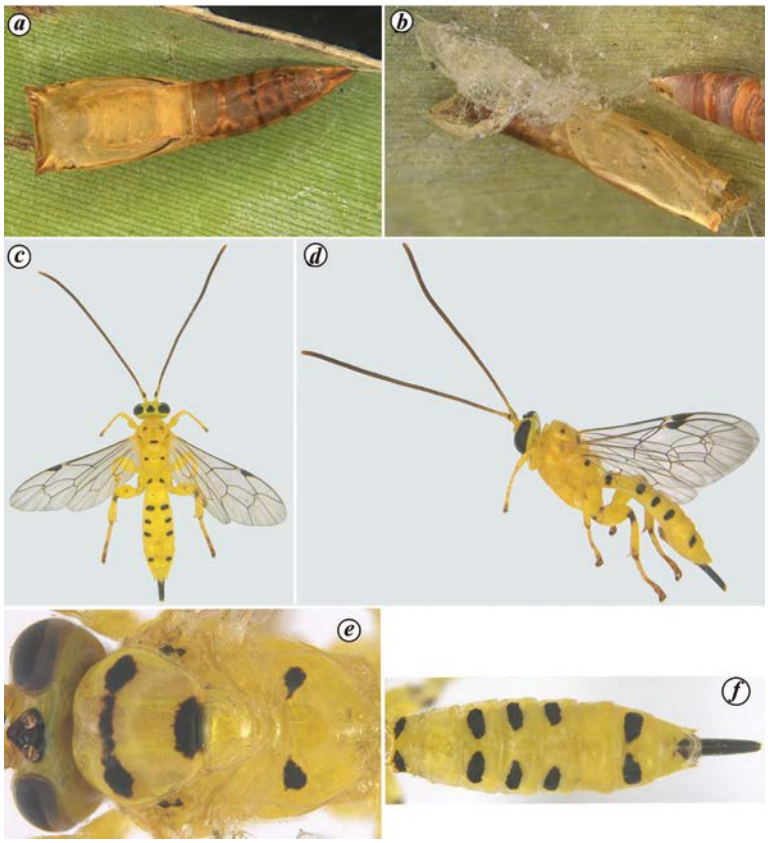


**Figure 3.** ***a***, Pupa of *P. illepidaria* parasitized by *Xanthopimpla nana*; ***b***, Pupa after parasitoid emergence; ***c***, *Xanthopimpla nana*, dorsal view; ***d***, *Xanthopimpla nana*, lateral view; ***e***, Mesosoma, variation; ***f***, Metasoma.

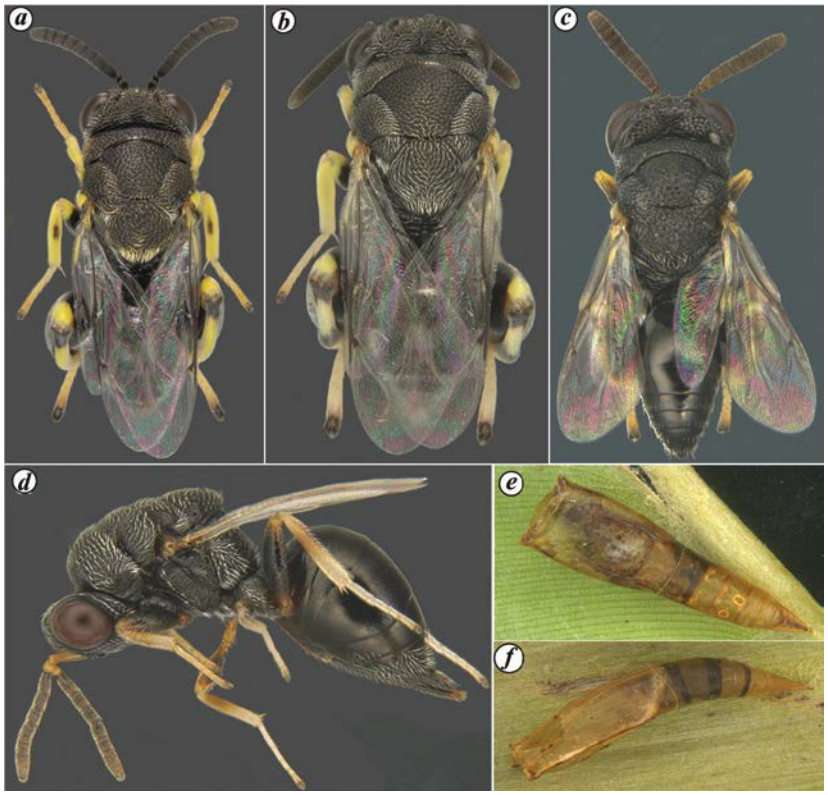


**Figure 4.** Pupal parasitoids of *P. illepidaria*: ***a–c***, *Brachymeria* spp.; ***d***, *Eurytoma* sp.; ***e***, Pupa parasitized by *Brachymeria* sp.; ***f***, Pupa with parasitoid emergence hole (*Brachymeria* sp.).

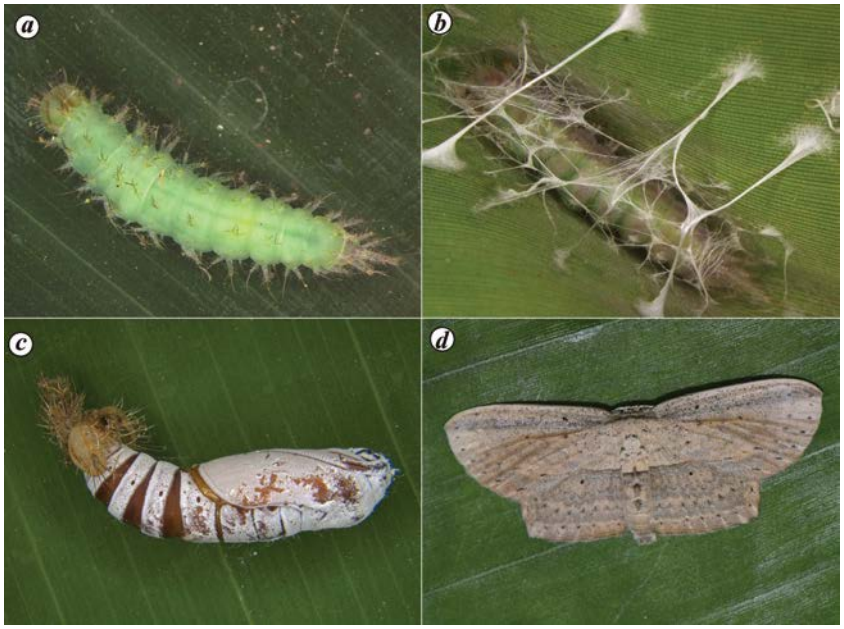


**Figure 5.** Life stages of coconut defoliator, *Phalacra vidhisara* (Walker) on banana.

of late instars to resting sites in the litter during the day often results in the larvae moving from one tree to another[17].

In the case of *P. illepidaria*, pupation usually takes place in the open and banana leaves appear to be much more exposed and open to predation and/or parasitism compared to mango, which has a dense canopy with many concealed niches that aid in sheltering the larvae and pupae. Hence, larval wandering of *P. illepidaria* from mango to banana, a non-host plant, for pupation defies explanation because banana does not seem to offer any adaptive advantage as a pupation site by way of concealment. This is confirmed by the moderately high rate of pupal parasitism observed though large samples were not involved. Due to the absence of any evidence of feeding by *P. illepidaria* on bananas in laboratory tests, we conclude that the larvae were only wanderers looking for a suitable pupation site. Further focused surveys on its natural host plants like mango are likely to yield more information on this aspect.

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