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Scientific Note

New state records for the introduced bee species *Osmia taurus* Smith, 1873 and *Osmia cornifrons* (Radoszkowski, 1887) (Hymenoptera: Megachilidae) in western North America

Solitary bees of the genus *Osmia* Panzer, 1806 (Hymenoptera: Megachilidae) are important agricultural pollinators, and several species are commercially managed for fruit tree pollination in the United States. This includes North American natives like the blue orchard mason bee, *Osmia lignaria* Say, 1837. It also includes introduced, non-natives like *Osmia cornifrons* (Radoszkowski, 1887), which was intentionally imported to the U.S. from Japan in 1965 to Utah (Rust 1974) and again from Japan in 1978 to Maryland (Batra 1982). Females of both species provision nests in pre-existing cavities, including holes in wood, hollow plant stems, or artificial nesting substrates, and use mud to partition their brood cells (Batra 1982, Cane et al. 2007). Their nesting habits have contributed greatly to their successful management as pollinators in agricultural systems.

However, the nesting habits that make *Osmia* and other cavity-nesting bee taxa good candidates for commercial management can also lead to accidental introductions via movement of hidden nests in a variety of substrates (Russo 2016). In fact, among all accidental bee species introductions globally, more than three-quarters are cavity-nesters, and the majority are in the family Megachilidae (Russo 2016); this is despite most bees (ca. 75%) being ground nesters (Cane & Neff 2011, Harmon-Threat 2020). In North America, more than 30 species have been accidentally introduced, yet for most of these species little is known about the impacts of their establishment and spread on native bee populations (reviewed in Russo 2016, Delphia 2023).

Evidence for negative impacts of *Osmia taurus* Smith, 1873, a non-native species from eastern Asia, is accumulating, suggesting this species may become invasive in North America (LeCroy et al. 2020, Gutierrez et al. 2023, LeCroy et al. 2023). This species was originally hypothesized to have been accidentally introduced to Maryland with *O. cornifrons* in the late 1970s since the two species look very similar to one another and are sympatric in Japan (Maeta 1978, Gibbs et al. 2017, MacIvor et al. 2022, Gutierrez et al. 2023). However, the earliest specimen records of *O. taurus* from North America were collected in 2002 from West Virginia and Maryland (Droege & Maffei 2023). Despite efforts to find specimens of *O. taurus* in regional museums and private collections that may have been mislabeled as *O. cornifrons* prior to the discovery of *O. taurus* in 2002, none were found (LeCroy et al. 2020, Gutierrez et al. 2023). This raises the possibility of a separate, accidental introduction occurring after that of *O. cornifrons,* especially given that *O. taurus* was first detected < 30 km from the Port of Baltimore which is a major U.S. shipping port (Droege & Maffei 2023). It is also possible that *O. taurus* was introduced with *O. cornifrons* but evaded detection for more than 20 years; however, this seems less likely given efforts to find specimens of *O. taurus*. While the timing of *O. taurus* introduction is uncertain, since its detection in the U.S., this species has rapidly spread to exhibit a similar distribution as *O. cornifrons* in North America (Gutierrez et al. 2023). *Osmia cornifrons* ranges generally from southern Ontario, Canada and the mid-Atlantic seaboard in the U.S. as far west

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as eastern Missouri and has also been recorded from isolated locations in Colorado, Utah, and Oregon (Gutierrez et al. 2023). *Osmia taurus* ranges from southern Quebec, Canada and the Atlantic seaboard in the U.S. as far west as eastern Missouri (Normandin et al. 2017, Gutierrez et al. 2023). Additionally, *O. taurus* has experienced a rapid population growth over 15 years (2003–2017) in the mid-Atlantic region compared to *O. cornifrons*, whose populations have remained stable during this period (LeCroy et al. 2020). Increases in the abundance of *O. taurus* were also correlated with declines of six native *Osmia* spp. in the region (LeCroy et al. 2020). *Osmia taurus* has also been implicated in pathogen spillover to wild, native bees (LeCroy et al. 2023).

The purpose of this note is to document new specimen records for *O. taurus* in Idaho and for *O. cornifrons* in Idaho and Montana. These *O. taurus* records represent the first western North American vouchered specimen records and a large known range extension (Fig. 1). The closest published specimen records are more than



Figure 1. Geographic distribution of *Osmia cornifrons* (A) and *Osmia taurus* (B) in North America. Gray shading = species distributions based on physical specimen records in Gibbs et al. (2017), Normandin et al. (2017), Spring et al. (2017), Decker et al. (2020), Branstetter et al. (2021), Best et al. (2022), MacIvor et al. (2022), Veit et al. (2022), Gutierrez et al. (2023), and Getz et al. (2024) (note: physical specimen records reported from Kansas for *O. cornifrons* and *O. taurus* were errors; M. Getz, in litt.), black circles = specimen records from this study.

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2337 km away in southern Illinois (Jackson County) (Decker et al. 2020). The *O. cornifrons* records fill in distributional gaps in the western U.S. These records provide important information for monitoring the continued spread and potential impacts of these two introduced species across North America, particularly *O. taurus* whose distribution and populations in the western U.S. could potentially expand beyond that of *O. cornifrons*, given that this species is thought to tolerate a greater range of climatic conditions than *O. cornifrons* (Maeta 1978). These records also add to our overall understanding of the distribution of North American bee fauna and represent the first instance of *O. taurus* overlapping in its range with the native western subspecies of *O. lignaria* (*O. l. propinqua* Cresson, 1864).

On April 23, 2022, a photo observation was posted on iNaturalist from Boise, Idaho, by beetleman and identified as *O. taurus* (iNaturalist 2022) and brought to the attention of CMD by John Ascher. CMD then reached out to KRG to look for this species in the Boise area. In 2024, KRG collected some bees she thought could be *O. taurus* and sent them to CMD for identification. CMD identified the specimens as *O. taurus* and *O. cornifrons* (see below for specimen data) using the key and taxon concepts of Yasumatsu & Hirashima (1950) as well as photos of defining characters in MacIvor et al. (2022) and Gutierrez et al. (2023). CMD also compared specimens to reference material in the Montana Entomology Collection (MTEC) identified by Sam Droege (USGS), and, for male specimens, dissected and examined the genitalia which are distinctive. CMD identified specimens of *O. cornifrons* from Montana collected as part of the Wild Bees of Montana Project using the same methods above. Females of these two species are easily distinguished from other North America *Osmia* by the two long, horn-like projections on the clypeus (Rust 1974). However, they are difficult to confidently distinguish from one another without examination of microscopic characters, including the distance between the clypeal horns and the shape of the apical margin of the clypeus (Yasumatsu & Hirashima 1950). Males are more difficult to differentiate from one another and require examining the shape of and presence/absence of punctures on the apical margin of the clypeus and the shape of the apex of the gonocoxite of the genitalia.

The single above-mentioned iNaturalist observation record for *O. taurus* (iNaturalist 2022) and two *O. cornifrons* observation records from Boise (iNaturalist 2023a, 2023b) were recently included in a paper mapping the distribution of several nonnative *Osmia* spp. in North America (Getz et al. 2024). However, given that 1) these species can be difficult to distinguish from one another, 2) they are the first records of both species in Idaho, and 3) they represent a large known range extension and the first record for *O. taurus* in western North America, it is best practice to document new state records with physical specimens that can be deposited in a museum for future reference. These findings highlight the importance of community naturalist data for targeting locations for collecting efforts to obtain voucher material for confirming target species occurrences. Vouchers also provide a means for reexamining specimens and correcting/updating species names/concepts as our taxonomic understanding changes. This is particularly relevant given that some uncertainty exists regarding the identity of *O. taurus* in the U.S. and China versus Japan where the type species was described (Branstetter et al. 2021). Briefly, the morphology of *O. taurus* specimens from Japan differ from specimens from the U.S. and China, however the type specimen has yet to be examined, and additional genetic studies are needed. The differences may represent greater within species variation or different species. Should they represent the latter, voucher specimens will be important for reexamining species identities.

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The following *O. taurus* specimens were examined: UNITED STATES: Idaho, Ada Co., Boise, along canal, 43.5643°N, 116.1523°W, 15 APR 2024, coll. K. Gnojewski, net [1♂, MTEC]; same locality and collector, 17 APR 2024 [2♀♀, MTEC], **new state record.** The following *O. cornifrons* specimens were examined: UNITED STATES: Idaho, Ada Co., Boise, along canal, 43.5643°N, 116.1523°W, 15 APR 2024, coll. K. Gnojewski, net [1♂ 1♀, MTEC]; 6.5 km SE Boise, 43.5679°N, 116.1552°W, 846 m, 28 APR 2024, coll. K. Gnojewski, collecting mud [2♀♀, MTEC]; same locality and collector, 3 May 2024, collecting mud [2♀♀, MTEC]; same locality and collector, nest collected 25 June 2024, cocoon dissected September 2024 [21♂♂ 21♀♀, MTEC], **new state record.** Montana, Gallatin Co., Bozeman, 1470 m, 45.6776°N, 111.0484°W, 12 May 2019, coll. C. M. Delphia, net [1♀, MTEC]; same locality and collector, 28 May 2020, [1♀, MTEC]; Flathead Co., Creston, along river, 48.1682°N, 114.1663°W, 12 JUNE 2022, 887 m, coll. S. Glutting, in bee house [3♀♀, MTEC]; same locality and collector, nest collected 12 June 2022, emerged spring 2023 [1♂ 1♀, MTEC]; Gallatin Co., Marsh Labs, 1495 m; 45.6643°N, 111.0646°W, emerged spring 2021, coll. A. Slominski [8♂♂ 2♀♀, MTEC], **new state record.**

The *O. taurus* specimens from Idaho were collected from an access road along the New York Canal in southeast Boise. Spring blooming plants along the canal included *Prunus virginiana* L. (Rosaceae), *Ribes aureum* Pursh (Grossulariaceae), *Erodium cicutarium* (L.) L'Hér. ex Aiton (Geraniaceae), *Convolvulus arvensis* L. (Convolvulaceae), *Lepidium draba* L. (Brassicaceae), and *Sisymbrium altissimum* L. (Brassicaceae) (Fig. 2). Additionally, the collection area hosted several decaying *Robinia pseudoacacia* L. (Fabaceae) trees. The *O. cornifrons* specimens from Idaho were collected from this same location, as well KRG's backyard where females were observed collecting mud, presumably for nesting. The backyard habitat is a standard suburban subdivision and includes a small amount of turf grass along with several native and ornamental shrubs and forb species, including a *Malus* sp. (Rosaceae) tree very close to the mud collection site, *R. aureum, Mahonia repens* (Lindl.) G. Don (Berberidaceae), and *Amelanchier alnifolia* (Nutt.) Nutt. ex M. Roem (Rosaceae). KRG also noticed six bamboo nesting tubes in a bee house in her yard that were provisioned during the spring and capped with mud. KRG mailed the nests to CMD, and each nest was opened and all cocoons dissected in early September. All six nests contained *O. cornifrons* that had developed to the adult stage for overwintering (Nest 1: 15 total brood cells, 8♂♂, 2♀♀; Nest 2: 8 cells, 3♂♂, 2♀♀; Nest 3: 4 cells, 3♂♂; Nest 4: 12 cells, 5♀♀; Nest 5: 16 cells, 4♂♂, 8♀♀; Nest 6: 14 cells, 3♂♂, 4♀♀), indicating this species is actively nesting and has likely established populations in Idaho. Of note, KRG has never purchased any *Osmia* cocoons for release in her yard (see below for further discussion of purchased bees). It is unknown whether *O. taurus* has established populations in the Boise area. Given the husbandry and care instructions provided by suppliers to those who purchase *Osmia* cocoons for backyard release (e.g., cleaning and storing cocoons during the winter), this could facilitate the successful spread of these bees in areas that may otherwise be inhospitable.

The *O. cornifrons* specimens from Montana were collected during casual observations from CMD's urban backyard in Bozeman, the same location where three other introduced cavity-nesting bee species were found (Delphia 2019, 2023). Specimens were also collected from another backyard 365 km northwest of Bozeman in Creston. In the case of the Creston specimens, *O. lignaria* cocoons were purchased from a mason bee supplier and placed in a backyard bee house in spring 2021 by a mason

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bee hobbyist to initiate adult emergence and offspring production/nest provisioning (S. Glutting, in litt.). The completed nests were collected in the fall, the cocoons removed, cleaned, overwintered, and then placed back into the yard the following spring for adult emergence. In June 2022, near the end of the nesting season, S. Glutting noticed what he thought were adult *O. cornifrons* in his neighbor's backyard where the *O. lignaria*



Figure 2. Canal habitat where *Osmia taurus* was collected in Boise, Idaho. Photos: K. R. Gnojewski.

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cocoons were released. He collected three individuals and sent them to CMD for identification along with three mud-capped nests from the same location. All three nests were opened; the first nest was empty, the second contained three brood cells with offspring that did not survive to the adult stage, and the third contained three brood cells with one individual that did not survive and two individuals that developed into adult *O. cornifrons* (1♂ 1♀) in 2023.

Although we cannot say for certain that the *O. cornifrons* specimens from Creston originated from the *O. lignaria* cocoons purchased in 2021, it seems highly likely for several reasons. First, *O. cornifrons* specimens were found emerging from commercial shipments of *O. lignaria* cocoons and eggs/larvae purchased from multiple suppliers for research projects in Bozeman (A. Slominski, personal communication). In one case, purported *O. lignaria* eggs, larvae, and cocoons were reared in the laboratory to the adult stage, at which point *O. cornifrons* were detected and identified. We have cited data from these specimens in the specimens examined as documentation of this method of transportation to Montana. Furthermore, *O. cornifrons* were intentionally supplied by vendors in 2016 for research in enclosed flight cages in Bozeman, Montana (Slominski & Burkle 2021). To our knowledge, no bees escaped from flight cages in those experiments, but the fact that *O. cornifrons* were being intentionally shipped to Montana in 2016 shows a clear path for their introduction to Montana. Clearly, commercial sales by mason bee vendors to researchers and hobbyists have played a role in the spread of *O. cornifrons*, and possibly *O. taurus* as well. Currently, few regulations exist regarding the shipment of solitary bees between states within the U.S., though the Orchard Bee Association provides shipping guidelines for best practices for managing orchard mason bees (Orchard Bee Association 2024).

Notably, the Boise area is also the location of the first established population of the eastern carpenter bee, *Xylocopa virginica* (Linnaeus, 1771), that we are aware of in the western U.S. (Delphia 2019). Boise is situated along a major east-west Highway, Interstate 84, and has a metro population of ca. 750K people and growing (United States Census Bureau 2024). Because urban areas can serve as favorable habitats for introduced bee species (e.g., MacIvor & Packer 2015, Geslin et al. 2020), the Boise area is a good location for continued targeted surveying and monitoring of non-native bee species.

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