

Digging into diversity: Ghost shrimp taxonomy from Guam's shallow soft-bottom habitats

Diego Ray Quiogue

Abstract

Guam's marine ecosystem contains more species than any other US region, and most of these species are poorly known, especially in unique, difficult to sample habitats such as shallow water burrows. Only two species of ghost shrimp (Decapoda: Axiidea) were reported in a 2003 checklist of Guam's crustaceans. However, recent yabby pump surveys of shallow water burrows have yielded eight ghost shrimp species (Decapoda: Axiidea). Of the eight species, only one was reported in the 2003 checklist, while the remaining seven were previously recorded in scattered literature but were never documented in an updated checklist. In total, ten species are currently known from Guam. The present study focuses on: 1) expanding sampling of Guam's shallow, soft-bottom habitats using yabby pumps; 2) identifying newly collected ghost shrimp species and their symbionts using morphological examination and DNA barcoding; and 3) producing an updated checklist of ghost shrimp in the region. Morphological examination has resulted in the identification of species of *Neocallichirus*, *Glypturus*, *Corallianassa*, *Paratrypaea*, *Callianidea*, and *Eucalliaxopsis*. Key traits such as cheliped asymmetry, rostrum shape, and tail fan morphology were used to distinguish species. This study presents the first updated checklist of Guam's ghost shrimp species in over two decades. As a Pacific-Islander led project, it also reflects a commitment to place-based research and the protection of Guam's unique biological heritage.

Introduction

Despite decades of sampling and study, Guam's marine invertebrate fauna is severely understudied and may harbor hundreds of undocumented species (Paulay 2003). This is especially true of habitats that are difficult to sample, such as shallow water burrows, as they are only accessible during low tides and specialized equipment is needed to sample them effectively. Ghost shrimp (Decapoda: Axiidea) and their symbionts contribute to the rich, but largely hidden diversity in these habitats. Axiidea includes both ghost shrimp and other burrowing shrimp. Previous taxonomic reviews of Guam axiidean species focused on taxa that inhabit coral reef areas and other hard substrates, neglecting true ghost shrimp species that live in soft bottom habitats (Kensley, 2003). Notably, Paulay *et al.* (2003) reported only two true ghost shrimp species from Guam: *Corallianassa assimilis* (Kensley, 2001) and *Callianidea typa* H. (Edwards, 1879). Since then, scattered publications have reported 8 additional species from Guam, highlighting the need for a review. The present study aims to: 1) resolve the identity of the recently collected ghost shrimp species using morphological examination and DNA barcoding; 2) increase sampling of Guam's soft bottom, shallow habitats using a yabby (hand) pump; and 3) document Guam's ghost shrimp with an updated checklist and taxonomic monograph.

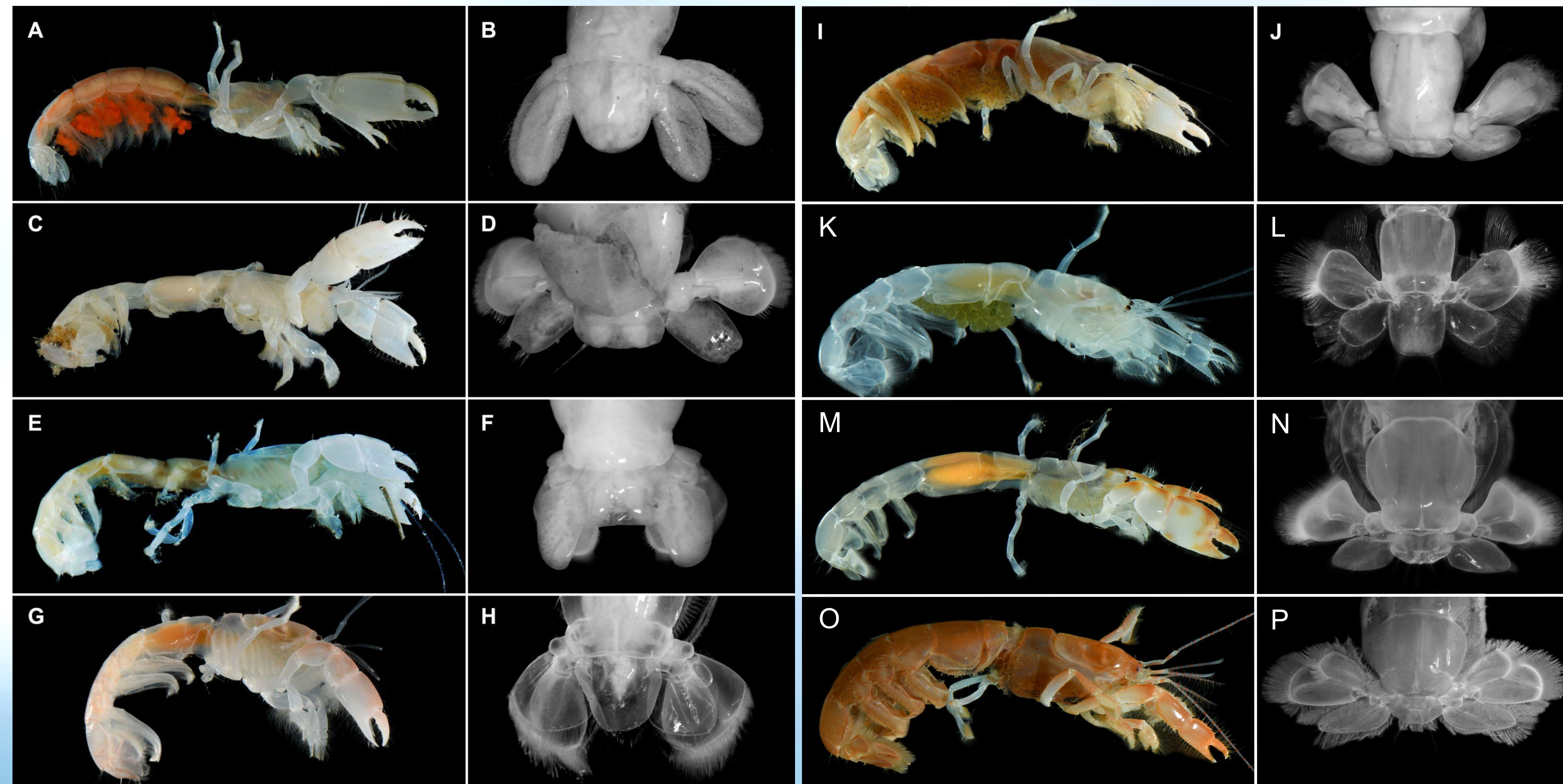


Fig. 1 Eight distinct morphospecies of ghost shrimp collected during the 2024 Guam Bioblitz and more recent sampling. a. *Callianidea typa* H; c. *Eucalliaxopsis dworschaki*; e. *Eucalliaxopsis inaequimana*; g. *Neocallichirus calmani*; i. *Neocallichirus vigilax*; k. *Paratrypaea maldivensis*; m. *Corallianassa borrailei*; o. *Glypturus armatus*.

Methods

Sampling sites were selected in sandy/muddy areas with burrows that are accessible during low tides. To collect specimens from burrows, yabby pumps and sieves were used. A yabby pump is a steel tube hand pump designed to extract organisms from burrows (Fig. 3). The contents of the pump were expelled into a sieve, and specimens were separated from sediment. Locality, habitat, and symbionts were recorded. Specimens were then transported to the Marine Lab and photographed, tissue sampled, and preserved in 75% ethanol. Tissues were placed in 96 well plates and sent to the National Museum of Natural History, Smithsonian Institution, in Washington DC for DNA extraction, PCR, and sequencing of the DNA barcoding marker COI. Resulting COI DNA barcodes were checked against known barcodes using NCBI Blast and BOLD (Barcode of Life Database). Morphological identification was conducted using species lists, keys, and diagnoses in Paulay *et al.* (2003), Hernez and Vargas (2013), Poore (2021), Poore *et al.* (2023), and Sato *et al.* 2024.

Preliminary Results

Examination of specimens collected during the 2024 Guam Bioblitz and more recent sampling efforts resulted in eight distinct morphospecies of ghost shrimp in the four families: Eucalliidae, Callianassidae, Callianideidae, and Callichiridae (Fig. 1). The morphospecies were distinguished based on morphological characters including: 1) pleopods; 2) chelipeds; and 3) the tail fan (Fig. 1). A literature review indicated that 10 species have been reported from Guam (Komai *et al.* 2020; Poore 2001, 2023a, 2023b; Poore & Kou 2024; Poore *et al.* 2022, 2023). DNA barcodes were generated for four individuals of three species. BOLD and NCBI Blast searches did not return any matches within 10 percent, indicating no COI sequences are available.

Conclusion

The recent records of ghost shrimp from Guam, combined with the lack of targeted collecting efforts, underscore a significant gap in our understanding of these species. Surveys at six localities revealed eight species spanning four families, highlighting the diversity within soft-bottom habitats (Fig. 2). Morphological and genetic analysis not only expanded our understanding of local biodiversity but also highlighted the absence of reference DNA barcodes for the COI gene of these species, pointing to broader gaps in global databases. These findings emphasize the need for a taxonomic review of Guam's ghost shrimp to document their biodiversity and guide future research efforts. As a Pacific-Islander led initiative, this research reflects a commitment to place-based science and the conservation of Guam's unique marine ecosystems.

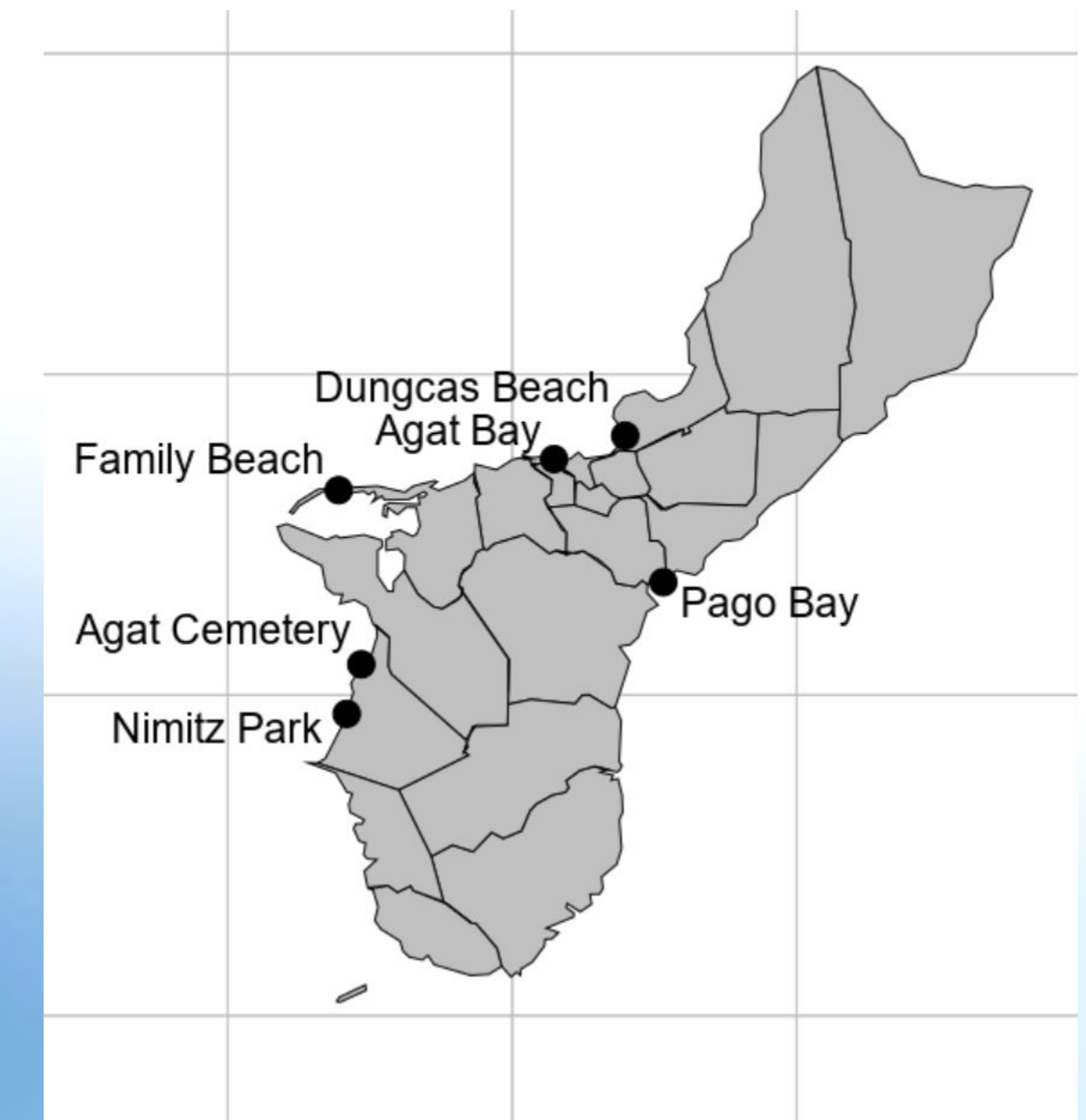


Fig. 2 Map of Guam showing collection sites of ghost shrimp specimens.



Fig. 3 Yabby pumping for specimens.

Acknowledgements

Grateful acknowledgement is extended to the scientists who contributed their time and expertise to the 2024 Guam Bioblitz. Special thanks goes to the Biorepository staff for their support and efforts in making this work possible. I also thank Robert Lasley Jr. for his support and mentorship throughout this project.

References

- Kensley, (2001). A new species of *Corallichirus* Manning, (Crustacea: Decapoda: Callianassidae) from Guam
- Paulay, (2003). The crustaceans and pycnogonids of the Mariana Islands. Micronesia.
- Poore, G. C. B., & Ah Yong, S. T. (2023). Marine Decapod Crustacea: A Guide to Families and Genera of the World. CSIRO Publishing
- Poore, G.C.B. (2023a). New records and one new species of Callichiridae (Crustacea, Axiidea) from the Indo-West Pacific, with keys to species of *Corallianassa*, *Lepidophthalmus* and *Neocallichirus*. *Memoirs of Museum Victoria* 82: 71-95. <https://doi.org/10.24199/mmv.2023.82.04>
- Sato, T., Komai, T., & Shimizu, N. (2024). *Glypturus ferox*, a new species of ghost shrimp (Decapoda: Axiidea: Callichiridae) from the Ryukyu Islands, southwestern Japan. *Zootaxa*, 5432(3), 379–397. <https://doi.org/10.11646/zootaxa.5432.3.3>

THIS MATERIAL IS BASED
UPON WORK SUPPORTED BY THE
NATIONAL SCIENCE FOUNDATION
UNDER GRANT NUMBER OIA-1946352