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NOTES ON GEOGRAPHIC DISTRIBUTION

Rediscovery after more than four decades of the endemic wasp *Isodontia boninensis* (Tsuneki, 1973) (Hymenoptera, Sphecidae) in the Ogasawara Islands, Japan, with a discussion on a hypothesized indirect impact of invasive predators via prey depletion

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Abstract. The rediscovery of the Ogasawaran endemic wasp *Isodontia boninensis* (Tsuneki, 1973) is reported. This species has not been recorded since 1980. Individuals were collected from Ototo-jima in 2023–2025. No individuals were detected on the other surveyed islands. Two hypotheses to explain the long-term non-detection on anole-invaded islands are evaluated: prey limitation and nesting-cavity limitation. These island-level records are consistent with an invasion-history gradient and suggest that satellite islands not invaded by the Green Anole, *Anolis carolinensis* Voigt, 1832, may function as refugia for vulnerable insects and should be prioritized for multi-season monitoring.

Keywords. Invasive predators, nesting cavity, oceanic islands, prey limitation, refugia

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Introduction

Oceanic islands often support highly endemic insect faunas that are particularly vulnerable to ecological disturbance (Reaser et al. 2007; Wilson and Holway 2010; Krushelnycky 2015; Russell and Kueffer 2019). In the Ogasawara Islands, Japan, multiple alien predators and other introduced organisms have been implicated in native arthropod declines through both direct predation and indirect pathways, including shifts in prey availability and habitat conditions (Takakuwa and Suda 2004; Karube 2009; Hisasue et al. 2025; Suzuki et al. 2026). Consequently, an increasing number of insect taxa, including orthopterans and wood-boring beetles, have gone unrecorded for long periods (Ishikawa 2022; Tsuji 2026). However, prolonged non-detection alone does not demonstrate extinction; it may also reflect limited survey effort or a mismatch between survey design and species detectability (Tominaga and Hisasue 2024; Souma 2025).

Within the archipelago, satellite islands with low invasion pressure, or without major alien predators, have received attention as potential refugia for native insects (Funakoshi 1992; Takakuwa 2008; Kaga et al. 2026). New distributional records from such islands are therefore valuable not only as baseline biogeographic data, but also for interpreting island-level patterns in relation to invasion history.

Among the introduced predators, the green anole, *Anolis carolinensis* Voigt, 1832 (Cuvier and Voigt 1832) is regarded as a major ecological threat to native insect communities in the Ogasawara Islands (Karube 2005; Yoshimura and Okochi 2005; Toda et al. 2010). Its predation on a broad range of arthropods has been well documented, with reports of community-level effects that extend beyond direct consumption, including trophic and habitat-mediated consequences (Karube and Suda 2004; Takakuwa and Suda 2004; Karube 2009). This context is important when evaluating long-term non-detection patterns among islands that differ in invasion history and intensity.

Isodontia boninensis (Tsuneki, 1973) (Hymenoptera, Sphecidae), one of the wasps endemic to the Ogasawara Islands, is listed as Endangered II (Vulnerable) on the Japanese Red List (Ministry of the

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Environment, Government of Japan 2020). This species was recorded in the 1970s, with some adults collected within a short period on Chichi-jima and Haha-jima Islands (Haneda 1973; Nambu and Shimizu 1984). These records provide an important historical baseline for evaluating subsequent long-term non-detection. Despite this early documentation, the species has not been recorded in surveys since 1980 (Nishimura and Arai 1989; Miyano 1998; Karube et al. 2004). This history makes *I. boninensis* a useful focal species for examining how long-term non-detection should be interpreted under contrasting island conditions.

The genus *Isodontia* Patton, 1880 typically provisions nests with Orthoptera and, in some species, cockroaches (Iwata 1971; Murota 1999; Barthélémy 2010; Ito et al. 2015; Krichilsky et al. 2025; Pulawski 2026). Members of this genus nest in pre-existing cavities, including beetle-bored holes and naturally formed openings (Rennwald 2005; Terayama and Tano 2006; Terayama et al. 2016; Bosch et al. 2018). Collectively, these life-history traits suggest that local persistence likely depends on the concurrent availability of prey and suitable nesting cavities (Hisasue 2025; Hisasue and Hideshima 2025). However, for many wasps endemic to Ogasawara, including *I. boninensis*, basic ecological information remains limited, and the drivers of decline and extinction risk are poorly documented (Tokyo Metropolitan Government 2014).

Here, I report the rediscovery of *I. boninensis* and provide updated information on its locality and habitat. I also evaluate two non-exclusive mechanisms that may underlie long-term non-detection on invaded islands: prey limitation and nesting-cavity limitation.

Study Area

Collecting surveys were conducted from May 2023 to January 2026 on Chichi-jima and Ani-jima Islands: from July 2023 to October 2025 on Ototo-jima Island; from May to October 2025 on Nishi-jima, Higashi-jima, Minami-jima, and Tatsumi-jima Islands; and from June 2023 to October 2025 on Haha-jima Island.

Methods

The dried specimens examined in this study were deposited in the Kanagawa Prefectural Museum of Natural History, Odawara, Kanagawa, Japan (KPM-NK).

Photographs were captured using an M.ZUIKO DIGITAL ED 60 mm F2.8 Macro lens mounted on an Olympus OM-D E-M1 MarkIII digital camera. Images further edited in Adobe Photoshop CC.

The distribution map was produced using QGIS v. 3.28 (QGIS Development Team 2024) and SimpleMappr (Shorthouse 2010). Morphological terminology mainly followed that of Bohart and Menke (1976).

Results

Order Hymenoptera
Family Sphecidae Latreille, 1802
Subfamily Sphecinae Latreille, 1802
Tribe Sphecini Latreille, 1802
Genus *Isodontia* Patton, 1880

Isodontia boninensis **(Tsuneki, 1973)**
Figures 1, 2

New records. JAPAN — Ogasawara Islands • Ototo-jima Island, Ichi-no-tani; 11.VII.2023; Naomichi Tsuji leg.; 1 ♀, KPM-NK 100566 • same locality; 12.VII.2023; Yu Hisasue leg.; 1 ♂, KPM-NK 100567; • Ai-no-sawa, Mt. Tenkai-dake; 30.VI.2025; Yu Hisasue leg.; 1 ♂, KPM-NK 100568.

Identification. *Isodontia boninensis* is distinguished from other *Isodontia* species by the following combination of characteristics: body black; basal half of mandibles reddish brown; erect setae of clypeus yellowish brown; pubescence on frons yellowish brown; pubescence on scutum and abdominal tergite 1 silvery to yellowish brown; forewing hyaline except apex, apex of forewing membrane pale brown; hindfemur black; abdomen black.

The specimens examined in this study agreed with published descriptions and diagnoses of *I. boninensis* (Tsuneki 1973; Terayama et al. 2016) and were therefore identified as this species.

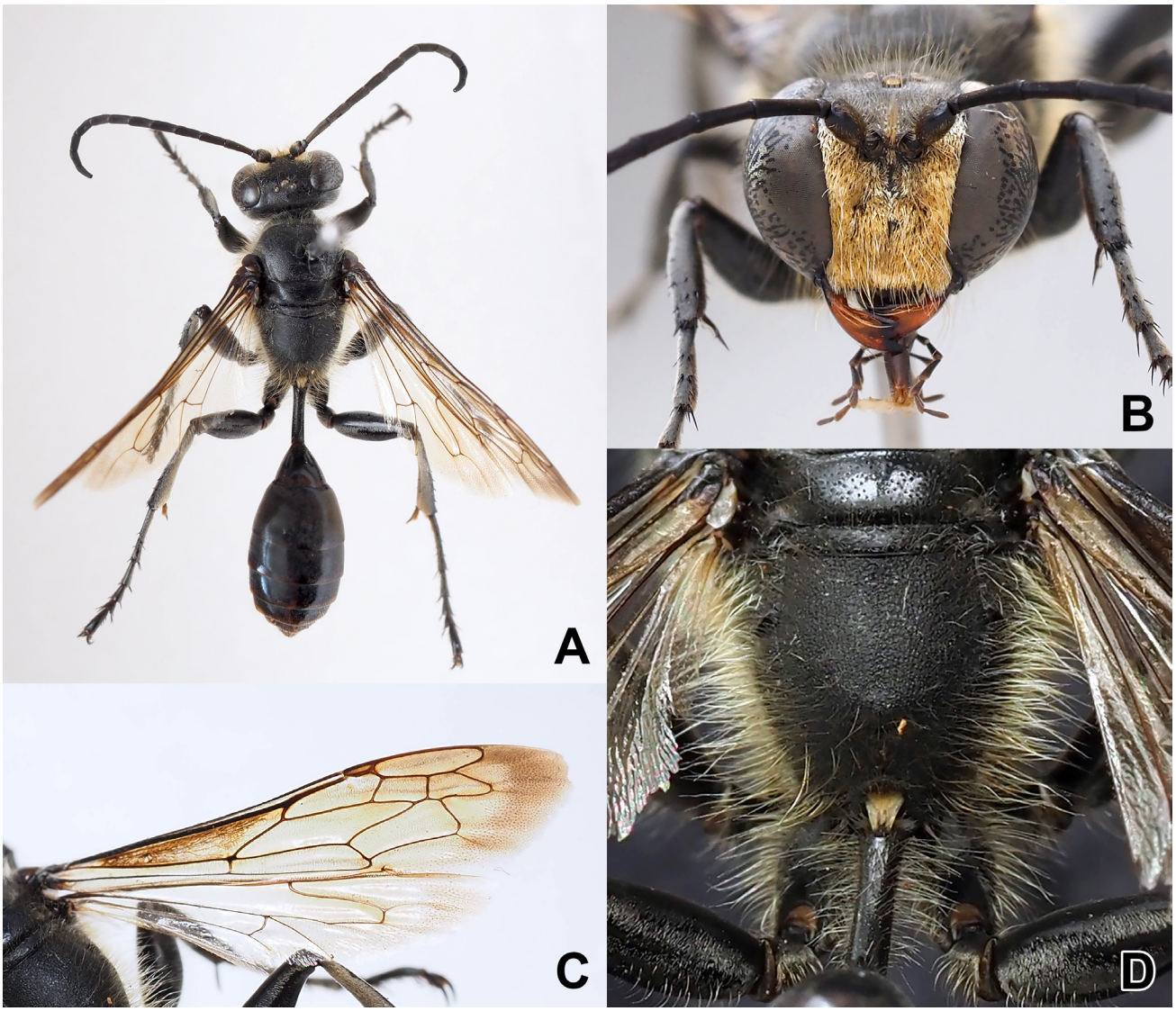

Figure 1. Male of *Isodontia boninensis* from Japan. **A.** Dorsal habitus. **B.** Frontal view of head. **C.** Forewing and hindwing. **D.** Dorsal view of propodeum and petiole.

Figure 2. Living habitus of *Isodontia boninensis* (Ototo-jima Island).

Distribution. Japan (Ototo-jima Island, Chichi-jima Island, Haha-jima Island) (Tsuneki 1973; Nambu and Shimizu 1984; Terayama 2020; present study) (Figure 3A–C).

Biology. The two individuals collected in July 2023 were captured while flying within the herb layer in forest canopy gaps. The single individual collected in June 2025 was captured with an aerial net while visiting flowers of *Schima wallichii* subsp. *mertensiana* (Siebold & Zucc.) Bloemb. in a dry shrub forest.

Discussion

The rediscovery of *Isodontia boninensis* is reported after more than four decades. Adults were collected from forest-interior habitats, including canopy gaps, with one individual captured while visiting the blossoms of *Schima wallichii* subsp. *mertensiana*, indicating use of floral resources. Haneda (1973) previously recorded nine individuals on Chichi-jima Island within a single day, indicating that the species was not extremely rare on the island in the early 1970s. Therefore, the prolonged absence of records cannot be attributed to intrinsic rarity alone.

Prolonged non-detection does not, by itself, demonstrate extinction. However, based on repeated island-wide surveys, the current pattern on anole-invaded islands is more consistent with a substantial decline than with detectability bias alone. *Isodontia boninensis* is large and conspicuous in flight, yet no individuals have been detected on Chichi-jima, despite repeated surveys across multiple seasons and major habitat types (May 2023–January 2026).

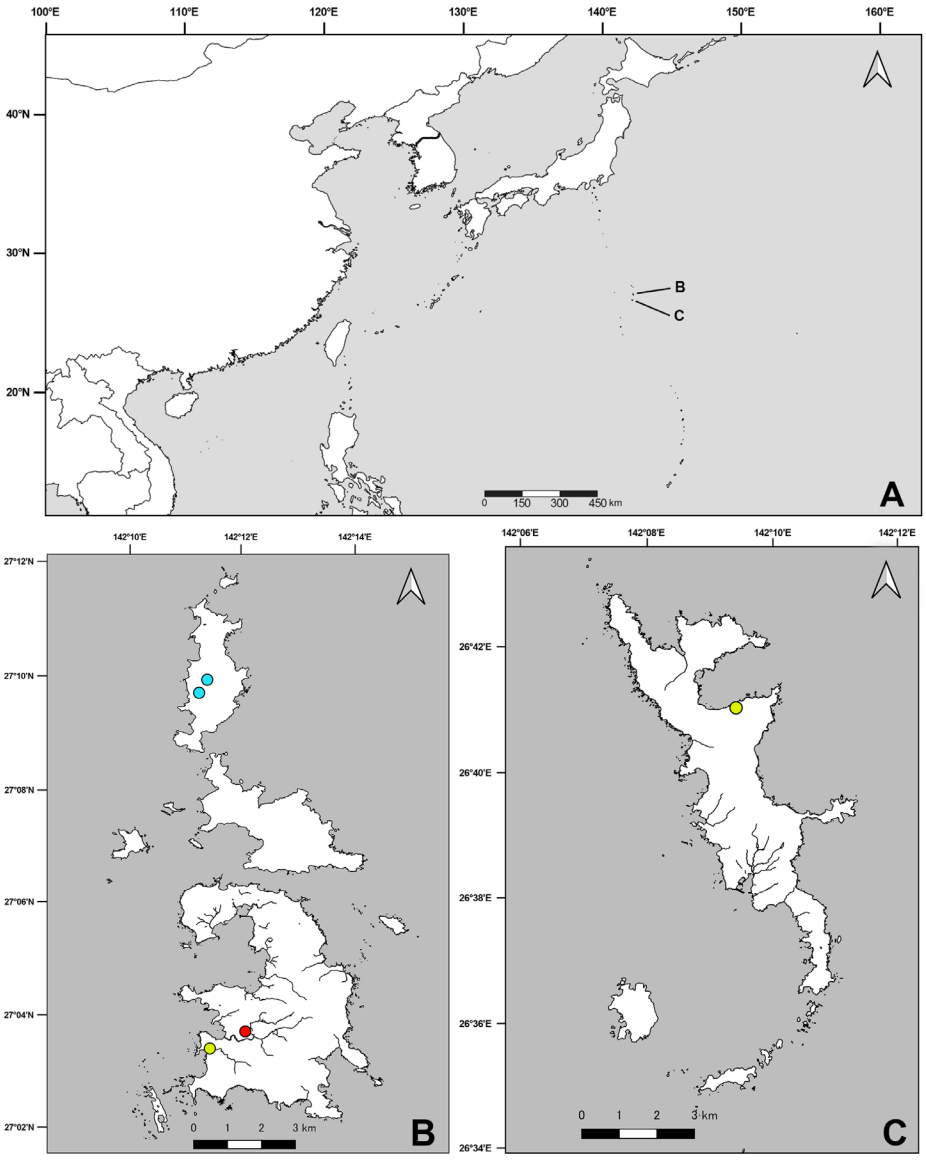

Figure 3. Distribution map of *Isodontia boninensis*. **A.** Location of the Ogasawara Islands. **B.** Distribution of *I. boninensis* in Chichijima Island group. **C.** Distribution of *I. boninensis* in Hahajima Island group. Type locality (Blue circle). Additional localities in the previous studies before 1980s (yellow circles). New localities in the present study (red circles).

Current records are restricted to Ototo-jima, where the invasive green anole has not yet been recorded (as of January 2026). In contrast, Green Anoles have a longer invasion history on Chichi-jima Island and have also been recorded on Ani-jima and Haha-jima Islands (Hasegawa et al. 1988; Suzuki 2002; Toda 2022). On Ani-jima, I conducted more than 30 standardized daytime surveys, including approximately 10 in the northern anole-free area, without detecting *I. boninensis*. On Ototo-jima, my colleague and I collected two individuals from one locality on 11–12 July 2023, and one additional individual from a nearby locality on 30 June 2025. These records suggest that Ototo-jima may function as a refugium for this wasp, which is consistent with the island-level invasion gradient. However, the sample size remains small, and further systematic surveys are needed.

Alternative explanations for the absence on Ani-jima include habitat differences among islands. In particular, Ani-jima contains more dry shrubland, whereas Ototo-jima includes more mesic forest. Chichi-jima, where the species was recorded historically, also supports mesic forest (Shimizu 1991; Shimizu et al. 1991). If *I. boninensis* depends on the forest-interior or mesic forest conditions, this vegetation contrast may contribute to the current island-level pattern. If the number of islands suitable for the persistence of this species is limited, then Ototo-jima, where the species still occurs, should be regarded as being of particularly high conservation importance.

Direct predation of adults by Green Anoles may occur, but indirect mechanisms appear to be particularly important, especially prey and nesting-cavity limitations. *Isodontia boninensis* is comparable in size to the carpenter bee *Xylocopa ogasawarensis* Matsumura, 1912 and may therefore be less vulnerable to frequent direct predation by anoles. Predation on large endemic insects has been documented (Karube and Suda 2004; Nagano et al. 2016), yet several such taxa remain extant on Chichi-jima (Nagano et al. 2016; Nagata et al. 2021; Kaga et al. 2026). In contrast, *I. boninensis* has not been recorded in major surveys since the 1980s (Nishimura and Arai 1989; Miyano 1998; Karube et al. 2004), suggesting an earlier or stronger decline than that in some other large endemic insects.

One plausible indirect pathway is prey limitation in this wasp. The prey of *I. boninensis* remains unknown. If *I. boninensis* similarly depends on orthopterans, reduced prey availability could lower provisioning rates and reproductive output. On Ani-jima and Ototo-jima Islands, numerous threatened endemic orthopterans occur in small and vulnerable assemblages, and recent invasions by alien species, including the Green Anole, *Geonemertes* sp., and others, have been suggested to affect native arthropod fauna, including orthopterans (Ishikawa 2022; Kishimoto 2022; Karube 2024; Yoshino 2025). This interpretation is plausible in Ogasawara.

Nesting-resource limitation is a second plausible pathway. Many *Isodontia* species nest in pre-existing cavities (Bohart and Menke 1976; Murota 1999; O'Neill and O'Neill 2003; Terayama et al. 2016). In the Ogasawara Islands, suitable native hollow substrates for a large-bodied species such as *I. boninensis* may be limited, and small hollow twigs used by small species of Apoidea may be unsuitable (Abe 2009; Kaga 2022). Rennwald (2005) documented *Isodontia* nesting in old *Xylocopa* burrows, suggesting that abandoned nests of the endemic *X. ogasawarensis* may function as potential nesting substrates in Ogasawara. In addition, declines in wood-boring beetles on Chichi-jima and Haha-jima may reduce cavity supply (Makihara et al. 2004; Hisasue et al. 2025), and this mechanism has been proposed as a risk factor for cavity-nesting wasps in the archipelago (Hisasue 2025; Hisasue and Hideshima 2025; Hisasue et al. 2025). Despite the presence of exotic predators, *X. ogasawarensis* remains abundant in the Ogasawara Islands (Kaga et al. 2026), any future decline in this cavity-producing bee could further increase extinction risk for *I. boninensis* by reducing the availability of suitably large nesting cavities.

Taken together, the persistence of *I. boninensis* likely depends on two linked resource domains: trophic and habitat/structural resources. Trophic resources include floral resources for adults and sufficient prey for provisioning. Habitat/structural resources include forest structure that supports these resources and suitably sized nesting cavities. On Chichi-jima, the long-term absence of records is more consistent with a substantial decline, possibly including local extirpation, than with underdetection alone. Detection probability was not directly quantified, however, and some uncertainty remains. Therefore, definitive conclusions should await expanded targeted surveys. Repeated records from Ototo-jima (2023, 2025) highlight the conservation value of less-invaded satellite islands as potential refugia for long-unrecorded native insects. A key next step is standardized multi-season monitoring across islands, using occupancy as a primary endpoint and integrating flower-visitation surveys, prey assessments, and large-diameter trap nests to test persistence mechanisms and guide conservation actions.

Additional Information

Conflict of interest
The author has declared that no competing interests exist.

Ethical statement
No ethical statement was reported.

Artificial intelligence (AI) use
No use of AI was reported.

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Data availability
All data that support the findings of this study are available in the main text.

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