Published online: 16 April 2025

Records of the Hawaii Biological Survey for 2025. Evenhuis, N.L. (ed.). *Bishop Museum Occasional Papers* 163: 103–108 (2025).

ISSN (online) 2376-3191

First record of *Mieniplotia scabra* (Gastropoda: Thiaridae) in Hawai‘i: Another non-native introduction to Hawai‘i’s already imperiled freshwater systems[1]

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We report the establishment of yet another globally invasive freshwater snail belonging to the family Thiaridae Gill, 1871 (1823) in the Hawaiian Islands.

Thiaridae Gill, 1871 (1823)
***Mieniplotia scabra* (Müller, 1774)** **New state record**
(Figs. 1, 2)

Cowie (1997) listed seven species of thiarids in the Hawaiian Islands: *Melanoides tuberculata* (Müller, 1774), *Tarebia granifera* (Lamarck, 1816), *Tarebia lateritia* (I. Lea & H.C. Lea, 1851), *Thiara baldwini* (Ancey, 1899), *Thiara indefinita* (I. Lea & H.C. Lea, 1851), *Thiara kauaiensis* (Pease, 1870), and *Thiara verreauiana* (I. Lea, 1857). *Melanoides tuberculata* and *Tarebia granifera* are known from archaeological sites, and considered “canoe snails”, brought with the Polynesian voyagers (Athens *et al.* 2014; Christensen *et al*. 2021). These are now among the most widely distributed freshwater invasives in the islands and are known to carry several zoonotic disease agents that impact birds, fish, and even humans (Hayes *et al.* 2007; Pinto & de Melo 2011). The origins and identities of other thiarids in Hawai‘i, *Tarebia lateritia*, *Thiara baldwini*, *T. indefinita*, *T. kauaiensis*, and *T. verreauiana*, are unresolved, but appear to be modern introductions (Cowie 1997; Cowie *et al*. 2008; Christensen *et al*. 2018). Here we report the first record in Hawai‘i of another introduced thiarid, *Mieniplotia scabra*, the pagoda tiara. A total of 462 specimens were collected live from streams (Fig. 1 A–B) and in local pet stores.

Originally described as *Buccinum scabrum* Müller, 1774, and until recently it was widely recognized as *Thiara scabra*. Low & Tan (2014) established the genus *Mieniplotia* and placed this species in it as the only representative. *Mieniplotia scabra* is generally considered to have origins in the Indo-Pacific, and it is reported from South and Southeast (SE) Asia, through the Western Pacific Islands (Thompson *et al*. 2009). Pliocene fossil records attributed to this species indicate that it is native to Indonesia (Oostingh 1935; O’Connor *et al.* 2005), while archaeological records place it in the Philippines historically (Kress 2000;

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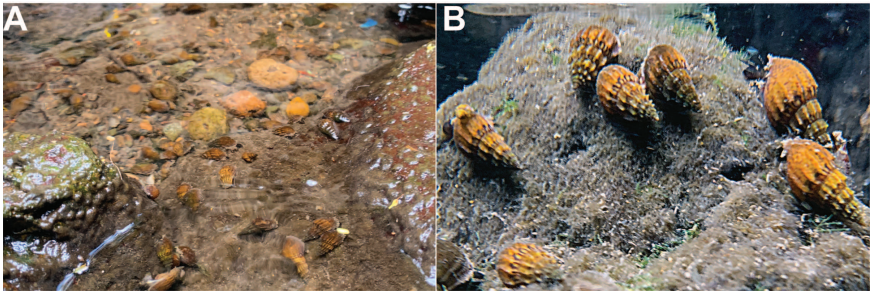

Figure 1. **A**) Live specimens of *Mieniplotia scabra* in Makiki Stream, Oʻahu. **B**) Specimens under water feeding on algae growing on the rocks in the stream. Photo: C. Atta

Pawlik & Piper 2019). However, given how widely it has been introduced and the taxonomic uncertainty, the full extent of its original native range may never be known. It is frequently found in the aquarium trade and is one of the most often encountered freshwater snails in SE Asia (Thompson *et al.* 2009; Cianfanelli *et al.* 2016).

Most specimens collected on Oʻahu, which included a range of size classes (Fig. 2), were consistent with the current concept of *M. scabra*, and were brown in color, some with irregular spiral rows of spots that sometimes fuse into axial maculations. The elevated spire with angled shoulders, which may bear spines, gives the shell a pagoda-like appearance. The specimens collected from Mānoa Stream were the exception, with nearly all the shells appearing black with no spines and less-angled shoulders (Fig. 2 D–F). Specimens collected in Hawaiʻi match the syntype material in the Mollusc collection at the Natural History Museum of Denmark (NHMD-90997; Fig. 2 A–C).

One hundred three specimens from across all collections sites on Oʻahu were sequenced for a portion of the mitochondrial cytochrome *c* oxidase subunit I (COI) gene. A subset of these were sequenced for a fragment of the mitochondrial large ribosomal subunit 16S, and the nuclear ribosomal 28S gene. All sequences were 100% identical within each locus for all Oʻahu specimens. An NCBI BLASTn (https://blast.ncbi.nlm.nih.gov) search using the COI sequences returned matches of 97.8 and 100% (accession numbers MK879275 and PQ327780, respectively) with sequences identified as *M. scabra* on GenBank. Similarly, BLASTn results for 16S matched at similar levels (98.6-100%) for the same species. As part of another ongoing study (Hayes *et al.* unpubl.), all sequences were aligned with other thiarids from Hawaiʻi and available sequences on GenBank to produce a concatenated alignment of 1,762 bp, which was used for Maximum Likelihood (ML) phylogenetic estimation implemented using IQ-TREE (Nguyen *et al.* 2015) with 40,000 ultrafast bootstrap (UFB) replicates (Hoang *et al.* 2018). The ML analysis of a reduced dataset with COI only (Fig. 3) and the full dataset recovered (not shown) all Hawaiian *M. scabra* specimens in a strongly supported clade (99%) with multiple *M. scabra* sequences on GenBank from specimens collected in the Philippines (MH319875-6; Stelbrink *et al.* 2019), Thailand (MK879275-8, MK879282; Boonmekam *et al.* 2019), and one sequence identified as *Thiara* cf. *granum* (AY958759; Genner *et al.* 2007), from an aquarium store in Germany. The latter name is an unaccepted combination for *Melania granum* von dem Busch, 1842, which itself is a junior synonym of *M. scabra*

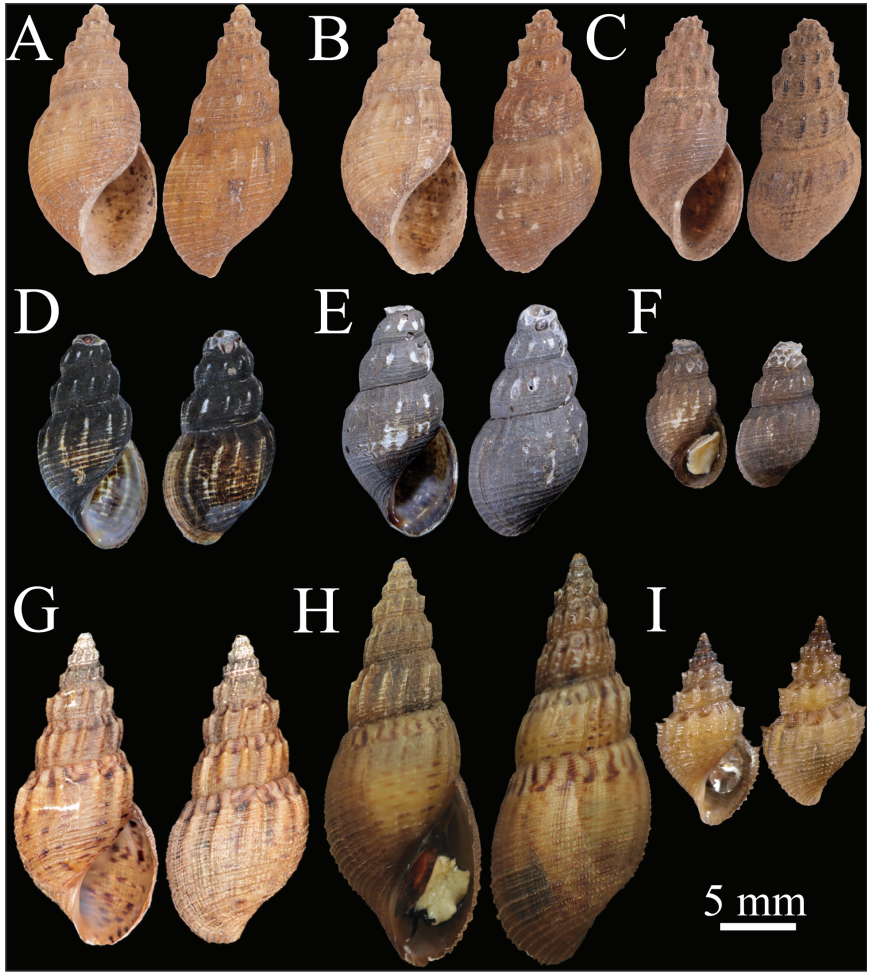

Figure 2. Representative shell images of *Mieniplotia scabra*. **A–C**) Probable syntypes from the Natural History Museum of Denmark (NHMD-90997). **D–H**) Shells of specimens collected from three sites on Oʻahu representing multiple size classes. **D–F**) Mānoa Stream, BPBM 288131; **G–H**) Makiki Stream, BPBM 293901; **I**) Makiki Stream, BPBM 293905.

(Starmühlner 1984). Several other *M. scabra* sequences from GenBank, collected from Thailand, Indonesia, Australia, and Papua New Guinea were recovered in a close relationship to the Hawaiian clade of *M. scabra* (Fig. 3). These initial phylogenetic results along with species delimitation analysis indicate that *M. scabra* represents a species complex that will require more extensive geographic sampling and taxonomic revision to resolve (Hayes *et al.* unpubl.).

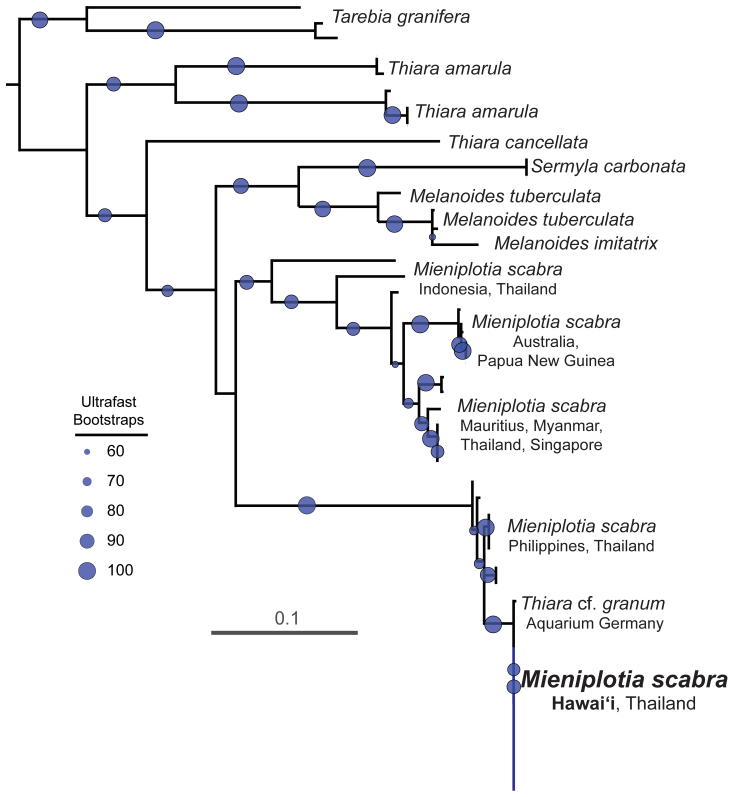

Figure 3. Maximum likelihood reconstruction of COI sequences from all *Mieniplotia scabra* specimens collected from O‘ahu and thiarid sequences from GenBank. Node symbols are for 40,000 ultrafast bootstrap replicates.

All collected material is deposited in the Bishop Museum (BPBM) Malacology Collection and tissue and genomic resources from each in the Pacific Center for Molecular Biodiversity (PCMB). Numbers are for those respective collections.

Material examined. O‘ahu: 213, Mānoa Stream, 21.308527, -157.809162, coll. 8 Jan 2022, K. A. Hayes, Y. Channel, B. Derne, hand collected (BPBM 288131; PCMB60815; PCMB60818-24; PCMB6867-8); 5, Makiki Stream, 21.309886, -157.830536, coll. 22 May 2022, C. Atta, E. D’Amelio, hand collected (BPBM 293901; PCMB56414; PCMB61274); 1, same data except 21.310097, -157.830444 (BPBM 293904; PCMB56413); 8, same data except 21.30097, -157.830444 (BPBM 293904; PCMB56413); 8, same data except 21.309736, -157.830581 (BPBM 293905; PCMB56415-6); 16, pet store, coll. 12 Jan 2024, T. P. Kinzler, hand collected (BPBM 297000; PCMB68851-2; PCMB68854-5); 1, pet store, coll. 12 Jan 2024, T. P. Kinzler, hand collected (BPBM 297004; PCMB68851-2; PCMB68854-5); 78, Mānoa Stream, 21.3076265, -157.80899, coll. 6 Feb 2024, T. P. Kinzler, hand collected (BPBM 297326; PCMB68895-9; PCMB68901; PCMB68903); 87, same data except Nu‘uanu Stream, 21.3200035, -157.85481 (BPBM 297328; PCMB68914-9; PCMB68921); 32, Makiki Stream, 21.3096253, -157.8306158, coll. 8 Mar 2024, T. P. Kinzler, hand collected (BPBM 297068; PCMB68969-77); 21, Waimānalo Stream, 21.35027, -157.72815, 13 m, coll. 29 Aug 2024; C. Yap, hand collected (BPBM 298011).

ACKNOWLEDGMENTS

We thank Adrienne Antonsen, Chase Arensdorf, Kevin Barbosa, Youya Channel, Kelli DeLeon, Meagan Haubner, Sam Shizuru, August Sullivan, Tonatiuh Trejo-Cantwell, and Rochelle Waldman for invaluable assistance with sample collections, processing, DNA extraction, sequencing, and imaging. We owe a special debt of gratitude to Tom Schiøtte, Collections Manager at the Natural History Museum of Denmark, for locating and imaging, on short notice, the probable syntypes of *Buccinum scabrum*. Support for this work was provided in part by grants from the US Fish and Wildlife Service (F20AC11607) to KAH and NWY, US Department of Agriculture (PPA721) to NWY and KAH, and the National Science Foundation awards (DEB-2301564, DBI 1902328) to NWY and KAH. We are indebted for the support and access to lands by the many state agencies and conservation organizations and their staff across Hawai‘i who continue to work towards a better and more sustainable future for Hawai‘i and its natural resources.

REFERENCES

Athens, **J**.**S**., **Ward**, **J**.**V**., **Christensen**, **C**.**C**., **Ciugulea**, **I**., **Wells**, **S**. **& Miller**, **M**. 2014. Fishpond Cores at Pu‘uhonua o Hōnaunau National Historical Park, South Kona, Hawai‘i Island. International Archaeological Research Institute report prepared for National Park Service, Honolulu.

Boonmekam, **D**., **Krailas**, **D**., **Gimnich**, **F**., **Neiber**, **M**.**T**. **& Glaubrecht**, **M**. 2019. A glimpse in the dark? A first phylogenetic approach in a widespread freshwater snail from tropical Asia and northern Australia (Cerithioidea, Thiaridae). *Zoosystematics and Evolution* **95**(2): 373–390.

Christensen C.**C**., **Hayes**, **K**.**A**. **& Yeung**, **N**.**W**. 2021 Taxonomy, conservation, and the future of native aquatic snails in the Hawaiian Islands. *Diversity* **13**(5): 215.

Christensen, **C**.**C**., **Kahn**, **J**.**G**. **& Kirch**, **P**.**V**. 2018. Nonmarine mollusks from archaeological sites on Mo‘orea, Society Islands, French Polynesia, with descriptions of four new species of recently extinct land snails (Gastropoda: Pulmonata: Endodontidae). *Pacific Science* **72**(1): 95–123.

Cianfanelli, **S**., **Talenti**, **E**. **& Bodon**, **M**. 2016. *Mieniplotia scabra* (Müller, 1774), another gastropod invasive species in Europe and the status of freshwater allochthonous molluscs in Greece and Europe. *Mediterranean Marine Science* **17**(1): 253–263.

Cowie, **R**.**H**. 1997. Catalog and bibliography of the nonindigenous nonmarine snails and slugs of the Hawaiian Islands. *Bishop Museum Occasional Papers* **50**: 1–66.

Cowie, **R**.**H**., **Hayes**, **K**.**A**., **Tran**, **C**.**T**. **& Meyer**, **W**.**M**., **III**. 2008. The horticultural industry as a vector of alien snails and slugs: widespread invasions in Hawai‘i. *International Journal of Pest Management* **54**(4): 267–276.

Genner, **M**.**J**., **Todd**, **J**.**A**., **Michel**, **E**., **Erpenbeck**, **D**., **Jimoh**, **A**., **Joyce**, **D**.**A**., **Piechocki**, **A**. **& Pointier**, **J**.**P**. 2007. Amassing diversity in an ancient lake: evolution of a morphologically diverse parthenogenetic gastropod assemblage in Lake Malawi. *Molecular Ecology* **16**(3): 517–530.

Hayes, **K**., **Tran**, **C**. **& Cowie**, **R**.**H**. 2007. New records of alien Mollusca in the Hawaiian Islands: non-marine snails and slugs (Gastropoda) associated with the horticultural trade. *Bishop Museum Occasional Papers* **96**: 54–63.

Hoang, **D**.**T**., **Chernomor**, **O**., **von Haeseler**, **A**., **Minh**, **B**.**Q**. **& Vinh**, **L**.**S**. 2018. UFBoot2: improving the ultrafast bootstrap approximation. *Molecular Biology and Evolution* **35**(2): 518–522.

Kress, **J**.**H**. 2000. The malacoarchaeology of Palawan Island. *Journal of East Asian Archaeology* **2**: 285–328.

Low, **M**.**E**. **& Tan**, **S**.**K**. 2014. *Mieniplotia* gen. nov. for *Buccinum scabrum* O.F. Müller, 1774, with comments on the nomenclature of *Pseudoplotia* Forcart, 1950, and *Tiaropsis* Brot, 1870 (Gastropoda: Caenogastropoda: Cerithioidea: Thiaridae). *Occasional Molluscan Papers* **3**: 15–17.

Nguyen, **L**.**-T**., **Schmidt**, **H**.**A**., **von Haeseler**, **A**. **& Minh**, **B**.**Q**. 2015. IQ-TREE: a fast and effective stochastic algorithm for estimating maximum-likelihood phylogenies. *Molecular Biology and Evolution* **32**(1): 268–274.

O'Connor, **S**., **Aplin**, **K**., **Szabó**, **K**., **Pasveer**, **J**., **Veth**, **P**. **& Spriggs**, **M**. 2005. Liang Lemdubu: a Pleistocene cave site in the Aru Islands. *Terra Australis* **22**: 171–204.

Oostingh, **C**.**H**. 1935. Die mollusken des Pliozäns vom Boemiajoe (Java). *Dienst van den Mijnbouw in Nederlandsch-Indië, Wetenschappelijkke Mededeelingen* **26**: 1–247.

Pawlik, **A**.**F**. **& Piper**, **P**.**J**. 2019. The Philippines from c. 14,000 to 4,000 cal. BP in regional context. *Cambridge Archaeological Journal* **29**(1): 1–22.

Pinto, **H**.**A**. **& de Melo**, **A**.**L**. 2011. A checklist of trematodes (Platyhelminthes) transmitted by *Melanoides tuberculata* (Mollusca: Thiaridae). *Zootaxa* **2799**(1): 15–28.

Starmühlner, **F**. 1984. Results of the Austrian-Indian hydrobiological mission 1976 to the Andaman-Islands: Part IV: The freshwater gastropods of the Andaman-Islands. *Annalen des Naturhistorischen Museums in Wien* (B) **86**: 145–204.

Stelbrink, **B**., **von Rintelen**, **T**., **Albrecht**, **C**., **Clewing**, **C**. **& Naga**, **P**.**O**. 2019. Forgotten for decades: Lake Lanao and the genetic assessment of its mollusc diversity. *Hydrobiologia* **843**(1): 31–49.

Thompson, **F**.**G**., **Heyn**, **M**.**W**. **& Campbell**, **D**.**N**. 2009. *Thiara scabra* (O. F. Müller, 1774): the introduction of another Asian freshwater snail into the United States. *The Nautilus* **123**(1): 21–22.