# Sphecid wasp larvae feeding on large-sized cockroaches in a dead wood cavity

Ito, Masato
Oshio, Takumi
Handa, Hironobu
Watanabe, Kyohei

(Citation)
Journal of Hymenoptera Research,46:173-177

(Issue Date)
2015-11-30

(Resource Type)
journal article

(Version)
Version of Record

JHR 46: 173–177 (2015)
doi: 10.3897/JHR.46.5393
http://jhr.pensoft.net

SHORT COMMUNICATION

JOURNAL OF Hymenoptera RESEARCH
A peer-reviewed open-access journal
The International Society of Hymenopterists

# Sphecid wasp larvae feeding on large-sized cockroaches in a dead wood cavity

Masato Ito[1], Takumi Oshio[1], Hironobu Handa[2], Kyohei Watanabe[3]

**1** *Laboratory of Insect Biodiversity and Ecosystem Science, Kobe University, Rokkodaicho 1–1, Nada, Kobe, Hyogo 657–8501, Japan* **2** *Saitama Museum of Natural History, Nagatoro 1417–1, Chichibu, Saitama 369–1305, Japan* **3** *Kanagawa Prefectural Museum of Natural History, Iryuda 499, Odawara, Kanagawa 250–0031, Japan*

Corresponding author: *Masato Ito* (fixsenia@hotmail.co.jp)

Academic editor: *Jack Neff* | Received 30 May 2015 | Accepted 13 August 2015 | Published 30 November 2015

*http://zoobank.org/60F1104F-C754-456D-BBD1-C86A3F43200B*

**Citation:** Ito M, Oshio T, Handa H, Watanabe K (2015) Sphecid wasp larvae feeding on large-sized cockroaches in a dead wood cavity. Journal of Hymenoptera Research 46: 173–177. doi: 10.3897/JHR.46.5393

## Abstract

We investigated the nest site and prey items of *Isodontia auripygata* (Hymenoptera: Sphecidae) in a subtropical forest on Iriomote Island, ca. 200 km east of Taiwan. *I. auripygata* used the cavity of a dead branch as their nest site, and the nest was composed of two cells that were divided by wood offcuts. Inside the branch, we found large-sized adult cockroaches, *Rhabdoblatta formosana* (Blattodea: Epilampridae), *R. formosana* adults were fed to an *I. auripygata* larva in each cell. To our knowledge, this is the third record of species of the genus *Isodontia* that prey on cockroaches.

## Keywords

Sphecidae, Iriomote Island, *Isodontia auripygata*, cockroach prey, *Rhabdoblatta formosana*

## Introduction

Sphecid wasps (Sphecidae s. str. Latreille, 1802) are a diverse and cosmopolitan group, consisting of 19 genera and 736 species (Pulawski 2015). Each wasp species hunts a limited range of arthropod groups, e.g., Hymenoptera, Lepidoptera, Coleoptera, Orthoptera, or Araneae (Bohart and Menke 1976), and uses particular substrates as its nest site, e.g., plant cavities or ground nests (Bohart and Menke 1976).

*Isodontia* Patton, 1880 is a medium-sized genus of the family Sphecidae (Hymenoptera), which contains 61 described species that are distributed worldwide (Pulawski 2015). Of these, 23 species are recorded from the Oriental region, 14 from the Neotropical region, seven from the Nearctic region, six from the Palearctic region, five from the Ethiopia region, four from the Oceania region, and three from the Australia region (Pulawski 2015).

In the genus *Isodontia*, prey items for only 13 species (21%) have been recorded; 11 of these species (85%) use orthopterans (Pulawski 2015). Only two species, *I. diodon* (Kohl, 1890) and *I. formosicola* (Stand, 1913), have been reported to use cockroaches (Blattodea) as food for their larvae (Barthélémy 2010; Iwata 1939).

Five species of *Isodontia, I. auripygata* (Strand, 1913), *I. boninensis* (Tsuneki, 1973), *I. harmandi* (Perez, 1905), *I. maidli* (Yasumatsu, 1938), and *I. nigella* (Smith, 1856), have been recorded from Japan. Among these, the nesting biology (cavity of dead plants) and prey items (Orthoptera) are known for only *I. harmandi*, *I. maidli*, and *I. nigella* (Murota, 1999). Nest sites and prey items of the other two species have not previously been reported. One of them, *I. auripygata* was originally described from Taiwan (Strand 1913). In Japan, this species was first collected from Iriomote Island, ca. 200 km east of Taiwan, in 1978 (Nagase 2005). However, only four individuals have been collected since the first record (Takahashi 2005).

In late May 2014, we observed at least 10 individuals of *Isodontia auripygata* visiting flowers of *Psychotria rubra* (Lour.) Poir. (Rubiaceae) in the subtropical forest of broad-leaved evergreen trees on Iriomote Is. (24.340137°N, 123.913752°E). They frequently visited flowers between 12:00 and 15:00. In the forest, one individual was observed to go out of a small hole (diameter: about 10.0 mm) on a dead branch of a live tree (height: about 5 m), suggesting that a nest of *I. auripygata* was formed in the branch. Therefore, we examined the inside of the branch to find the nest and prey.

## Materials and methods

We used a knife to dissect the branch from which a wasp went out. The structure of the nest and the prey items were examined. The insects collected from the nest were preserved in petri dishes (diameter: 85 mm, height: 20 mm) and observed under laboratory conditions.

To clarify whether the wasp larvae found in the nest were of *Isodontia auripygata*, we compared DNA sequences of the mitochondrial COI gene between the larva and

an *I. auripygata* adult. DNA was extracted from the larva found in the nest, and an adult collected from *Psychotria rubra* flowers. The detailed method of DNA extraction is described in Ito et al. (2014), who used the primer set (LCO1490, HCO2198) designed by Folmer et al. (1994). All the DNA sequences obtained are deposited in the DDBJ/EMBL GenBank database.

## Result

We found that the nest was composed of two cells in the branch. The cells were delimited by wood fragment partitions (each cell length: about 50 mm, tunnel diameter: about 1.5 mm (Fig. 1b, c)). We found anesthetized adults of the cockroach *Rhabdoblatta formosana* (Shiraki, 1906) (Epilampridae) in these cells: one female and one male cockroach were found in the upper cell (cell A), while two female and two male cockroaches were found in the lower cell (cell B; Fig. 1b, c). We found one wasp larva on the base of the fore coxa of a cockroach in each petri dish four days after the collection (May 16 2014).

The wasp larva collected from cell B consumed three cockroaches. The COI sequence of the wasp larva was identical to the sequence of *I. auripygata* adult (570 bp, 100% sequence homology).

The wasp larva collected from cell A consumed two cockroaches. This larva spun a cocoon 10 days after the collection. This individual pupated on 17 April 2015, and emerged on 6 May 2015, suggesting one generation per year in this species. (One assumes this individual was an Isodontia auripygata adult – perhaps a male given the lesser number of prey item.) (Since the nest was provisioned in May 2014 but the mature larva did not pupate until April 2015, this suggests extended larval diapause and fewer than one generation per year (although the extended diapause could be an artefact)).

## Discussion

Wasps of the genus *Isodontia* are known to use cavities of dead plants as nest sites (e.g. Iwata 1939; Barthélémy 2010; Murota 1999). Similarly, in the present study, *I. auripygata* nests were found in the cavities of dead tree branch. The cavity shape was similar to that of nests of the carpenter bee *Xylocopa appendiculata circumvolans* (Smith, 1873) (Sugiura 1995). Because *X. appendiculata circumvolans* does not occur on Iriomote Is., it is likely that *I. auripygata* may have used an empty nest of *X. albinotum* Matsumura, 1926, a similar carpenter bee which does occur there. (one might indicate that both belong to the same subgenus, *Alloxylocopa*).

Iwata (1939) reported that *Isodontia formosicola* used adults of an unidentified cockroach species (body length, ca. 35 mm) as food for its larvae. Barthélémy (2010) reported that *I. diodon* used adults and nymphs of the small-sized cockroach genera *Balta* and *Blattella* (5–15 mm) as food. In this study, we found *I. auripygata* used

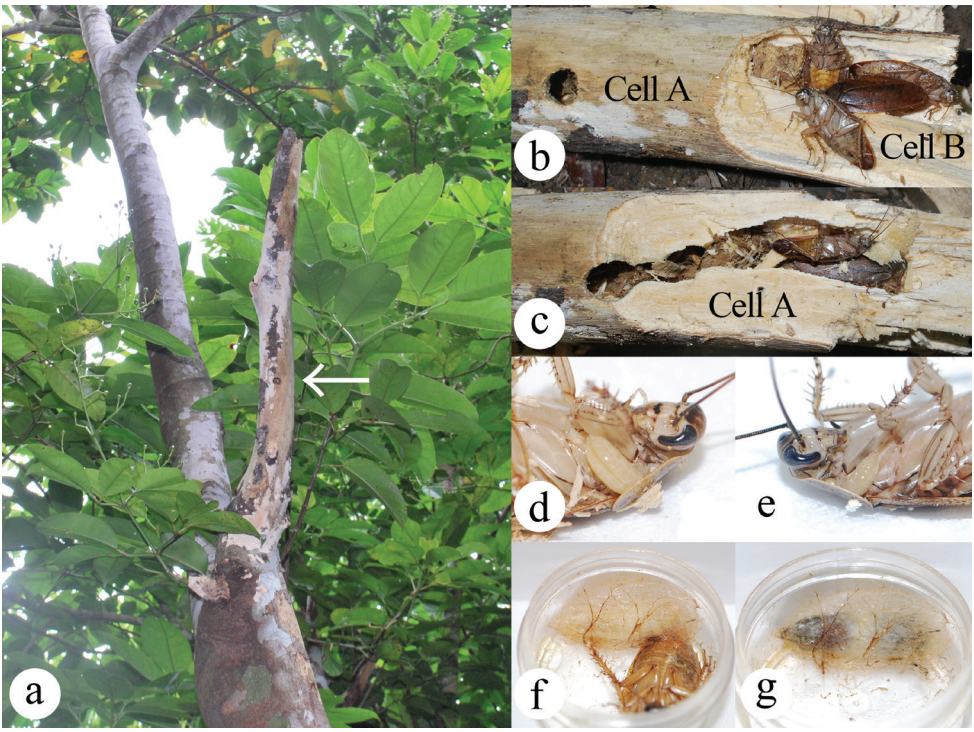


**Figure 1.** A dead branch of a live tree (**a**), inside of cell B (**b**), inside of cell A (**c**), wasp larva of cell B (**d**), wasp larva of cell A (**e**), prepupa of wasp in cell A (**f**), and cocoon of wasp in cell A (**g**).

adults of the large-sized cockroach *R. formosana* (23–33 mm; Asahina 1991). Female body length differed among *I. formosicola* (17–26 mm; Hensen, 1991), *I. diodon* (14–19 mm; Hensen 1991), and *I. auripygata* (30 mm; in this study). The widely differing body sizes of *Isodontia* wasps is a likely basis for the differences in prey (cockroach) size.

Nymphs of *Rhabdoblatta formosana* were not found among the prey items of *I. auripygata* detected by us. The habitats of *R. formosana* nymphs and adults are known to differ; nymphs are frequently being found under stones along forest streams, while adults are found on ferns in forests (Bell et al. 2007). While our sample size is small (1 incomplete nest), *Isodontia auripygata* adults are thus far known to prey only on *R. formosana* adults, but not nymphs.

## Acknowledgements

We thank T. Mita for his accompanying our investigation and kind advice, and T. Katsuyama (KPMNH) identified the visiting flower. S. Sugiura provided us with helpful comments on this manuscript. This research was partly supported by JSPS KAKENHI Grant Number 26840134 to KW and the Sasakawa Scientific Research Grant from the Japan Science Society to MI.

## References

Barthélémy C (2010) Nesting Biology of *Isodontia diodon* (Kohl, 1890) (Hymenoptera: Sphecidae), a predator of cockroaches, in Hong Kong. Journal of Hymenoptera Research 19: 201–216.

Asahina S (1991) Blattaria of Japan. Nakayama shoten, 253 pp.

Bell WJ, Roth LM, Nalepa CA (2007) Cockroaches Ecology, Behavior, and Natural History. The John Hopkins University Press, 230 pp.

Bohart RM, Menke AS (1976) Sphecid wasps of the world: a generic revision. University of California Press, 695 pp.

Folmer O, Black M, Hoeh W, Lutz R, Vrijenhoek R (1994) DNA primers for amplification of mitochondrial cytochrome c oxidase subunit I from diverse metazoan invertebrates. Molecular Marine Biology and Biotechnology 3: 294–297.

Hensen RV (1991) Review of Malesian Sphecina (Hymenoptera, Sphecidae, Sphecinae). Tijdschrift Voor Entomologie 134: 9–30.

Iwata K (1939) Habits of some solitary wasps in formosa (IV). The journal of the Natural History Society of Taiwan 29: 161–178.

Murota T (1999) On the nesting behavior of *Isodontia maidli* Yasumatsu (Hymenoptera) and the Fukui prefectural distribution. Entomological Journal of Fukui 24: 17–24.

Nagase H (2005) New record of Sphecid wasp from Japan. Tsunekibachi 4: 26.

Pulawski WJ (2015) Catalog of Sphecidae sensu lato: http://www.calacademy.org/scientists/projects/catalog-of-sphecidae [updated 18 Mar. 2015]

Sugiura N (1995) Burrow construction by the Japanese carpenter bee, *Xylocopa appendiculata circumvolans* Smith, for Overwintering (Hymenoptera: Anthophoridae). Journal of the Kansas Entomological Society 68: 116–119.

Strand E (1913) H. Sauter's Formosa-Ausbeute. Crabronidae und Scoliidae. I. (Die Gattungen *Sphex*, *Sceliphron* und *Ammophila*, nebst Literaturverzeichnis als Nachtrag zu Dalla Torres Katalog.). Archiv für Naturgeschichte 79A (3): 76–87.

Takahashi H (2005) Records of Isodontia auripygata (Hymenoptera, Sphecidae) in Japan and Taiwan. Tsunekibachi 5: 17–18.