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# Recent additional records of the little-known mydas fly, *Nemomydas gruenbergi* (Hermann, 1914) (Diptera, Mydidae), from Iriomote Island, southern Japan, with the first documentation of mating and oviposition

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**Abstract.** Mydas flies (Diptera, Mydidae) are primarily found in arid and semi-arid regions, with few records from East Asia. In Japan, *Nemomydas gruenbergi* (Hermann, 1914) is the only known species, previously reported mainly from southern Iriomote and Ishigaki Islands in the Yaeyama Islands, with very few records from northern Iriomote. Here, we report newly confirmed occurrences from northern Iriomote Island, based on direct observations and specimen collections conducted in summer. Observations include, for the first time to our knowledge, photographic documentation of a mating pair and confirmed oviposition behavior.

**Key words.** Biogeography, citizen science, East Asia, habitat preference, Leptomydinae, rare species, Yaeyama Islands

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## INTRODUCTION

Mydas flies (Diptera, Mydidae) are distributed primarily in arid and semi-arid regions worldwide, with the greatest diversity in southern Africa (Dikow 2017). This family includes some of the largest known flies (Calhau et al. 2015), yet mydids are generally rare and infrequently encountered (Dikow 2010, 2017; Lyons and Dikow 2010). Adults typically visit flowers, although some species do not feed, and many exhibit wasp mimicry (Wilcox 1981; Dikow 2017; Orfinger et al. 2018; Ferguson and Yeates 2019). Larval stages remain largely undescribed, but oviposition behavior suggests fossorial predation (Wilcox 1981; Dikow 2017; Ferguson and Yeates 2019). Despite a global presence in warm climates, records from East Asia are scarce, and the distribution and natural history of mydids in this region remain poorly understood (Dikow 2010).

In Japan, only a single species, *Nemomydas gruenbergi* (Hermann, 1914), has been reported, with known occurrences in Taiwan and the Yaeyama Islands (Shiraki 1932; Nagatomi and Tawaki 1985; Sugimoto 2014; Figure 1). While endemic to Taiwan and Japan, studies on Mydidae in the broader Oriental Region have begun filling biogeographic gaps by documenting new records from Nepal and Thailand, connecting previously disjunct occurrences between the southeastern Palaearctic (e.g., Afghanistan, Iran) and the eastern Oriental Region (e.g., Taiwan, Yaeyama Islands) (Dikow 2010). These findings highlight the importance of documenting rare or poorly known species in East Asia to improve understanding of regional Mydidae diversity and biogeography.

The first Japanese records of *N. gruenbergi* were based on specimens from Iriomote and Ishigaki Islands (Nagatomi and Tawaki 1985). Like other mydids, *N. gruenbergi* appears to be rare, with very few records. Illustrations in Japanese insect field guides, which note the species as endemic to Taiwan, describe it as globally rare (Shiraki 1932), although some identifications are inconsistent (e.g., individuals labeled as males in illustrations that appear to be female; Nagatomi and Tawaki 1985). Recent observations provide only limited additional information. The most recent record, from 2023, appears to be a Taiwan-based observation on iNaturalist, while the second-most recent record, from 2008, was published in a journal of the Dipterists' Club of Japan and is likely held in a private collection, though this is not explicitly stated (Sugimoto 2014). Moreover, the specimen in that record, originally identified as a male, appears to be female based

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on the published figure (Sugimoto 2014). Some photographs of the species lacking collection dates or precise localities are available online and in popular illustrated guides (Yamauchi 2022; Kumazawa and Suguro 2024). Nevertheless, Sugimoto (2014) remains the only formal published record in recent decades. Most domestic records have been limited to southern Iriomote and Ishigaki Islands, with very few from northern Iriomote. These patterns suggest that recent records are often based on observations rather than on physical specimens deposited in public collections, highlighting both the rarity of this species and the value of citizen-science contributions.

GBIF Backbone Taxonomy (2025b) lists 10 occurrence records of the species, including the single iNaturalist observation. Among these, one lacks collection date and locality data (Naturalis Biodiversity Center), two are from the Kagoshima Prefectural Museum and were collected in Taketomi Town in 1982, but not mentioned by Nagatomi and Tawaki (1985). The labels indicate "Taketomi Town," an administrative unit that includes Iriomote Island; thus, the specimens were most likely collected on the island, although this cannot be confirmed with certainty. The remaining six records are specimens collected in Taiwan during the 1960s and deposited in the National Museum of Natural History, Smithsonian Institution (GBIF 2025).

This species has historically been treated under the genus *Nemomydas* Curran, 1934 (Leptomydinae) since its first record from Japan (Nagatomi and Tawaki 1985), and we follow this usage here. It was originally described as *Leptomydas gruenbergi* Hermann, 1914, but later listed as *Mydas gruenbergi* (Hermann, 1914) (Mydinae) in Systema Dipterorum v. 6.2 (Evenhuis and Pape 2025) and GBIF Backbone Taxonomy (2025a). To date, no formal taxonomic revision has resolved its generic placement. Dikow (2010) suggested that it may more appropriately belong to *Leptomydas* within Leptomydinae, consistent with the original description, but this remains unconfirmed. Until a formal revision is published, we follow the usage *Nemomydas gruenbergi* here.

In this study, we report newly confirmed adult occurrences from northern Iriomote Island's coastal forest habitats. A local observer, the second author, submitted the first iNaturalist record of mating behavior for this globally rare species, highlighting the potential of community-based observations. To our knowledge, photographic records of mating or oviposition in this species have not previously been published, making these observations particularly noteworthy. By integrating past records with the new data, we also summarize the seasonal phenology of adult occurrence, contributing to a better understanding of the distribution, ecology, and potential conservation significance of this little-known East Asian mydid species.

## METHODS

The study site was visited intermittently, and observations were conducted primarily by visual search during daytime. The site was located near the sea, with a sandy ground substrate (Figures 1, 2A). Some individuals were collected using an insect net, and photographic records were taken; several of these observations

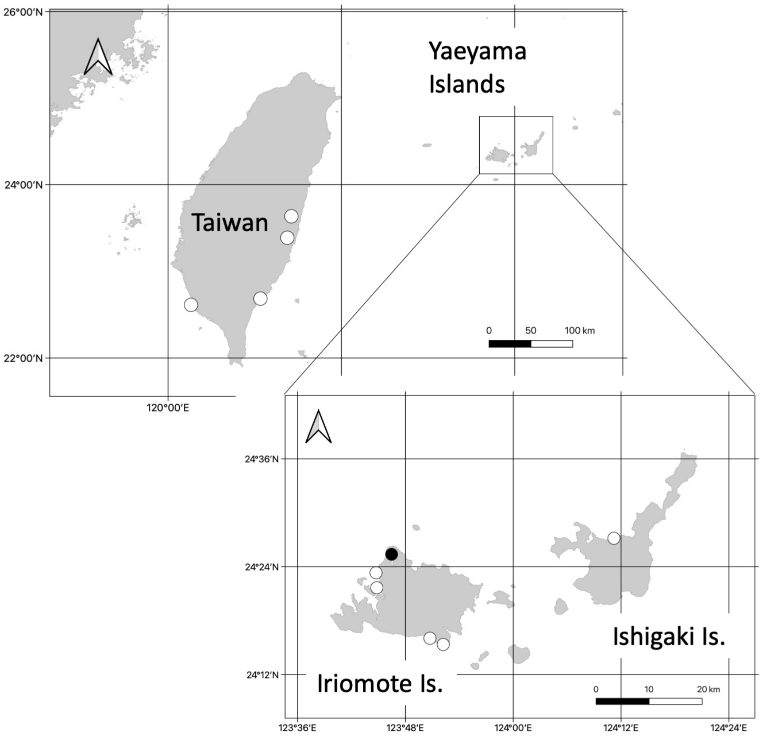


**Figure 1.** Distribution map of *Nemomydas gruenbergi*. Filled circles indicate the additional locality reported in the present study; open circles represent localities from previous studies and an online observation (Nagatomi and Tawaki 1985; Sugimoto 2014; Wang 2025). The locality "Haegishi" in Iriomote Island (Nagatomi and Tawaki 1985) is shown as uncertain due to its unclear geographical position.

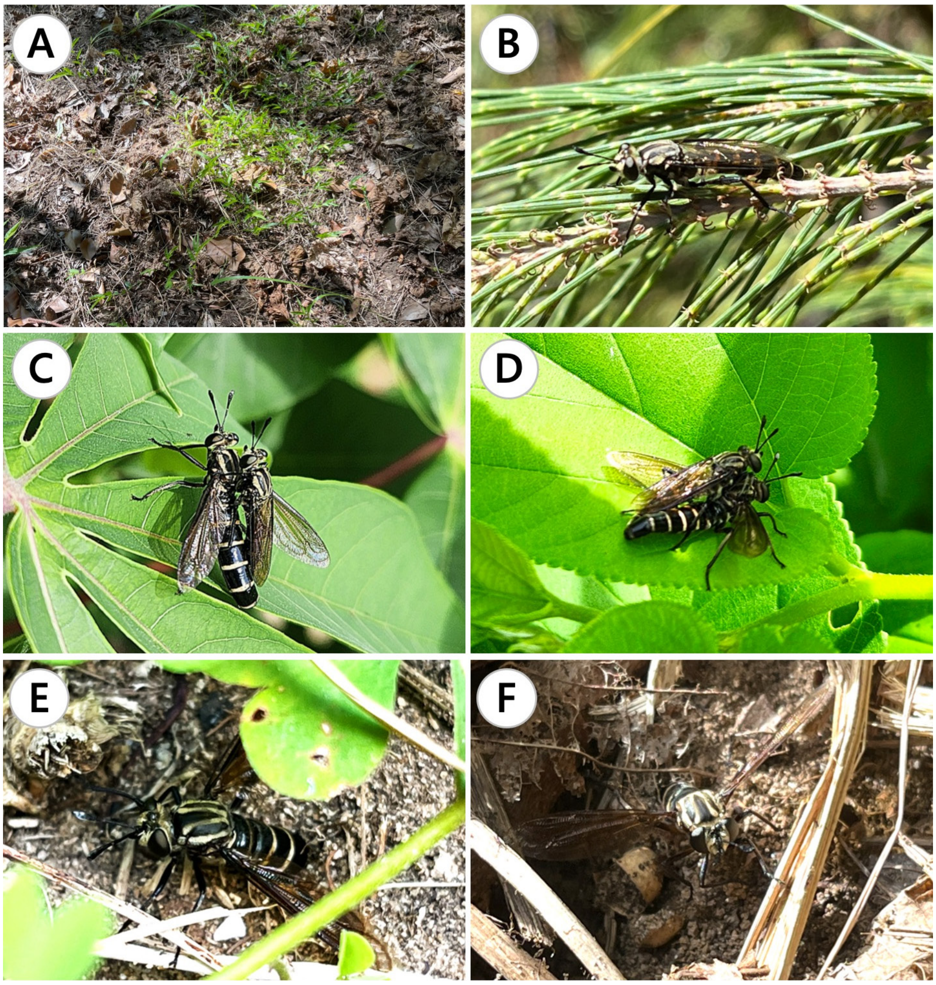


**Figure 2.** Habitat and individuals in nature of *Nemomydas gruenbergi*. **A.** Habitat where individuals of *Nemomydas gruenbergi* were observed on Iriomote Island, Okinawa, Japan. **B.** Live male, 28.VII.2024 (by Nakatada Wachi [@wachinakatada]; iNaturalist (2025a)), also shown in Figure 3A–E as a dry specimen. **C.** Mating pair, 18.VI.2025 (by Yosuke Yoshida [@naturalist134662]; iNaturalist (2025b)). **D.** Mating pair, 3.VIII.2025 (by Yosuke Yoshida [@naturalist134662]; iNaturalist (2025c)). **E.** Ovipositing female, 7.VIII.2025 (by Nakatada Wachi [@wachinakatada]; iNaturalist (2025d)), also shown in Figure 3H, I as a dry specimen. **F.** Ovipositing female, 7.VIII.2025 (by Nakatada Wachi [@wachinakatada]; iNaturalist (2025e)).

were reported on iNaturalist. A substantial number of individuals were only observed without collection or photography and some of these uncollected individuals are described here as observation records. External morphology of the specimens was examined under a stereomicroscope and photographed using a digital camera with a zoom lens (L-851 and L-870, HOZAN). Species identification followed Shiraki (1932) and Nagatomi and Tawaki (1985). The examined specimens are deposited in the Iriomote Station, Tropical Biosphere Research Center, University of the Ryukyus (TBRCI).

Based on these records, observation dates, behaviors, and collection sites were compiled to gain insight into aspects of the life history of this species on Iriomote Island. Furthermore, previous collection records from earlier studies (Nagatomi and Tawaki 1985; Sugimoto 2014), additionally, occurrence data recorded on GBIF (2025) including an iNaturalist observation (Wang 2025), were reviewed and integrated for comprehensive analysis together with the results of this study. The base map was downloaded from DIVA-GIS v. 1.4 (Hijmans et al. 2001) and visualized using QGIS v. 3.8 (QGIS 2019).

The initial English translation of the manuscript was performed using DeepL, and the clarity and fluency of the English text were further refined with the assistance of ChatGPT (OpenAI). All content was thoroughly reviewed and finalized by the authors.

## RESULTS

### ***Nemomydas gruenbergi* (Hermann, 1914)**

Japanese name: ムシヒキアブモドキ, Mushihiki-abu-modoki
Figures 2B–F, 3A–I
*Leptomydas gruenbergi* Hermann 1914: 34 (originally spelled *grünbergi*) — Shiraki 1932: 144 (as *grünbergi*).
*Nemomydas gruenbergi* — Nagatomi and Tawaki 1985: 125; Dikow 2010: 71.

**New records.** JAPAN — Ryukyu Islands • Okinawa Prefecture, Iriomote-jima Island, Uehara, Tudumari-no-hama [西表島, 竹富町上原, トゥドゥマリの浜]; 24°25′23″N, 123°46′28″E; 28.VII.2024; N. Wa-

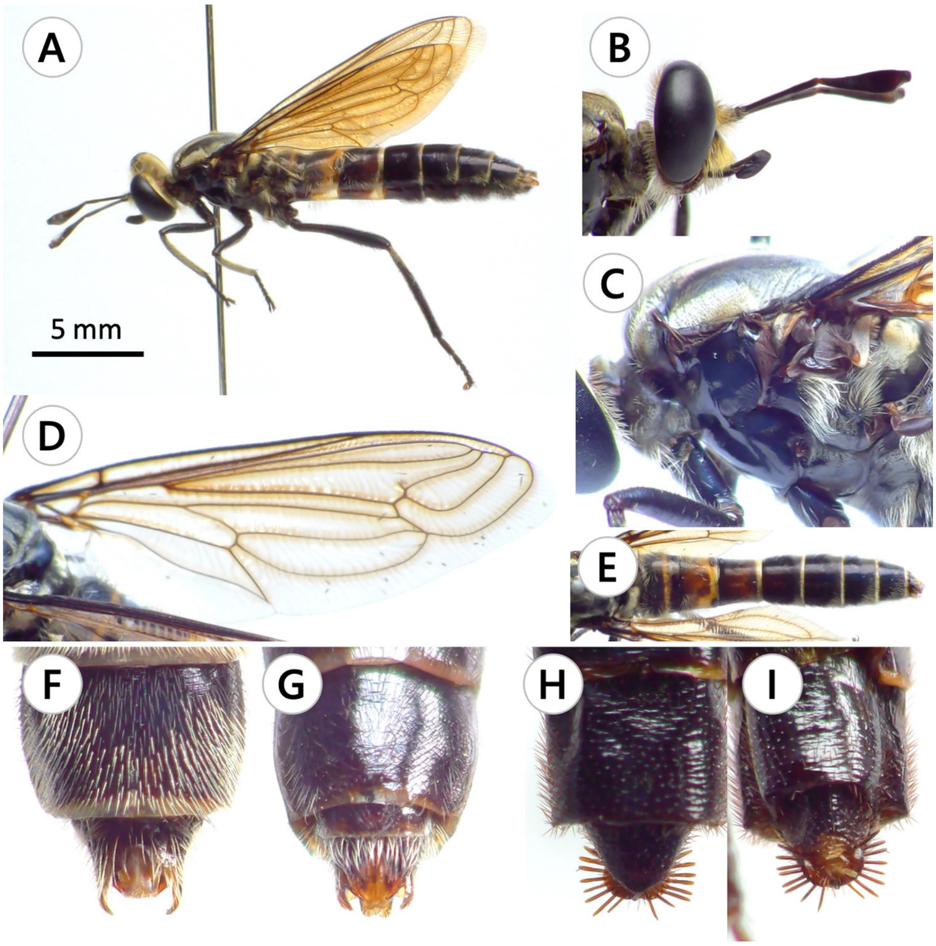


**Figure 3.** *Nemomydas gruenbergi* from Iriomote Island, Okinawa, Japan. **A–G.** – Male. **A.** Habitus (lateral view). **B.** Head (lateral view). **C.** Thorax (lateral view). **D.** Wing (right). **E.** Abdomen (dorsal view). **F.** Terminal segments of abdomen (dorsal view). **G.** Same (ventral view). **H, I.** – Female. **H.** Terminal segments of abdomen (dorsal view). **I.** Same (ventral view).

chi leg.; iNaturalist ID: 314747945; 1 ♂, TBRCI, Nem-gru-01 • same locality; 26.VII.2025; Y. Yoshida leg.; 1 ♂, TBRCI, Nem-gru-02 • same locality; 29.VII.2025; same collector; 2 ♂, TBRCI, Nem-gru-03, 04 • same locality; 30.VII.2025; same collector; 4 ♂, TBRCI, Nem-gru-05–08 • same locality; 3.VIII.2025, same collector; in copula; 1 ♂ 1 ♀, TBRCI, Nem-gru-09, 10 • same collection data; 2 ♂, TBRCI, Nem-gru-11, 12 • same locality; 4.VIII.2025; same collector; 3 ♂, TBRCI, Nem-gru-13–15 • same locality; 7.VIII.2025; N. Wachi & Y. Yoshida leg.; in oviposition, iNaturalist ID: 314748279; 1 ♀, TBRCI, Nem-gru-16 • same collection data; in oviposition, iNaturalist ID: 314748483; 1 ♀, TBRCI, Nem-gru-17 • same collection data; iNaturalist ID: 314748220, 314748243, 314748298 and 314748460; 3 ♂, 1 ♀, TBRCI, Nem-gru-18–21.

**Identification**. The specimens were identified as *Nemomydas gruenbergi* based on Shiraki (1932) and Nagatomi and Tawaki (1985), with external morphology (Figure 3A–H) consistent with those description and with earlier records from Iriomote and Ishigaki Islands in Japan. Although this species was originally described as *Leptomydas gruenbergi* and later listed as *Mydas gruenbergi* in some databases, no formal taxonomic revision has yet clarified its generic placement. The occurrence of this genus in the Oriental Region is biogeographically unusual, and future taxonomic studies, including molecular phylogenetic analyses, are needed. Previous work (e.g., Dikow 2010) suggested that the species may more appropriately belong to *Leptomydas*, but this remains unconfirmed pending further phylogenetic study. In the absence of a published revision, and because only a single species of this group is known from the Yaeyama Islands, we use the name *Nemomydas gruenbergi* here for practical purposes, while acknowledging that its classification may change in the future. Although the present specimens were identified as this species based on current knowledge, some individuals showed slight morphological differences, particularly in body coloration, when compared with images available on GBIF (Wang 2025), which are based on iNaturalist observations. The paler coloration closely resembled that of a newly emerged individual of *Diochlistus gracilis* (Macquart, 1847) (Diochlistinae) and *Miltinus viduatus* (Westwood, 1835) (Apiophorinae) illustrated in Ferguson and Yeates (2019), suggesting that the observed variation may reflect a teneral condition rather than significant taxonomic differences. While the species is currently regarded as occurring in Taiwan and Japan, these possible morphological variations highlight the need for further taxonomic reassessment, potentially including molecular analyses.

**Observation records.** JAPAN — Ryukyu Islands • Okinawa Prefecture, Iriomote-jima Island, Uehara, Tudumari-no-hama [西表島, 竹富町上原, トゥドゥマリの浜]; 24°25′23″N 123°46′28″E; 18.VI.2025; Y. Yoshida obs.; in copula; 1 ♂, 1 ♀; iNaturalist ID: 291120186 • same locality; 22.VII.2025, same observer; in copula; 1 ♂, 1 ♀; iNaturalist ID: 300111389 • same locality; 3.VIII.2025; same observer; in copula; 1 ♂, 1 ♀; iNaturalist ID: 306672829 • same locality; 5.VIII.2025; same observer; 7 sex indet. • same locality; 6.VIII.2025; same observer; in copula; 1 ♂, 1 ♀; iNaruralist ID: 307200800 • same observation data; 4 ♂ • same locality; 7.VIII.2025; N. Wachi obs.; 1 ♂ • same locality; 8.VIII.2025; Y. Yoshida obs.; in copula; 1 ♂, 1 ♀ • same observation data; 1 ♂ • same locality; 10.VIII.2025, same observer, 1 ♀; iNaturalist ID: 306141507.

**Observed habitat and phenology.** Adults were observed from June to August in the present study. A previous record from the Yaeyama Islands includes a specimen collected in May (Nagatomi and Tawaki 1985), but otherwise the phenology appears largely consistent with our observations (Figure 4). The site with the highest abundance, including observations of both mating and oviposition behavior, was located beside a cultivated field within a forested area, characterized by a relatively open environment (Figure 2A). Previous records (e.g., Nagatomi and Tawaki 1985; Sugimoto 2014) also indicate occurrences near coastal habitats. In Taiwan, a presumed conspecific was observed at Takao, similarly close to the shore (Wang 2025). Even when including individuals observed visually, females were markedly fewer than males (28 ♂ vs. 10 ♀). Of these females, only four were observed alone, and two of them were ovipositing. This male-biased pattern has also been reported in previous studies, where collected specimens included 18 ♂ and 4 ♀ (Nagatomi and Tawaki 1985). Such a bias may reflect behavioral differences between males and females, similar to patterns described for *Rhaphiomidas terminatus abdominalis* (Crazer, 1985) (Rhaphiomidinae; Kingsley 1996).

**Mating and oviposition behavior.** Several mating pairs were observed on sunny days during daylight. In all cases, the male and female were oriented in the same direction, with the male grasping the female's thorax and/or wings (Figure 2C, D). The male genitalia appeared to be rotated approximately 180°, connecting to the female by wrapping from the ventral side (Figure 2C, D). Both the mating posture and genital orientation closely resembled those of *D. gracilis* (Diochlistinae; Ferguson and Yeates 2019). On a different day at the same site, two females were seen inserting the tips of their abdomens into the soil (Figure 2E, F). Although eggs were not directly observed, this behavior closely matches oviposition behavior reported for *R. t. abdominalis* in Kingsley (1996), *Eremomidas arabicus* Bequaert, 1961 (Leptomydinae) in Dikow (2017) and *D. gracilis* in Ferguson and Yeates (2019), and is therefore interpreted as oviposition.

## DISCUSSION

The new records from the northern part of Iriomote Island demonstrate that *Nemomydas gruenbergi* is not restricted to the island's southern regions, where it was previously documented (Nagatomi and Tawaki 1985; Sugimoto 2014). This suggests that the species may be more widely distributed across the island than previously recognized. Adults were observed primarily in summer, and the confirmation of mating and oviposition provides one of the very few detailed accounts of the reproductive ecology of an East Asian mydid fly. Although observations ceased after early September, mydids are generally known to have short-lived as adults (Lyons and Dikow 2010; Calhau et al. 2015), suggesting that *N. gruenbergi* likely emerges for a limited period, consistent with the scarcity of historical records.

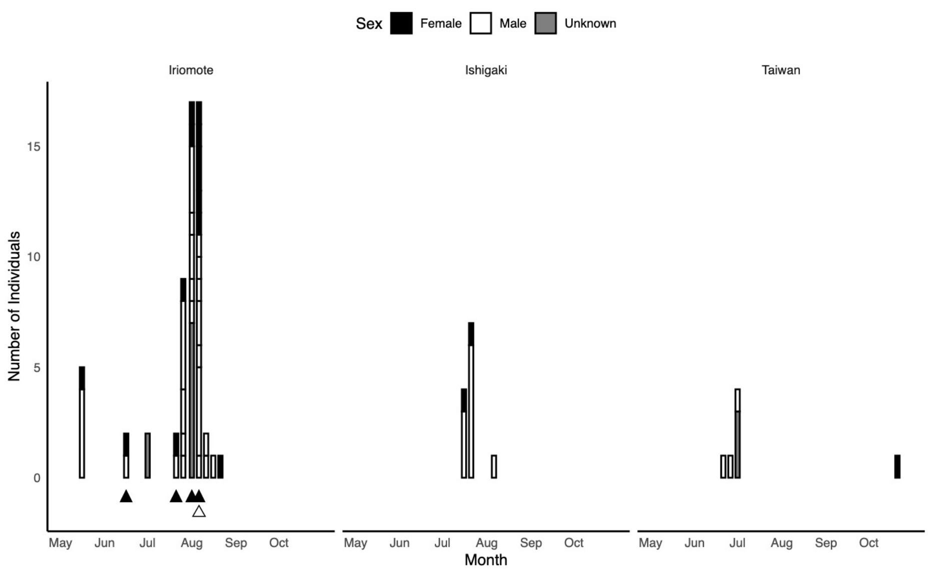


**Figure 4.** Number of individuals of *Nemomydas gruenbergi* observed per island, separated by sex where known and grouped into 5-day bins from May to October. White, black, and gray bars represent males, females, and individuals whose sex could not be determined, respectively. Upward solid triangles (▲) indicate bins in which mating behavior was observed, and hollow triangles (△) indicate bins where oviposition behavior was observed. Historical data were incorporated from the literature and GBIF as follows: Iriomote - 4 ♂ and 1 ♀ in May, 1 ♀ in July, and 4 ♂ in August; Ishigaki - 9 ♂ and 2 ♀ in July, 1 ♂ in August (Nagatomi and Tawaki 1985); Iriomote - 1 ♀ in August (Sugimoto 2014); Iriomote - 2 individuals in July; Taiwan - 2 ♂ in June, 4 individuals including 1 ♂ in July, and 1 ♀ in October (GBIF 2025).

Individuals were observed in relatively open areas at the forest edge near the coast. Most of previous records from southern Iriomote and Taiwan also originated from open coastal habitats, indicating a general preference for such environments. While the generic placement of this species remains uncertain, members of *Nemomydas* are typically associated with hot, dry habitats with sandy soils, especially in arid regions (Wilcox 1981; Woodley 2009). Frequent observations of males, along with copulation and oviposition near males, suggest potential sexual differences in habitat use and microhabitat preference, echoing behavioral patterns reported in other mydids, such as *R. t. abdominalis*, where males and females occupy distinct microhabitats for specific behaviors (Kingsley 1996).

Mydid larvae are thought to occur not only in sandy substrates but also in decomposing wood, such as stumps or fallen logs, where they prey on other insect larvae (Wilcox 1981; Woodley 2009; Dikow 2017; Ferguson and Yeates 2019). Although the larval ecology of *N. gruenbergi* remains unknown, it is plausible that this species similarly exploits prey in sandy or semi-decayed environments. The observed activity in relatively open coastal forest-edge habitats suggests that such environments may be critical resources, supporting both adult and potentially larval stages.

These new records extend the known distribution of *N. gruenbergi* to northern Iriomote Island and provide valuable ecological information for this little-known species. Coastal sandy habitats with high natural integrity are declining across Japan, and fly species dependent on such environments, including *Clinopogon sauteri* Bezzi, 1910 (Asilidae), often show highly localized distributions (Utsuki 2014; Hayashi 2015). *Nemomydas gruenbergi* may represent another case, potentially serving as an indicator of ecosystem integrity in the Yaeyama Islands' coastal habitats. More broadly, our study contributes to understanding the ecology of Mydidae in East Asia, complementing knowledge of mydid flies from arid and semi-arid regions worldwide. Continued monitoring, including investigations into larval microhabitats and life history, will be essential for both conservation and for placing East Asian species within the global context of this uncommon fly family. In addition, because such species are rarely encountered and often overlooked, observations made by non-professional researchers through citizen-science initiatives can provide critical contributions. Engaging a broader community of observers may help detect new populations, document behaviors, and ultimately improve our understanding of the ecology and conservation needs of elusive taxa such as *N. gruenbergi*.

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## ADDITIONAL INFORMATION

### Conflict of interest

The authors declare that no competing interests exist.

### Ethical statement

No ethical statement is reported.

### Author contributions

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

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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/w2pwfk.

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