



First record of *Macrobrachium australe* (Guérin-Méneville, 1838) (Crustacea, Decapoda, Palaemonidae) from Ogasawara (Bonin) Islands, an oceanic island group of Japan

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Abstract. The Ogasawara (Bonin) Islands are an oceanic island group and World Natural Heritage site in Japan. This study reports the first record of the freshwater prawn *Macrobrachium australe* (Guérin-Méneville, 1838) on Chichi Island in the Ogasawara Islands. Although this amphidromous species has high dispersal ability, our comprehensive surveys across the islands found only one individual, with no evidence of establishment or reproduction. This case study of the accidental dispersal of amphidromous species to oceanic islands is significant from a biogeographical perspective.

Key words. Amphidromous, biogeography, DNA barcoding, mitochondrial DNA

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Introduction

Infrequent colonization events and subsequent adaptive evolution have shaped unique ecosystems on oceanic islands that have never been connected to a continent. Consequently, oceanic islands are widely regarded as model systems for investigating the processes and mechanisms of community formation (Whittaker et al. 2008; Shaw and Gillespie 2016). However, most previous studies have focused on terrestrial and marine ecosystems, and our knowledge of freshwater biotic community formation on oceanic islands remains limited (McDowall 2003).

Macrobrachium Spence Bate, 1868 is a large genus of freshwater and brackish-water prawns that are widely distributed in temperate and tropical regions worldwide, comprising approximately 280 species (DecaNet Eds. 2025). Eighteen species have been reported in Japan, 17 of which have an amphidromous life history, spending their larval stages in brackish water or seawater (Shokita 2019; Fuke and Maruyama 2023). Such amphidromous species are presumed to possess a high dispersal ability via ocean currents (Iida et al. 2010; Anger 2013). The number of species capable of reaching highly isolated oceanic islands is believed to be limited by the length of their planktonic larval stage (McDowall 2003; Fuke and Sasazuka 2021). The genus *Macrobrachium* represents a suitable taxon for examining these processes, and its species diversity on oceanic islands needs to be clarified.

This study reports the first record of *Macrobrachium australe* (Guérin-Méneville, 1838) on the Ogasawara (Bonin) Islands, an oceanic island group in Japan. This finding is important for understanding the regional freshwater fauna of the Ogasawara Islands.

Study area

The Ogasawara Islands are a subtropical archipelago in the Pacific Ocean located approximately 1,000 km south of mainland Japan (Figure 1). Adaptive radiation has repeatedly occurred among the plants and land snails of the Ogasawara Islands (Ito 1998; Chiba and Cowie 2016), making them important



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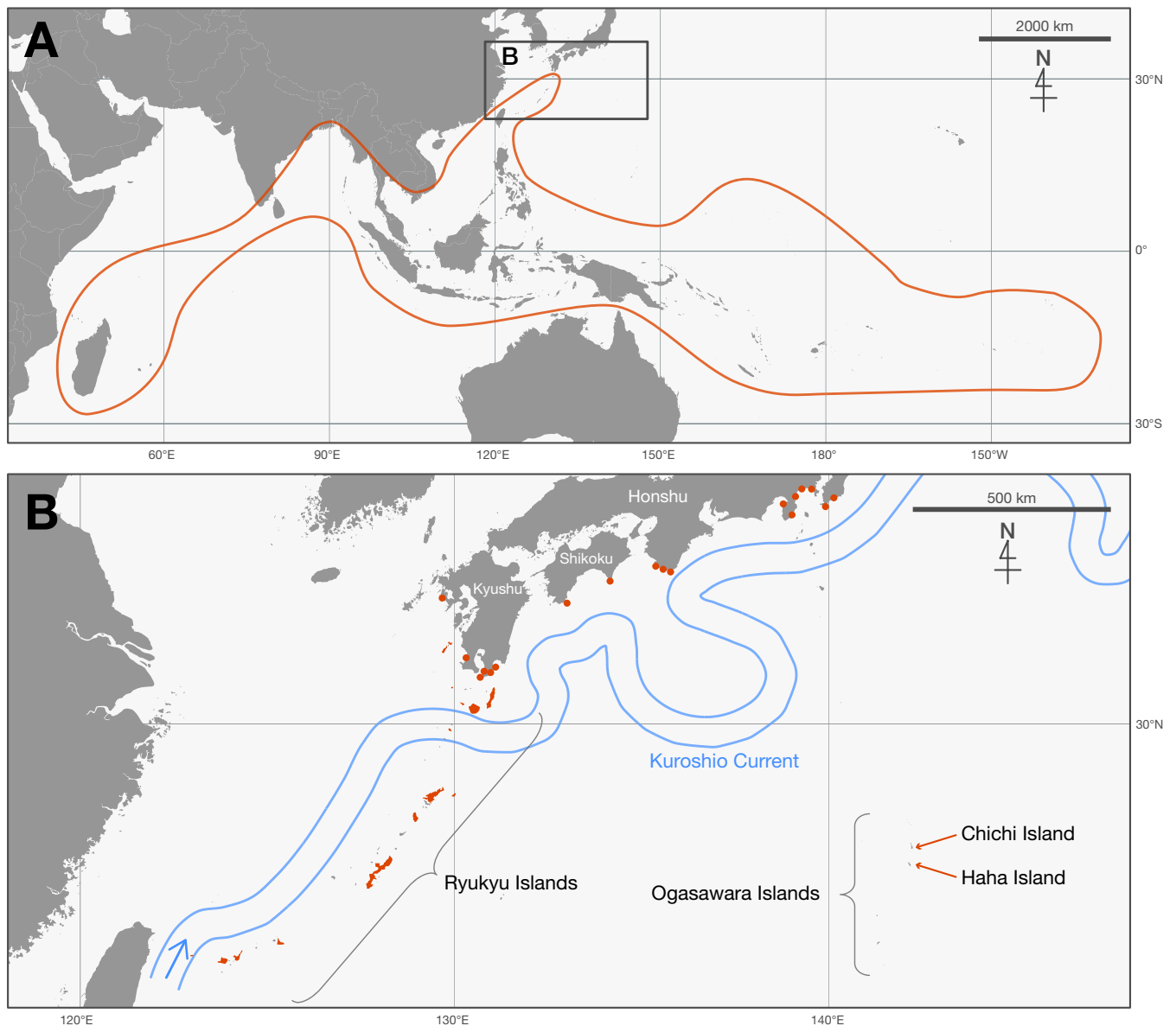


Figure 1. Distribution maps of *Macrobrachium australe*. **A.** World map. The red line indicates the distribution range of this species. **B.** Detailed map around Japan. Red points and fills represent the occurrence of this species in Japan.

natural laboratories for studying evolution. Furthermore, rare colonization from various regions and subsequent adaptive evolution have been documented across a wide range of taxa (e.g. Noda et al. 2022; Tomikawa et al. 2022, 2023; Tsujimoto et al. 2023; Nishimura and Takayama 2025; Souma 2025). The value of these ecosystems has been recognized, leading to their designation as a UNESCO World Heritage Site and a national park. The freshwater habitats of the islands also harbour several endemic species (Satake et al. 2019), although research on these habitats remains limited compared to that on terrestrial ecosystems.

Eight species of freshwater shrimp have been reported on the Ogasawara Islands (Table 1; Fuke et al. 2025; Fuke and Sasaki 2025). Among these eight species, *Palaemon ogasawaraensis* Kato & Takeda, 1981 and *Paratya boninensis* Satake & Cai, 2005 are endemic to the Ogasawara Islands, whereas the remaining six species are widely distributed.

Methods

Thirty-one surveys in the Ogasawara Islands were conducted between March 2022 and August 2025, covering 11 river systems on the Chichi and Haha islands (Figure 2). Access to national forests was granted after completion of the Ogasawara Islands Forest Ecosystem Conservation Area Usage

Table 1. List of freshwater shrimps in Ogasawara (Bonin) Islands, Japan.

Family	Species	Life history type	Note	References
Palaemonidae	<i>Macrobrachium australe</i> (Guérin-Méneville, 1838)	Amphidromous		This study
Palaemonidae	<i>Macrobrachium japonicum</i> (De Haan, 1849)	Amphidromous		Fuke et al. 2025
Palaemonidae	<i>Macrobrachium lar</i> (Fabricius, 1798)	Amphidromous		Yoshigou 2002
Palaemonidae	<i>Palaemon ogasawaraensis</i> Kato & Takeda, 1981	Amphidromous	Type locality, endemic	Kato and Takeda 1981
Atyidae	<i>Atyoida pilipes</i> (Newport, 1847)	Amphidromous		Cai et al. 2006
Atyidae	<i>Caridina multidentata</i> Stimpson, 1860	Amphidromous	Type locality	Cai et al. 2006
Atyidae	<i>Caridina serratiostris</i> De Man, 1892	Amphidromous		Fuke and Sasaki 2025
Atyidae	<i>Caridina typus</i> H. Milne Edwards, 1837	Amphidromous		Cai et al. 2006
Atyidae	<i>Paratya boninensis</i> Satake & Cai, 2005	Land-locked	Type locality, endemic	Satake and Cai 2005

course. The collected specimen was preserved in 100% ethanol onsite and deposited at the Zoological Collection of Kyoto University (KUJ). To assess the morphological characteristics of the specimen, the postorbital carapace length (CL) was measured after preservation using digital callipers.

Total DNA was extracted from the fifth pleopod using the Monarch Spin gDNA Extraction Kit (New England Biolabs). A partial mitochondrial 16S rRNA gene was amplified using PCR with the primer pairs 16S-F1 (5'-GTA CCT TTT GTA TCA GGG-3') and 16S-R1 (5'-CGG TYT GAA CTC AAA TCA TG-3') (Fuke and Maruyama 2023). The composition of the 12 µL PCR reaction mixture was as follows: 6.0 µL of 2×PrimeSTAR GXL Premix Fast (TaKaRa, Japan), 0.7 µL of each 5 µM primer, 0.8 µL of template DNA, and 3.8 µL of ultrapure water. The PCR amplification conditions were as follows: initial denaturation (98°C, 10 s); 30 cycles of denaturation (98°C, 10 s), annealing (55°C, 5 s), and extension (68°C, 5 s); and a single final extension (68°C, 10 s). The PCR product was purified using ExoSAP-IT Express (Applied Biosystems, USA) and outsourced to Macrogen, Japan, for Sanger sequencing. The obtained sequence was checked for quality and was manually edited using Unipro UGENE 51.0 (Okonechnikov et al. 2012). For DNA barcoding, similarity search of the nucleotide sequence was performed using BLAST (Johnson et al. 2008) with default settings. The sequence was deposited in the International Nucleotide Sequence Database via the DDBJ (accession number: LC897214).

The maps were created using QGIS 3.40 (QGIS.org 2025). The GIS data were sourced from publicly available datasets provided by MLIT of Japan (2024) and Natural Earth (2024).

Results

Order Decapoda

Family Palaemonidae Rafinesque, 1815

Genus *Macrobrachium* Spence Bate, 1868

Macrobrachium australe (Guérin-Méneville, 1838)

Figure 2C

Materials examined. JAPAN — TOKYO • Ogasawara (Bonin) Islands, Chichi Island, Stream of Kopepe Beach; 27°03'54.1"N 142°11'37.5"E; 31 Mar. 2022; Motoya Hanai leg.; DNA accession number: LC897214; 1♀, CL 6.97 mm, KUJ Z6318.

Identification. The examined specimen was identified by DNA barcoding, and its morphological characteristics also supported this identification. A similarity search using mtDNA 16S rRNA (970 bp) showed that the individual obtained from the Ogasawara Islands matched *M. australe*, identified based on morphological traits (Castelin et al. 2017; Fuke and Imai 2018), at 100% (Table 2). Because the examined specimen was female and immature, the morphology of the second pleopod was not examined. The rostrum is slender and upcurved, with its tip extending beyond the end of the scaphocerite. The rostrum tooth formula was 3+6+2/5. The specimen exhibited three red bands on the lateral surface of the carapace in its fresh condition. These characteristics are consistent with those of *M. australe* (Holthuis 1950; Castelin et al. 2017).

Distribution. *Macrobrachium australe* has been reported to occur from the Indian Ocean to the Central Pacific Ocean (Figure 1A; Holthuis 1950; Ito et al. 2002; Chen et al. 2009; Castelin et al. 2017). In Japan, this species has been recorded in Honshu (Imai et al. 2008; Kitano and Terada 2015; Maruyama 2017, 2018), Shikoku (Imai et al. 2015), Kyushu (Suzuki et al. 1993; Imai and Nakaso 2019; Imai and Oonuki 2023), and the Ryukyu Islands (Shokita 2019; Fuke and Imai 2018) (Figure 1B). Among these, stable

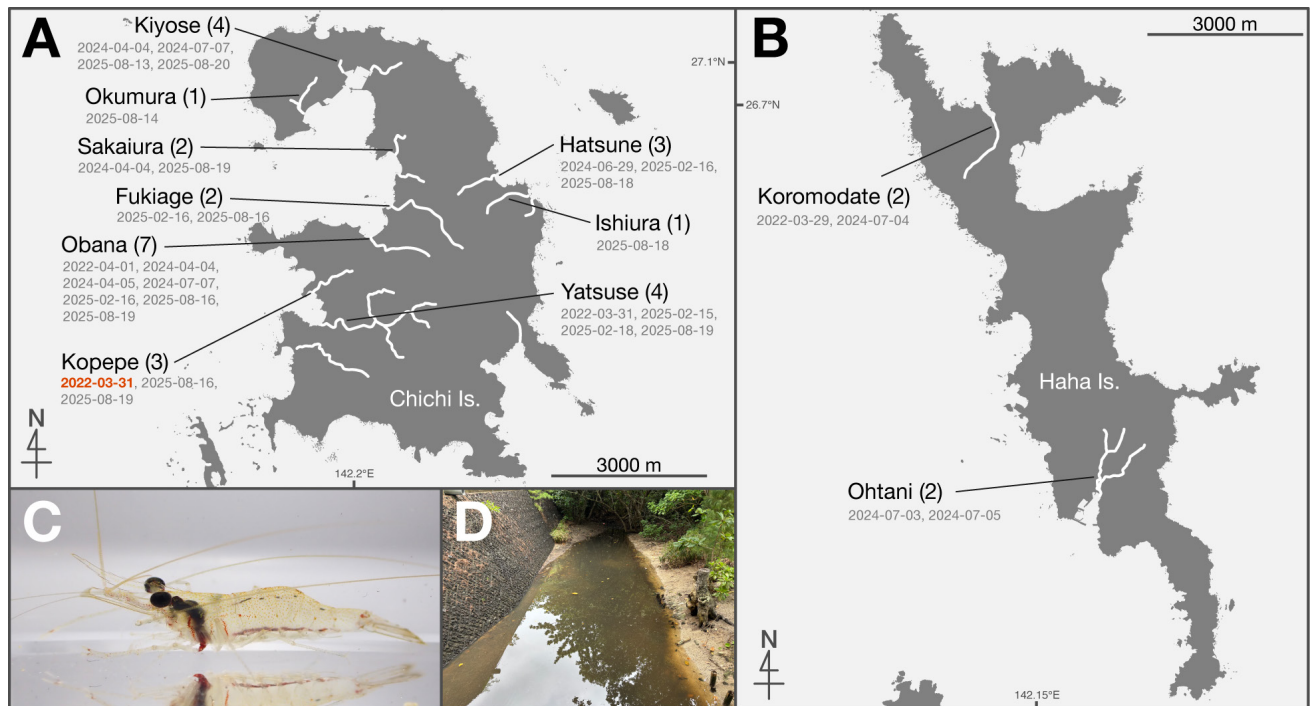


Figure 2. Survey sites in the Ogasawara Islands with photographs of the specimen and its habitat. Numbers following river names indicate the number of surveys conducted. Dates in gray represent survey dates, and dates in bold indicate when the species was collected. **A.** Chichi Island. **B.** Haha Island. **C.** *Macrobrachium australe* collected from Chichi Island. **D.** Habitat, small stream of Kopepe Beach, Chichi Island.

Table 2. BLAST search results for *Macrobrachium australe* collected Ogasawara Islands based on partial mtDNA 16S rRNA. Only the top 10 hits were shown.

Query sample	Hit species	Length (bp)	Query cover	Identity	Accession	Reference
KUZ Z6318	<i>Macrobrachium australe</i>	509	50%	100%	KY039501.1	Castelin et al. 2017
LC897214	<i>Macrobrachium australe</i>	509	50%	100%	KY039513.1	Castelin et al. 2017
	<i>Macrobrachium australe</i>	509	50%	100%	KY039517.1	Castelin et al. 2017
	<i>Macrobrachium australe</i>	507	48%	100%	LC366024.1	Fuke and Imai 2018
	<i>Macrobrachium australe</i>	472	47%	100%	LC316193.1	Fuke and Imai 2018
	<i>Macrobrachium australe</i>	472	47%	100%	LC316195.1	Fuke and Imai 2018
	<i>Macrobrachium australe</i>	472	47%	100%	LC316196.1	Fuke and Imai 2018
	<i>Macrobrachium australe</i>	472	47%	100%	LC316197.1	Fuke and Imai 2018
	<i>Macrobrachium australe</i>	472	47%	100%	LC316201.1	Fuke and Imai 2018
	<i>Macrobrachium australe</i>	472	47%	100%	LC316203.1	Fuke and Imai 2018

establishment and reproduction have only been confirmed in a few rivers in Honshu, with year-round high-water temperatures due to warm wastewater and hot springs, and in the Ryukyu Islands.

Habitat. *Macrobrachium australe* was confirmed in a single individual from a small stream draining into Kopepe Beach on Chichi Island (Figure 2A, D). In the Ryukyu Islands, this species typically occurs in stagnant water environments in the lower to middle reaches of small streams (Shokita 1975; Fuke et al. 2024), and in the Ogasawara Islands, the species was likewise found in a similar habitat.

Discussion

We report the first record of *Macrobrachium australe* in the Ogasawara Islands. As this species is not commonly available in the Japanese pet trade and no other non-native freshwater crustaceans have been documented in the region, the collected specimen is considered to be of natural origin rather than introduced. The specimen was immature, indicating that recruitment occurred recently.

Our study successfully documents accidental dispersal, which is generally difficult to observe despite its importance, and thus provides valuable biogeographical insights on oceanic islands. Accidental dispersal is a crucial initial step in the formation of regional biota and speciation (Heaney 2000; Whittaker et al. 2008, 2017). Despite our comprehensive survey and previous surveys of the Ogasawara Islands, only a single individual was recorded, and no evidence of establishment or reproduction in

the region was obtained (Fuke et al. 2025). Although the complete zoeal stage of this species remains unclear, it is known to have a planktonic larval period of at least 50–147 days (Ito et al. 2002). Given its wide distribution range, this species possesses a high dispersal ability. This suggests that even species with high dispersal ability, such as *M. australe*, rarely reach the Ogasawara Islands.

The processes and mechanisms underlying the community formation of freshwater crustaceans on the Ogasawara Islands remain unresolved. Eight shrimp species, excluding *M. australe*, are reliably known to occur in this region (Fuke et al. 2025). However, it remains unclear whether the Ogasawara populations of these species are genetically isolated from those of other regions or whether they maintain gene flow. *Macrobrachium lar* (Fabricius, 1798) have relatively long planktonic larval stages (77–110 days; Lal et al. 2014), suggesting that they may maintain gene flow to other regions, as demonstrated by *M. australe* in this study. In contrast, whether the Ogasawara populations of other widely distributed species, such as *M. japonicum* (De Haan, 1849) (42–47 days; Morizane and Minamizawa 1971), *Caridina typus* H. Milne Edwards, 1837 (22–44 days; Nakahara et al. 2005), *C. multidentata* Stimpson, 1860 (26–49 days; Hayashi and Hamano 1984), and *C. serratirostris* De Man, 1892 (34–46 days; Nakahara et al. 2005) are isolated or connected through gene flow requires further examination using phylogeographic approaches. No information is available regarding the complete larval stages of *Atyoida pilipes* (Newport, 1847), *Pal. ogasawaraensis*, and *Par. boninensis*, highlighting the need to accumulate fundamental knowledge of their early life histories. In the future, a detailed examination of the migration patterns and gene flow from other regions may provide important insights into the origin of freshwater biodiversity on oceanic islands.

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Additional information

Conflict of interest

The authors declare that no competing interests exist.

Ethical statement

No ethical statement is reported.

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Author contributions

Conceptualization: MH. Investigation: MH, YF. Data curation and formal analysis: YF. Writing – original draft: YF. Writing – review and editing: MH, YF.

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Data availability

The collected specimen was deposited in the Zoological Collection of Kyoto University (KUZ Z6318). The mtDNA sequence has been deposited in the International Nucleotide Sequence Database (accession number: LC897214).

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