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# New occurrence records and updated global distribution of *Limnias novemceras* (Rotifera: Floscullariaceae) using citizen-contributed and published data

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## Abstract

We report new occurrence records and an updated global distribution of *Limnias novemceras* Meksuwan, Jaturapruek & Maiphae, 2018 (Rotifera: Floscullariaceae) based on citizen-science observations and published data. Twenty-two records were compiled, 19 from social media, extending the species range from its presumed endemic area in southern Thailand to Nearctic, Neotropical, Afrotropical, Palearctic, Sino-Japanese, and Oriental realms. Morphological features were consistent across populations, while minor corona variation and ecological traits indicate behavioral flexibility.

**Key words:** Biogeography; biodiversity; zooplankton; Rotifera; citizen science.

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## Introduction

Knowledge in biodiversity, ecology, and the biogeography of organisms is typically generated through field research, in which a researcher or team visits the habitats of target species. These habitats may range from small ponds and forests to entire mountain ranges or extensive coastal areas, where organisms are studied and collected using a variety of sampling methods. Specimens are primarily identified based on their morphological characteristics, which are then compared with existing taxonomic descriptions to assign the appropriate scientific name and taxonomic classification. If the observed characters do not match any known species, researcher may propose a new species or even a new taxonomic category (Meiri and Mace, 2007; Braby *et al*., 2024). In addition to taxonomic identification, researchers also document ecological and biological aspects such as microhabitat preferences, feeding behavior, mating patterns, and interspecific interactions (Jaturapruek *et al*., 2018; García-Morales *et al*., 2021). The scope and depth of these observations are guided by the specific research questions and objectives.

In recent decades, the era of digital technology, the Internet, and social media has transformed how biodiversity data are generated. While traditional field expeditions remain essential, these new tools have made the process more convenient and cost-effective by reducing the need for extensive travel to distant locations. Online platforms allow researchers and citizen scientists to share photographs, videos, and ecological observations in real time, providing valuable records that complement field sampling. As a result, biodiversity research can now be conducted with lower budgets and wider geographic coverage than ever before (Atsumi *et al*., 2024; Jansen *et al*., 2024). Even so, as taxonomists, we emphasize that accurate identification of any group of organisms requires highly skilled specialists. In many cases, working on a single order, family, or even genus may demand a lifetime of dedicated study (Meksuwan *et al*., 2015; Franch *et al*., 2024; Jattupan *et al*., 2024; Jaturapruek and Maiphae, 2025; Pokpongmongkol *et al*., 2025). However, citizen observations are proving to be valuable, particularly for species with distinct and easily recognizable features, where the risk of misidentification is minimal.

*Limnias novemceras* is a sessile rotifer first described from a stream in Krabi Province, southern Thailand, where individuals were found attached to the roots of the aquatic plant *Hydrilla verticillata* (L.f.) Royle (Meksuwan *et al*., 2018). Since its original discovery, no additional records were reported, leading to the assumption that the species was restricted to southern Thailand. This perception changed when multiple observations of the species began to appear on social media platforms. The objectives of the present study were therefore to compile photographs and videos from various online sources that clearly display the diagnostic features of *L. novemceras*, and to analyze these materials in order to reassess its geographic distribution, morphological variation, and substrate utilization.



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## Methods

Photographs and videos of *Limnias novemceras* were compiled from various social media platforms, including Facebook, Instagram, iNaturalist, Reddit, YouTube, and X (formerly known as Twitter). Other platforms were also searched but no records were found. Additionally, published research articles were reviewed for material identifiable as *L. novemceras*, including instances in which the specimens had been assigned to a different taxon.

Searches were conducted using both the search engines of each platform and general internet search engines. The keywords applied were "*Limnias*," "*L. melicerta*," and, in some cases, the broader term "rotifer".

Specimens were identified as *L. novemceras* based on the diagnostic characters described by Meksuwan *et al.* (2018). Identification was confirmed when all three key traits were observed: i) the dorsal plate with nine distinct projections (Fig. 1C); ii) a dorsal gap of the corona wider than the tube opening (Fig. 1D); and iii) ventral antennae extending beyond the fully expanded corona (Fig. 1 A,C). When either the dorsal gap or the ventral antennae could not be clearly assessed, identification was classified as uncertain.

## Results

A total of 33 social media posts and 3 research publications, including the original species description, were compiled in this study. Of these, Facebook (12) contributed the most posts, followed by Instagram (8), YouTube (7), X (4), iNaturalist (1), and Reddit (1). However, among the social media data, 11 posts were traced to four original videos that had been reposted on different social media sites (LN9, LN10, LN11, and LN21). In addition, another 11 posts were interpreted as likely depicting the same populations that individual authors photographed or filmed within short intervals of time (LN2, LN3, LN16, and LN18). After accounting for these duplications, 19 independent records were retained for analysis of the global distribution of *L. novemceras* (Tab. 1). Of these, three were specifically labeled as *L. novemceras* by the content creator, and one by a commenter. In the following sections, we examine biological information on *L. novemceras* from these online sources, focusing on its biogeography, morphology, and ecological characteristics.

### Biogeographical distribution

Based on the most recent information in the Rotifer World Catalog, *L. novemceras* had previously been reported only from its type locality (Jersabek *et al.*, 2025). Our findings, however, show that the species occurs on six zoogeographic realms, including the Nearctic, Neotropical, Afrotropical, Palearctic, Sino-Japanese, and Oriental realms (Holt *et al.*, 2013). These records span tropical, subtropical, and temperate regions, with no observations yet from Australia or Antarctica (Fig. 2).

### Morphological variation

Specimens from different continents exhibited remarkably little morphological variation, indicating a high degree of consistency across populations. The three diagnostic traits -the structure of the dorsal plate, the wide dorsal gap of the corona, and the elongated ventral antenna- consistently matched the original description and illustrations. Most specimens recorded from social media appeared to be attached to filamentous algae (Fig. 1A).

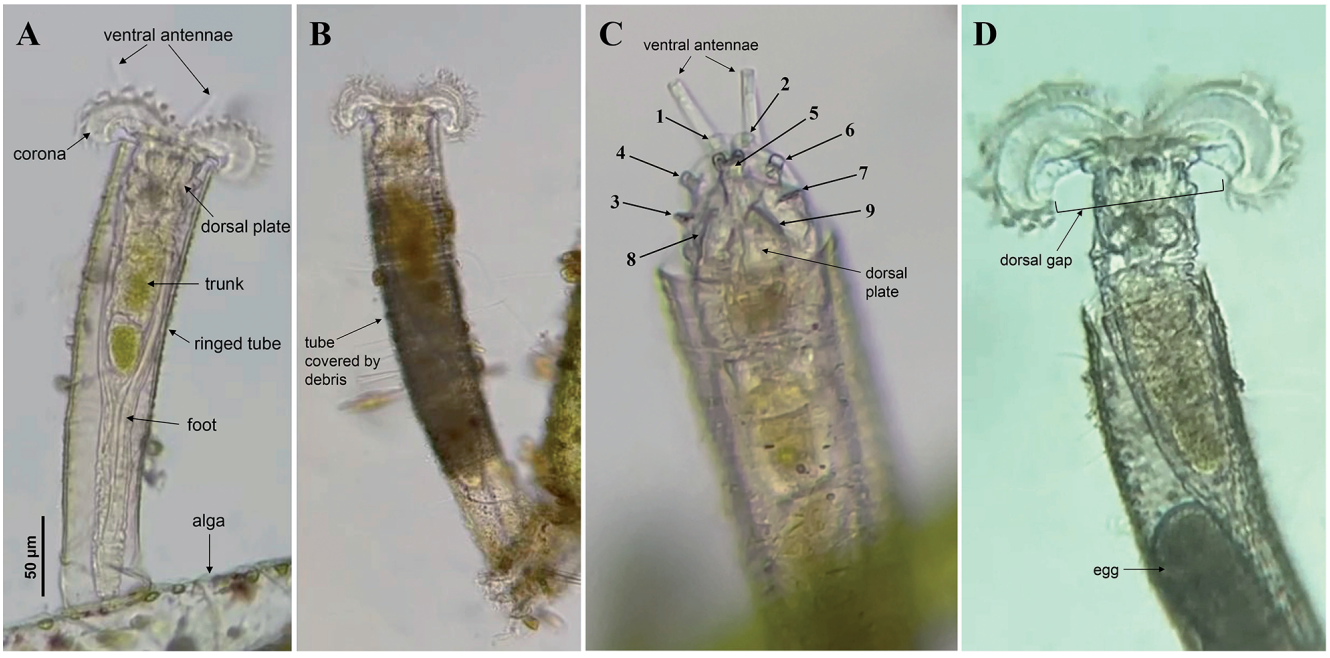


**Fig. 1.** General features of *Limnias novemceras* under the microscope (*in vivo*). A) Specimen with a transparent, ringed tube (LN20). B) Specimen with an opaque tube covered with debris (LN20). C) Contracted specimen showing the dorsal plate with nine projections and long antennae (LN19). D) Specimen elevating its corona well beyond the tube opening (LN14). Specimens are not shown to scale.



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**Tab. 1.** Summary of records of *Limnias novemceras*, including locations, social media sources, and additional information.

| Code | Location | Country | Substrate | Source | Authors | Link |
|---|---|---|---|---|---|---|
| LN1 | Small lagoon, San José | Uruguay | Detached from substrate | YouTube (2015) | @microuruguay | https://www.youtube.com/watch?v=i3Ww0je0guQ |
| LN2* | Not specified | Ukraine | Filamentous green algae and macrophyte | Facebook (2017)<br>X (2017) | Sergey Lysak (Сергей Лысак) | https://www.facebook.com/groups/Amateur.Microscopy/permalink/807754042739346/<br>https://www.facebook.com/groups/Amateur.Microscopy/permalink/800498316798252/<br>https://x.com/digiP2eam/status/936137439470551040/photo/1<br>https://x.com/digiP2eam/status/929742267488919552/photo/1<br>https://x.com/digiP2eam/status/928538258463653889/photo/2 |
| LN3* | Not specified | Ukraine | Filamentous green algae and macrophyte | Facebook (2018)<br>X (2018) | Sergey Lysak (Сергей Лысак) | https://www.facebook.com/groups/Amateur.Microscopy/permalink/867959546718795/<br>https://x.com/digiP2eam/status/976355001915277312/photo/1 |
| LN4 | Stream, Krabi Province | Thailand | Leaves of *Hydrilla verticillata* (L.f.) Royle | Meksuwan *et al.* (2018) | Phuripong Meksuwan, Rapeepan Jaturapruek & Supiyanit Maiphae | https://zookeys.pensoft.net/articles.php?id=28098 |
| LN5* | Not specified | Taiwan | Unidentified macrophyte | Facebook (2018) | Wei-Fang Tsai | https://www.facebook.com/groups/324721808316035/permalink/345899052864977/?mibextid=rS40aB7S9Ucbxw6v |
| LN6* | Not specified | Taiwan | Filamentous green algae | Facebook (2018) | Hei Xiaoxin | https://www.facebook.com/ever.ritachang/videos/10157060320132764/?idorvanity=324721808316035&mibextid=rS40aB7S9Ucbxw6v |
| LN7 | Cement pond, Phuket Province | Thailand | Roots of *Pistia stratiotes* L. | Meksuwan and Somkhaoyai (2019) | Phuripong Meksuwan & Aphitsara Somkhaoyai | https://drive.google.com/file/d/1giWPWSli0DdWlVkmVnwsceEcNltnYWUn/view?usp=sharing |
| LN8* | Lake, Xochimilco | Mexico | Roots of *Eichhornia crassipes* (Mart.) Solms (water hyacinth) | Jiménez-Santos *et al.* (2019) | Marco Antonio Jiménez-Santos, S. S. S. Sarma, S. Nandini | https://www.jeb.co.in/index.php?page=abstract&issue=201907_jul19&number=19 |
| LN9 | Not specified | Taiwan | Filamentous green algae | YouTube (2019)<br>Facebook (2019) | @changlynn8730 | https://www.youtube.com/shorts/QPoxo2vjF2A<br>https://www.facebook.com/groups/324721808316035/permalink/436361567152058/?mibextid=rS40aB7S9Ucbxw6v |
| LN10 | Not specified | Mexico | Unclear | YouTube (2020)<br>Facebook (2020)<br>Instagram (2020) | Uriel Ruíz | https://www.youtube.com/watch?v=ams4X8oG78U<br>https://www.facebook.com/uriel.ruiz.710/videos/1535092820023328/?idorvanity=254539018060854&mibextid=rS40aB7S9Ucbxw6v<br>https://www.instagram.com/p/CJMeEL5jEUP/?hl=es-es<br>https://www.instagram.com/p/CJdow4DjKzc/<br>https://www.instagram.com/p/CJJeiiFjti7/ |
| LN11 | Lake, Baltimore | USA | Detached from unclear substrate | YouTube (2020)<br>Facebook (2020) | Steve Cunningham | https://www.youtube.com/watch?v=2SMshBeYhSU<br>https://www.facebook.com/groups/Amateur.Microscopy/permalink/1420071244840953/ |
| LN12 | Not specified | Not specified | Unidentified macrophyte | YouTube (2021) | @Omicrosis | https://www.youtube.com/watch?v=ZhQlpKuwjlw(at aout 1:22-1:35 in the clip) |
| LN13 | Not specified | Not specified | Filamentous green algae | YouTube (2022) | @Omicrosis | https://www.youtube.com/watch?v=ar6PvZyRW8k&ab_channel=Omicrosis |
| LN14 | Shrimp tank | Japan | Not seen | Instagram (2022) | @suziebi3 | https://www.instagram.com/p/CeEz9kmBBcX/?hl=es-es. |
| LN15* | Benoni, Gauteng Province | South Africa | Detached from substrate | iNaturalist (2022) | Jane Trembath | https://mexico.inaturalist.org/photos/199427842 |
| LN16 | Aquarium | Malaysia | Decomposing macrophyte | Facebook (2022) | Chen Kai Wen | https://www.facebook.com/groups/Amateur.Microscopy/posts/1988729997975072/<br>https://www.facebook.com/100033718688968/videos/473600310973021/ |
| LN17* | Not specified | Taiwan | Not seen | Facebook (2022) | Zhan Zhengwei | https://www.facebook.com/groups/324721808316035/permalink/1315794522542087/?mibextid=rS40aB7S9Ucbxw6v |
| LN18 | Artificial lake, Veneto Region | Italy | Filamentous algae | Instagram (2023) | @itsallinmyhands_micro | https://www.instagram.com/p/CvZdPc_NMQk/?hl=es-es<br>https://www.instagram.com/p/Cy3TgEGtCq3/?hl=es-es |
| LN19 | Artificial pond, Barcelona | Spain | Filamentous green algae | Instagram (2024) | Mayte Martín | https://www.instagram.com/reel/C_2OLBTNxL5/?utm_source=ig_web_copy_link&igsh=MzRlODBiNWFlZA== |
| LN20 | Artificial pond, Barcelona | Spain | Filamentous green algae | Instagram (2024) | Mayte Martín | https://www.instagram.com/reel/DDjqpSqAmSP/?utm_source=ig_web_copy_link&igsh=MzRlODBiNWFlZA== |
| LN21* | Lake, Southern New Jersey | USA | Filamentous green algae | Reddit (2024)<br>YouTube (2024) | microscopequestion | https://www.reddit.com/r/microscopy/comments/1eqxubh/found_some_limnias_rotifers/<br>https://youtu.be/Kk7gIrE0ewk |
| LN22* | Not specified | Not specified | Unidentified decomposing substrate | Facebook (2024) | Rylee Alland | https://www.facebook.com/groups/Amateur.Microscopy/posts/2801425040038893/ |

*Records with uncertain identification.

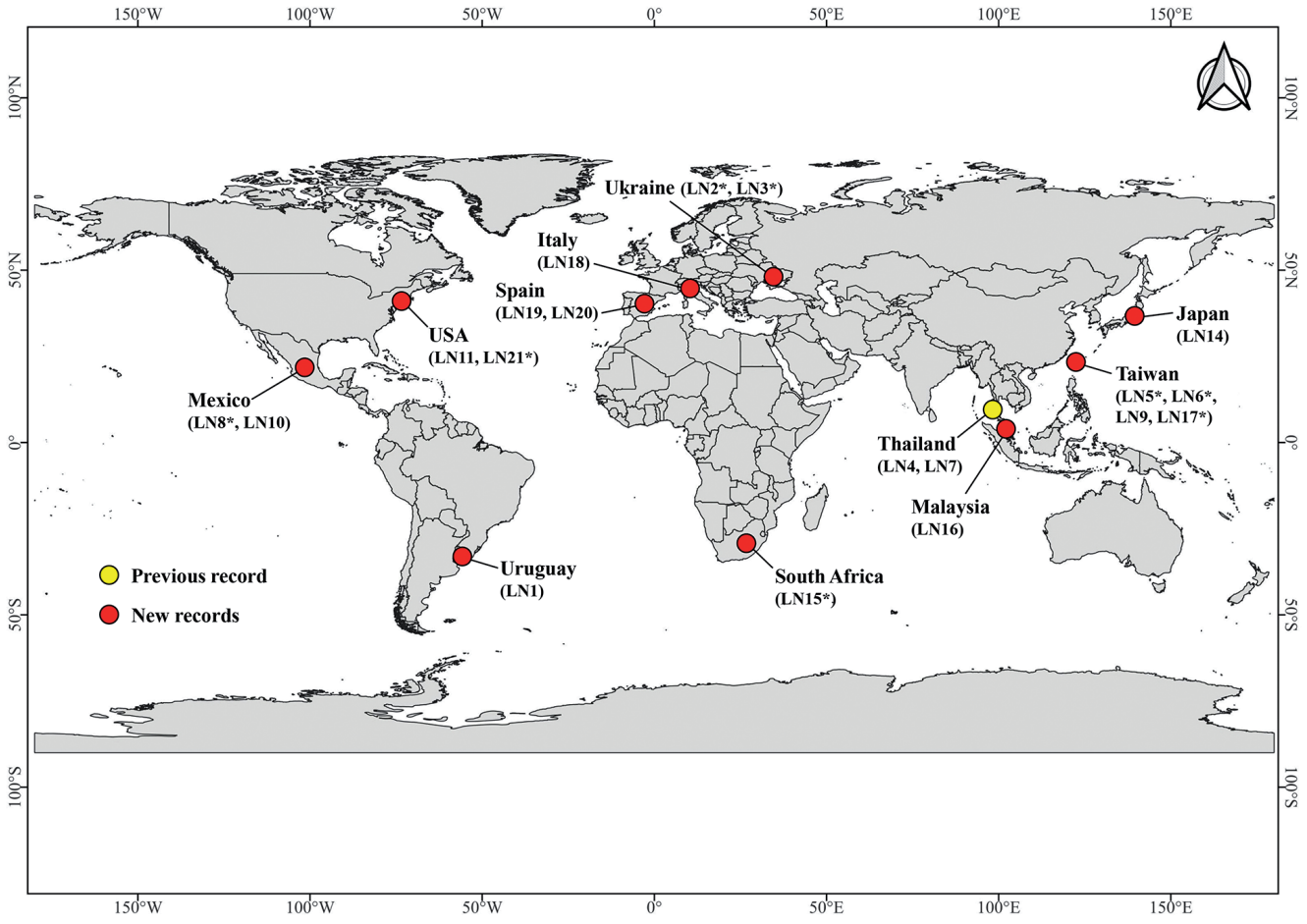


**Fig. 2.** Distribution of *Limnias novemceras*. Records without specified locations (LN12, LN13, and LN22*) are not shown on the map. The asterisk indicates records with uncertain identification.

Some populations were also observed constructing opaque tubes covered with debris (Fig. 1B). Egg production was noted in several social media records, with most individuals carrying one or two eggs (Fig. 1D). Notably, six specimens (LN10, LN11, LN14, LN18, LN19, and LN20) were observed extending their corona well above the tube opening, with LN14 occurring at the highest elevation (Fig. 1D).

## Discussion

The results expand the known range of *L. novemceras*, showing that it occurs across six zoogeographic realms. This broad geographic range indicates that *L. novemceras* is not a narrowly endemic rotifer but can persist in diverse freshwater ecosystems. Its presence across both hemispheres and multiple continents suggests high dispersal potential, possibly facilitated by passive vectors such as aquatic birds, water currents, or human-mediated transport (Fontaneto, 2019; Green *et al*., 2023). Moreover, these observations imply that *L. novemceras* possesses broad ecological tolerance, which may explain its success in colonizing diverse habitats ranging from warmer low-latitude waters to cooler mid-latitude regions. The absence of records from Australia and Antarctica may reflect genuine biogeographic limits or a lack of targeted surveys or published observations in these regions, consistent with the "rotiferologist effect", wherein apparent patterns of species richness are strongly shaped by where specialists have worked rather than by true biodiversity (Fontaneto *et al*., 2012).

In addition to its wide distribution, morphological traits were generally consistent with the original description, supporting their reliability as diagnostic characters. However, variation in the degree of corona elevation indicates behavioral flexibility. This variation may be influenced by factors such as activity level, the presence of suspended particles in the surrounding water, individual health condition, or may simply represent normal behavioral variation (Obertegger and Wallace, 2023). Importantly, this study highlights the value of citizen observations, which can substantially broaden knowledge of morphological variation and even contribute to taxonomic research (Chandler *et al*., 2017).

Beyond morphology, *L. novemceras* also exhibits behaviors that have long been recognized in sessile rotifers. The construction of opaque tubes covered with debris, observed in some populations, is a behavior recognized in tube-building sessile rotifers for more than a century (Hudson and Gosse, 1889, as cited in Wallace *et al*., 2006). The debris consists of suspended particles from the water column and/or fecal material expelled by the rotifers. These



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particles could be gathered by the ciliary currents of the corona and bound with secretions produced from epidermal glands (Franch-Meneu and Pastor, 2025). In addition, the ultrastructure of these tubes has been examined in detail with transmission electron microscopy (TEM), both in earlier work by Yang and Hochberg (2018) and more recently by Franch-Meneu and Pastor (2025).

With regard to habitat, although most specimens recorded from social media appeared to be attached to filamentous algae, we hypothesize that this pattern does not necessarily reflect a true preference for algal substrates over submerged parts of aquatic plants, which are the more typical attachment sites of sessile rotifers (Meksuwan *et al*., 2011, 2014). Instead, it may result from the collection methods used by observers, who often scoop water or employ plankton nets to obtain samples. Portions of this material are subsequently examined under a microscope, where individuals of *L. novemceras* are observed attached to suspended substrates such as algal filaments and decayed plant fragments. Such an approach likely underestimates the true density of sessile rotifers in their natural habitats. A more suitable sampling protocol involves collecting submerged portions of aquatic plants, placing them in containers filled with filtered water from the habitat, and transporting them to the laboratory. Small plant fragments can then be examined in chambers filled with field water under a stereoscopic microscope. Once the target species is located, fresh slides can be prepared for detailed examination under a compound microscope, particularly for species-level identification (Meksuwan *et al*., 2011). Following this method allows for a more accurate assessment of both habitat preferences and population density.

Reproductive observations also provide insights into the species' biology. Most individuals carried a single egg within the tube and occasionally two, consistent with the original species description (Meksuwan *et al*., 2018). However, one record mentioned that three eggs were observed, although this was not shown in the post (LN18). Moreover, because amictic and mictic females of *L. novemceras* may differ in their egg production (Wallace *et al*., 2006), the reproductive biology of this species remains an important subject for future study.

Finally, valuable data were obtained not only from original posts but also from public comments, which are particularly important in citizen-science research. In the present study, ecologists and rotifer taxonomists contributed noteworthy input through comments, providing species identifications and ecological observations. Two-way communication between posters and public users facilitated question-and-answer discussion, yielding more detailed information on the topic of interest. In several cases, comments also provided details on sample locations, habitat characteristics, and permissions to use posted photographs and video clips.

### Notes on the limitations of data from social media

A common limitation in species distribution studies using citizen-generated data is the potential for misidentification by non-experts. In the present study, this issue was minimized because all rotifer records were verified and confirmed by experts based on clearly defined diagnostic traits described in this paper. Images or videos lacking sufficient morphological details for species-level confirmation were conservatively categorized as "uncertain."

Another limitation often raised concerns the temporal accuracy of observations. Because the sampling date is frequently unavailable in social media posts, the upload date was used as a proxy in this study. This approach is considered appropriate, as our aim was to document the geographical occurrence of *L. novemceras* rather than to analyze temporal patterns.

A further limitation involves the accuracy of geographic information. Some social media records lacked explicit geolocation data and were therefore inferred from post descriptions or user profiles. For instance, records from the Facebook group "Taiwan Freshwater Microorganism Fans Club" were assumed to originate from Taiwan. Although the spatial precision of these data varied - from exact localities to broader regional assignments- such resolution is sufficient for illustrating the broad distribution of *L. novemceras* across continents.

Overall, despite these inherent limitations, the verified and curated citizen-sourced records provided a reliable foundation for assessing the species' global distribution.

## Conclusions

This study provides new occurrence records and an updated global distribution of *Limnias novemceras*, extending its range from southern Thailand to five continents. Citizen-science observations, combined with published data, confirm the consistent morphology and reveal ecological traits linked to tube construction and substrate use. These records highlight the value of citizen-contributed material for documenting and expanding knowledge of microscopic animal distributions.

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