

Short communication

## Subterranean ant *Pyramica hexamera* (Hymenoptera, Formicidae) recorded from Okayama Prefecture: first specimens collected in Okayama City

Shuji KOBAYASHI<sup>1\*</sup>, Risa SAKAI<sup>1</sup>, Haruka KAJI<sup>1</sup>, Seika KIZU<sup>1</sup>,  
Shion TATEISHI<sup>1</sup>, and Hiroyuki TAKASAKI<sup>1</sup>

**Abstract:** The subterranean ant *Pyramica hexamera* (Insecta, Hymenoptera, Formicidae, Myrmicinae, Dacetini) was recorded in Okayama Prefecture for the first time. Three worker specimens were collected by using a simplified Berlese-Tullgren apparatus on the Okayama University of Science campus in Okayama City, southwestern Honshu, Japan. The collection site was a secondary deciduous broadleaf forest in the warm temperate evergreen broadleaf forest zone, developed on a hill slope in the urban fringe of the city center, spread on a flood plain facing the Seto Inland Sea. Its infrequent capture, along with intermittently scattered areas with no collection records despite its widespread distribution throughout southern Japan, was discussed, as well as its likely invasive global dispersion in the near future.

### I. Introduction

*Pyramica hexamera* was originally described by Brown (1958) with one dealate female specimen from Numazu (central Honshu) and two workers from Chikugo (northern Kyushu) in Japan. This species is supposedly rare, but widespread throughout southern Japan, although unrecorded areas are intermittently scattered (Japanese Ant Database Group [JADG] 2003; updated in JADG's [2003-2009] Japanese Ant Image Database [JAnt]). Neither JAnt nor Okayama Prefecture Wildlife Species List 2009 (Okayama Prefecture Wildlife Survey Committee [OPref-WSC] 2009) includes this species as present in Okayama Prefecture. We collected three worker specimens of this species, the first time in the prefecture, and report here their collection locality with a brief description of the habitat's vegetation. The rarity of this species in Japan is discussed in view of global dispersion of subterranean ants due to human commerce.

### II. Materials and Methods

In the 2013 Undergraduate Fieldwork class of

Okayama University of Science's (OUS) Department of Zoology, forest floor leaf litter and soil quadrat samples (25 × 25 cm<sup>2</sup> [leaf litter surface area] × 20 cm [depth]) were collected to study subterranean animals. They were screened by a simplified Berlese-Tullgren apparatus (Fig. 1) applied to the soil layer after roughly removing the leaf litter layer. The removed leaves were checked one by one with the naked eye to recover remaining animals. The apparatus was simplified by using a sieve instead of a funnel, and the heat



Fig. 1. A sieve instead of a funnel realizes a simplified Berlese-Tullgren apparatus, using the intensive heat and light of the sun on the rooftop of a building instead of an electric light.

\*To whom correspondence should be addressed. E-mail: [skobaya@zool.ous.ac.jp](mailto:skobaya@zool.ous.ac.jp)

1. Department of Zoology, Faculty of Science, Okayama University of Science, 1-1, Ridai-cho, Kita-ku, Okayama-shi, Okayama-ken 700-0005, Japan.

and light of the sun on the rooftop of a building instead of an electric light. The subterranean animals fleeing from the heat and light fell into the detergent solution in a washbowl set under the sieve. On 11 June 2013, 12 quadrat samples were collected and applied to the apparatus, and the specimens were preserved in 70% ethanol. The specimens were identified and counted on 18 and 22 June.

The collection site (Fig. 2; 34°41'51"N, 133°55'45"E) was on the OUS campus at Ridai-cho, kita-ku, Okayama City, southwestern Honshu, Japan. The campus is on a hill slope in the urban fringe of the city center, spread on a flood plain facing the Seto Inland Sea in the warm temperate zone. The climatic climax vegetation there is an evergreen broadleaf forest. As of July 2013, the vegetation at the exact location of the quadrat concerned was dominated by the deciduous *Quercus variabilis* and *Q. serrata* with dead trunks of *Pinus densiflora* still standing in the top layer (about 15 m high). The evergreen *Q. glauca* and *Ilex rotunda* were growing in the lower layers, which will replace the top layer species in the future following a secondary succession sequence, typical in the area after human disturbance of the vegetation. Some part of the top layer was tangled by the climbing liana *Wisteria floribunda*. In the shrub layer were *Rhododendron reticulatum*, *Eurya japonica*, *Dendropanax trifidus*, and *Elaeagnus pungens*. In the disturbed sun-lit forest edges were *Deutzia crenata*, *Mallotus japonicus*, and *Cornus macrophylla*.

### III. Results

Three worker specimens of *Pyramica hexamera* (original specimen Nos. OUSZ189-00001, OUSZ189-00002, and OUSZ189-00003) were found in only one quadrat sample. All aspects in the distinct morphology shown in the collected specimens (Fig. 3) were identical to the description by Brown (1958) and matched with the images found in JADG (2003) and JAnt: "Total length of workers around 2 mm. Body color yellowish brown. Mandibles with 2 pairs of preapical teeth; apical dentition including a distinct dorsal spiniform tooth. Anterior margin of clypeus without peculiar hairs. Dorsal outline of mesosoma horizontal from pronotum to mesonotum; the latter overhanging the propodeum. Propodeal spine distinct. Spongiform appendages on posterolateral portion of propodeum relatively weakly developed."

OPrefWSC (2009) did not list this species as occurring in Okayama Prefecture. Instead, but it



Fig. 2. View of the collection site forest vegetation (Photo by H. Takasaki).

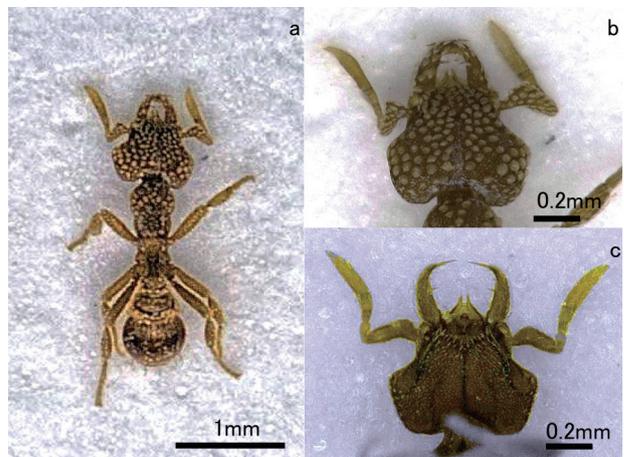


Fig. 3. Worker specimen of *Pyramica hexamera* (Photo by S. Kobayashi): dorsal view of OUSZ189-00001(a), dorsal head of OUSZ189-00001(b) and ventral head of OUSZ189-00002(c).

only listed *Pyr. canina*, whereas JADG (2003) and JAnt mapped the half-sized *Pyr. hirashimai* as present in the prefecture (Y. Okushima [personal communication, 2013], curator at Kurashiki Museum of Natural History [KNMH], regards the presence of *Pyr. hirashimai* in the prefecture as dubious.). Worker specimens of the congeneric *Pyr. canina*, which is also "rare" (JADG 2003; JAnt), were obtained in numbers in two other quadrats sampled from separate forest patches on the OUS campus.

The specimens differed from *Pyr. canina*, of which the "worker is around 2.5–3 mm, with rather long mandibles 1.5 times as long as preapical (5th) antennal segment or longer; largest tooth present at about mid-length of masticatory margin" (JADG 2003). Also, they differed from *Pyr. hirashimai*, of which the "worker is around 1 mm in total length, with mandibles without small teeth on their shafts, and spongiform appendages on

posterolateral portion of propodeum developed” (JADG 2003).

One of the three worker specimens of *Pyr. hexamerai* was donated to Kurashiki Museum of Natural History (KMNH) for permanent storage (museum specimen No. KURA JI134379, original specimen No. OUSZ189-00003), the remaining two are stored at the OUS Department of Zoology. The other ant (Formicidae) specimens found in the same quadrat sample were workers of the following three species: *Crematogaster matsumurai* (Myrmicinae, Crematogastrini) 1 ex.; *Myrmecina nipponica* (Myrmicinae, Myrmecini) 2 exs.; and *Pachycondyla pilosior* (Ponerinae, Ponerini) 3 exs. Incidentally, *Pachy. pilosior* is remarked as being “relatively rare” in JADG (2003) and JAnt.

#### IV. Discussion

The ants of the genus *Pyramica*, in which the present species is classified, are subterranean predators, which specialize in feeding on minute arthropods, springtales (Collembola) in particular, and dwell in leaf litter (e.g., Masuko 2009). In general, this genus of ants has been the subject of only a few studies. *Pyr. hexamera* is one of the few functionally monogamous ant species in which uninseminated queens have been reported (T. Kikuchi’s unpublished data cited in Kikuchi and Tsuji 2005), although the reasons for the presence of such queens are variously hypothesized, though not yet clarified. Notably, one of the congeneric species, *Pyr. incerta*, is suggested through its co-occurrence and behavior to be a social parasite in xenobiosis or even lestopobiosis depending on *Cryptopone sauteri* (Masuko 1993).

The worldwide transfer of ant species has become a global concern (e.g., McGlynn 1999). As information on the “rare” *Pyr. hexamera* in Japan is insufficient, its endangered status on the Red List is still pending (Japan Red List Species Database Search System, as of 21 June 2013). On the other hand, this species has been reported to have spread to some southeastern states in North America (Florida, Louisiana, Mississippi, and Alabama) due to human commerce, outside of its presumed native distribution range in East Asia, i.e. Japan, southern Korea, and Taiwan (MacGown and Wetterer, 2012). It is not the only dacetine ant which has been reported to be spreading through transfer by humans (e.g., *Strumigenys emmae*, Wetterer 2012).

*Pyr. hexamera* can only be found by careful studies of the forest floor via leaf litter and soil

samples, and many prefectures in Japan still lack such detailed studies regarding ant fauna, as Sato et al. (2010) suggest. Although the Chugoku District in southwestern Honshu, Japan, comprises Okayama, Tottori, Shimane, Yamaguchi, and Hiroshima Prefectures, this species has only been formerly recorded in Hiroshima (JADG 2003, JAnt). Extensive surveys may reveal it is present in all of Chugoku’s prefectures and is thus not rare. In a detailed nest density study in an evergreen broadleaf forest in central Honshu, Masuko (2010) found 10 colonies of this species in 30 1-m<sup>2</sup> quadrats. In fact, it may be widespread and continuously distributed throughout similar climatic areas not only in Japan, southern Korea, and Taiwan, but also in other regions of East Asia. Up until 2012, however, *Pyr. hexamera* has not been listed in the ant fauna on mainland China (Xu and Zhou 2004; Guénard and Dunn 2012). Further studies of subterranean ant fauna including this species are urgently wanted before likely-to-occur worldwide dispersal of many species due to human activities.

#### Acknowledgements

All the students in the 2013 OUS Zoology Department fieldwork class shared this exciting discovery. Y. Okushima at KMNH kindly checked the ant fauna records of the prefecture. K. Masuko at Senshu University, K. Nakamura and I. Kuroki at OUS Department of Biosphere-Geosphere Science helped us obtain some reference materials. L. Bonick kindly read the manuscript to eliminate linguistic errors. We are grateful to these people.

#### References

- Brown, W.L., Jr. (1958). A new Japanese species of the dacetine ant genus *Epitritus*. *Mushi*, 31: 69-72.
- Guénard, B. and Dunn, R.R. (2012). A checklist of the ants of China. (Zootaxa 3558) Magnolia Press, Auckland, New Zealand, 77 p.
- Japan Red List Species Database Search System (<http://www.jpnrdb.com/search.php?mode=region&q=13&k=07&disp=&pageID=15&t=f&cd=0719025&s=sca>). Accessed 21 June 2013.
- Japanese Ant Database Group [JADG] (2003). *Ants of Japan*. Gakken, Tokyo, 196 p. 「日本産アリ類全種図鑑」. 学研, 東京.
- Japanese Ant Database Group (2003-2009). *Japanese Ant Image Database [JAnt]*. 「日本産アリ類画像データベース」. (Japanese, <http://ant.edb.miyakyo-u.ac.jp/J/Taxo/F42901.html>; English, <http://ant.edb.miyakyo-u.ac.jp/E/Taxo/F42901.html>) アリ類データベース作成グループ (Original text by K. Ogata

- and K. Onoyama. English translation by K. Ogata, edited by R.W. Taylor. Revised by M. Yoshimura). Accessed 21 June 2013.
- Kikuchi, T. and Tsuji, K. (2005). Unique social structure of *Probolomyrmex longinodus*. *Entomological Science*, 8: 1-3.
- MacGown, J.A. and Wetterer, J.K. (2012). Geographic spread of *Pyramica hexamera* (Hymenoptera: Formicidae: Dacetini) in the southeastern USA. *Terrestrial Arthropod Reviews*, 5: 3-14
- Masuko, K. (1993). Is the subterranean ant *Pyramica incerta* trophobiotic? *Transactions of the Association for Natural Science, Senshu University*, 59: 1-9. 益子恵一. 「ノコバウロコアリは盗食共生者か」. 専修自然科学研究会会報.
- Masuko, K. (2009). Studies on the predatory biology of oriental dacetine ants (Hymenoptera: Formicidae). III. predation on gamasid mites by *Pyramica mazu* with a supplementary note on *Pyr. hexamerus*. *Journal of the Kansas Entomological Society*, 82(2):109-113. doi: <http://dx.doi.org/10.2317/JKES806.17.1>
- Masuko, K. (2010). Nest density and distribution of subterranean ants in an evergreen broad-leaf forest in Japan with special reference to *Amblyopone silvestrii*. *Entomological Science*, 13:191-198. DOI: 10.1111/j.1479-8298.2010.00383.x
- McGlynn, T. (1999). The worldwide transfer of ants: geographical distribution and ecological invasions. *Journal of Biogeography*, 26(3): 535-548.
- Okayama Prefecture Wildlife Survey Committee [OPrefWSC] (2009). Okayama Prefecture Wildlife Species List 2009. 岡山県生物調査委員会「岡山県生物目録. 2009 ([http://www.pref.okayama.jp/uploaded/life/67604\\_227826\\_misc.pdf](http://www.pref.okayama.jp/uploaded/life/67604_227826_misc.pdf)). Accessed 21 June 2013.
- Sato, T., Tsurusaki, N., Hamaguchi, K., and Kinomura, K. (2010). Ant fauna of Tottori Prefecture, Honshu, Japan. *Bulletin of the Tottori Prefectural Museum* 47: 27-44. 佐藤隆士・鶴崎展巨・濱口京子・木野村恭一. 「鳥取県のアリ類」. 鳥取県立博物館研究報告.
- Wetterer, J.K. (2012). Worldwide spread of Emma's dacetine ant, *Strumigenys emmae* (Hymenoptera: Formicidae). *Mymercological News*, 16: 69-74.
- Xu, Z.-H., and Zhou, X.-G. (2004). Systematic study on the ant genus *Pyramica* Roger (Hymenoptera, Formicidae) of China. *Acta Zootaxonomica Sinica*, 29 (3): 440-450.
- 小林秀司・酒井理沙・梶 遥香・木津聖花・立石風音・高崎浩幸：岡山県初記録の落葉土壌性セダカウロコアリ *Pyramica hexamera* (Hymenoptera, Formicidae)を岡山市北区で採集

#### 和文要約

落葉土壌性のセダカウロコアリ *Pyramica hexamera* (昆虫綱, ハチ目, アリ科, フタフシアリ亜科, ウロコアリ族)が, 岡山県で初めて記録された. 岡山市北区理大町にある岡山理科大学の構内で, 簡素化したベルレーゼ-ツルグレン装置を用いて, 3個体の働きアリが採集された. 採集地は暖温帯にあり, 常緑広葉樹林を極相とする二次林のアベマキやコナラが優占する落葉広葉樹林である. 本種の国内での報告例の少なさと, 人為活動にともなう世界的な分布拡大の危険性が議論された.

(Accepted 28 November 2013)