

## SHORT COMMUNICATIONS

### Habitat preferences of *Strumigenys* ants in western Japan (Hymenoptera: Formicidae)

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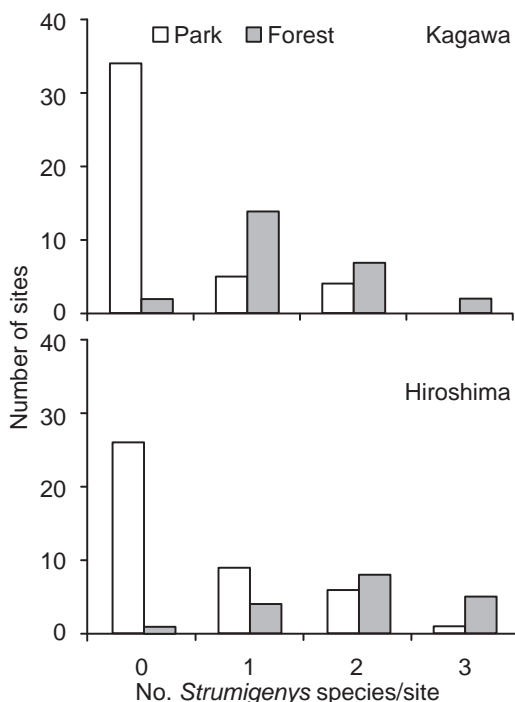
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The ant tribe Dacetini contains more than 800 species (Bolton *et al.* 2006). Many dacetine ants are specialized predators on soil inhabiting arthropods such as Collembola, Acarina, and to some extent also Diplura (Brown and Wilson 1959; Masuko 1984, 2009ab; Wilson 1953). Due to their peculiar morphological characteristics related to this specialized predation, dacetine ants have attracted the interest of many myrmecologists, who have described a diversity of hunting behaviors in these ants (e.g. Brown and Wilson 1959; Dejean 1986, 1988; Wilson 1953; Masuko 1984, 2009ab). Moreover, some species are known as tramp species, e.g. *Strumigenys emmae* (Emery, 1890), *Strumigenys membranifera* Emery, 1869, and *Strumigenys rogeri* Emery, 1890 (Brown 1949, 1954; Brown and Wilson, 1959). To date, habitat preferences of dacetine ants have been poorly reported and quantitative results remain scarce except for some ant community studies (e.g. Graham *et al.* 2004). In this tribe, *Strumigenys* and *Pyramica* are the most species-rich genera (Bolton 2000, Bolton *et al.* 2006). However, the classification of the tribe Dacetini is highly debated. Baroni Urbani and de Andrade (2007) treated *Pyramica* as synonym of *Strumigenys*, and phylogenetic analysis based on molecular data show that neither genus is monophyletic (Moreau and Bell 2013). Therefore we follow Baroni Urbani and de Andrade (2007),

since no large-scale phylogenetic study has resolved the systematics of the dacetines.

Recently, we found a novel reproductive organisation in *S. membranifera* colonies. Eggs laid by virgin queens become workers or alate



**Fig. 1.** Frequency of surveyed sites with each number of collected *Strumigenys* species.

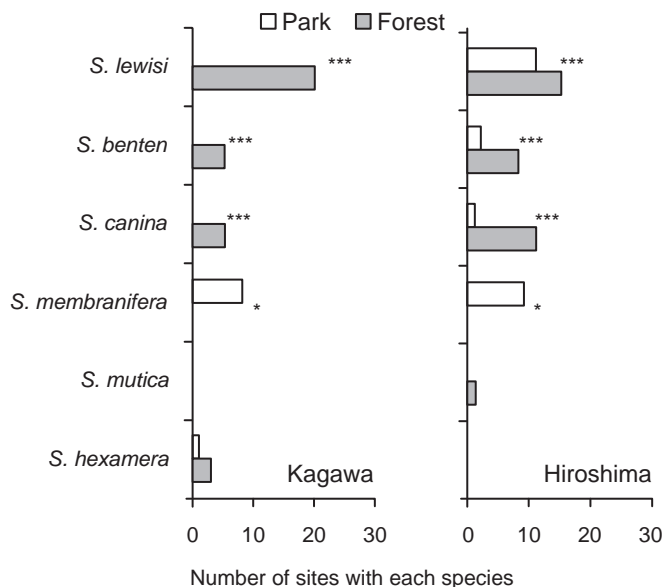
queens, whereas males have been never collected (Ito *et al.* 2010). Thus, *S. membranifera* may be an obligate thelytokous species, which shows a type of parthenogenesis in which females are produced from unfertilized eggs. To understand the evolution of thelytoky, a comparative study on several aspects of biology among related dacetines is needed. In this paper, we report on the habitat preference of *S. membranifera* and other Japanese *Strumigenys*.

To investigate the habitat preferences of *Strumigenys* ants, we carried out quantitative sampling of the ant fauna across several sites in and around Hatsukaichi-shi, Hiroshima Prefecture (Honshu Island) and Takamatsu-shi, Kagawa Prefecture (Shikoku Island). Hiroshima and Kagawa are located across the Seto Inland Sea. In this study, a total of 85 urban parks (43 in Kagawa, and 42 in Hiroshima) and 43 forest sites (25 in Kagawa, and 18 in Hiroshima) were surveyed between 2000 and 2009. These urban parks were typically arranged as follows. A large area of bare ground was surrounded by a hedge of azalea and/or boxwood, and some taller trees such as cherry trees and camphor trees were planted. Leaf litter was accumulated under the hedge and taller trees. Some playground equipment such as a sliding bed, an iron bar and a seesaw were

located at the edge of the park. The size of parks varied between 152 m<sup>2</sup> and 7700 m<sup>2</sup>. Forest sites included evergreen forests, deciduous broad-leaved forests, and bamboo forests. In this paper, we treated these as “forest sites”, irrespective of the dominant plant species.

To collect litter-dwelling ants, we used two standardized methods, that is, 5 min. sampling (only for urban parks in Kagawa) or quadrat sampling (other sites). In the 5 min. sampling, we continuously collected litter under a hedge and/or beneath taller trees, and sieved using a handy sieve over a plate and the falling ants were collected for 5 min. In the quadrat sampling, leaf litter from a 30 cm × 30 cm area was sieved onto a plate and the ants collected. In both methods, we tried to collect as many species as possible. Ten samples were taken from each forest site, but the number of samples from urban parks varied from five to ten depending on the area of park. We analyzed only the presence/absence of each species in each study site in order to obtain an overview of the distribution. All statistical analyses were conducted in the statistical package R v3.0.2 (R Development Core Team 2013).

In total six species of *Strumigenys* were collected. Five of these species formally belong to the genus *Pyramica* (except for *Strumigenys*



**Fig. 2.** Frequency of occurrence of *Strumigenys* ants in forest sites and residential parks in Kagawa and Hiroshima. \* P < 0.05 \*\*P < 0.01 \*\*\*P < 0.001

*lewisi* Cameron, 1886). In both Hiroshima and Kagawa, *Strumigenys* ants were more diverse in forest sites than urban parks (Fig. 1, Fisher's exact probability test, Hiroshima,  $P < 0.0001$ ; Kagawa,  $P < 0.0001$ ). One of the reasons may be the difference of sample size between parks and forests ( $< 10$  vs.  $10$ ), however, the limitation of possible nesting sites for these ants in urban parks may result in the lower diversity of *Strumigenys* ants. *Strumigenys lewisi* was the most common species in both Hiroshima and Kagawa (Fig. 2). This species was collected from more than 80% of the forest sites of both regions, but its frequency was much lower in urban parks in Hiroshima (Fisher's exact probability test,  $P < 0.001$ ), and no *S. lewisi* was collected from urban parks in Kagawa. With respect to other species, *Strumigenys mutica* (Brown, 1949) and *Strumigenys hexamera* (Brown, 1958) were relatively rare: the former was found in only one forest site in Hiroshima, and the latter was collected in three forest sites and one urban park in Kagawa. *Strumigenys benten* (Terayama, Lin & Wu, 1996), *Strumigenys canina* (Brown & Boisvert, 1979) and *S. membranifera* were collected in both regions. *S. benten* and *S. canina* were almost exclusively found in forests, but in Hiroshima, they were also collected from a few parks. In contrast, *S. membranifera* was collected in eight of 41 urban parks in Kagawa, while they were not collected in any of 25 forest sites (Fisher's exact probability test,  $P < 0.05$ ). Also in Hiroshima, nine of 42 parks harbored *S. membranifera*, while this species was not collected from any of the 18 forest sites (Fisher's exact probability test,  $P < 0.05$ ).

The present study shows that *S. membranifera* in Japan apparently prefers open habitats. Wetterer (2011) showed the same tendency in several populations of this species. Among 29 dacetine species known from Japan, *Strumigenys minutula* Terayama & Kubota, 1989, *Strumigenys exilirhina* Bolton, 2000, *S. emmae* and *S. membranifera* are found in open habitats, while the others are mostly found in forests (Japanese ant database group 2008). In Costa Rica, Longino (2010) found that five (*Strumigenys margaritae* Forel, 1893, *Strumigenys simoni* Emery, 1895, *S. membranifera*, *S. emmae*, and *Strumigenys marginiventris* Santschi, 1931)

of 63 *Strumigenys* species are found in open, disturbed areas. Thus, species exclusively found in open habitats such as *S. membranifera* are relatively rare in *Strumigenys*.

As discussed by Ito *et al.* (2010), thelytokous reproduction, which was recently confirmed for Japanese populations of *S. membranifera*, seems to be adaptive for inhabiting open, disturbed habitats. This is because the high intrinsic rate of natural increase made possible by the reduction of male production is favored in areas that experience frequent disturbances (MacArthur and Wilson 1967; Tsuji and Tsuji 1996). Recently, Masuko (2013) reported that *S. hexamera* shows thelytokous reproduction in the same way as in *S. membranifera*. *S. hexamera* is mainly found in evergreen forests (Japanese ant database group, 2008), however, it is also distributed in urban parks as found in this study. Thus, the association between habitat preferences and the mode of reproduction seems to be robust. Further investigation into the biology of the dacetine ants distributed in open habitats, especially tramp ants like *S. emmae* and *S. rogeri*, is necessary to confirm this hypothesis.

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