A first report of plastic use for nesting materials in an apoid wasp (Hymenoptera: Sphecidae: Isodontia elegans)

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SHORT COMMUNICATION

A first report of plastic use for nesting materials in an apoid wasp (Hymenoptera: Sphecidae: *Isodontia elegans*)

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Abstract

Plastic use has recently been reported for numerous bee species but it had so far remained undocumented for the related apoid wasps. Here, we report a female of *Isodontia elegans* (Hymenoptera: Sphecidae) collecting plastic fibers from a bag of building materials and then sealing multiple nests with them.

Keywords: anthropogenic, Apoidea, behaviour, life history, natural history.

Zusammenfassung

Die Verwendung von Kunststoffen wurde in jüngster Zeit für zahlreiche Bienenarten berichtet, für die verwandten apoiden Wespen war dies bisher jedoch noch nicht dokumentiert. Hier berichten wir über ein Weibchen von *Isodontia elegans* (Hymenoptera: Sphecidae), das Plastikfasern aus einem Beutel mit Baumaterialien sammelte und dann mehrere Nester damit versiegelte.

Apoid wasps (Hymenoptera: Apoidea) play varied and important roles across ecosystems, but receive remarkably less attention than many other taxa, including closely related groups such as bees (Brock et al. 2021). Our understanding of their ecological dynamics, especially in terms of anthropogenic effects, are relatively limited for most groups (but see Taki et al. 2008; Gonçalves et al. 2014). This lack of study is problematic because we know that wasps can respond markedly differently to pressures than better-studied groups such as bees (Flores et al. 2019; Guo et al. 2021). As a first step toward the ecological and physiological impact studies necessary to fill these knowledge gaps, natural history observations serve to document important biological phenomena. This includes documenting potential proximal threats caused by unusual behaviors that may prove deleterious, including the use of plastics for nest construction.

Plastic use has been widely recorded in bees in recent years. Observations are typically in trap nests, which are much more easily observed than ground bee nests and which house taxa that normally gather and provision with various nesting materials (Staab et al. 2018). In most examples, leaf-cutter bees (Megachilidae: *Megachile* Latreille) have been found to use pieces of plastic in place of leaves or possibly petals, as well as to actively cut these pieces (MacIvor & Moore 2013; Allasino et al. 2019; Wilson et al. 2020; Quintos-Andrade et al. 2021). Bees of the genus *Hylaeus* Fabricius (Colletidae) have also recently been reported nesting inside polystyrene (Prendergast 2020), but nesting inside of plastic or similar materials should generally be considered separately from collecting plastics as nesting materials, as the former can have more demonstrably negative effects via the complete insulation of the nesting cavity, which can inhibit the ventilation of moisture (Stephen & Every 1970). To the best of our knowledge, however, no reports exist of apoid wasps using plastic materials to build their nests.

Species in the genus *Isodontia* Patton are relatively well-documented among wasps, perhaps due to their large size and, more recently, to the invasive potential of the group (O'Brien & Craves 2006; Notton 2016). Readily accepting trap nests, these wasps typically collect crickets or cockroaches as food for their offspring and seal their nests with grass, mosses, or other plant material (Buschini et al. 2006; O'Neill & O'Neill 2009; Barthelemy 2010; Imasaki & Endo 2023). *Isodontia elegans* has been recently well-studied, and this species is known to also use plant material for its nests, such as dried grass strands that may stick out of the nest tunnels like a broom (O'Neill & O'Neill 2007; Spendal et al. 2021; O'Neill et al. 2022). Here, we report use of plastic for nesting materials in a trap-nesting population of *Isodontia elegans* (F. Smith) for the first time.

Observations took place at the residence of FDP near the intersection of the street address E 1500 N and N 1600 E (approximately 41.758439, -111.794623; Logan, Utah, USA), less than 3 km from the edge of development on the western face of the Wasatch Mountains. The neighborhood is residential, most yards with some form of a garden, and the specific backyard of this study is well-stocked with

Fig. 1. Trap nests where use of plastic for nesting by *Isodontia elegans* took place. **A**. The trap nests set up in FDP's backyard, with the ten plastic fiber nests marked in red. **B**. Close-up view of a nest closure made with plastic fibers.

a wide variety of vegetables and flowering trees that house all manner of insects. A series of trap nests of highly variable sizes in irregular formation is also present (Fig. 1A), ranging in diameter from 2 mm to over 1 cm and numbering well into the hundreds. Over a period of about two weeks inclusive of July 23–26, 2021, at least two females of *Isodontia elegans* were observed provisioning nests in ~9 mm diameter trap nest holes with what seemed to be exclusively *Oecanthus fultoni* Walker (Orthoptera: Gryllidae), then sealing the nests with an unusual plastic material, sometimes forming apical brooms as they normally do with grass (Fig. 1B, Supplementary Video 1). The source of the material was discovered directly over the fence of FDP's backyard, roughly 7 m from the nests, and identified as a green, friable bag made of interwoven plastic fibers used to house and carry various heavy building materials (possibly sought because very little grass was present in the backyard of FDP). In total, ten nests were provisioned in 2021 (Fig. 1A), only one of which had some grass visible in the closure. The site was visited by both authors for imaging in mid-June 2022, but no wasp activity was evident. Based on the partial excavation of one nest tunnel, the "broom" of plastic was replaced by normal grass 2 cm into the tunnel (additional nests were not excavated to see whether the wasps had emerged successfully). Later, beginning on July 24, 2022, five females emerged and were seen re-nesting, though that year they were using only grass for their nests (the bag of building materials had since been removed). Nineteen total nests were made in 2022 based on counting nest closures but all used grass (compared to 10 using entirely or mostly plastic in 2021) likely all constructed by *Isodontia elegans*, as other species were not evident.

Given that many wasps emerged successfully and that their numbers have increased at the site, the use of plastics cannot be an entirely lethal strategy for this species, but there could be sub-lethal effects, such as exposure to various chemicals associated with the plastics. At the same time, it has been suggested that novel material use might confuse detrimental nest associates including parasitoids (MacIvor & Moore 2013), so there may be positive effects as well. We hypothesize that negative effects are negligible, but testing this would require experimental study of potential effects on parasitism and wasp mortality rates,

ideally using nests constructed with both natural grass and plastic fibers over several generations. It is also unclear how widespread this behavior might be in wasps, possibly because relatively fewer wasps than bees will use nesting materials that are easily replaced by plastics (leafcutters dominate bee-related reports). The need for more information underscores the ongoing importance of life history observations such as those reported here, quickly highlighting potential emerging issues in insect health (Orr et al. 2020).

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Supplementary video:

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Supplementary Video 1: A female of *Isodontia elegans* closing its nest with plastic fibers.