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BRIEF COMMUNICATION

Euryglossina (*Euryglossina*) *perpusilla* (Hymenoptera: Colletidae: Euryglossinae) nesting in pre-formed cavities in *Bankisa attenuata* (Proteaceae)

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Abstract. This article reports observations of nesting by *Euryglossina* (*Euryglossina*) *perpusilla* Cockerell in preformed cavities in a *Banksia attenuata* Brown tree in an urban bushland remnant.

INTRODUCTION

The natural history of biological organisms — what they are, and how they live and interact with their biotic and abiotic environment, *e.g.*, habitat preferences and their reproductive behaviours, are vital for advancing science (Boero, 2013). Moreover, effective conservation requires knowledge of a species' niche and interactions with its environment. Consequently, the task of increasing knowledge and understanding of the natural history of Australian native bees is one of urgency given the rapid transformation of natural habitats to urbanization, as well as reports of bee declines across the globe (IPBES, 2016). Australia's native bee assemblages include a great diversity of species, many endemic, but there are large gaps in our knowledge about their taxonomy, ecology, and habitat requirements (Batley & Hogendoorn, 2009).

The subfamily Euryglossinae is the most speciose of bee subfamilies in Australia, with 404 named species comprising minute to small-bodied bees endemic to Australia (Kayaalp, 2011; Michener, 2007; Randall, 2017). Their nesting habits are poorly known, and observations of the reproductive behaviors of Euryglossinae are rare. Within this taxon, nesting behaviors and nesting substrates are not conserved. From a hypothesized plesiomorphic condition of ground-nesting for colletids, followed by a shift to wood-nesting in the common ancestor of the clade comprising Colletinae, Euryglossinae, Hylaeinae, Scrapterinae, and Xeromelissinae, and *Callomelitta* Smith, there have

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been multiple reversals to ground nesting (in soil and rotten wood) in some lineages. Even though recorded observations on the reproductive behavior of euryglossines are rare, bees in this subfamily have been found to vary in nesting substrate, with both ground- and cavity-nesting species, and exhibit a range of sociality in nesting, nesting habitats, and nest construction behaviors (Almeida, 2008).

Few *Euryglossina* Cockerell have had their nesting habits recorded, the first being by Rayment (1944), who recorded *Euryglossina* (*Euryglossina*) *lynettae* Rayment nesting in powder-post beetle tunnels of a telegraph pole.

More detailed observations of nesting *Euryglossina* were made by Houston (1969). The nesting habits of *E*. (*E*.) *hypochroma* Cockerell were recorded in Adelaide, South Australia, in December 24, 1967. Bees of both sexes were observed entering and leaving three small holes in soft and pulpy wood of an unidentified branch at ground level in a wood pile. The branch was dissected and it was found that the three entrance holes led to interconnected tunnels. In the same wood pile, nests of *E*. (*Turnerella*) *pulchra* Exley were found, following observations of females entering small holes in hard, solid sections of eucalypt branches. Entrance holes were 1.4–1.5 mm in diameter, which opened into short cylindrical tunnels with opened into cavities, largely filled with frass, in which cellopane-like cells similar in composition to *E*. *hypochroma* were present.

NESTING OBSERVATIONS

Prior to the observations reported here, there have been no published records of nesting habits of *E*. (*E*.) *perpusilla* Cockerell. Nesting observations of *E*. *perpusilla* were conducted at Star Swamp Reserve, an A-Class Reserve, and a declared Bush Forever site [no. 204] (Natural Area Consulting, 2012), located in the suburbs of North Beach and Watermans Bay, 15 km north of Perth, Western Australia. The Reserve covers a total of 96 hectares of remnant coastal scrub vegetation, composed of a 4 hectare seasonal freshwater lake with paperbark trees and 92 hectares of *Banksia* L.f. (Proteaceae), tuart, jarrah, and marri woodlands, and areas of low heath.

Whilst undertaking a native bee survey at Star Swamp Reserve on 9 January 2017, I observed a number of tiny bees entering small holes in a branch of a live *Banksia attenuata* Brown (Proteaceae) tree that showed evidence of being burnt some time ago. Three tiny holes approximately 2–3 mm in diameter and situated approximately 8 cm apart were located in a section of the branch where the outer bark had come away, with a number of other holes where bark was still present located across the branch (Fig. 1). A few females of a small as-yet-undescribed species of *Megachile* Latreille (recorded as *Megachile* sp. M306/F366 at the Western Australian Museum) were seen entering the exposed holes, along with some even tinier bees in the subfamily Euryglossinae. In the middle and inner holes, individuals of both species were at times seen to enter and exit the same hole. Four specimens of these euryglossine bees were collected, which were identified as *E*. *perpusilla*, using Exley (1968). The specimens have been deposited in the Western Australian Museum (accession numbers: 94104, 94105, 94106, 94107).

All specimens collected were females, which strongly suggests that the bees were nesting in the tree. As a number of females were entering the same holes, this may suggest communal nesting. The conditions of permission to survey Star Swamp stipulated that the vegetation was not to be disturbed prevented more detailed examination of the putative nest sites in any further detail, and as such the branch was not able to be opened to inspect the burrows for architecture and progeny, nor was collection of

Figure 1. Nesting holes (preformed) in a branch of a live, yet partially burnt tree of *Banksia attenuata* Brown located at Star Swamp Reserve, Western Australia. A number of individuals of *Euryglossina* (*Euryglossina*) *perpusilla* Cockerell (Colletidae: Euryglossinae) were observed entering and exiting the holes, and two specimens, both females, were collected on 9 January 2017.

the nests for examination in the laboratory permitted. There have been no previous publication of observations of any euryglossine species sharing a nesting substrate with megachilids to my knowledge.

There have been few published records regarding the nesting habits and behavior of euryglossine bees, the most recent being (Houston, 1969) involving eight species. The observations of *E. perpusilla* described here add to the knowledge about the nesting habits of Euryglossinae, and can contribute to phylogenetic analyses used to understand the evolution of cavity-nesting vs. ground-nesting within this group. Unlike many bee taxa in which species within a subfamily usually share similar nesting habits, Euryglossinae exhibit a range of nesting biologies. Most colletids nest in the soil (the proposed plesiomorphic condition for colletids), but Euryglossinae nest in a range of substrates, including inside stems, soft wood, and pre-existing cavities, as well as in the soil (Almeida, 2008). Species of *Euryglossa* Smith, *Euhesma* Michener, *Euryglossula* Michener, *Xanthesma* Michener, and *Brachyhesma* Exley have been noted to nest in soil, whereas species of *Pachyprosopsis* Perkins and *Euryglossina* nest in wood (Houston, 1969). Unlike in Houston's (1969) observations of euryglossine bees nesting in a dead tree branch, the branch in which *E. perpusilla* were observed to enter was still attached to a living tree.

Although it cannot confirmed with certainty that the tunnels were interconnected and that females of *E. perpusilla* were nesting together, based on these observations

along with the nesting observations of other *Euryglossina* it appears that this genus may prefer to nest in small (approximately 1.5–3 mm diameter) cavities in wood branches, and that they likely have gregarious or possibly communal nesting behavior. Unlike *E. hypochroma* and the other euryglossine genera documented by Houston (1969), *E. perpusilla* appears to share the trait of *E. pulchra* in that the females use preformed cavities, rather than excavating the nests themselves. These tiny bees do not appear capable of chewing through the fairly hard *Banksia* wood and therefore, like megachilid and hylaeine bees, it is likely they rely on pre-existing holes created by wood-boring beetles.

The use of holes in *Banksia* underscores the importance of preserving urban *Banksia* woodland remnants such as this one in Star Swamp. As with the other sites across urbanized southwest Western Australia that I have been surveying, eight trap nests were installed at this location. Each trap-nest comprised a 200 mm × 100 mm × 100 mm block of *Eucalyptus marginata* Donn ex Sm. (Myrtaceae), with five holes of 4 mm, 7 mm, and 10 mm diameters drilled to depth of 120 mm, into which cardboard bee tubes were inserted. Such trap-nests can provide extra nesting habitat for cavity-nesting bees (MacIvor, 2016). Despite extra nesting habitat being provided, no *E. perpusilla* occupied the trap-nests. Indeed, no euryglossine species utilized any of my trap nests for the duration of my study across all sites. This contrasts with the high occupancy rates of trap nests by cavity-nesting bees in the genus *Megachile* (Megachilidae), and to a lesser extent, *Hylaeus* Fabricius and *Meroglossa* Smith (Colletidae). At Star Swamp, for this particular survey, only two bee tubes from two separate trap nests, both 4 mm in diameter, were utilized. Although bees have yet to emerge from the collected tubes, the caps of a mixture of resin and sand indicate that they are occupied by megachilids. This low trap-nest occupancy may be due to the presence of other natural cavities in the environment, and may indicate that trap nests are most useful in environments with limited natural cavities available such as in areas where old dead trees have been cleared. However, this potential explanation is unlikely owing to how in the following month, 19 bee tubes were collected from Star Swamp. The larger diameter of the tubes in my trap nests (4 mm being the smallest, compared with the approximately 2–3 mm diameter holes in the *Banksia* branch) may preclude tiny euryglossine bees from utilizing them. The low trap-nest occupancy during this survey also cannot be attributed to a low abundance of cavity-nesting bees because in January 2017, 87 cavity-nesting native bee specimens (including the four *E. perpusilla*) were recorded.

With much of the original natural Bankisa woodland having been destroyed or converted to agriculture and urbanization in the southwest Australian biodiversity hotspot (Hopper & Burbidge, 1989; Hopper & Gioia, 2004), remnant bushland habitats such as that in Star Swamp represent a refuge for native bees in the now largely urbanized landscape. Strategies to preserve such bushland habitats and prevent their degradation should be implemented (Fisher *et al*., 2009; Hopper & Burbidge, 1989; Phillips *et al*., 2010; Prendergast, 2010), as they may be fundamental to ensuring endemic species such as euryglossine bees persist.

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