

# MAIL-ORDER SOLITARY BEE COCOONS AS A GATEWAY FOR BIOLOGICAL INVASION

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**Abstract**—The unregulated online trade of solitary bee cocoons, particularly mason bees (*Osmia* spp.), poses growing risks to biodiversity. Marketed as tools to enhance pollination, these mail-order cocoons can include non-native species, including invasive ones that are difficult to distinguish from native bees. Such introductions can displace native bees and spread parasites and pathogens, undermining the stability of wild bee communities. Existing regulations in Canada and the U.S. remain fragmented and insufficient to address these threats. We recommend extending regulatory oversight, enforcing species-specific trade restrictions, and supporting local suppliers to safeguard native pollinators from unintended ecological consequences.

**Keywords**—Crop pollination, solitary bees, biological invasion, *Osmia*

## INTRODUCTION

Pollination success in many agricultural systems relies on more than just honey bees. Although the western honey bee (*Apis mellifera*, Apidae: Hymenoptera) remains the most widely managed pollinator, research shows that numerous crops benefit significantly from the complementary traits and behaviours of solitary native bees (Garibaldi et al. 2013). Recognizing this, breeding programs in North America have increasingly focused on rearing and distributing solitary species such as mason bees (*Osmia*, Megachilidae: Hymenoptera), which are well-suited to managed pollination systems (Torchio et al. 1987; Bosch & Kemp 2002; Sampson et al. 2004) (Table 1). Mason bees can be managed in artificial nesting structures and overwinter in cocoons that can be separated and cleaned then moved to different regions making them ideal for commercial sale and distribution through mail (Mader et al. 2010; MacIvor et al. 2022). However, the growing, largely unregulated trade in solitary bee cocoons has moved into global online marketplaces and is promoted to the public who seek opportunities to support pollinators. This now poses a conservation concern as non-native bee species can become invasive (Russo et al. 2021). Numerous biological invasions have resulted from

interregional or intercontinental shipment of live animals and plants through mail that bypass security checkpoints either because it is unregulated or because it was not inspected properly has been documented (Lenda et al. 2014). There is reason to be concerned that the emergent internet trade in mason bee cocoons could facilitate biological invasions.

Reputable North American growers focus production on one widespread native mason bee species, the blue orchard bee (*Osmia lignaria* Say), but dozens of online vendors and resellers offer mason and leafcutter bees with ambiguous names such as “spring mason bees”, “leaf bees”, or “sunflower bees” that do not distinguish species or subspecies, or indeed the geographical origin of material. Based on our investigations, websites contain photos of the wrong bee species relative to what is advertised or sell nesting structures filled with unmarked or inspected cocoons that appear to contain parasitoids, even in online global marketplaces like eBay and Etsy. A more careful approach used by reputable growers is to process loose cocoons that are examined for species identity and parasites. However, even suppliers purporting to carry out these necessary steps can make mistakes and commercial shipments of cocoons may be mixed with unwanted non-native

**Table 1. List of select native and non-native *Osmia* species involved or potentially involved in the mail-order internet trade in North America.**

Species Name	Common Name	Present	Native	Origin	Mail Trade	Notes
<i>Osmia lignaria</i> Say*	Blue orchard bee	✓	✓	Nearctic	✓	
<i>Osmia texana</i> Cresson	Texas mason bee	✓	✓	Nearctic (South US, Mexico)	✓	
<i>Osmia ribifloris</i> Cockerell	Blueberry bee	✓	✓	Nearctic (Southwest US, Mexico)	✓	
<i>Osmia californica</i> Cresson	California mason bee	✓	✓	Nearctic (Western US, Canada)	✓	
<i>Osmia cornifrons</i> (Radoszkowski)	Horned-face bee	✓	X	Palaearctic (East Asia)	✓	
<i>Osmia taurus</i> Smith	Taurus mason bee	✓	X	Palaearctic (East Asia)	?	Found mixed with <i>O. cornifrons</i>
<i>Osmia cornuta</i> (Latrielle)	European orchard bee	✓	X	Palaearctic (Europe, West Asia)	?	Found mixed with <i>O. lignaria</i> ; pers. observation
<i>Osmia bicornis</i> (Linnaeus)	Red mason bee	✓	X	Palaearctic (Europe, West Asia)	X	commercially traded in Europe
<i>Osmia caerulea</i> (Linnaeus)	Blue mason bee	✓	X	Palaearctic (Europe, Asia, N. Africa)	X	commercially traded in Europe

\* There are two recognized subspecies of *O. lignaria*. *Osmia l. propiqa* Cresson is native to Western North America, and *O. l. lignaria* Say is native to Eastern North America; since the major suppliers of cocoons are in the Pacific Northwest it is expected that the internet trade is dominated by the former subspecies.

and potentially invasive species (Delphia & Gnojewski 2024). For example, our lab has purchased *O. lignaria* cocoons from a local vendor who we learned sources stock from suppliers located in both British Columbia and Washington. Two separate batches each contained a different non-native species: *O. cornifrons* in one and *O. cornuta* in the other. Both species have only recently been documented in Canada (MacIvor et al. 2022; Getz et al. 2024), with observations increasingly reported on iNaturalist. In their study, Getz et al. (2024) demonstrated using a machine learning tool that based on visual features *O. cornuta* cocoons are difficult to distinguish from *O. lignaria* cocoons. They also observed both species provisioning brood in the same artificial nest box. For these reasons we can assume these species can be mixed in samples sold. As the presence of species such as *O. cornifrons* and *O. cornuta* outside their native ranges increase, it highlights how misidentification and unregulated mixed-stock sales could facilitate new invasions.

The consequences are multifold. First, non-native species may compete with native bees for floral and nesting resources and become invasive (Russo et al. 2021; Getz et al. 2024). For example, *Osmia taurus* became established in North America after being inadvertently introduced alongside the deliberately imported (Rust 1974) and now commonly traded non-native species *O. cornifrons*, due in part to their close similarity in appearance (MacIvor et al. 2022). One study in the Mid-Atlantic US noted *O. taurus* catch rates increased by 800% over a fifteen-year period with an associated decline of 76-91% in six native *Osmia* species (LeCroy et al. 2020). Second, traded non-native mason bees may vector pathogens or parasites to which native species have limited resistance (Hedtke et al. 2015). Both *O. cornifrons* and *O. taurus* have introduced *Chaetodactylus* mites (Chaetodactylidae: Oribatida) (McKinney and Park 2013) and chalkbrood-causing *Ascospaera* fungi (LeCroy et al. 2023) that impact native mason bees. Third, *O. lignaria* ranges across North

America, exhibiting genetic and morphological variation from east to west. Two subspecies are recognized: *O. lignaria propinqua* Cresson in the west and *O. lignaria lignaria* Say in the east. As most large-scale *O. lignaria* producers are in the Pacific Northwest, shipments from west to east are common. However, the ecological (e.g., synchrony with local native flora) and genetic consequences of mixing these subspecies remain unknown (Mader et al. 2010). Though some propose moving western populations east to bolster populations this could risk outbreeding depression and the loss of genetic lines and locally adapted traits (Bartomeus et al. 2020).

Given these consequences, the United States Department of Agriculture has regulations that restrict the importation of non-*Apis* bees into the country (USDA APHIS 2023). However, these are not uniformly applied across states or federally enforced (Getz et al. 2024). Several individual states have implemented their own laws. For example, Hawaii has strict regulations prohibiting the importation of bees, including *Osmia* species, to protect its unique ecosystems from potential threats posed by non-native species. Oregon and California prohibit the import of mason bees except for certified *O. lignaria* and require permits for others. Wyoming does not permit the mailing or importation of bees into the state unless strict regulatory conditions are met including inspection and quarantine Wyoming Statutes Title 11, Chapter 7, Article 4. Bee cocoons must be loose cells and cocoons in nesting materials like drilled boards or straws are not permitted (§11-7-404d,f) (Wyoming Legislature 2024). In Canada, oversight is even more limited. The Canadian Food Inspection Agency (CFIA) governs importation of non-*Apis* pollinators from outside the country under Directive D-12-02 (CFIA 2021), which specifically lists *Osmia* spp. as requiring risk assessments and permits for releases. Yet, there is no regulation of interprovincial bee trade, and CFIA provides no publicly accessible list of approved *Osmia* species. This creates loopholes through which bees are regularly moved across regions without scrutiny.

The rise of home gardening and public interest in pollinator conservation has further amplified demand. Many buyers believe they are aiding bee conservation by purchasing solitary bee cocoons

and releasing them. However, without proper identification and pathogen screening, these good intentions can undermine local biodiversity. The Orchard Bee Association ([www.orchardbee.org](http://www.orchardbee.org)) has developed guidelines discouraging interregional trade and advocating for species identification and disease screening as well as production of local populations. These recommendations, however, lack regulatory backing and remain inconsistently followed. Based on the currently lack of oversight on interregional trade with both Canada and the US, we propose the following:

1. **Regulate all *Osmia* movement:** Extend CFIA's Directive D-12-02 (CFIA 2021) to include interprovincial trade, require identification to species level, and mandate permits for mail-order bee sales.
2. **Adopt species-specific import restrictions:** Canada and the US should harmonize restrictions, limiting commercial trade to regionally native *Osmia* from verified local sources.
3. **Establish a bee movement registry:** A centralized registry should track interregional and international movement of mason bee cocoons, with reporting requirements for vendors and resellers.
4. **Enforce Orchard Bee Association guidelines:** OBA recommendations for disease screening and stock provenance should be incorporated into law.
5. **Expand public education:** Launch coordinated educational campaigns emphasizing that supporting pollinators must be done responsibly and locally, not via indiscriminate species movement.
6. **Support local wild bee growers:** Choose local suppliers who follow ethical practices such as disease screening, habitat-friendly harvesting, and avoid any imported bees from outside the region. Ask vendors and resellers where the bees originated and what species are being propagated.

Mail-order internet trade could contribute to the erosion of genetic, species, and ecosystem-level diversity in wild bee communities. To prevent this, conservation biologists and policymakers must

ensure that pollinator augmentation is regulated to avoid invasive species introductions, pathogen spread, and destabilization of native communities.

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#### AUTHOR CONTRIBUTION

Concept and design JSM & SI, writing of first draft JSM, edits and approval for publication JSM & SI.

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No potential conflict of interest was reported by the authors.

#### DATA AVAILABILITY STATEMENT

No data were used to write this article.

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