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Toxomerus geminatus, a common and widespread flower fly, visiting Rose Coreopsis (*Coreopsis rosea*), A species of conservation concern in Canada

Atlantic Coastal Plain Pollinator Surveys

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Executive Summary
Pollinator surveys were conducted in southwestern Nova Scotia. The purpose of the surveys was to document species of bee (Apoidea) and flower fly (Syrphidae) with affinities to the Atlantic Coastal Plain, representing disjunct populations, and species previously unknown in Nova Scotia and Canada. Surveys were conducted at a variety of sites in a variety of habitats, including *Corema* barren, granite barren, salt marsh, mixed woods, lakeshore meadow, and treed fen in the spring and summer of 2013 and 2014.

Although no pollinator species with Atlantic Coastal Plain distributions were discovered in the study, 96 flower fly species were collected, including 7 species not previously collected in the Maritimes, and 11 others not previously collected in Nova Scotia. Most of the bee specimens collected have not been identified to species, but of the 42 species determined so far two have not been reported previously from Nova Scotia. The species records recorded during these surveys will help immensely with the assignment and refinement of conservation statuses to the bees and flower flies in Nova Scotia. This is particularly true for flower flies, where most of the species collected were previously known from too few records to assign meaningful ranks.

Pollinators visiting three rare Atlantic Coastal Plain plant species (Redroot, Rose Coreopsis, and Plymouth Gentian) were documented. In general, the bee and flower fly species visiting these flowers are common and widespread in the province.

Introduction
Insect pollinators are of growing interest to conservation science. Native insects, namely the bees (Apoidea) and flower flies (Syrphidae), are the primary pollinators for a variety of agricultural crops and native plants. The diversity and abundance of this very important guild is in a global state of decline, the result of a variety of threats including habitat loss, disease, introduced species, and climate change. Bees and flower flies are having their conservation statuses assessed nationally, and several bees are now listed as at risk by COSEWIC or are assessment candidates.

To date, bees have received a significant amount of research attention in Nova Scotia, though the focus of most work has been on agroecosystems such as orchards and blueberry fields. Flower flies have received comparatively little attention, and there are undoubtedly dozens of flower fly species occurring in the province that have yet to be recorded. An area that has been little sampled for either group is the coastal plain region of southwestern Nova Scotia. This area hosts nearly 100 Atlantic Coastal Plain plant species, a third of which are found nowhere else in Canada. There is also a small assemblage of insects with known Nova Scotia Atlantic Coastal Plain affinities (the dragonflies Seaside Dragonlet[1] [*Erythrodiplax berenice*] and Martha's Pennant[2] [*Celithemis martha*], and the horse fly *Merycomyia whitneyi*[2]). However, given the low level of general insect surveying that has been conducted on Nova Scotia's Atlantic Coastal Plain the small suite of insects known to be special to the area likely represents just the tip of the iceberg of the true number of species with disjunct southwestern Nova Scotia populations.

The presence of disjunct bee and flower fly populations is very likely, especially given the unique assemblage of wildflower species (and therefore nectar sources) present. Species like Cornell's Azalea Bee[3] (*Andrena cornelli*) and *Mixogaster johnsoni* (a flower fly currently known only from Massachusetts to New Jersey) with strong Atlantic Coastal Plain affinities are excellent possibilities. The distribution of

[1] View species profile at http://www.natureserve.org/explorer/
[2] See range map at http://www.biology.ualberta.ca/bsc/ejournal/tm_08/chrysops111.htm
[3] Range map at http://www.discoverlife.org/mp/20m?kind=Andrena+cornelli

these species is shared with plants like Redroot[4] (*Lachnanthes caroliniana*) and Goldencrest[5] (*Lophiola aurea*). Others, like Productive Cellophane Bee[6] (*Colletes productus*) and Summer Cellophane Bee[7] (*Colletes aestivalis*), have a broader eastern United States distribution with Atlantic Coastal Plain affinities in the northeast and are also strong possibilities. The distribution of these species is similar to the distribution of Round-leaved Greenbrier[8] (*Smilax rotundifolia*) and Virginia Meadow-beauty[9] (*Rhexia virginiana*).

The documentation of such disjunct populations is important from a national conservation perspective, as many of these species may be found nowhere else in Canada. These disjunct populations might also be very important for the pollination of Atlantic Coastal Plain flora. Documenting the bee and flower fly community of the Atlantic Coastal Plain is a first step in identifying species with special relationships with rare plant hosts. Nova Scotia's Atlantic Coastal Plain was specifically mentioned by Sheffield et al. (2003) as one of three areas in the province that would benefit most from studying bee-floral host relationships.

***Sericomyia chrysotoxoides* - a common and widespread flower fly**

Furthermore, all pollinator records from southwestern Nova Scotia will help with the General Status assessments of bees and flower flies. Basic occurrence information forms the basis for these ranks, and there is a need for more records for the groups targeted during this survey, particularly flower flies. Generally, species known from only a handful of locations are left unranked, as it is not known if rarity in collection is due to genuine scarcity on the landscape or low collecting efforts. General surveys help fill in the holes, resulting in ranks being assigned to common species, and the identification of species that may indeed be genuinely rare.

To this end pollinator surveys were conducted in 2013 and 2014 in southwestern Nova Scotia in a variety of habitats. Originally field work was to be completed in 2013, but poor weather hampered

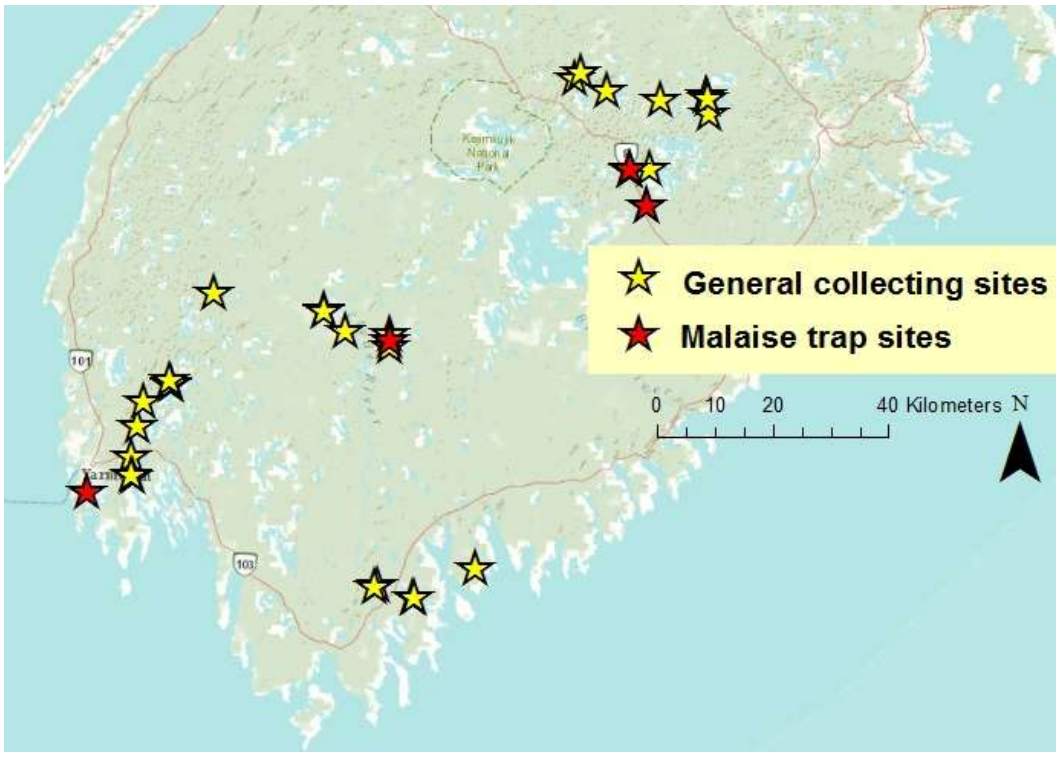
[4] Range map at http://bonap.net/NAPA/TaxonMaps/Genus/County/Lachnanthes
[5] Range map at http://bonap.net/NAPA/TaxonMaps/Genus/County/Lophiola
[6] Range map at http://www.discoverlife.org/mp/20m?kind=Colletes+productus
[7] Range map at http://www.discoverlife.org/mp/20m?kind=Colletes+aestivalis
[8] Range map at http://bonap.net/NAPA/TaxonMaps/Genus/County/Smilax
[9] Range map at http://bonap.net/NAPA/TaxonMaps/Genus/County/Rhexia

survey efforts so funding was carried over to 2014 to complete the surveys. Additional support for this project was received from the Sage Environmental Program for both the 2013 and 2014 field seasons.

In addition to general surveying, surveys were undertaken specifically targeting the pollinators of Redroot (*Lachnanthes caroliana*, S2, SARA Special Concern), Plymouth Gentian (*Sabatia kennedyana*, S1, SARA Threatened), Goldencrest (*Lophiola aurea*, S2, SARA Threatened), and Rose Coreopsis (*Coreopsis rosea*, S1, SARA Endangered). All four of these plants are species of conservation concern and members of the Atlantic Coastal Plain Flora.

Methods

Collecting was done by hand and with pan traps and Malaise traps. Sites were visited across southwestern Nova Scotia (see Map 1), and a variety of habitats were visited, including Corema barren, granite barren, salt marsh, mixed woods, treed fen, and lakeshore meadow.



Map 1. Collection sites.

In 2013 hand collecting was conducted on May 15 by John Klymko and Adam Cruickshank (MTRI intern), June 4-6 (JK and Sarah Robinson, AC CDC ecologist), July 10 (JK and SR) and July 31 (JK and SR). In 2014 hand collecting was done May 29 and 30 (JK and SR) and August 19-21 (JK). The three field days in August focussed on monitoring pollinators of Atlantic Coastal Plain plant species.

Malaise traps (tent-like structures that intercept and ultimately trap flying insects, see picture below) were run at two sites in 2013 and two sites in 2014. Details of the sites are in Table 1. In 2013 short-term pan traps (bowls of slightly soapy water which passively collect insects that mistake the bowls' bright colour for flowers) were used at several hand-collecting sites. In 2014 long-term pan traps (instead of soapy water these are filled with propylene glycol, a non-toxic liquid that can be left for weeks before it will dry) were run at the two Malaise trap sites.

In August 2014, the pollinators visiting Redroot, Goldencrest, Plymouth Gentian, and Rose Coreopsis were surveyed at Ponhook Lake, Wilsons Lake, and Sloans Lake.

Table 1. Malaise traps run during the 2013 and 2014 field seasons

Site	Coordinates	Dates	Caretaker	Habitat
Cameron Lake	44.3294N, 64.9542W	15 May-29 Aug 2013	MTRI interns	Forested edge of a large lakeshore meadow that is host to several plants with Atlantic Coastal Plain affinities, including Redroot, Common Buttonbush (*Cephalanthus occidentalis*), and Virginia Chain Fern (*Woodwardia virginica*).
Wyman Road, Yarmouth	43.8024N, 66.1051W	5 June - 30 July, 2013	Volunteer John Sollows	Edge of regenerating field. This trap, on volunteer John Sollows' property, was meant to be temporary- the original plan was to move it to nearby lakeshore in August, when Plymouth Gentian and Rose Coreopsis are in bloom. These plans were cancelled due to the high water levels of that area in mid-summer.
Pleasantfield, 18 Mile Brook wetland	44.2738N, 64.9175W	30 May - 19 Aug 2014	MTRI interns and staff	Edge of treed fen known to host Long's Bullrush (*Scirpus longii*).
Middle Ohio, Shelburne Barrens	44.0532N, 65.4656w	29 May - 19 Aug 2014	Volunteer Scott Robinson	*Corema* barren known to host Netted Chain Fern (*Woodwardia areolata*).

Volunteer Scott Robinson standing beside a Malaise trap

Results

Over the course of the survey, 1,009 flower fly and 978 bee specimens were collected. These specimens will be deposited in the Nova Scotia Museum, and the data associated with them will be incorporated into the Atlantic Canada Conservation Data Centre (AC CDC) database where they'll be available to the Nova Scotia Department of Natural Resources and other interested parties.

Flower Flies

Among the 1,009 specimens there are at least 95 species collected (additional species will almost certainly be added to this tally, a number of specimens require reference material for species-identification confirmation). No species with Atlantic Coastal Plain affinities were found, however 18 of the species have never before been recorded in Nova Scotia, and seven are new to the Maritimes (see appendix 1).

Perhaps the most interesting species found was *Heringia intensica*. This species was found in *Corema* barrens at Bowers Meadows (13km southwest of Shelburne). Very little is known about *Heringia intensica* - it is only known only from a few specimens collected in Ontario, it hasn't been collected anywhere else in Canada or the US. *Heringia* in general is a poorly understood genus, it has not been studied in detail since the 1920s, and many museum specimens remain unidentified. Nonetheless, the specimen collected in this study represents the only records for the species from outside of Ontario.

***Sphecomyia vittata* - This species and genus was recorded for the first time ever in Nova Scotia during the surveys.**

Bees

In total 978 specimens were collected, representing 16 genera. Of which 42 species have been identified thus far (see appendix 1, species-level identification has only been done less than half the specimens). All the 2013 material is on loan to Cory Sheffield, a Canadian bee expert. Cory is identifying and verifying the materials on a volunteer basis. No identifications or verifications have been made to date, but when they are the AC CDC's database will be updated, and the 2014 specimens will be sent out.

No species with Atlantic Coastal Plain affinities were found, however two of the species have never before been recorded in Nova Scotia (the identifications of these need to be confirmed): *Andrena brevipalpis* and *Osmia inspergens*. *Andrena brevipalpis* is known from Ontario, Quebec, and New Brunswick (Ascher and Pickering, 2014); it is considered uncommon throughout its Canadian range (C. Sheffield, unpublished data). A single specimen of *Andrena brevipalpis* was collected in 2013 in the Malaise trap south of Yarmouth. *Osmia inspergens* is known from Alberta, Ontario, Quebec, and New Brunswick (Ascher and Pickering, 2014); it too is infrequently collected throughout its Canadian range (C.

Sheffield, unpublished data). *Osmia inspergens* was collected in 2013 in pan traps at Bowers Meadows (13km southwest of Shelburne).

Yellow-banded Bumble Bee (*Bombus terricola*) is a species currently under review by COSEWIC. This species was once one of the most abundant bumble bee throughout the Maritimes. It still exists throughout the Maritimes, though in much lower numbers. The surveys yielded two records, one at Bowers Meadows, and another at a saltmarsh on at Johnson Cove, 8km east of Yarmouth. These records have been shared with COSEWIC.

Non-target species of interest

During surveys records of non-target species of interest were also recorded. In 2014 records were taken of Eastern Ribbonsnake (*Thamnophis sauritus septentrionalis*, S2S3, SARA Special Concern) on Ponhook Lake and in 2013 a record of Canada Warbler (*Wilsonia canadensis*, S3S4B, SARA Threatened) was documented at New Albany.

Surveys produced 84 records of 18 butterfly species. This is a significant contribution to the Maritimes Butterfly Atlas, as southwestern Nova Scotia is one of the most poorly surveyed areas in the Maritimes. The most significant species collected were Juvenal's Duskywing (Erynnis juvenalis, S3), Common Roadside Skipper (Ambliscirtes vialis, S2), Eastern Pine Elfin (*Callophrys niphon*, S2), and Gray Hairstreak (*Strymon melinus*, S2). The Gray Hairstreak was collected in the Middle Ohio Malaise trap. This is only the third Nova Scotia record for the species from the Maritimes Butterfly Atlas period (2010-2015). Surveys also yielded the sixth ever Nova Scotia record of Ebony Boghaunter (*Williamsonia fletcheri*, S2).

Hand collecting ant trapping resulted in over 700 specimens of non-target groups (bee flies, robber flies, lacewings, deer and horse flies, etc). Some of these records have already helped with General Status Assessments for these groups. For example, the deer fly *Chrysops aberrans* was collected at Cameron Lake in 2013, the first ever Nova Scotia record.

Records for all these taxa will be incorporated into the AC CDC database.

Atlantic Coastal Plain Flora pollinator monitoring

On August 19, Redroot and Goldencrest was monitored at Ponhook Lake from 11:00AM-3:00PM. Two kilometers of shoreline was walked at a site known to have the two plant species in fair abundance. All Goldencrest encountered was finished flowering. Only three flowering stems of Redroot were found in bloom, and the only pollinator observed visiting them was Tricoloured Bumble Bee (*Bombus ternarius*), an abundant species found across the province.

On August 20, Rose Coreopsis and Plymouth Gentian were surveyed at Wilsons Lake from 10:40AM to 2:40PM. The species were both flowering in fair abundance in the 750m of shoreline monitored for four hours. The following were observed visiting Plymouth Gentian: Tricoloured Bumble Bee, *Chrysotoxum derivatum* (Syrphidae), *Sphaerophoria sp.* (Syrphidae), and *Toxomerus geminatus* (Syrphidae). The two flower fly species identified to species are all common species in Nova Scotia, and the genus *Sphaerophoria* has many common species. The *Sphaerophoria* visiting the flower was a female, which in this genus are often unidentifiable. Only *Toxomerus marginatus*, a very common flower fly species, was observed visiting Rose Coreopsis. Visits to flowers were infrequent - five Plymouth Gentian flowers were watched for one hour and only three individual insects visited, one each of Tricoloured Bumble Bee, and the flower flies *Chrysotoxum derivatum*, and *Toxomerus geminatus*.

On August 20, Plymouth Gentian was surveyed at Gillfillan Lake, but the 500m stretch of shoreline walked only had a single flowering plant, so surveys there were abandoned.

On August 20, while scouting the north end of Sloans Lake, two metallic sweat bees (*Lasioglossum* subgenus *Dialictus*) were observed at Rose Coreopsis flowers. The bees escaped capture and cannot be identified to species.

On August 21, the south end of Sloans Lake was surveyed from 10:00AM to 2:00PM. Rose Coreopsis was flowering in fair abundance on the 500m of shoreline surveyed. The following species were observed visiting Rose Coreopsis flowers: *Meliscaeva cinctella* (Syrphidae), *Sericomyia chrysotoxoides* (Syrphidae), *Eristalis anthophorina* (Syrphidae), *Eristalis tenax* (Syrphidae), *Platycheirus* sp. (Syrphidae), *Toxomerus geminatus* (Syrphidae), *Sphaerophoria philanthus* (Syrphidae), *Parhelophilus porcus* (Syrphidae), *Chrysotoxum* sp. (Syrphidae), *Lucilia illustris* (Calliphoridae), *Clausicella* sp. (Tachinidae), *Chlorops* sp. (Chloropidae), *Rhamphomyia* sp. (Empidae) *Climacia areolaris* (Sisyridae), and very small shoreflies (Ephydridae), likely in the genus *Hydrellia*. Of the flower flies, *Toxomerus marginatus*, *Meliscaeva cinctella*, and *Sphaeophoria* (*philanthus* and possibly others), were all seen frequently at flowers, the other flower fly species were each seen making just a single visit. All the flower fly species identified to species are known to be common and widespread in Nova Scotia except *Parhelophilus porcus*. This species has only been collected three times in Nova Scotia (twice during these surveys). It too is likely fairly common.

It should be noted that gauging how efficient any of these insects are at pollinating the target plant species would require further research.

Tricoloured Bumble Bee (*Bombus ternarius*) visiting Redroot (*Lachnanthes caroliniana*)

Conclusions

This project vastly increased the knowledge of the pollinator community in southwestern Nova Scotia. The records obtained will help immensely with the general status assessments of Nova Scotia's flower flies and with the refinement of bee assessments in future. The 18 species of Flower Flies added to the Nova Scotia species list are evidence of this. The baseline data collected in this survey helps form the foundation for future monitoring. Should some of our pollinator species decline in the future, it will be data from surveys like this that will be used to detect it.

One of the goals of the project was to discover disjunct populations of pollinator species with Atlantic Coastal Plain affinities. No such species were found, though most bee specimens still have to be identified to species.

The data collected on insects visiting flowers of Redroot, Rose Coreopsis, and Plymouth Gentian increases what is known about these three species SARA-listed species in Canada.

Acknowledgements

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Appendix 1. Flower fly and bee species documented during survey.

Species	New for Nova Scotia	New for the Maritimes	Comment*
Flower flies			
Allograpta obliqua			
Blera analis			
Blera confusa			
Blera nigra			
Brachyopa notata			
Brachypalpus oarus			
Chalcosyrphus anomalus	X	X	Collected in the Malaise trap in a treed fen near Pleasantfield. In Canada it is known from Quebec, Ontario, and Manitoba.
Chalcosyrphus inarmatus			
Chalcosyrphus libo			
Chalcosyrphus nemorum	X		Collected in the Malaise trap at Cameron Lake. Known to be widespread in New Brunswick and Canada.
Chalcosyrphus piger			
Cheilosia bardus			An introduced species.
Cheilosia latrans			
Chrysosyrphus frontosus			
Chrysotoxum derivatum			
Criorhina nigriventris			
Criorhina verbosa			
Didea alneti			
Doros aequalis			
Epistrophe emarginata			
Eriozona laxus			
Eristalis anthophorinus			
Eristalis arbustorum			An introduced species.
Eristalis interruptus			
Eristalis obscura			
Eristalis tenax			An introduced species.

Species	New for Nova Scotia	New for the Maritimes	Comment*
Eristalis transversa			
Eumerus funeralis			An introduced species.
Eupeodes americanum			
Eupeodes luniger			
Ferdinandea buccata			
Helophilus lapponicus	X		Collected in two sites during the survey. Known to be widespread in New Brunswick and Canada.
Heringia intensica	X	X	Previously known only from Ontario, and only from a few specimens. A single specimen was collected at Bowers Meadows. See discussion in document body.
Lapposyrphus lapponicus			
Lejops curvipes			
Melangyna lasiophthalma			
Melanostoma mellina			
Microdon cothurnatus			
Microdon manitobensis			
Microdon megalogaster	X	X	This species was collected in the Malaise trap in a *Corema* barren near Middle Ohio. In Canada it is known from Quebec and Ontario.
Microdon tristis			
Neoascia distincta	X		Species hand collected near New Albany. Known from two New Brunswick sites. In Canada also known from Ontario and Quebec.
Neoascia metallica			
Ocyptamus fascipennis			

Species	New for Nova Scotia	New for the Maritimes	Comment*
Orthonevra pulchella			
Orthonevra weemsi			
Paragus haemorrhous			
Parasyrphus genualis			
Parasyrphus semiinterruptus	X	X	Collected at two sites during the survey. Widespread in Canada.
Parhelophilus porcus			
Parhelophilus rex			
Pipiza puella	X		Collected in the Yarmouth Malaise trap. Known to be common in Ontario and Quebec, known from a single New Brunswick record. In Canada also known from Ontario and Quebec.
Pipiza quadrimaculata			
Platycheirus hyperboreus			
Platycheirus immarginatus			
Platycheirus nearcticus			
Platycheirus obscurus			
Platycheirus quadratus			
Platycheirus rosarum			
Platycheirus scambus			
Platycheirus thompsoni	X		Found at three sites during study. Widespread in New Brunswick. In Canada also known from Ontario and Quebec.
Rhingia nasica			
Sericomyia chrysotoxoides			
Sericomyia transversa			
Sphaerophoria contigua			

Species	New for Nova Scotia	New for the Maritimes	Comment*
Sphaerophoria philanthus			
Sphecomyia vittata	X		Collected by hand and in the Malaise trap at the *Corema* barren near Middle Ohio. Known to be widespread in New Brunswick and Canada.
Sphegina rufiventris			
Spilomyia fusca			
Spilomyia sayi			
Syritta pipiens			An introduced species.
Syrphus rectus			
Syrphus ribesii			
Syrphus torvus			
Syrphus vitripennis			
Temnostoma alternans			
Temnostoma barberi			
Temnostoma excentrica			
Teuchocnemis lituratus	X	X	Collected in the Malaise trap in a *Corema* barren near Middle Ohio. In Canada it is known from Quebec and Ontario.
Toxomerus geminatus			
Toxomerus marginatus			

Species	New for Nova Scotia	New for the Maritimes	Comment*
Trichopsomyia apisaon	X		Collected in the Malaise trap at Cameron Lake. Known to be widespread in New Brunswick and Canada.
Trichopsomyia recedens			
Vollucella fasciata			
Volucella bombylans			
Xylota angustiventris	X	X	Collected in the Malaise trap at Cameron Lake. In Canada known from Ontario and Quebec.
Xylota annulifera			
Xylota confusa			
Xylota flavifrons	X		Hand collected near Pug Lake in Shelburne County. Known from one New Brunswick record. Widespread in Canada.
Xylota flukei	X	X	Collected in the Malaise trap in a *Corema* barren near Middle Ohio. In Canada it is known from Quebec and Ontario.
Xylota hinei			
Xylota naknek	X		Collected in short-term pan traps near Colpton. Widespread in New Brunswick and Canada.
Xylota ouelleti	X		Found at two sites during study. Known from two sites in New Brunswick, widespread in Canada.
Xylota quadrimaculata			
Xylota segnis			
Xylota subfasciata	X		Collected at two sites during the study. Known from two sites in New Brunswick, widespread in Canada.

Species	New for Nova Scotia	New for the Maritimes	Comment*
Bees			
Agapostemon virescens			
Andrena alleghaniensis			
Andrena bisalicis			
Andrena bradleyi			
Andrena brevipalpis	X		In Canada known from Ontario, Quebec, and New Brunswick.
Andrena carlini			
Andrena carolina			
Andrena clarkella			
Andrena crataegi			
Andrena cressonii			
Andrena forbesii			
Andrena hirticincta			
Andrena milwaukeensis			
Andrena rufosignata			
Andrena vicina			
Augochlorella aurata			
Bombus borealis			
Bombus fernaldae			
Bombus impatiens			
Bombus insularis			
Bombus perplexus			
Bombus ternarius			
Bombus terricola			
Bombus vagans			
Calliopsis andreniformis			
Ceratina calcarata			
Ceratina dupla			
Ceratina mikmaqi			
Coelioxys moesta			
Coelioxys porterae			
Colletes inaequalis			
Colletes simulans			

Species	New for Nova Scotia	New for the Maritimes	Comment*
Dufourea novaeangliae			
Halictus confusus			
Halictus rubicundus			
Lasioglossum albipenne			
Lasioglossum athabascense			
Megachile gemula			
Megachile relativa			
Osmia atriventris			
Osmia inspergens	X		Known from New Brunswick. Widespread in Canada.
Sphecodes johnsonii			

* distribtion data based on draft general status reports prepared by Cory Sheffield and Jeffrey Skevington