

First records of *Maruca amboinalis* (Felder, Felder & Rogenhofer, 1875) (Lepidoptera, Crambidae) from mangrove habitats, and additional host-plant records from Iriomote Island, southern Japan

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Abstract. *Maruca amboinalis* (Felder, Felder & Rogenhofer, 1875) (Lepidoptera, Crambidae) was reared from larvae on the mangrove-associated vine *Derris trifoliata* Lour. in mangrove forests on Iriomote Island, Japan, providing the first confirmed evidence of its occurrence in mangrove habitats. Light-trap and citizen-science records from Japan, Taiwan, and India indicate a multivoltine life cycle and suggest broad ecological tolerance. Together with previous host records from *Pongamia pinnata* (L.) Pierre, our findings demonstrate the species' adaptability to coastal legumes and emphasize mangroves as overlooked habitats supporting Indo-Pacific lepidopteran diversity.

Key words. *Derris trifoliata*, habitat use, Indo-Pacific, larval ecology, mangrove insects, phenology, Yaeyama Islands

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Introduction

The genus *Maruca* Walker, 1859 (Lepidoptera, Crambidae) currently comprises four described species, all distributed within the Oriental region (Srinivasan et al. 2021). In Japan, two species have been recorded: *Maruca vitrata* (Fabricius, 1787), a cosmopolitan agricultural pest, and *M. amboinalis* (Felder, Felder & Rogenhofer, 1875), which occurs on Okinawa, Ishigaki, and Iriomote Islands in the Ryukyu Islands, southwestern Japan (Figure 1; Yoshiyasu 1975; Inoue et al. 1982; Yamanaka and Sasaki 2013; Nasu 2023; GBIF 2025a; iNaturalist 2025). *Maruca amboinalis* is widely distributed from India to the Ryukyu Islands (Figure 1), with the first Japanese record from Ishigaki Island in the Yaeyama Islands in the 1970s (Yoshiyasu 1975).

Among the four *Maruca* species, the biology of *M. vitrata* has been studied extensively because of its economic impact on legume crops, whereas ecological information on the remaining congeners is still fragmentary (Srinivasan et al. 2021). The reported host plants of *M. amboinalis* are all members of the Fabaceae and include *Butea monosperma* (Lam.) Kuntze, *Dalbergia latifolia* Roxb., *Derris elliptica* (Wall.) Benth., an unidentified species of *Derris* Lour., *Lablab purpureus* (L.) Sweet, *Ougeinia oojinensis* (Roxb.) Hochr. (under the name *Desmodium oojinense* (Roxb.) H. Ohashi), an unidentified species of *Pongamia* Adans., *Tephrosia candida* DC., an unidentified species of *Tephrosia* Pers., and *Vigna radiata* (L.) R. Wilczek, *Xylia xylocarpa* (Roxb.) W.Theob. (Natural History Museum 2025). However, none of these records provides illustrations or documentation of larval morphology or feeding behavior for this species.

In Japan, *Pongamia pinnata* (L.) Pierre (Tominaga 2009; Yoshiyasu 2023) and *Derris trifoliata* Lour. (Tominaga 2023) have been recorded as host plants of *M. amboinalis*. Both plant species are also widespread outside Japan: *P. pinnata* ranges from southern Mainland China and Taiwan through India, Malaysia, Polynesia, and northern Australia (Huang and Ohashi 1993; GBIF 2025b), whereas *D. trifoliata* extends from southern Mainland China and Taiwan across tropical Asia to eastern Africa (Hamid 1999; GBIF 2025c). Within the Japanese archipelago, *P. pinnata* occurs from Yakushima Island southward and *D. trifoliata* from Amami-Oshima Island southward (Figure 2; Ohkawa and Hayashi 2016; Ryukyu Plant Research Group 2018–; GBIF 2025b, 2025c). Although Tominaga (2009, 2023) and



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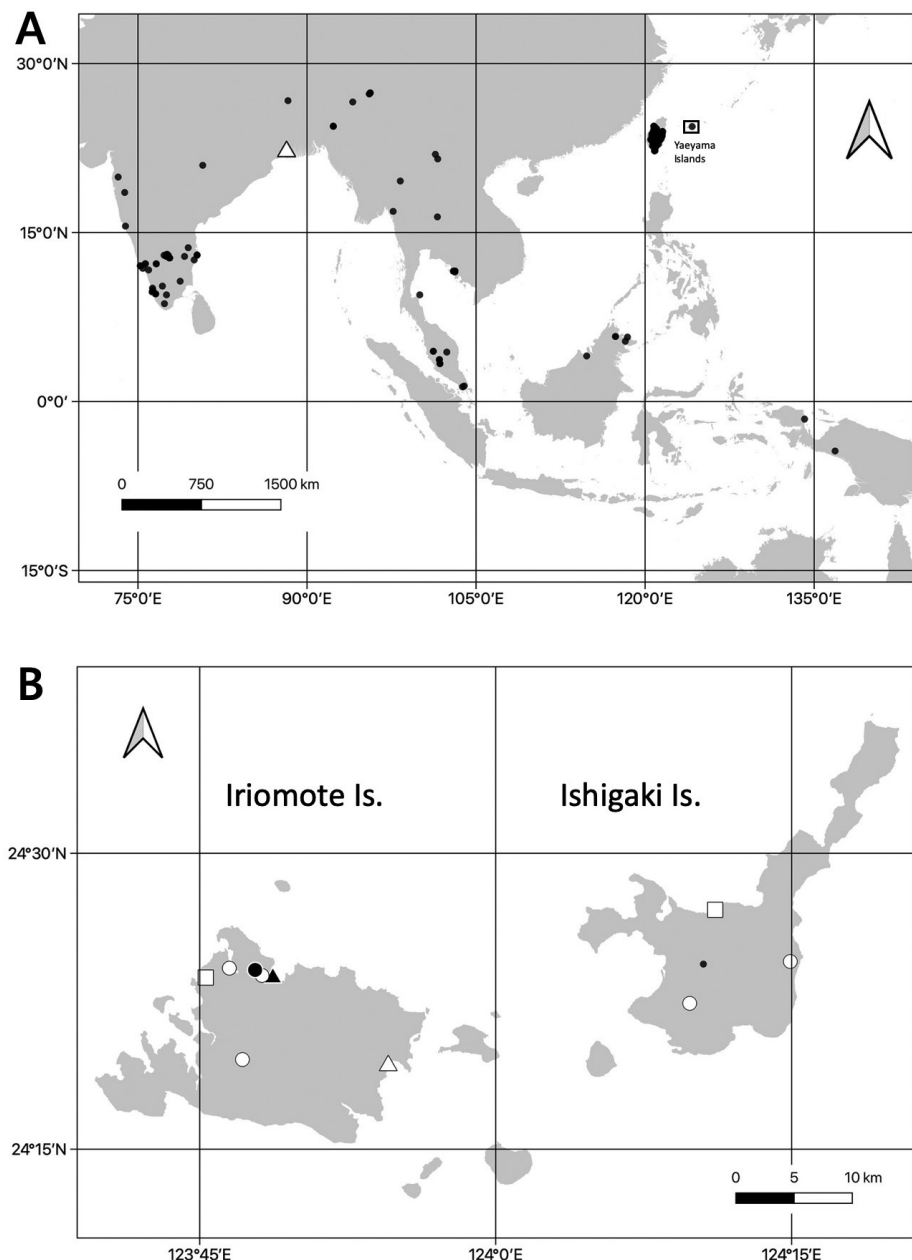


Figure 1. Distribution map of *Maruca amboinalis*. **A.** Overall range. **B.** Iriomote and Ishigaki Islands, in the Yaeyama Islands, Japan. Dots indicate occurrence records obtained from GBIF (2025) and research-grade records of iNaturalist (2025). The filled triangle (▲) indicates the larval record from *Derris trifoliata* obtained in the present study. Triangles (△) represent larval records from *D. trifoliata* (Sondhi et al. 2025 in A; Tominaga 2023 in B), and squares (□) represent larval records from *Pongamia pinnata*. (Tominaga 2009; Yoshiyasu 2023). Open circles (○) show adult records from previous reports (Azuma and Kinjo 1991; Azuma and Kinjo 1994; Kinjo et al. 2001), and filled circles (●) indicate adults collected at light traps in the present study.

Yoshiyasu (2023) provided detailed accounts of the larval feeding habits of *M. amboinalis*, their observations were published only in Japanese, non-peer-reviewed journals (e.g. *Yadoriga*, or *Yugato*). As a result, these data remain largely unrecognized internationally and have not been incorporated into global biodiversity databases such as GBIF. Consequently, the ecology of *M. amboinalis*, including host range, larval behavior, and habitat associations, remains poorly understood across its broad Indo-Pacific distribution.

Although mangrove forests are globally recognized as unique and productive ecosystems, their insect fauna remain understudied across most regions (Yeo et al. 2021). This gap is particularly evident in Japan, where published studies on mangrove-associated insects are largely confined to domestic government reports (e.g. commissioned research by the Cabinet Office, Government of Japan) (Kinjo et al. 2001, 2003) that are not readily accessible. Consequently, information on Lepidoptera and other insects associated with Japanese mangroves remains fragmented and poorly integrated into global biodiversity knowledge. Recent surveys of the mangrove insect fauna on Iriomote Island have already produced several noteworthy findings, including new locality records for *Hymenoptychis sordida* Zeller, 1852 (previously known from Japan only on Okinawa Island; Wachi and Matsui 2024), and the first genus-level record for Japan together with new biological insights into the rare *Dichrocrocis frenatalis* Lederer, 1863 (Matsui et al. 2025). Other studies have documented new Japanese records for *Assara*

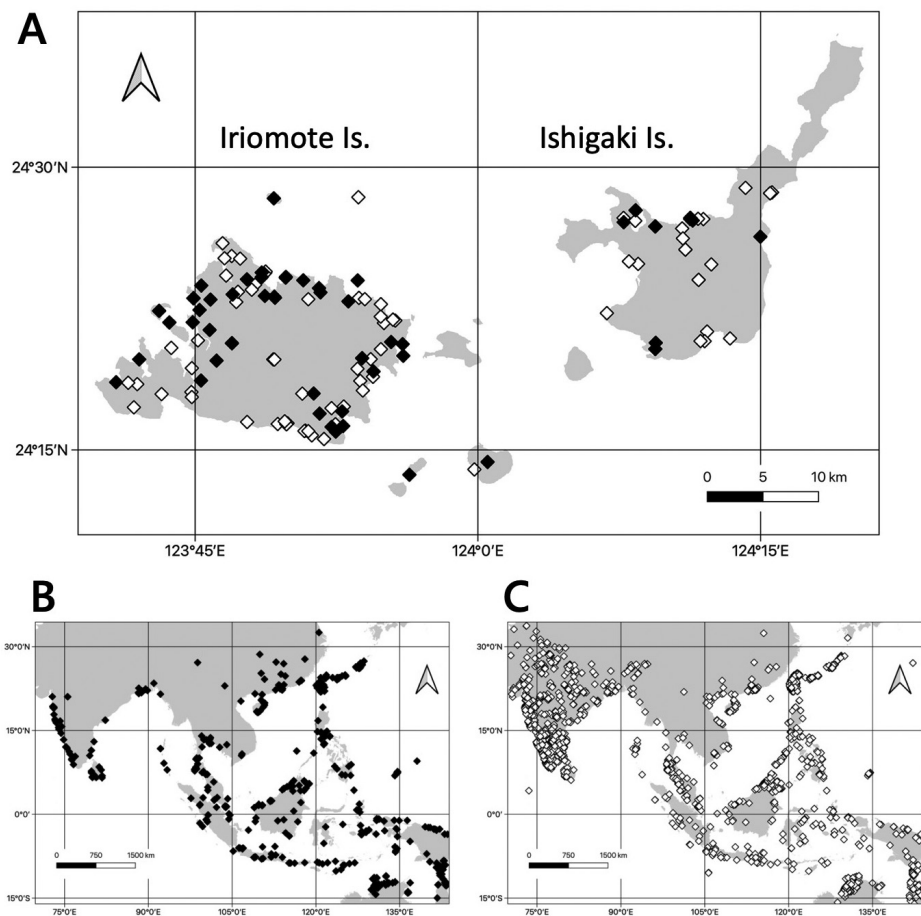


Figure 2. Distribution of *Derris trifoliata* and *Pongamia pinnata* in the Indo-Pacific region, in relation to the distribution of *Maruca amboinalis*. **A.** Iriomote and Ishigaki Islands in the Yaeyama Islands, Japan. **B.** distribution of *D. trifoliata*. **C.** distribution of *P. pinnata*. Filled diamonds (◆) indicate records of *D. trifoliata* and open diamonds (◇) indicate records of *P. pinnata* retrieved from GBIF (2025a, 2025b, 2025c).

seminivalis (Turner, 1904) (Osada et al. 2021) and new Yaeyama localities of *Eristena argentata* Yoshiyasu, 1988 (Yamamoto and Tachikake 2020). In addition to previously unrecorded regional species, several undescribed taxa have also been discovered in these habitats, with subsequent taxonomic studies (Komai and Nasu 2003; Sasaki and Jimbo 2010; Kyaw et al. 2021) describing them as new species such as *Cryptophlebia palustris* Komai & Nasu, 2003, *Nola furumii* Sasaki & Jimbo, 2010, and *Thiotricha lumnitzeriella* Kyaw, Ueda & Hirowatari, 2021. Collectively, these findings highlight the mangrove forests of the Ryukyu Islands as harboring a substantial yet still insufficiently explored insect fauna and underscore their importance for advancing our understanding of Indo-Pacific lepidopteran diversity and ecology.

In the present study, we reared adults of *M. amboinalis* from larvae collected on *D. trifoliata*, a mangrove-associated vine (Tomlinson 2016), in mangrove forests on Iriomote Island. This provides additional evidence of *D. trifoliata* as a host plant and the first unequivocal evidence that the species occurs in mangrove environments. Beyond larval host records, the species has also been documented from scattered light-trap samples on Iriomote Island and from citizen-science observations across the Indo-Pacific region, indicating a broader geographic distribution and seasonal activity.

Methods

The specimens of *M. amboinalis* reported here were obtained during an ongoing long-term survey of the insect fauna in mangrove forests (since 2022) and adjacent swamp forests (since 2024) on Iriomote Island, Yaeyama Islands, Japan—one of the northernmost regions where Indo-Malayan mangrove ecosystems occur. Although flight-intercept traps (FITs) and Malaise traps have been deployed in both habitats as part of this survey, the specimens reported here were not collected from these traps. Instead, they were collected opportunistically during regular field visits (2–4 times per month) conducted to check and service the traps along established survey routes. These visits also provided opportunities for routine observations and targeted collections of insects encountered along the routes.

Several late-instar larvae were collected from leaf shelters constructed on *D. trifoliata*. The larvae, along with their shelters, were brought back to the laboratory and reared in plastic containers at room temperature. Pupation occurred within a few days, followed by adult emergence several days later. The emerged adults were killed by freezing and subsequently pinned and dried as voucher specimens.

Species identification was based on comparison of wing pattern characters with the original description (Felder et al. 1875) and subsequent regional works (Yoshiyasu 1975; Inoue et al. 1982; Tominaga 2009, 2023; Yamanaka and Sasaki 2013; Nasu 2023). Information on known host plants was compiled from public biodiversity databases (Natural History Museum 2025). Adult external morphology was examined under a stereomicroscope and photographed using a digital camera equipped with a zoom lens (L-851 and L-870, HOZAN). Voucher specimens obtained in this study are deposited in the Iriomote Station, Tropical Biosphere Research Center, University of the Ryukyus (TBRCI).

To examine voltinism and broader distributional tendencies of the species, we also compiled additional records from intermittent light-trap monitoring conducted outside mangrove habitats on Iriomote Island, as well as occurrence data available from GBIF (2025a) and iNaturalist (2025).

Data visualization was conducted using R v. 4.4.2 implemented in WebR (Stagg and Lionel 2023). The *ggplot2* and *dplyr* packages were used for data processing and visualization. The base map was downloaded from DIVA-GIS v. 1.4 (Hijmans et al. 2001) and visualized using QGIS v. 3.8 (QGIS 2019).

Parts of the manuscript were originally written in English by the authors, while other sections were drafted in Japanese and translated into English using DeepL. The clarity and fluency of the English text were subsequently refined with ChatGPT (OpenAI). All text and interpretations were carefully reviewed and finalized by the authors.

Results

Maruca amboinalis (Felder, Felder & Rogenhofer, 1875)

Siriocauta amboinalis Felder et al. 1875: 18; pl. 135, fig. 24.

Japanese name: [アンボイナノメイガ], Anboina-nomeiga

Figure 3C–E

New records. JAPAN — RYUKYU ISLANDS • Okinawa Prefecture, Iriomote-jima Island, Funaura Bay [西表島, 竹富町上原, 船浦湾マングローブ]; 24°23'52"N, 123°48'31"E; 13.I.2025; N. Wachi leg.; mangrove forests, larvae on *Derris trifoliata*, pupated before 22.I.2025, emerged 04.II.2025; 2 ♂, 1 ♀, TBRCI, Mar-amb-01–03 • same collection data; emerged 05.II.2025; 1 ♀, TBRCI, Mar-amb-04.

Identification. Because the two *Maruca* species known from Japan can be reliably distinguished by wing patterns alone, the specimens were identified as *M. amboinalis* based on their collection locality (Iriomote Island) and external wing patterns, which closely matched the original description (Felder et al. 1875) and previously recorded and figured Japanese specimens (Yoshiyasu 1975; Inoue et al. 1982; Tominaga 2009, 2023; Yamanaka and Sasaki 2013; Nasu 2023).

Other materials examined. JAPAN — RYUKYU ISLANDS • Okinawa Prefecture, Iriomote-jima Island, Funaura [西表島, 竹富町上原, 船浦]; 24°23'48"N, 123°48'09"E; 02.XII.2024; N. Wachi and Y. Matsui leg.; light trap; iNaturalist ID: [322358289](#); 1 ♀, TBRCI, Mar-amb-05 • same locality; 12.III.2025; N. Wachi leg.; light trap; iNaturalist ID: [266446831](#); 1 ♂, TBRCI, Mar-amb-06 • same locality; 20.III.2025; same collector; light trap; iNaturalist ID: [267153237](#); 1 ♂, TBRCI, Mar-amb-07 • same locality; 30.X.2025; same collector; light trap; iNaturalist ID: [325244998](#); 1 ♂, TBRCI, Mar-amb-08 • same locality; 15.XI.2025; same collector; light trap; iNaturalist ID: [326942275](#), [326942642](#); 2 ♀, TBRCI, Mar-amb-09–10 • same locality; 23.X.2023; N. Wachi and S. Arai leg.; light trap; 2 ♀, unmounted, TBRCI, Mar-amb-11–12 • same locality; 24.X.2023; same collector; light trap; 1 ♂, 1 ♀, unmounted, TBRCI, Mar-amb-13–14 • same locality; 25.X.2023; same collector; light trap; iNaturalist ID: [189838614](#); 1 ♀, unmounted, TBRCI, Mar-amb-15 • same locality; 29.XII.2024; N. Wachi leg.; light trap; iNaturalist ID: [257437721](#); 1 ♂, unmounted, TBRCI, Mar-amb-16.

Observation records. JAPAN — RYUKYU ISLANDS • Okinawa Prefecture, Iriomote-jima Island, Funaura Bay [西表島, 竹富町上原, 船浦湾マングローブ]; 24°23'52"N, 123°48'31"E; 13.I.2025; N. Wachi obs.; mangrove forests, larva on *Derris trifoliata*; several sex indet.; iNaturalist ID: [322354160](#), [322354161](#), [322354163](#) [unknown individual identity with the specimen Mar-amb-01–04] • same locality; 15.X.2025; same observer; mangrove forests, larva on *Derris trifoliata*; 3 sex indet.; iNaturalist ID: [322354164](#), [322354167](#) • Okinawa Prefecture, Iriomote-jima Island, Funaura-maare [西表島, 竹富町上原, 船浦マール]; 24°23'21"N, 123°48'38"E; 09.XII.2023; same observer; light trap; 1 sex indet.; iNaturalist ID: [193560555](#).

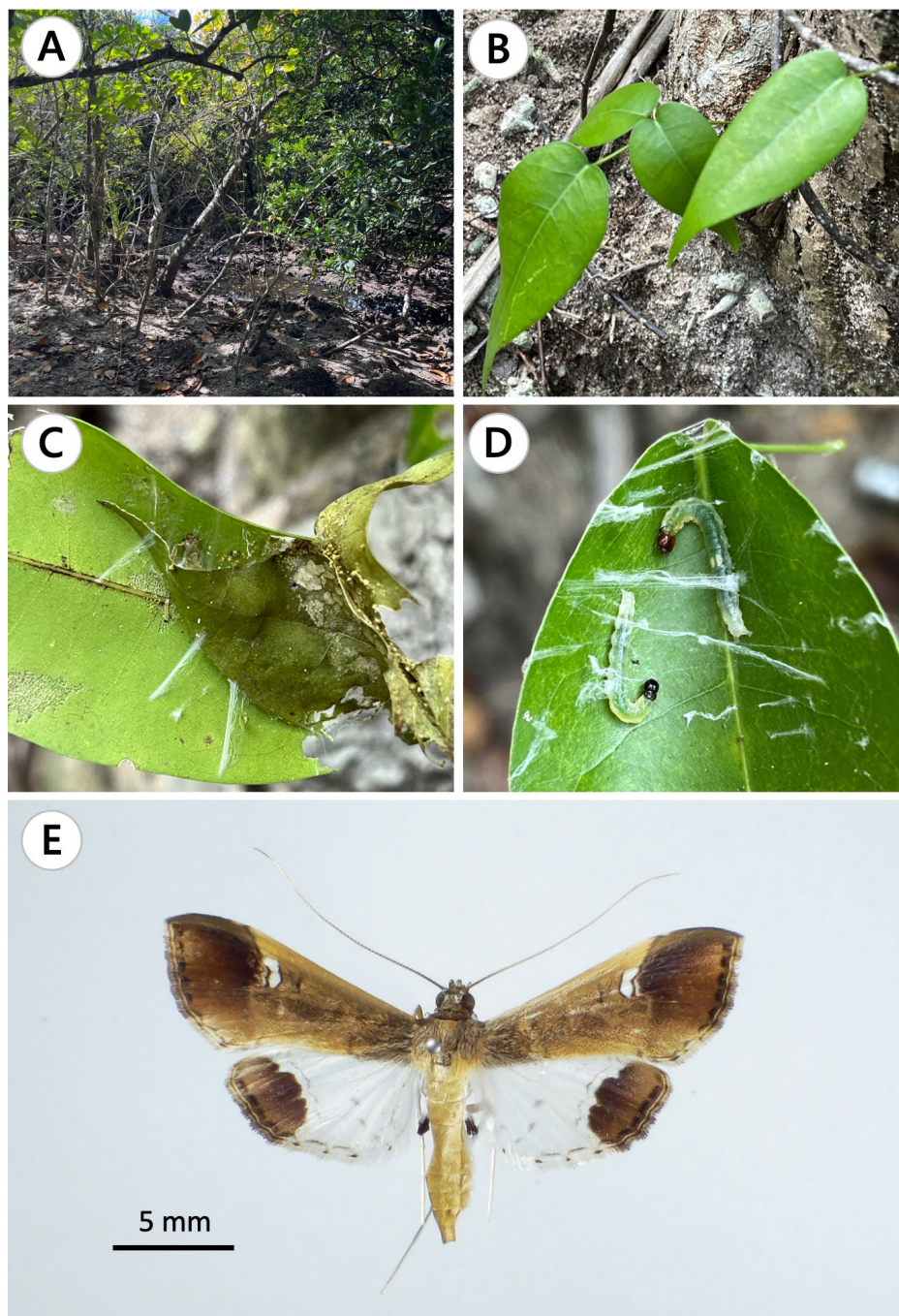


Figure 3. Habitat, natural appearance, and specimen of *Maruca amboinalis*. **A.** Habitat where larvae of *M. amboinalis* were observed on Iriomote Island, Okinawa, Japan. **B.** Host plant, *Derris trifoliata*. **C.** Larval shelter (Wachi 2025a). **D.** Late-instar larvae within a shared shelter (Wachi 2025b). **E.** Adult female (dorsal view), reared from a larva collected on 13 January 2025.

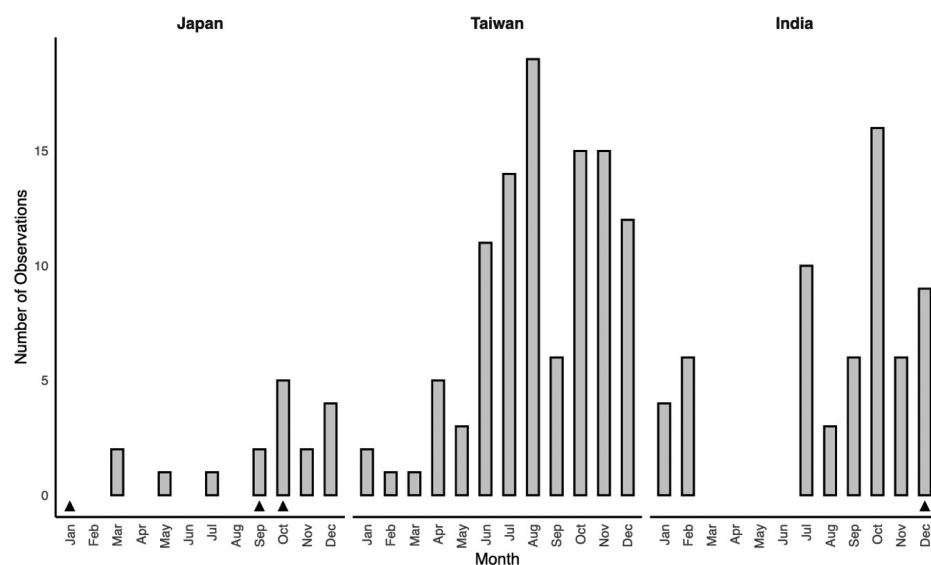
Host plants (Japanese population). *Derris trifoliata* (Tominaga 2023; present study); *Pongamia pinnata* (Tominaga 2009; Yoshiyasu 2023; N. Wachi and Y. Matsui pers. obs.).

Larval behavior. The larval shelters were located on a single clump of *D. trifoliata* growing on sandy substrate within mangroves, where coastal shrubs such as *Excoecaria agallocha* L., *Guettarda speciosa* L., *Pandanus odorifer* (Forssk.) Kuntze, and *Volkameria inermis* L. were present (Figure 3A). The larvae fed from the leaf surface, leaving portions of the lamina intact at first, although some leaves were eventually consumed almost entirely (Figure 3C). The larvae constructed leaf shelters on *D. trifoliata*, with multiple individuals frequently sharing a single shelter (Figure 3D). Previous illustrations of larvae on *P. pinnata* (Tominaga 2009) and *D. trifoliata* (Tominaga 2023) showed single individuals resting on leaves, whereas subsequent observations on *P. pinnata* (Yoshiyasu 2023) depicted groups of larvae within a shared shelter. Our observations on Iriomote Island were consistent with the latter, as multiple larvae were often found together in a single shelter. Under rearing conditions, pupation occurred within a silk cocoon attached to or associated with the leaf shelter, consistent with the cocooning behavior illustrated by Tominaga (2009) and Yoshiyasu (2023).

Occurrence data. Most occurrence records available from GBIF (2025a) are concentrated in Taiwan (104 of 200 records, contributed by the Taiwan Biodiversity Research Institute), whereas the 107 research-grade records on iNaturalist (2025) cover a broader geographic range (numbers in parentheses indicate the number of records), including India (60), Myanmar (1), mainland China (2), Thailand (3), Cambodia (10), Singapore (2), Malaysia (13), Indonesia (2), Taiwan (9), and Japan (5) (Figure 1A). Excluding four records contributed by the first author, only a single iNaturalist record from Japan was found (Risu 2024), which was from Ishigaki Island (Figure 1B).

Seasonal pattern. Most observations in the database appear to be of adults attracted to artificial lights; indeed, all 107 iNaturalist records correspond to such adults (iNaturalist 2025). Based on both adults collected in light traps and those reared from larvae in the present study, the species is likely multivoltine rather than univoltine in the Ryukyu Islands (Figure 4). This inference is supported not only by 104 GBIF records from Taiwan, geographically close to Japan, but also by 60 iNaturalist records from India, where adult observations are distributed over several months within a year, suggesting the occurrence of multiple generations annually (Figure 4; GBIF 2025a).

Figure 4. Seasonal pattern of adult occurrence of *Maruca amboinalis* in Japan, Taiwan, and India. Bars show the number of adult records in each month. Japanese data are from the present study and are based on previous studies—May (Yoshiyasu 1975), September and November (Azuma and Kinjo 1991), December (Azuma and Kinjo 1994), July, and October (Kinjo et al. 2001)—and an iNaturalist observation—September (Risu 2024). Taiwanese 104 data are from GBIF (2025a), and Indian 60 data are from iNaturalist (2025). Filled triangles (▲) indicate months when larvae were recorded by this study, incorporated from the literature as follows: Japan—January (Tominaga 2009; Yoshiyasu 2023) and September (Tominaga 2023); India—December (Sondhi et al. 2025).



Discussion

In the mangrove forests of Iriomote Island, Yaeyama Islands, Japan—one of the northernmost regions of Indo-Malayan mangroves—approximately 70 species of pyraloid moths have been recorded, including *M. vitrata* (under the name *M. testulalis* (Geyer, 1832)) and *M. amboinalis* (Kinjo et al. 2001, 2003). However, no previous study has explicitly documented these species inhabiting mangrove habitats, and their ecological associations with such environments have remained unclear. Our observations provide the first unequivocal evidence of *M. amboinalis* breeding within mangrove forests, as multiple larvae were found constructing and sharing leaf shelters on *D. trifoliata*, a mangrove-associated vine. These findings confirm that *M. amboinalis* not only occurs in but also utilizes mangrove habitats for larval development. They extend the known ecological range of the genus *Maruca* beyond its previously recognized association with terrestrial legumes and suggest that *M. amboinalis* may represent an ecologically flexible component of coastal and mangrove insect assemblages. Although this study adds only a single species to the known mangrove insect fauna of Japan, it constitutes a small but meaningful step toward a more complete understanding of this unique ecosystem.

The larvae of *M. amboinalis* were frequently found sharing a single leaf shelter on *D. trifoliata*, and similar behavior has also been reported for larvae on *P. pinnata* (Yoshiyasu 2023). Our observations indicate that this gregarious behavior may be particularly common in coastal or mangrove populations. Gregariousness in lepidopteran larvae, including members of Crambidae, has independently evolved in multiple lineages and is associated with various ecological benefits such as cooperative feeding, thermoregulation, and collective defense (Qian et al. 2024). These group-living advantages often enhance larval survivorship and developmental rate, especially under environmental stress, although they may diminish at later instars due to competition or pathogen transmission (Qian et al.

2024). The shared sheltering observed in *M. amboinalis* may therefore represent an adaptive strategy for coping with the complex predator community characteristic of coastal or mangrove environments, where both terrestrial and aquatic predators can occur. Further behavioral observations will be necessary to evaluate this possibility.

Although *M. amboinalis* has previously been reported from *D. trifoliata* on Iriomote Island (Tomimaga 2023), that record was based on a small number of larvae (two late instars, two middle instars, and one early instar) and remains the only published observation of this species utilizing this plant in Japan. Our observations of multiple larval stages on *D. trifoliata* suggest that the plant provides suitable conditions for larval development, indicating that it is not merely an accidental host. On Iriomote Island, the frequent occurrence of both mangrove forests and *D. trifoliata* may create relatively favorable conditions that allow *M. amboinalis* to be a stable component of the mangrove insect fauna. In contrast, on other islands where *D. trifoliata* is less common, the species' use of this host may be sporadic or locally restricted, highlighting the need for further surveys to assess the regional stability of this association in mangrove habitats.

The ability of *M. amboinalis* to utilize both *D. trifoliata* and *Pongamia pinnata* suggests a degree of ecological flexibility and potential adaptation to mangrove-associated legumes. Across the Indo-West Pacific, several leguminous trees and lianas—not only the two species but also others such as *Aganope heptaphylla* (L.) Polhill, *Inocarpus fagifer* (Parkinson) Fosberg, and *Intsia bijuga* (Colebr.) Kuntze—are characteristic components of mangrove or mangrove-associated vegetation (Tomlinson 2016). The observation that Japanese populations of *M. amboinalis* exploit two of these species highlights the potential for similar associations across the species' wider Indo-Pacific range.

Based on both light-trap and rearing records, *M. amboinalis* appears to be multivoltine, as previously suggested (Yoshiyasu 2023), rather than univoltine. This interpretation is further supported by GBIF and iNaturalist data from Taiwan, which show multiple observation peaks per year, indicating similar voltinism patterns across its range. Patterns of host use may also vary geographically. Although *D. elliptica* is a confirmed host in other regions and has been introduced to the Ryukyu Islands, including Iriomote Island (Ohkawa and Hayashi 2016), larval feeding has not yet been observed on this species locally. This suggests that host use in the Ryukyu Islands may differ from that in other regions. Seasonality may further influence host association. On Iriomote Island, larvae were found on *D. trifoliata* only during the fall–winter months, emphasizing the need for further year-round observations to clarify seasonal host use and potential shifts in habitat or host preference.

Molecular phylogenetic analyses indicate a close relationship between *M. vitrata* and *M. amboinalis* (Matsui et al. 2022). Despite this relationship, the two species differ markedly in both larval morphology and feeding habits: *M. vitrata* bores into flowers and young pods, whereas *M. amboinalis* feeds externally within a leaf shelter. These differences may reflect ecological divergence within the genus, but further comparative studies would be required to evaluate this possibility. It is noteworthy that *M. vitrata*, a serious legume pest in mainland Japan (Inoue et al. 1982; Yamanaka and Sasaki 2013), was not recorded in our surveys in the Yaeyama Islands. Although earlier studies reported both *M. vitrata* and *M. amboinalis* in the region (Azuma and Kinjo 1994; Kinjo et al. 2001), some studies documented only *M. amboinalis* (e.g. Azuma and Kinjo 1991). In addition, the early record of *M. vitrata* by Takara and Azuma (1968) may have represented *M. amboinalis*, which had not yet been recognized at that time, suggesting the possibility of misidentification. Taken together, these observations indicate that *M. vitrata* is either currently rare or possibly absent in the Yaeyama Islands, whereas *M. amboinalis* appears to be the consistently observed species. Further comparative surveys on their distribution and host use will help clarify the factors shaping their local occurrence in the islands.

Overall, our findings demonstrate that *M. amboinalis* can reproduce on multiple mangrove-associated legumes, representing a true component of the mangrove insect community in the Ryukyu Islands. More broadly, this study contributes to understanding lepidopteran ecology in Indo-Pacific mangrove ecosystems, underscoring the importance of even single-species records in revealing overlooked aspects of mangrove biodiversity.

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Additional information

Conflict of interest

The authors declare that no competing interests exist.

Artificial intelligence (AI) use

Parts of the manuscript were originally written in English by the authors, while other sections were drafted in Japanese and translated into English using DeepL. The clarity and fluency of the English text were subsequently refined with ChatGPT (OpenAI). All text and interpretations were carefully reviewed and finalized by the authors.

Ethical statement

No ethical statement is reported.

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Author contributions

Conceptualization: NW. Data curation: NW. Formal analysis: NW. Funding acquisition: NW, YM. Investigation: NW. Methodology: NW. Project administration: NW. Resources: NW, YM, AN. Software: NW. Supervision: NW. Validation: NW, YM, AN. Visualization: NW. Writing – original draft: NW. Writing – review & editing: NW, YM, AN.

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Data availability

All data that support the findings of this study are available in the main text. Data of specimens obtained in this study will be deposited in GBIF via the Pensoft IPT and available at the following link: <https://doi.org/10.15468/5n4797>.

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