Insect Pollinator Voucher Collection: Pollinator Visitation to Pacific Northwest Native Plants and Native Cultivars

Jen J-M. Hayes*[a], Nicole C. Bell[a], Lincoln R. Best[a], Svea R. Bruslind[a], Devon O. Johnson[a], Mallory E. Mead[a], Tyler S. Spofford[a] and Gail A. Langellotto[a]

[*] Corresponding author: Jen.JM.Hayes@gmail.com
[a] Department of Horticulture, Oregon State University, Corvallis, OR 97330, USA.

Cite this work as:

Hayes, Jen J-M, N.C. Bell, L.R. Best, S.R. Bruslind, D.O. Johnson, M.E. Mead, T.S. Spofford and G.A. Langellotto. 2024. Insect Pollinator Voucher Collection: Pollinator Visitation to Pacific Northwest Native Plants and Native Cultivars. Catalog. Oregon State Arthropod Collection. 8(1) p 1—8.
DOI: https://dx.doi.org/10.5399/osu/cat_osac.8.1.6034.

Abstract

Planting native flora continues to grow in popularity as a means of conserving pollinator fauna in fragmented landscapes. Due to the limited availability of native plants, consumers may encounter cultivars in their search for plants native to their region. Though consumers have a documented interest in planting native flora for their purported benefits to pollinators, it is unclear whether cultivars provide the same benefits as wild-type native plants. Over three years (2020-2022), we observed and collected pollinators from a common garden experiment in Corvallis, OR containing 8 species of Pacific Northwest native plants, 18 cultivars derived from native plant species, and one exotic perennial plant. Methods for collection are described in further detail in Hayes et al. (in prep.). Here, we report on and document the deposition of taxonomic voucher specimens (OSAC_AC_2024_01_30-001), which represent the primary species concepts used throughout Hayes et al. (in prep.). Specimens were identified to the lowest possible taxonomic level by L. R. Best (bees, Hymenoptera: Apoidea) and J. J-M. Hayes (syrphid flies, Diptera: Syrphidae). The vouchered material includes 139 individual specimens with at least one representative per caste and sex, as available, of 55 species and 14 morphospecies of bees (Hymenoptera: Apoidea) and 13 species and one morphospecies of syrphid flies (Diptera: Syrphidae). Additional vouchers are included for specimens identified only to the morphospecies level, and *Megachile brevis* Say, 1837 individuals that were captured while collecting sections of petals from *Clarkia amoena* (Lehm.) A.Nelson & J.F.Macbr. plants. These 139 voucher specimens come from a much larger dataset, containing over 6,500 observational records of plant-pollinator interactions.

Introduction

Planting native flora is a popular practice to conserve pollinators and other wildlife in fragmented landscapes. The number of nurseries that specialize exclusively on native plants, however, is limited (Oregon State University Survey Research Center & Langellotto, 2023; Rihn et al., 2022; White et al., 2018). Consumers looking to buy native plants, then, may encounter difficulties sourcing plants (Anderson, 2022, 2019; Brzuszek et al., 2010) or cultivars of native plants, which are not necessarily representative of wild genotypes (Coombs et al., 2020; Wilde et al., 2015). Research evaluating pollinator use of cultivars, compared to native plants, has yielded mixed results (Baisden et al., 2018; A. M. Baker et al., 2020; Dibble et al., 2020B; Nevison, 2016; Ricker et al., 2019; Torrez et al., 2023; White, 2016), and has yet to explore plant taxa native to the Pacific Northwest. We thus selected 8 plant species native to the Pacific Northwest and 18 cultivars of those native plants, to evaluate in a common garden

experiment. We additionally included one popular, exotic plant (lavender, *Lavandula x intermedia* 'Grosso') in our trial to understand the pollinator communities visiting lavender in gardens. The other goals of our project were to understand if pollinators differentially visit native plants and cultivars, and to identify potential plant traits that may drive pollinator visitation. The focal pollinator groups we explored includes bees (Hymenoptera: Apoidea), butterflies (Lepidoptera: Papilionoidea), and syrphid flies (Diptera: Syrphidae).

Methods

Over three field seasons (2020-2022) we vacuum-sampled pollinators from a common garden experiment at the Oak Creek Center for Urban Horticulture in Corvallis, OR. Additional information about plant establishment, sampling protocols, and methodology can be found in Hayes et al. (in prep). Pollinators were also recorded, without specimen retention, in some cases. Butterflies were collected in a net for identification, and then immediately released. A single honey bee (*Apis mellifera* L.) was collected from each plant during each sample, but remaining individuals were counted and recorded. A single queen bumble bee (*Bombus flavifrons* Cresson) was also released in 2022 after taking photographs and adding the observation to iNaturalist (Hayes, 2022). The voucher material described here are based upon specimens that were collected and retained only (OSAC_AC_2024_01_30-001).

L. R. Best identified bee specimens and J. J-M. Hayes identified syrphid fly specimens. Specimens were identified to the lowest taxonomic level possible, using taxonomic and identification resources listed in Table 1. At least one representative per caste and sex, as available, of each species and morphospecies of collected bees and syrphid flies were curated for deposition in the Oregon State Arthropod Collection in Corvallis, OR. Additional vouchers were included for taxa identified to the morphospecies level and for individuals collecting petals from *Clarkia amoena* plants. A corresponding dataset containing only the vouchered material is presented here. Current nomenclature and taxonomic authority for each taxon was obtained using the GBIF Species Matching Tool.

The dataset contains 49 DarwinCore fields, including:

occurrenceID: a unique identification number and URL to the observational record of an individual specimen in the OSAC museum record. The observational records are not yet connected to the museum's inventory. For each specimen, the prefix http://osac.oregonstate.edu/SP/OSAC_ is followed by a 10-digit museum-issued catalog number, e.g., 0001310208, to build the entire occurrence ID (e.g., http://osac.oregonstate.edu/SP/OSAC_0001310208).

catalogNumber: a unique catalog number for voucher specimens deposited into the OSAC collection. The catalogNumber is the last portion of specimens' occurrenceID (e.g., OSAC_0001310208), and was also printed on a physical label attached to the specimen.

fieldNumber: a unique identification number that ties a voucher specimen to a row in Hayes et al.'s entire database of collected specimens. The prefix (NNP) indicates specimens collected from the Native Plant and Native Cultivar Project, which is followed by a four-digit year of collection (2020, 2021, or 2022), and a four- or five-digit collection ID (e.g., 00001).

disposition: though not all specimens in our study were retained, all vouchered specimens are confirmedPresent.

datasetName: Hayes_etal_vouchers2023.csv; included with each record to identify where the records came from if they are ever compiled in other datasets.

basisOfRecord: all observational records in the voucher dataset were based upon pinned specimens.
bibliographicCitation: a full bibliographic citation was included for each record to allow individual specimens to be referenced and the authors to be credited for the use of records in future works.
license: specimen records were released under a creative commons license. Non-commercial use is permitted with proper attribution.

institutionCode: OSAC

ownerInstituionCode: OSAC

rightsHolder: Oregon State University

Collecting Date: the date of collection is included across four fields including: *verbatimEventDate* which is formatted as m/dd/yyyy (e.g., 7/11/20), year (2020, 2021, or 2022), month (1-12), and day (1-31).

Collection Locality: locality information is reported across 6 fields (country, stateProvince, county, locality, decimalLongitude, decimalLatitude). All specimens were collected at a single site in Corvallis, OR with georeferences consistent across all records.

samplingProtocol: all collected specimens were sampled using a modified RYOBI ONE+TM 18V battery-powered hand vacuum (Bioquip Products, Gardena CA).

associatedTaxa: all records were sampled directly from plants. Here, we record all specimens as "foraging on" : followed by the scientific name of the plant taxon in quotation marks. Wild-type native plants are listed with their scientific name (genus, specific epithet, and subspecies as appropriate) only (e.g., *Clarkia amoena lindleyi*), cultivars are identified by a name in single quotation marks (e.g., *Clarkia amoena* 'Dwarf White') following the genus or scientific epithet. A genus followed by a cultivar name is indicative of a hybrid plant (e.g., *Nemophila* 'Penny Black'), and plant taxa with an x between their genus and cultivar name are interspecific hybrids (e.g., *Achillea* x 'Moonshine').

recordedBy: the name of the person that collected an individual record.

Taxonomic Information: taxonomy is recorded across 10 fields (scientificName, phylum, class, order, family, genus, subgenus, specificEpithet, identificationRemarks, and rank). Scientific names, authorities, and publication dates were verified using the GBIF Species Name Tool. The identificationRemarks field contains morphospecies identifiers for records identified only to the genus level (e.g., sp. 1).

identifiedBy and *dateIdentified*: records were identified by L. R. Best or J. J-M. Hayes in 2023.

Table 1. List of keys, guides, and other resources used for identification of bee and syrphid fly specimens.

Focal Taxa	**Identification Resources**
Diptera: Syrphidae	Churran & Fluke, 1926; Knutson, 1973; Miranda et al., 2013; Skevington et al., 2023; Telford, 1970; Vockeroth, 1958; Vockeroth & Thompson, 1993. In addition to: BugGuide. Identification, images, & information for insects, spiders, & their kin for the United States and Canada. Available from https://www.bugguide.net/node/view/15740. (Used as a reference for Syrphidae known to exist in the Corvallis, OR area.) iNaturalist. Available from iNaturalist.org. (Used as a reference for Syrphidae known to exist in the Corvallis, OR area.)
Hymenoptera: Andrenidae	W. E. LaBerge, 1969, 1977; Michener, 2007a.
Hymenoptera: Apidae	Brooks, 1988; CANPOLIN Bee Course, 2012; Daly, 1973; Koch et al., 2012; W. LaBerge, 1956, 1961, 1963; Ram, 1969; Rightmyer, 2008; Timberlake, 1969; Williams et al., 2014.
Hymenoptera: Colletidae	Oram, 2018; Snelling, 1966, 1967, 1970.
Hymenoptera: Halictidae	Gardner & Gibbs, 2023; Gibbs et al., 2013; McGinley, 1986, 2003; Roberts, 1972, 1973. In addition to: Engler et al (In prep.). Draft key to females of *Lasioglossum* subgenera *Evylaeus*, *Hemihalictus*, and *Sphecodogastra*.
Hymenoptera: Megachilidae	J. R. Baker, 1975; Bzdyk, 2012; Hurd & Michener, 1955; Michener, 2007b; Mitchell, 1937; Rightmyer et al., 2013; Rust, 1974; C. Sheffield et al., 2011; C. S. Sheffield, 2020.

Results

The voucher material and included dataset document 139 individual specimens, from 55 species and 14 morphospecies of bees and 13 species and one morphospecies of syrphid flies. We included five *Megachile brevis* Say females that were sampled while they were actively cutting segments of *Clarkia amoena* petals from plants.

Discussion

The data presented here are a subset of a dataset containing over 6,500 observational records of plant-pollinator interactions. The vouchered specimens represent over 30 pollinator genera that vary in their life histories: from highly abundant eusocial species (e.g., *Apis mellifera* and *Bombus vosnesenskii)*, to uncommon eusocial species (*Bombus caliginosus*), as well as several pollen-specialist taxa (*Diadasia nigrifrons*, *Megachile apicalis*, *M. fidelis*, *M. gravita*, *Melissodes clarkiae*, *Me. lupinus*, *Me. microstictus*). These specimens are currently being used to help understand the pollinator communities visiting native plants, native cultivars, and lavender in Oregon, and may have further applications for use in understanding pollinator foraging preferences as well as non-trophic herbivory.

Acknowledgements

Our research was conducted, and samples were collected "within the traditional homelands of the Mary's River, or Ampinefu Band of Kalapuya. Following the Willamette Valley Treaty of 1855 (Kalapuya etc. Treaty), Kalapuya people were forcibly removed to reservations in Western Oregon. Today, living descendants of these people are a part of the Confederated Tribes of Grand Ronde Community of Oregon (https://www.grandronde.org) and the Confederated Tribes of the Siletz Indians (https://ctsi.nsn.us)" (Kaku-Ixt Mana Ina Haws, 2016 Nov 8).

Our research was supported by the Native Plant Society of Oregon, the Garden Club of America, the Oregon Department of Agriculture, and Y. Sherry Sheng. Our plants were sourced with support from Annie's Annuals and Perennials, Bluestone Perennials, Eden Brothers, Gray's Garden Center, Heritage Seedlings, Xera Plants, Inc., Northwest Meadowscapes, Seven Oaks Native Nursery, Silver Falls Seed Co., Willamette Gardens LLC, Easy to Grow Bulbs, and Native Foods Nursery. And we thank Angelee Calder, Isabella Messer, Jay Stiller, Cliff Brock, Mericos Rhodes, Elliot Ariel and Aaron Anderson in assisting with the initial phases of this research.

References

Anderson, A. (2022). Evaluating the Attractiveness of Pacific Northwest Native Plants to Insects and Gardeners [Doctoral Dissertation, Oregon State University]. https://ir.library.oregonstate.edu/concern/graduate_thesis_or_dissertations/dv140206v

Anderson, A. (2019, April 26). Native plant production and marketing. Digger Magazine. http://www.diggermagazine.com/native-plant-production-and-marketing/

Baisden, E. C., Tallamy, D. W., Narango, D. L., & Boyle, E. (2018). Do Cultivars of Native Plants Support Insect Herbivores? HortTechnology, 28(5), 596–606. https://doi.org/10.21273/HORTTECH03957-18

Baker, A. M., Redmond, C. T., Malcolm, S. B., & Potter, D. A. (2020). Suitability of native milkweed (*Asclepias*) species versus cultivars for supporting monarch butterflies and bees in urban gardens. PeerJ, 8, e9823. https://doi.org/10.7717/peerj.9823

Baker, J. R. (1975). Taxonomy of five Nearctic subgenera of *Coelioxys* (Hymenoptera: Megachilidae). The University of Kansas Science Bulletin, 50, 649--730.

Brooks, R. W. (1988). Systematics and phylogeny of the Anthophorine bees (Hymenoptera: Anthophoridae; Anthophorini). The University of Kansas Science Bulletin, 53(9), 436–575.

Brzuszek, R. F., Harkess, R. L., & Kelly, L. (2010). Survey of Master Gardener Use of Native Plants in the Southeastern United States. HortTechnology, 20(2), 462–466. https://doi.org/10.21273/HORTTECH.20.2.462

Bzdyk, E. L. (2012). A revision of the *Megachile* subgenus *Litomegachile* Mitchell with an illustrated key and description of a new species (Hymenoptera, Megachilidae, Megachilini). ZooKeys, 221, 31–61. https://doi.org/10.3897/zookeys.221.3234

CANPOLIN Bee Course. (2012). Key to Bee Genera in Canada (pp. 1–42). University of Guelph. http://www.uoguelph.ca/canpolin

Churran, C. H., & Fluke, C. L. (1926). Revision of the Nearctic species of *Helophilus* and allied genera. Transactions of the Wisconsin Academy of Sciences, Arts and Letters, 22, 207–281.

Coombs, G., Gilchrist, D., & Watson, P. (2020). An assessment of the native and invasive horticultural plants sold in the mid-Atlantic region. Native Plants Journal, 21(1), 74–82.

Daly, H. V. (1973). Bees of the genus *Ceratina* in America north of Mexico (Hymenoptera: Apoidea). University of California Publications in Entomology, 74, 1–131.

Dibble, A. C., Drummond, F. A., & Stack, L. B. (2020B). Plant Origin and Other Attributes Impact Bee Forage Patterns in a Common Garden Study in Maine, United States; Part II. Environmental Entomology, 49(3), 738–752. https://doi.org/10.1093/ee/nvaa029

Gardner, J., & Gibbs, J. (2023). Revision of the Nearctic species of the *Lasioglossum* (*Dialictus*) *gemmatum* species complex (Hymenoptera: Halictidae). European Journal of Taxonomy, 858, 1–222. https://doi.org/10.5852/ejt.2023.858.2041

Gibbs, J., Packer, L., Dumesh, S., & Danforth, B. N. (2013). Revision and reclassification of *Lasioglossum* (*Evylaeus*), *L.* (*Hemihalictus*) and *L.* (*Sphecodogastra*) in eastern North America (Hymenoptera: Apoidea: Halictidae). Zootaxa, 3672(1), 1. https://doi.org/10.11646/zootaxa.3672.1.1

Hayes, J. J.-M. (2022, July). Yellow-Fronted Bumble Bee (*Bombus flavifrons*). iNaturalist. https://www.inaturalist.org/observations/192591274

Hurd, P. D., & Michener, C. D. (1955). The Megachiline bees of California (Hymenoptera: Megachilidae). University of California Press, 3, 1–248.

Knutson, L. V. (1973). Taxonomic Revision of the Aphid-Killing Flies of the Genus *Sphaerophoria* in the Western Hemisphere (Syrphidae). Miscellaneous Publications of the Entomological Society of America, 9, 1–50. https://doi.org/10.4182/MCYE1664.9-1.3

Koch, J., Strange, J., & Williams, P. (2012). Bumble Bees of the Western United States (Technical Report 12–053; pp. 1–144). U.S. Department of Agriculture, U.S. Forest Service, and the Pollinator Partnership. https://www.xerces.org/publications/identification-and-monitoring-guides/bumble-bees-of-western-united-states

LaBerge, W. (1956). A revision of the bees of the genus *Melissodes* in North and Central America. Part I (Hymenoptera, Apidae). University of Kansas Science Bulletin, 37(18), 911–1194.

LaBerge, W. (1961). A revision of the bees of the genus *Melissodes* in North and Central America. Part III (Hymenoptera, Apidae). University of Kansas Science Bulletin, 42(5), 283–663.

LaBerge, W. (1963). New species and records of little-known species of *Melissodes* from North America (Hymenoptera: Anthophoridae). Bulletin of the University of Nebraska State Museum, 4(10), 227–242.

LaBerge, W. E. (1969). A revision of the bees of the genus *Andrena* of the Western Hemisphere. Part II. *Plastandrena*, *Aporandrena*, *Charitandrena*. Transactions of the American Entomological Society (1890-), 95(1), 1–47. JSTOR.

LaBerge, W. E. (1977). A Revision of the bees of the genus *Andrena* of the Western Hemisphere. Part VIII. Subgenera *Thysandrena*, *Dasyandrena*, *Psammandrena*, *Rhacandrena*, *Euandrena*, *Oxyandrena*. Transactions of the American Entomological Society (1890-), 103(1), 1–143. JSTOR.

McGinley, R. J. (1986). Studies of Halictinae (Apoidea: Halictidae), I: Revision of New World *Lasioglossum* Curtis. Smithsonian Contributions to Zoology, 429, 1–294. https://doi.org/10.5479/si.00810282.429

McGinley, R. J. (2003). Studies of Halictinae (Apoidea: Halictidae), II: Revision of *Sphecodogastra* Ashmead, Floral Specialists of Onagraceae. Smithsonian Contributions to Zoology, 610, 1–64.

Michener, C. D. (2007a). Subfamily Andreninae; *Andrena*. In Bees of the World (pp. 243–251). The Johns Hopkins University Press.

Michener, C. D. (2007b). Subfamily Megachilinae. In Bees of the World (pp. 424–569). The Johns Hopkins University Press.

Miranda, G. F. G., Young, A. D., Locke, M. M., Marshall, S. A., Skevington, J., & Thompson, F. C. (2013). Key to the genera of Nearctic Syrphidae. Canadian Journal of Arthropod Identification, 23, 1–351. *https://doi.org/10.3752/cjai.2013.23*

Mitchell, T. B. (1937). A revision of the genus *Megachile* in the Nearctic region. Part VIII. Taxonomy of the subgenus *Chelostomoides*, addenda and index (Hymenoptera: Megachilidae). Transactions of the American Entomological Society (1890-), 63(4), 381–421. JSTOR.

Nevison, K. (2016). Considering a role for native plant cultivars in ecological landscaping: An experiment evaluating insect preferences and nectar forage values of Phlox species vs. Its cultivars [Master of Science]. University of Delaware.

Oram, R. J. (2018). Revision of the genus *Hylaeus* Fabricius (Hymenoptera: Colletidae) in Canada [Faculty of Graduate Studies and Research, University of Regina]. https://hdl.handle.net/10294/8896

Oregon State University Survey Research Center, & Langellotto, G. A. (2023). Native Plant Producer Survey: Report of Research Procedures and Results (pp. 1–117). Oregon State University. https://blogs.oregonstate.edu/nativeplantconnection/why-survey-native-plant-growers/

Ram, L. A. (1969). A systematic revision of the bee genus *Diadasia* Patton in America north of Mexico (Hymenoptera, Anthophoridae) [Dissertation]. University of California, Davis.

Ricker, J. G., Lubell, J. D., & Brand, M. H. (2019). Comparing Insect Pollinator Visitation for Six Native Shrub Species and Their Cultivars. HortScience, 54(11), 2086–2090. https://doi.org/10.21273/HORTSCI14375-19

Rightmyer, M. G. (2008). A review of the cleptoparasitic bee genus *Triepeolus* (Hymenoptera: Apidae). - Part I. Zootaxa, 1710(1), 1. https://doi.org/10.11646/zootaxa.1710.1.1

Rightmyer, M. G., Griswold, T., & Brady, S. G. (2013). Phylogeny and systematics of the bee genus *Osmia* (Hymenoptera: Megachilidae) with emphasis on North American *Melanosmia*: Subgenera, synonymies and nesting biology revisited. Systematic Entomology, 38(3), 561–576. https://doi.org/10.1111/syen.12013

Rihn, A. L., Knuth, M. J., Peterson, B. J., Torres, A. P., Campbell, J. H., Boyer, C. R., Palma, M. A., & Khachatryan, H. (2022). Investigating Drivers of Native Plant Production in the United States Green Industry. Sustainability, 14(11), Article 11. https://doi.org/10.3390/su14116774

Roberts, R. B. (1972). Bees of Northwestern America: *Agapostemon* (Hymenoptera: Halictidae). Agricultural Experiment Station, Oregon State University.

Roberts, R. B. (1973). Bees of Northwestern America: *Halictus* (Hymenoptera: Halictidae) (Technical Report 126; Technical Bulletin (Oregon State University. Agricultural Experiment Station), pp. 1–23). Oregon State University. https://ir.library.oregonstate.edu/concern/technical_reports/3484zj261

Rust, R. W. (1974). The systematics and biology of the genus *Osmia*, subgenera *Osmia*, *Chalcosmia*, and *Cephalosmia* (Hymenoptera: Megachilidae). The Wasmann Journal of Biology, 32(1), 1–4.

Sheffield, C., Ratti, C., Packer, L., & Griswold, T. (2011). Leafcutter and mason bees of the genus *Megachile* Latreille (Hymenoptera: Megachilidae) in Canada and Alaska. Canadian Journal of Arthropod Identification, 18, 1–107. https://doi.org/10.3752/cjai.2011.18

Sheffield, C. S. (2020). Corrigendum: Leafcutter and mason bees of the genus *Megachile* Latreille (Hymenoptera: Megachilidae) in Canada and Alaska. Canadian Journal of Arthropod Identification, 1–2.

Skevington, J., Locke, M. M., Young, A. D., Moran, K. M., Crins, W. J., & Marshall, S. A. (2023). Field Guide to the Flower Flies of Northeastern North America ([Enhanced Credo edition]). Princeton University Press, Credo Reference.

Snelling, R. R. (1966). Studies on North American bees of the genus *Hylaeus* 1. Distribution of the western species of the subgenus *Prosopis* with descriptions of new forms (Hymenoptera: Colletidae). Contributions in Science, 98, 1–18. https://doi.org/10.5962/p.241088

Snelling, R. R. (1967). Studies on North American bees of the genus *Hylaeus*. 3. The Nearctic subgenera (Hymenoptera: Colletidae). Bulletin - Southern California Academy of Sciences, 66, 164–175.

Snelling, R. R. (1970). Studies on North American bees of the genus *Hylaeus*. 5. The subgenera *Hylaeus*, s. Str. and *Paraprosopis* (Hymenoptera: Colletidae). Contributions in Science - Los Angeles County Museum, No. 180, 1–59.

Telford, H. S. (1970). *Eristalis* (Diptera: Syrphidae) from America North of Mexico. Annals of the Entomological Society of America, 63(5), 1201–1210. https://doi.org/10.1093/aesa/63.5.1201

Timberlake, P. H. (1969). A contribution to the systematics of North America species of *Synhalonia* (Hymenoptera, Apoidea). University of California Press. https://cir.nii.ac.jp/crid/1130282269690389888

Torrez, V. C., B. Beauzay, P., McGinnis, E. E., Knudson, A. H., Laschkewitsch, B., Hatterman-Valenti, H., & Knodel, J. J. (2023). Pollinators and Other Insect Visitations on Native and Ornamental Perennials in Two Landscapes. HortScience, 58(8), 922–934. https://doi.org/10.21273/HORTSCI17146-23

Vockeroth, J. R. (1958). Two New Nearctic Species of *Spilomyia* (Diptera: Syrphidae), with a Note on the Taxonomic Value of Wing Microtrichia in the Syrphidae. The Canadian Entomologist, 90(5), 284–291. https://doi.org/10.4039/Ent90284-5

Vockeroth, J. R., & Thompson, F. C. (1993). Syrphidae. In J. F. MacAlpine (Ed.), Manual of Nearctic Diptera. Vol. 2 (Repr, Vol. 2, pp. 713–744). Canadian Gornvment Publ. Centre.

White, A. (2016). From Nursery to Nature: Evaluating Native Herbaceous Flowering Plants Versus Native Cultivars for Pollinator Habitat Restoration [Doctoral Dissertation, University of Vermont]. https://scholarworks.uvm.edu/cgi/viewcontent.cgi?article=1625&context=graddis

White, A., Fant, J. B., Havens, K., Skinner, M., & Kramer, A. T. (2018). Restoring species diversity: Assessing capacity in the U.S. native plant industry: Production capacity in native plant industry. Restoration Ecology, 26(4), 605–611. https://doi.org/10.1111/rec.12705

Wilde, H. D., Gandhi, K. J. K., & Colson, G. (2015). State of the science and challenges of breeding landscape plants with ecological function. Horticulture Research, 2(1), 14069. https://doi.org/10.1038/hortres.2014.69

Williams, P., Thorp, R. W., Richardson, L., & Colla, S. (2014). Bumble Bees of North America: An Identification Guide. Princeton University Press