# University of Calgary - Zoology 435
# 2022 Insect Survey Report


## Authors

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**Undergraduate and graduate student authorship in alphabetical order.*


## Executive Summary


Research findings from students enrolled in the fall 2022 Zoology 435 – Entomology - course at the University of Calgary. Students enrolled in this course conducted a biodiversity survey of insects throughout The City of Calgary. Insects were physically collected where permits and permissions were available in addition to digital observations from various localities using the iNaturalist platform from early May to mid-October, with most observations and collections occurring in September. In 2022, students observed 3045 insects in The City of Calgary on iNaturalist (4408 in the project overall) and collected 1241 physical specimens in The City of Calgary (1447 specimens overall). 854 total insect specimens were donated to the University of Calgary Teaching Collection, 666 of which were from The City of Calgary. Insects were observed and collected from 19 of the 25 parks in The City of Calgary where permits were obtained, with the most insects observed from Nose Hill Park (246), followed by Bowmont Park & Dale Hodges Park (82), Inglewood Bird Sanctuary (77), Prince's Island (71), South Glenmore Park (66), Weaselhead Flats (57), Douglasglen Park (40), and Pearce Estate (38). Our report focuses on iNaturalist observations and donated physical specimens collected in The City of Calgary.

Student identifications of physical specimens were first completed to order individually, and then donated specimens were identified to family level in teams. To estimate accuracy, we randomly selected ten specimens from each order and compared student team identifications. Consensus among student teams was reached for 70% or more of identifications across the different orders, with individual teams' accuracy at 60% or higher. Student team identification was best in Hymenoptera, where 100% of randomly selected specimens were agreed upon by students and were accurate. Coleoptera showed the lowest consensus and number of accurate identifications. iNaturalist identifications were sourced from the iNaturalist community, including specific requests for identifications from experts. For The City of Calgary observations, 275 experts provided 4815 identifications. 503 "species" were identified, and 1155 observations (26%) reached Research Grade. iNaturalist defines "species" as unique taxonomic groups, which could be species, genera, or families. To be a Research Grade observation, an observation must be identified to species level and verified by the community (at least 2 of 3 identifications to species must agree). Observations that are identified to Research Grade are automatically uploaded to the Global Biodiversity Information Facility (GBIF).

Through our 2022 survey, we observed 16 orders, 122 families, 207 genera, and 170 species in The City of Calgary. One specimen was flagged by the iNaturalist algorithm as threatened, and 23 as introduced. For observations outside of Calgary, four additional threatened species were flagged, including one COSEWIC listed threatened species, *Bombus occidentalis*, found in the Town of Okotoks. Thirty-seven total introduced species were observed by students in and outside of Calgary. Three threatened species (none in Calgary) and 18 introduced species (25 in Calgary) were not observed in 2020. iNaturalist observations from this 2022 survey represent 22% of total previously observed insect "species" diversity on iNaturalist for The City of Calgary. Continued observations of new species in The City of Calgary on iNaturalist show that our understanding of insect diversity is still improving. Student observations represent a significant number of total insect observations in The City (41% in 2022) and so play an important role in improving this knowledge.

This project was first developed in 2020 and has been successful in both improving understanding of insect diversity in The City of Calgary and providing meaningful experiences for students to learn about insects. After the 2020 offering, 57% of students continued to use iNaturalist following the course.

## Permit

## University of Calgary Insect Biodiversity Survey
## Permit #2970291

Number of observers and collectors – 63

## Dates

April 1 - November 30, 2022
May 12 - October 10, 2022 (physical collections)
April 8 – October 14, 2022 (iNaturalist digital collections)

## Calgary Park Permit Localities

Pearce Estate, Prince's Island, Edworthy Park, Bowmont Park and Dale Hodges, Nose Hill, McHugh Bluff, BeaverDam Flats, Carburn, North Glenmore, South Glenmore, Canyon Meadows Bee Blvd, St. Andrew's Heights/Parkdale, Murdoch Park, 12 Mile Coulee, Ralph Klein, Confluence Park & West Nose Creek, Weaselhead Flats, Memorial Drive & 14 St NW Sage Hill Natural Environment Park, Douglasglen Park, Patterson Natural Environmental Park, Coventry Pollinator Corridor Median, Inglewood Bird Sanctuary, Bridgeland Naturalization, and Reader Rock Garden

## Report Contents

# I. Introduction

Insects are the most extensive and diverse group of animals on earth and play a significant role in the function of terrestrial and aquatic ecosystems (Samways, 2005). Insects are also important members of urban environments. For instance, wild pollinators have demonstrated greater ability than managed populations of pollinators to increase yield in both urban and rural agricultural settings (Ayers and Rehan, 2021). However, increasing urbanization can destroy, fragment, and reduce the habitats and resources needed to support diverse insect populations (Samways, 2007). For example, studies examining the differences between urbanized and less urbanized areas have found that the number of native species has generally decreased in more urbanized areas (Adams et al., 2020; Baldock et al., 2015). These decreases can be attributed to human impacts, such as habitat loss and fragmentation, the use of pesticides, and pathogens (Gonzalez et al., 2013; Vanbergen, 2013). Species-specific characteristics can also determine success in urban environments, with dispersal ability and how well a particular species can manage new competition as important factors (McKinney, 2006). Another important risk to urban insects is that insects are frequently dismissed as insignificant or ignored by human societies (Samways, 2007). Likewise, the public's perception of insects can be shaped by negative messages that reinforce entomophobia or people's fear of insects inhabiting their yards and homes (Kuehn, 2008).

To promote appreciation of and interest in insects while advancing understanding of insect biodiversity, many community-scientist (or citizen scientist) initiatives have been launched. Citizen volunteers have played an important role in understanding insect biodiversity through contributing observations to online communities and databases, such as iNaturalist. iNaturalist has been particularly successful in engaging community scientists to share observations of nature around the world (Nugent, 2018). iNaturalist is accessible, free, and easy to use. The increasing usage of the iNaturalist platform could be attributed to the artificial intelligence technology that iNaturalist uses, technology that helps in identifying animals and plants to the species level (Nugent, 2018). Community scientists on iNaturalist and other online platforms contribute to the discovery of new insect species, participate in monitoring a wide range of species, and contribute to conservation and management initiatives (Gardiner & Roy, 2022). In addition, some entomology-focused courses have integrated the use of the iNaturalist platform (Summers et al., 2020; Echeveria et al., 2021). Integrating citizen science into entomology-focused courses may help in collecting and recording the global distribution of species, as well as to promote an appreciation and understanding of biodiversity among students (Paradise & Bartkovich, 2021). Most importantly, it has been found that students' data in these projects is highly verifiable, which makes these data potentially useful for biodiversity research (Aristeidou et al., 2021). Taken together, the contributions of students, amateur, and community (or citizen) volunteers are helping to increase the knowledge available on insects (Fontaine, Fontaine & Prevot, 2021). However, only a few studies (Aristeidou et al., 2021) have investigated the participation patterns of participants and, to our knowledge, none have done longitudinal studies using students' data on urban insect diversity.

The first City of Calgary insect biodiversity survey (Summers et al. 2021) was completed by students enrolled in an Entomology course (ZOOL 435) in fall 2020. This survey identified 18 orders, 113 families, 183 genera, and 207 species, including 23 species introduced to the city, and seven threatened species, including *Bombus occidentalis*. In terms of student experience, students overall expressed positive experiences and outcomes from this research project. Students were surprised by the extent of insect biodiversity they encountered and experienced in their neighborhoods. They reflected on the role of habitat in insect biodiversity, both on a small scale, such as different habitats in their own backyards or nearby parks, and the larger implications of Albertan habitats. Also, students enjoyed learning more about insects through experience and found their collaboration with other students in the course to be rewarding. Additionally, many students positively discussed their experience of sharing the importance of studying insects with members of the community who saw the project being carried out. Lastly, students enjoyed engaging their family members in the project, especially during a time of isolation due to COVID-19. For example, students shared stories of using the project to teach family members about their interests, share words of different languages for their findings, and be active and outside together. Given the success of the 2020 project, both in terms of increasing understanding of insect biodiversity in The City of Calgary, as well as students' positive feelings and increasing appreciation of insects, we repeated our study in the 2022 offering of this course.

# II. 2022 summary: iNaturalist observations and physical collection

Sixty-three students enrolled in Zoology 435, as well as two staff, two graduate teaching assistants, and two graduate research coaches, observed and collected insects as part of a course-based research project. Insects were observed and collected in various ways: some specimens were only physically collected; some were observed on iNaturalist only; while others were both physically collected and included as observations in iNaturalist. Students were also encouraged to add their observations to ongoing iNaturalist projects, with points being awarded to observations added to the Calgary Pollinators project. Physical specimens were collected following ethical sampling guidelines. Students were only allowed to collect in The City of Calgary parks from which permits had been obtained or on private property with the owner's consent. Each student was only allowed to collect up to 50 physical specimens, and no duplicates were allowed to avoid oversampling.

Students were invited to donate part or all of their physical collection to the University of Calgary Teaching Collection for future student use in courses and research projects. A summary of the total number of digital observations, physical collections, and donations for 2022 are provided with a comparison to the 2020 project in **Table 1**. Of the total collection, 69% of iNaturalist digital collection (3045 observations) and 78% of the donated physical collection (854 specimens) were from The City of Calgary, which will be the focus of this report. Despite fewer students in 2022 (63 vs 92 in 2020) and an updated assessment to require fewer observations and collections, more observations were contributed to iNaturalist for both the project overall (29.8% increase) and The City of Calgary (34.5% increase). The number of physically collected insects was 79% percent lower for the project overall and 74.1% lower for The City of Calgary.

**Table 1.** Physical and digital observations of insects made in 2022 Zoology 435 collection (63 enrolled students) compared to previous 2020 collection (90 enrolled students).

| | **The City of Calgary 2020** | **Total Survey 2020** | **The City of Calgary 2022** | **Total Survey 2022** |
|---|---|---|---|---|
| Observations made on iNaturalist | 2264 | 3396 | 3045 | 4408 |
| Physical specimens collected | 4795 | 6900 | 1241 | 1447 |
| Physical specimens donated to the University of Calgary teaching collection | 1397 | 3474 | 666 | 854 |

Students observed and collected insects from April 8th to October 14th, 2022 (**Figure 1**). iNaturalist observations were highest during and just preceding the start of the Fall term, peaking in September (2003 observations), with the next highest being in October (901 observations) and the third highest in August (589). The average number of iNaturalist observations per student in 2022 was 70.16 (median 47; mode 48), with a range of 1-256 observations. In 2020, the average was 36.55 (median 33; mode 41) with a range of 3-142. The average number of physical insect donations per student in 2022 was 25.12 (median 22.5; mode 22), and 36.56 in 2022 (median 33, mode 1). In 2020, 50.3% of specimens were donated to the University of Calgary teaching collection and in 2022, 59% of specimens were donated. In 2020, students were invited to engage in physical collection of insects associated with plants, while in 2022 they were encouraged to participate in digital observations of pollinating insects through the Calgary pollinator project. Students and staff contributed 2288 physical specimens to the 2020 project and 779 iNaturalist observations to the Calgary Pollinator project in 2022.

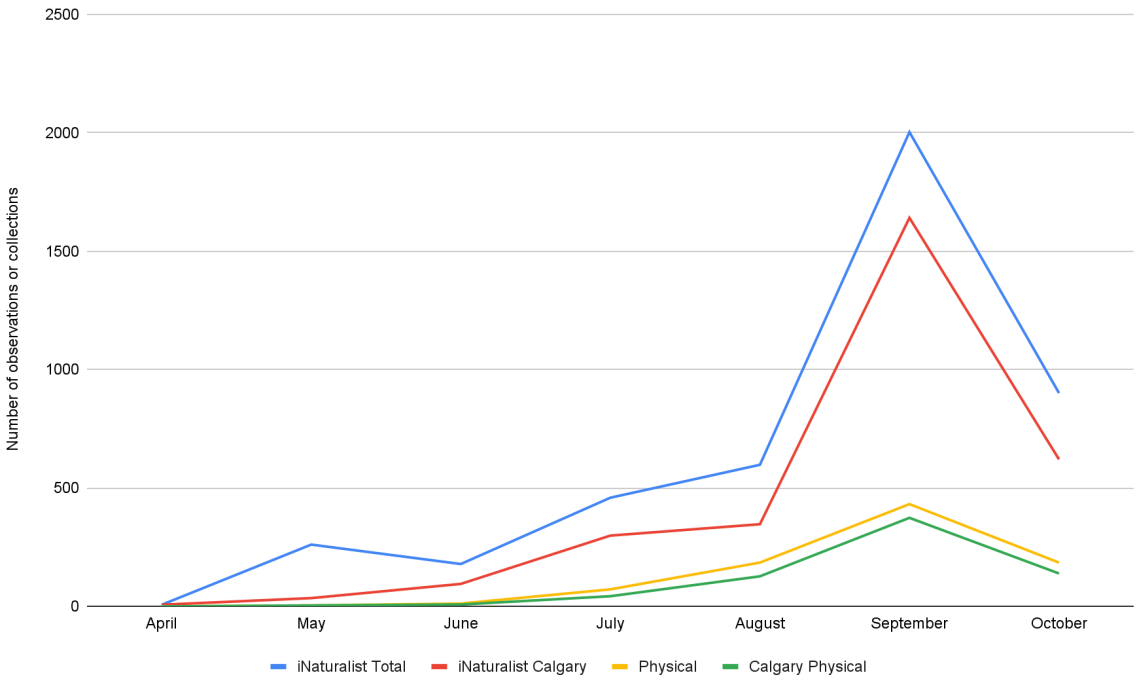


**Figure 1.** Total observations and physical collections per month in 2022 for both the overall project and for within The City of Calgary. The numbers for the physical collection are based only on specimens donated to the Teaching Collection.

**Data availability:** All observations made on iNaturalist are available in the Zoology 435 2022 Survey (https://www.inaturalist.org/projects/zool435-insect-survey-2022). A record of all physically donated specimens will be uploaded to Canadensys to be added to the Global Biodiversity Information Facility (GBIF).

We obtained permits to physically collect at 25 sites managed by The City of Calgary Parks. Students both physically collected and observed insects at 19 of these sites (**Table 2**). Sites with the highest number of observations/collections included Nose Hill Park, Bowmont Park & Hodges Park, Inglewood Bird Sanctuary and Prince's Island Park. iNaturalist reports the number of "species" (unique taxonomic groups, which could be species, genera, or families). The highest number of "species" was observed in Nose Hill Park (60 species), followed by Bowmont Park and Dale Hodges Park (40 species). 44% of all insects collected with a permit were donated to the teaching and research collection.

**Table 2.** Insects observed through iNaturalist, collected and/or donated to the teaching collection from The City of Calgary parks. iNaturalist defines "species" as unique taxonomic groups, which could be species, genera, or families.

| Park | iNaturalist Observations | Physical Specimens Donated | iNaturalist No. "Species" |
|---|---|---|---|
| Nose Hill Park | 246 | 67 | 60 |
| Bowmont Park & Dale Hodges Park | 82 | 20 | 40 |
| Inglewood Bird Sanctuary | 77 | 9 | 35 |
| Prince's Island | 71 | 8 | 38 |
| South Glenmore Park | 66 | 1 | 32 |
| Weaselhead Flats | 57 | 7 | 28 |
| Douglasglen Park | 40 | 0 | 12 |
| Pearce Estate | 38 | 0 | 25 |
| 12-Mile Coulee | 18 | 0 | 12 |
| Edworthy Park | 11 | 27 | 8 |
| Reader Rock Garden | 6 | 2 | 5 |
| Carburn Park | 5 | 24 | 3 |
| North Glenmore Park | 5 | 2 | 4 |
| McHugh Bluff Park | 4 | 4 | 4 |
| Beaver Dam Flats Park | 4 | 5 | 3 |
| St. Andrew's Heights/Parkdale Hillside | 2 | 1 | 2 |
| Canyon Meadows Boulevard | 1 | 1 | 1 |

| | | | |
|---|---|---|---|
| Confluence Park & West Nose Creek | 1 | 0 | 1 |
| Ralph Klein Park | 0 | 1 | 0 |
| Murdoch Park | 0 | 0 | 0 |
| Memorial Drive & 14 St NW | 0 | 0 | 0 |
| Sage Hill Natural Environment Park | 0 | 0 | 0 |
| Patterson Natural Environmental Park | 0 | 0 | 0 |
| Coventry Pollinator Corridor Median | 0 | 0 | 0 |
| Bridgeland Naturalization | 0 | 0 | 0 |
| **Totals** | **734** | **179** | **313** |

In The City of Calgary, insects were observed on iNaturalist (**Figure 2**) and physically collected (**Figure 3**) in all four quadrants, with more observations and collections occurring in the northwest.

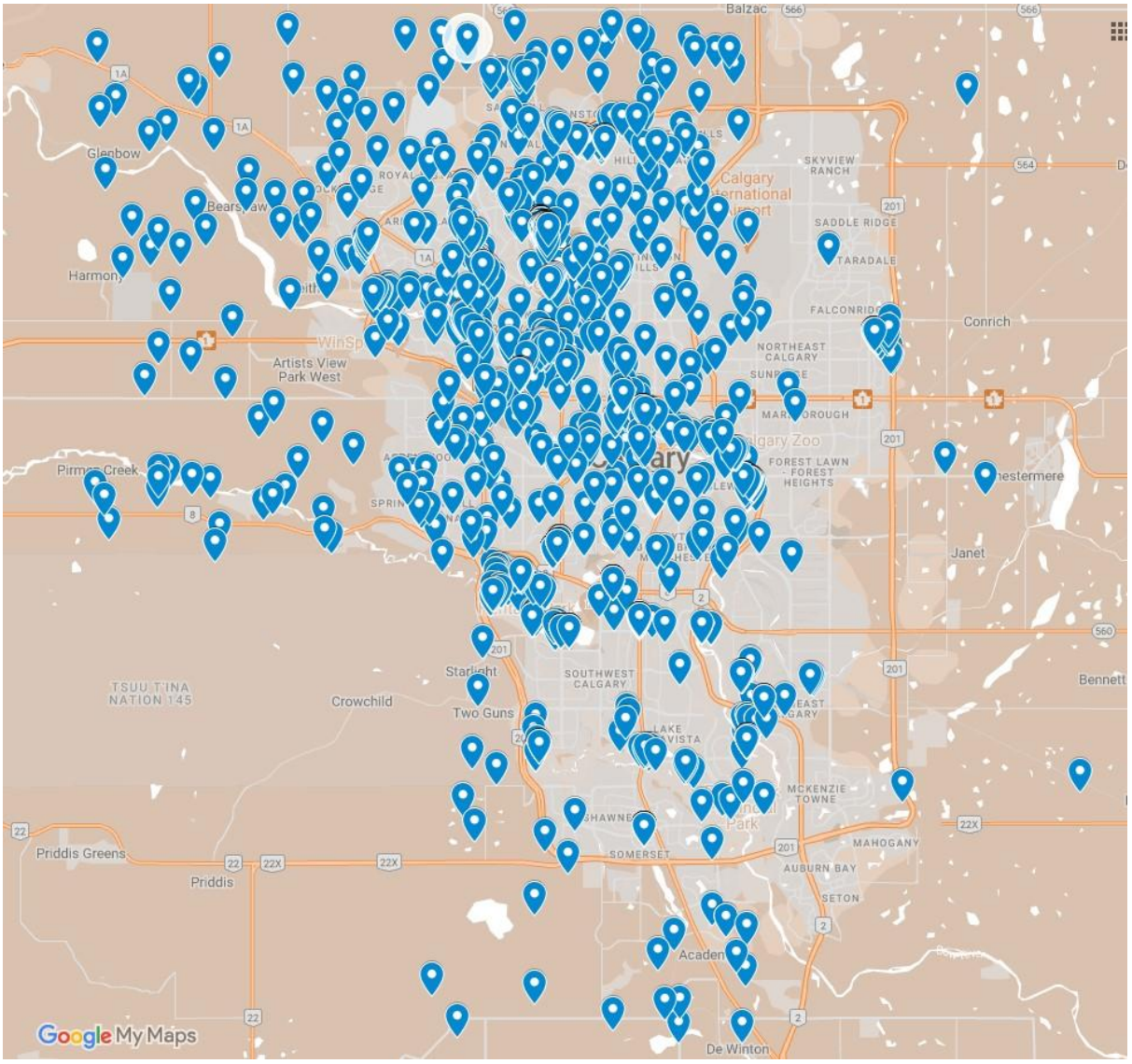


**Figure 2.** Zoology 435 2022 iNaturalist observation locations in The City of Calgary - interactive version here.

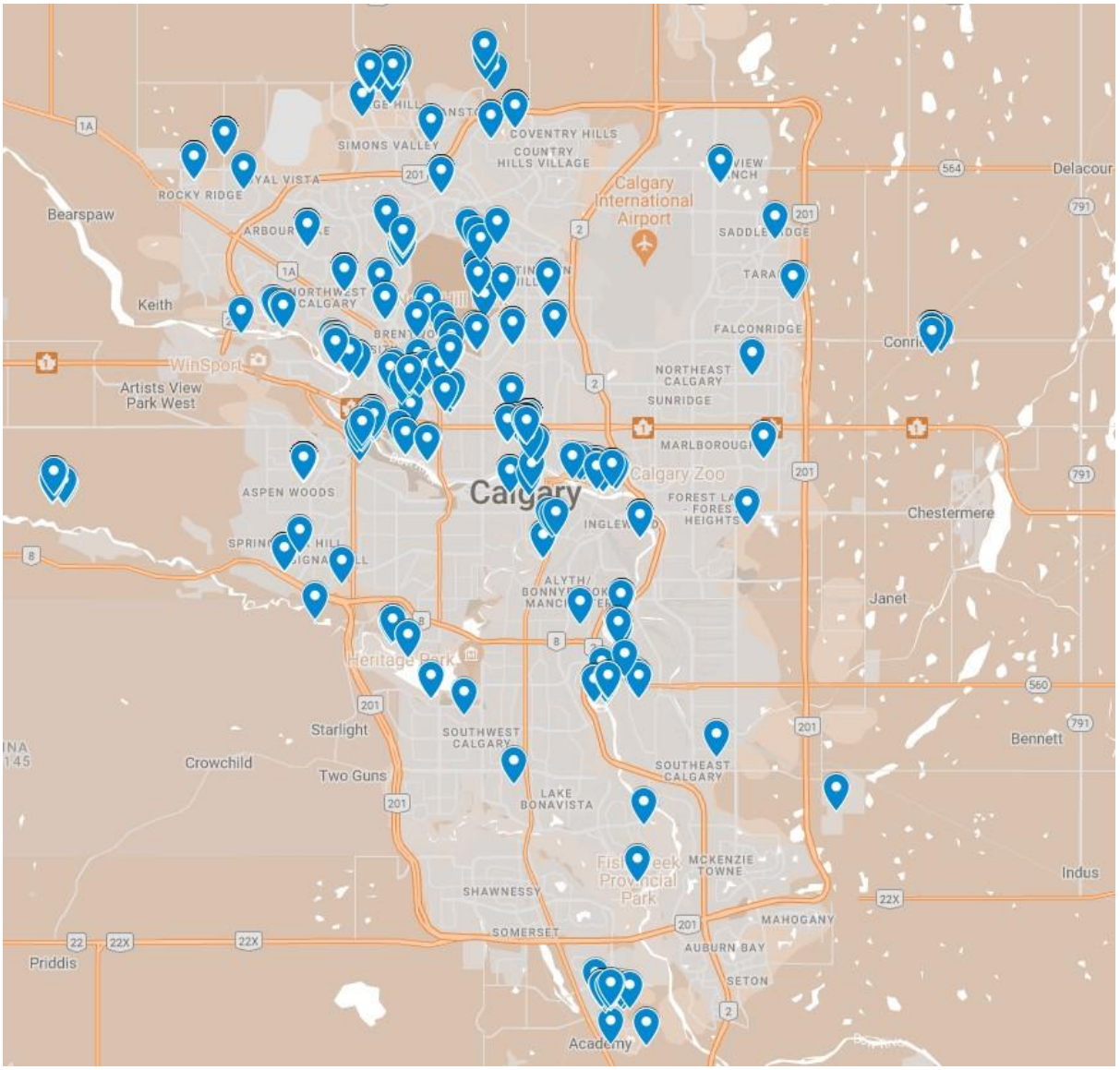


**Figure 3.** Zoology 435 2022 insect collection locations for donated physical specimens, zoomed in to show The City of Calgary - interactive version here.

# III. Insect identification

Students identified their digital and physical collections to Order individually. Students did not provide further identifications to their digital collection.

***Physical collection identification***

Student teams identified 460 physical specimens donated to our Teaching Collection before October 17, 2022 to family during laboratories. The instructional team reviewed student identifications, and provided identifications for any physical specimens donated later in the course. We examined the accuracy of student identifications by randomly selecting ten specimens for each major Order (equivalent to 10-43% of specimens donated in each Order), and identifying whether student teams reached consensus (66% or greater of teams agreeing on an identification), whether this consensus identification matched the instructional team's identification, and the percentage of total correct team identifications for each order (**Table 3**). Consensus was reached for 70% or more of identifications across the different orders, with individual teams' accuracy at 60% or higher. Student team identification was best in Hymenoptera, where 100% of randomly selected specimens were agreed upon by students and were accurate. Coleoptera showed the lowest consensus and number of accurate identifications.

**Table 3.** Accuracy of student team family-level (or superfamily for Coleoptera) identifications of donated physical specimens based on ten randomly selected specimens for each order. The total number of team identifications for each specimen varied depending on the number of teams in each lab. Each specimen was identified by two to four teams.

| **Family** | **Number of specimens where students reached consensus**<br><br>**n=10** | **Number of Accurate Student Consensus Identifications**<br><br>**n=10** | **Number of Individual Student Team Accurate Identifications** |
|---|---|---|---|
| Coleoptera | 9 (90%) | 9 (90%) | 33/37 (89%) |
| Diptera | 7 (70%) | 6 (60%) | 24/39 (62%) |
| Hemiptera | 8 (80%) | 6 (60%) | 29/39 (74%) |
| Hymenoptera | 10 (100%) | 10 (100%) | 40/40 (100%) |
| Lepidoptera | 9 (90%) | 9 (90%) | 32/37 (86%) |
| Odonata | 8 (80%) | 8 (80%) | 32/40 (80%) |
| Orthoptera | 9 (90%) | 9 (90%) | 34/38 (89%) |

***iNaturalist digital observation identification***

iNaturalist identifications were improved by the iNaturalist community following student uploads to the platform. By mid-November, 397 iNaturalist experts provided 7625 identifications to student observations, identifying 446 species and 1014 Research Grade observations (23% of total). At this point, we reached out to specific experts to request additional support in identifications. We identified 12 experts that were active, somewhat local, and showed expertise in a particular order of insects or insect identification in general. All 12 experts contacted submitted at least two further identifications, with one expert providing over 373 identifications, and six experts adding over 100 identifications. Together, these 12 experts identified 21.2% of all observations in our project.

By December 1, 2022, 275 experts provided 4815 identifications in The City of Calgary, which led to 825 Research Grade observations. Observations that are identified to Research Grade are automatically uploaded to the Global Biodiversity Information Facility (GBIF). To be a Research Grade observation, an observation must be identified to species level and verified by the community (at least 2 of 3 identifications to species must agree). Individual experts provided between 1 and 270 identifications. Thirteen experts provided over 100 identifications, 15 provided over 50, and 247 provided up to 50 observations.

# IV. Insect diversity in The City of Calgary

The number of observations and physically collected specimens for insect orders, families, genera, and species we observed and collected in 2022 are provided in **Appendix 1**. To provide a summary of insect biodiversity in The City of Calgary, we combined and summarized results from the 2020 and 2022 Zoology 435 surveys. A summary of the number of orders, families, genera, and species, as well as number of introduced and threatened species is provided in **Table 4** and **Table 5**. A list of diversity identified by the combined 2020 and 2022 Zoology 435 insect surveys is included in section **VI - Calgary Insect Diversity Checklist**.

**Table 4.** Orders, families, genera, and species identified in The City of Calgary in the years 2020 and 2022 through the Zoology 435 surveys. Most of the identifications beyond family level for 2020 and beyond order level for 2022 were provided by iNaturalist experts, who are world authorities on specific taxa.

| Identified number | 2020 Survey | 2022 Survey | ZOOL435 Combined Surveys | iNaturalist Combined Surveys |
|---|---|---|---|---|
| Orders | 18 | 16 | 19 | NA |
| Families | 113 | 122 | 156 | NA |
| Genera | 183 | 207 | 292 | NA |
| Species | 207 | 170 | 295 | 1257 |
| | | | | |
| Species introduced | 23 | 25 | 32 | 75 |
| iNaturalist* threatened species list: vulnerable and endangered | 7 | 1 | 7 | 33 |
| COSEWIC Listed Species for Alberta | 3 | 1 | 3 | 3 |

*To determine if a taxon is threatened, iNaturalist refers to a variety of databases and guides, and the source of information can be found on each species' page. See this iNaturalist forum for more information. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) specifically assesses insects in Alberta.

**Table 5.** The number of families, genera, and species identified within The City of Calgary by our insect surveys in 2020 and 2022. Identifying many insects beyond order and to family, genera, and species requires expert knowledge and these identifications have been provided by experts on iNaturalist. Zeros are provided where this rank was not able to be identified for any specimens identified to the order.

| Order | Number of Families | Number of Genera | Number of Species |
|---|---|---|---|
| Archaeognatha | 0 | 0 | 0 |
| Blattodea | 2 | 2 | 2 |
| Coleoptera | 24 | 58 | 51 |
| Dermaptera | 1 | 1 | 1 |
| Diptera | 35 | 47 | 28 |
| Ephemeroptera | 4 | 3 | 0 |
| Hemiptera | 26 | 34 | 25 |
| Hymenoptera | 15 | 36 | 73 |
| Lepidoptera | 27 | 77 | 75 |
| Mantodea | 1 | 2 | 2 |
| Neuroptera | 2 | 5 | 4 |
| Odonata | 6 | 7 | 13 |
| Orthoptera | 5 | 15 | 18 |
| Plecoptera | 4 | 3 | 2 |
| Psocodea | 0 | 0 | 0 |
| Siphonaptera | 0 | 0 | 0 |
| Thysanoptera | 0 | 0 | 0 |
| Trichoptera | 4 | 2 | 1 |
| Zygentoma | 0 | 0 | 0 |

Of the species observed on iNaturalist in 2022, five were identified by iNaturalist as threatened and 37 as invasive. Three threatened species (none in Calgary) and 18 introduced species (25 in Calgary) were not observed in 2020. A list of these species is provided below.

**Threatened species** (Non-Calgary diversity indicated with an asterisk; new species not observed in 2020 are indicated with an ^)**:**

iNaturalist uses different databases and guides to assign threatened species status to taxa, and the source used can be found on each species page. See this iNaturalist forum for more information. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) provides assessments specifically for Albertan insects.

**Lepidoptera**

*^*Boloria alberta* (Alberta Fritillary) - vulnerable in Alberta

*^*Boloria astarte* (Astarte Fritillary) - apparently secure in Alberta; imperiled in Montana

*Ochlodes sylvanoides* (Woodland Skipper) - apparently secure in Alberta; imperiled (Saskatchewan)

**Hymenoptera**

*^*Ancistrocerus antilope* (Lobed Mason Wasp) - not assessed in Alberta; critically imperiled (Saskatchewan); vulnerable (British Columbia)

**Bombus occidentalis* (Western Bumble Bee) – **COSEWIC Status: Threatened**

**Introduced species** (Non-Calgary diversity indicated with an asterisk; new species not observed in 2020 are indicated with an ^)**:**

**Blattodea**
**Blattella germanica* (German Cockroach)
**^Periplaneta americana* (American Cockroach)
*^Periplaneta australasiae* (Australian Cockroach)

**Coleoptera**
*Carabus granulatus* (Granulated Ground Beetle)
*Carabus nemoralis* (Bronze Ground Beetle)
**^Chilothorax distinctus*
*Coccinella septempunctata* (Seven-Spotted Ladybug)
**^Harmonia axyridis* (Asian Lady Beetle)
*^Larinus carinae* (Canada Thistle Bud Weevil)
*^Lilioceris lilii* (Lily Leaf Beetle)
*Otiorhynchus raucus*

*^*Phyllotreta striolata* (Striped Flea Beetle)
*^Polydrusus impressifrons* (Pale Green Weevil)
*Pterostichus melanarius* (Rain Beetle)
*^Romualdius scaber* (Crusted Root Weevil)
*^Sciaphilus asperatus* (Strawberry Root Weevil)
*Sitona hispidulus* (Clover Weevil)
*^*Sitona lineatus* (Pea Weevil)

**Dermaptera**
**Forficula auricularia* (European Earwig)

**Diptera**
*^*Eristalis arbustorum* (European Drone Fly)
*Eristalis tenax* (Common Drone Fly)
*^*Lucilia sericata* (Common European Greenbottle Fly)
*^*Musca autumnalis* (Face Fly)
*^Neomyia cornicina*
*^Syritta pipiens* (Thick-legged Hoverfly)

**Hemiptera**
*Athysanus argentarius* (Silver Leafhopper)
*Doratura stylata*
*^*Halyomorpha halys* (Brown Marmorated Stink Bug)
*Philaenus spumarius* (Meadow Spittlebug)

**Hymenoptera**
*Apis mellifera* (Western Honey Bee)
*Polistes dominula* (European Paper Wasp)
*^Vespula germanica* (German Yellowjacket)

**Lepidoptera**
*Leucoma salicis* (White Satin Moth)
*Pieris rapae* (Cabbage White)
*Thera juniperata* (Juniper Carpet)
*Thymelicus lineola* (European Skipper)

**Mantodea**
**Mantis religiosa* (European Mantis)

# V. Increasing understanding of insect biodiversity in The City of Calgary through student engagement

**What is the trend in iNaturalist insect observations, and how does this compare to iNaturalist observations in the City in general?**

iNaturalist observations in The City of Calgary have been increasing since launch of the platform in 2008, with particular growth following 2016. Insect observations are a smaller subset of total observations in Calgary, showing most growth following 2018. Despite a decrease in total observations in 2022 (as of December 2022), Calgary insect observations have continued to rise in 2022 (**Figure 4**).

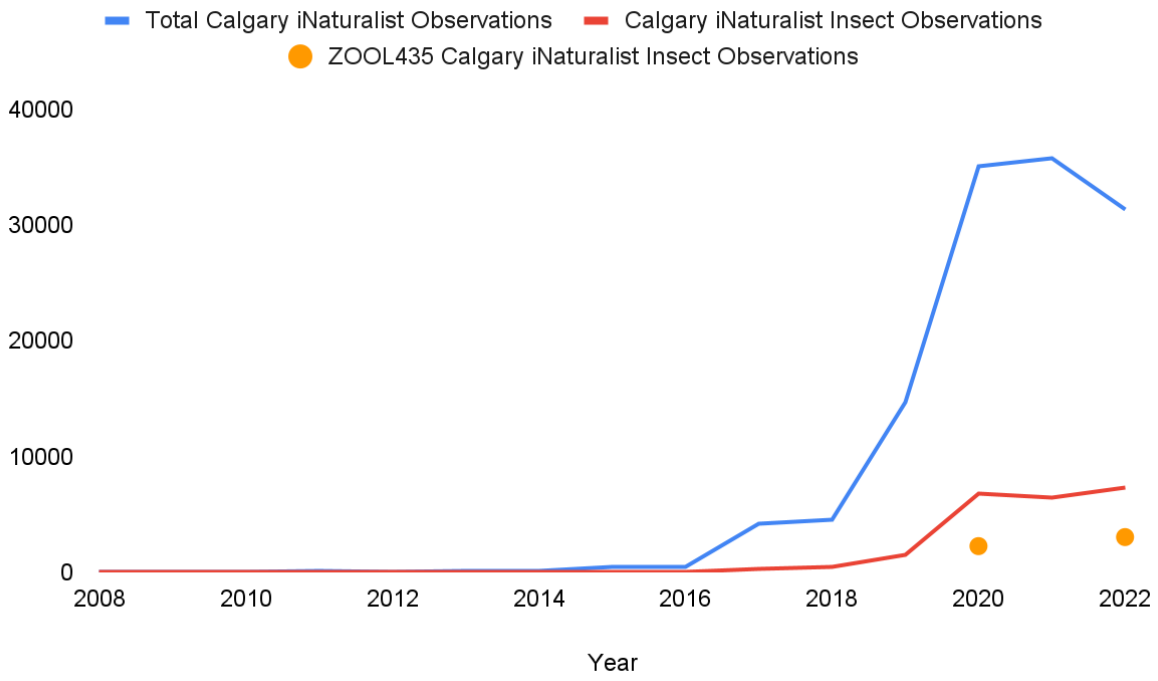


**Figure 4.** Total observations on iNaturalist in Calgary from 2008 to 2022 compared to observations of insects over the same period.

**What is the contribution of Zoology 435 students to insect observations in Calgary?**

Zoology 435 students have had a significant impact on insect observations in The City of Calgary, representing 33% of the total number of insect observations in 2020 and 41% of the total insect observations in 2022. Compared to other insect observers in Calgary, Zoology 435 students observe a large number of insects as they only make up 15% (2020) and 10% (2022) of the total number of observers (**Table 6**).

**Table 6.** Number of iNaturalist insect observations in Calgary, and the contribution of Zoology 435 students in 2020 and 2022.

| | **2020** | **2022** | | **2020** | **2022** |
|---|---|---|---|---|---|
| ZOOL435 Calgary iNaturalist insect observations | 2264 | 3045 | ZOOL435 Calgary insect observers | 90 | 63 |
| Total Calgary iNaturalist insect observations | 6765 | 7324 | Calgary iNaturalist insect observers | 619 | 624 |
| **Percent contribution** | **33%** | **41%** | **Percent of observers** | **15%** | **10%** |

**Are we still discovering insects in Calgary?**

Based on the total number of iNaturalist insect “species”, understanding of insect diversity in Calgary is still being improved. The number of species identified in The City of Calgary has been increasing, with particular growth following 2018 (**Figure 5**). The more observations made of insects in Calgary, the more insect species that are being identified (**Figure 6**).

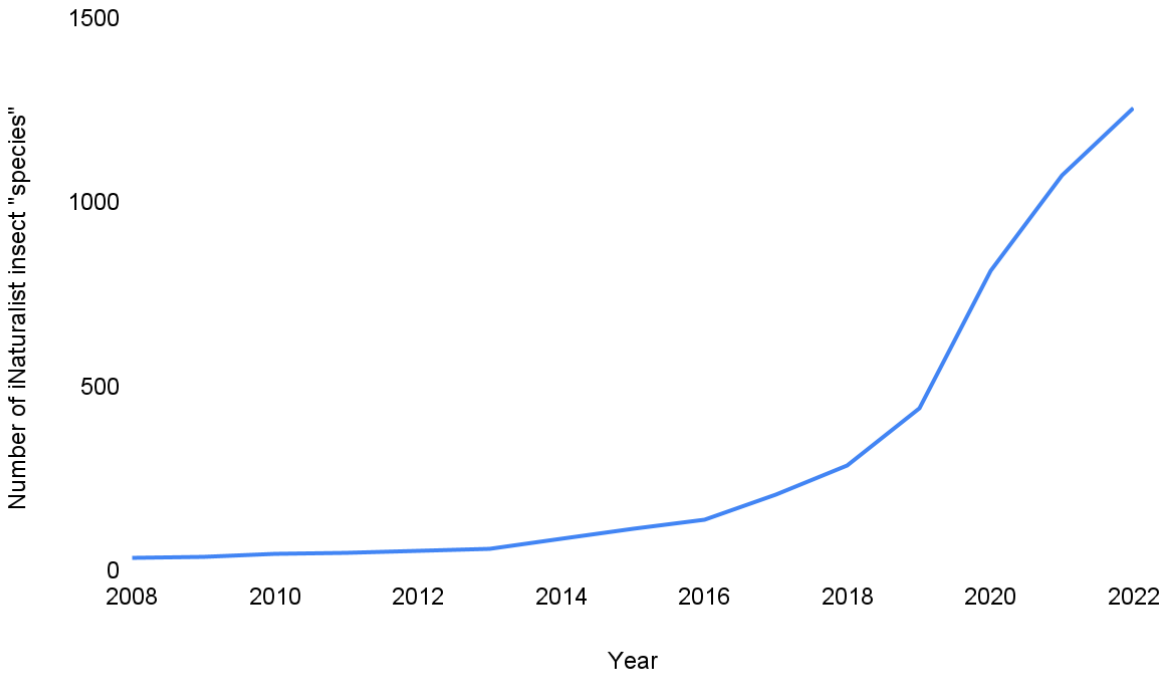


**Figure 5.** The cumulative number of insect “species” identified in The City of Calgary since 2008 on iNaturalist.

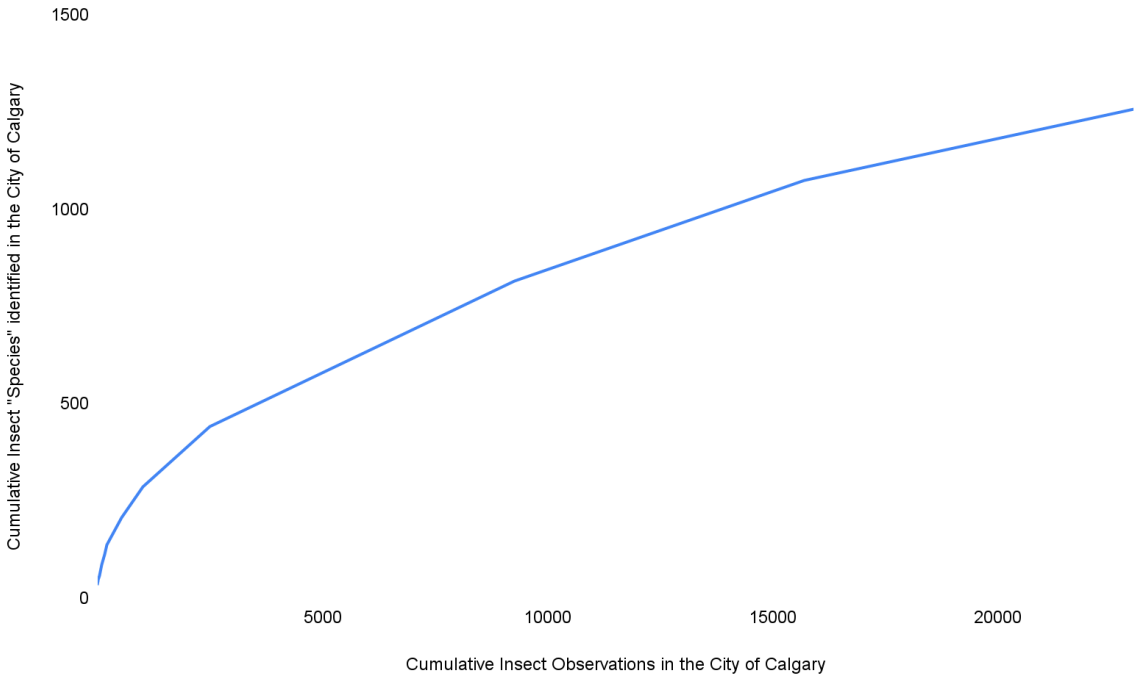


**Figure 6.** The cumulative number of insect “species” identified on iNaturalist as compared to cumulative number of insect observations in The City of Calgary.

**Do students continue using iNaturalist after the course?**

80 and 73% of students participating in the 2020 and 2022 insect surveys, respectively, were introduced to the iNaturalist platform through enrolling in ZOOL 435 - Entomology course. In 2020, 50% of students continued to use the platform after the course ended (**Table 7**).

**Table 7.** Undergraduate and graduate (teaching assistant or research coach) student participation on the iNaturalist platform. Continued iNaturalist use for members of the 2020 iNaturalist project examined two years after the course ended.

| | **Number of students**<br><br>**2020** | **Number who continued using iNaturalist after course**<br><br>**2020** | **Number of students**<br><br>**2022** |
|---|---|---|---|
| iNaturalist members before course | 18 (20%) | 12 (67%) | 14 (23%) |
| Signed up to iNaturalist for course | 72 (80%) | 39 (54%) | 46 (73%) |
| **Total** | **90** | **51 (57%)** | **61** |

**Overall experiences and ideas for future work with The City of Calgary and community**

Students developed an increased appreciation for insect diversity in both 2020 and 2022 offerings. In 2022, the ubiquitous presence of insects in their environment was unexpected, as was how late in the year they were able to still find insects active. Students found themselves noticing insects more than they did before participating in this research project, with one commenting that “if you just look a bit closer at your surroundings, you can see so many!” Students remarked on their new skills in insect collection, including learning the best conditions in which to find insects, curation, and identification. Students were particularly proud of their new identification skills, having learned by the end of the project how to identify many insects by sight and without the need of keys or guides. Many students said their fear of insects was reduced through the process of observing insects and learning more about them.

Students expressed a desire to have more courses available that included research components on surveying local biodiversity. They highlighted the value of these course-based research experiences in fostering an appreciation for local biodiversity, which one student identified as being “an invaluable tool for understanding and conserving” the biodiversity. While collecting, students enjoyed communicating with curious members of the public about what they were doing and why, sharing their interest in insects, research, conservation and more.

Students from 2020 expressed interest in working further with The City of Calgary and community. They suggested that emphasis be placed on producing communications that could be used with a variety of community audiences, such as K-12 students, visitors to The City of Calgary parks, and for those interested in furthering citizen science. Students also suggested that The City of Calgary could support further education into particular localities, taxa, or conservation projects for interested participants.

Students from 2022 suggested engaging other schools or post-secondary institutions in the project to improve coverage of sampling in The City of Calgary, and across Alberta, to capture a clearer picture of insect biodiversity. One student proposed assigning specific parks to individuals or groups of students to ensure sampling from currently underrepresented areas of The City of Calgary and to reduce oversampling. Students also suggested that repeated or regular collecting from target areas of interest to enable assessment of insect biodiversity changes over time or before and after special projects, such as planting native flowering plants along boulevards. Some students were interested in comparing the iNaturalist observations and physical collections to investigate biases that may result from the difference in sampling method.

# VI. Checklist of Calgary Insect Biodiversity

This Checklist was compiled using student observations from fall 2020 and fall 2022. Orders are written in bold; families in normal font; genera and species in italics. Common names for species from iNaturalist are provided where available. Identifying many insects beyond order and to family, genera, and species requires expert knowledge and is more possible for some groups (e.g., butterflies) based on photographs alone than others (e.g., flies). Identifications beyond the level of family were contributed and verified by iNaturalist experts.

**Colour coding:**

- Blue (found in 2020 but not in 2022)
- Orange (new in 2022)
- Black (both 2020 and 2022)

**Archaeognatha** (Bristletails)

**Blattodea** (not native; only found in dwellings)

- Blattidae
  - *Periplaneta*
    - *Periplaneta australasiae*
- Ectobiidae
  - *Blattella*
    - *Blattella germanica* (German Cockroach)

**Coleoptera**

- Attelabidae
  - *Merhynchites*
    - *Merhynchites wickhami*
- Buprestidae
  - *Agrilus*
    - *Agrilus ribesi*
  - *Melanophila*
    - *Melanophila acuminata* (Black Fire Beetle)
  - *Poecilonota*
- Cantharidae
- Carabidae (Ground Beetles)
  - *Agonum*
    - *Agonum punctiforme*
  - *Amara*
  - *Bembidion*
  - *Carabus*
    - *Carabus granulatus* (Granulated Ground Beetle)
    - *Carabus nemoralis* (Bronze Ground Beetle)
  - *Chlaenius*
    - *Chlaenius sericeus*
  - *Cicindela*

*Cicindela limbalis* (Common Claybank Tiger Beetle)
*Dicheirotrichus*
*Harpalus*
*Notiophilus*
*Pterostichus*
*Pterostichus melanarius* (Rain Beetle)
Cerambycidae
*Anthophylax*
*Anthophylax cyaneus*
*Batyle*
*Batyle suturalis*
*Grammoptera*
*Grammoptera subargentata*
*Monochamus*
*Monochamus scutellatus* (White-spotted Sawyer Beetle)
*Stictoleptura*
*Stictoleptura canadensis*
*Xylotrechus*
*Xylotrechus undulatus*
Chrysomelidae
*Diabrotica*
*Diabrotica balteata* (Banded Cucumber Beetle)
*Lilioceris*
*Lilioceris lilii* (Lily Leaf Beetle)
Cleridae
*Trichodes*
*Trichodes nuttalli* (Red-blue Checkered Beetle)
Coccinellidae
*Adalia*
*Adalia bipunctata* (Two-spotted Ladybug)
*Anatis*
*Anatis mali* (Eye-spotted Ladybug)
*Calvia*
*Calvia quatuordecimguttata* (Cream-spotted Ladybug)
*Coccinella*
*Coccinella septempunctata* (Seven-Spotted Ladybug)
*Coccinella trifasciata* (Three-banded Ladybug)
*Hippodamia*
*Hippodamia convergens* (Convergent Ladybug)
*Hippodamia parenthesis* (Parentheses Ladybug)
*Hippodamia sinuata* (Sinuate Ladybug)
*Hippodamia tredecimpunctata* (13-Spotted Ladybug)
*Mulsantina*
*Mulsantina picta* (Painted Ladybird)
Curculionidae
*Cryptorhynchus*
*Cryptorhynchus lapathi* (Poplar and Willow Borer)

- *Diaprepes*
  - *Diaprepes abbreviatus*
- *Dorytomus*
- *Larinus*
  - *Larinus carlinae* (Canada Thistle Bud Weevil)
- *Otiorhynchus*
  - *Otiorhynchus ovatus* (Strawberry Root Weevil)
  - *Otiorhynchus raucus*
- *Polydrusus*
  - *Polydrusus impressifrons* (Pale Green Weevil)
- *Rhinocyllus*
  - *Rhinocyllus conicus* (Nodding Thistle Receptacle Weevil)
- *Romualdius*
  - *Romualdius scaber*
- *Sciaphilus*
  - *Sciaphilus asperatus*
- *Sitona*
  - *Sitona hispidulus* (Clover Weevil)
- *Tournotaris*
  - *Tournotaris bimaculatus*

Dermestidae
- *Anthrenus*
- *Dermestes*
  - *Dermestes lardarius*

Dytiscidae (Predaceous Diving Beetles)
- *Dytiscus*
- *Graphoderus*
  - *Graphoderus perplexus*
- *Hydaticus*
  - *Hydaticus aruspex*
- *Rhantus*
  - *Rhantus sericans*

Elateridae
- *Aeolus*
  - *Aeolus mellillus*
- *Selatosomus*

Lampyridae

Melandryidae
- *Enchodes*
  - *Enchodes sericea*

Meloidae (Blister Beetles)
- *Lytta*
  - *Lytta nuttalli*

Melyridae
- *Malachius*
  - *Malachius aeneus*

Mordellidae

- Nitidulidae
  - *Glischrochilus*
    - *Glischrochilus fasciatus* (Picnic Beetle)
- Orsodacnidae
  - *Orsodacne*
    - *Orsodacne atra*
- Pyrochroidae
  - *Dendroides*
- Scarabaeidae
  - *Aphodius*
    - *Aphodius pedellus*
- Silphidae
  - *Nicrophorus*
  - *Thanatophilus*
    - *Thanatophilus lapponicus*
- Staphylinidae
  - *Aleochara*
- Tenebrionidae

**Dermaptera**

- Forficulidae
  - *Forficula*
    - *Forficula auricularia* (European Earwig)

**Diptera**

- Anisopodidae
  - *Sylvicola*
- Anthomyiidae (Root-maggot Flies)
  - *Anthomyia*
    - *Anthomyia oculifera*
    - *Anthomyia procellaris*
- Asilidae
- Bombyliidae
  - *Villa*
    - *Villa fulviana*
- Calliphoridae
  - *Calliphora*
    - *Calliphora vicina*
  - *Cynomya*
    - *Cynomya cadaverina* (Shiny Bluebottle Fly)
  - *Lucilia*
    - *Lucilia sericata (Common European Greenbottle Fly)*
  - *Phormia*
    - *Phormia regina*
- Cecidomyiidae
  - *Harmandiola*
- Ceratopogonidae

- Chironomidae
  - *Ablabesmyia*
- Chloropidae
- Clusiidae
- Culicidae
  - *Aedes*
  - *Culex*
  - *Culiseta*
- Dixidae
- Dolichopodidae
  - *Condylostylus*
  - *Dolichopus*
- Drosophilidae
  - *Drosophila*
  - *Scaptomyza*
- Ephydridae
- Limoniidae
- Muscidae
  - *Lispe*
  - *Musca*
    - *Musca domestica*
  - *Neomyia*
    - *Neomyia cornicina*
- Mycetophilidae
- Pallopteridae
  - *Toxonevra*
    - *Toxonevra superba*
- Phoridae
- Platypezidae
- Polleniidae
  - *Pollenia*
- Sarcophagidae
- Scathophagidae
  - *Scathophaga*
- Sciaridae
- Sciomyzidae
  - *Elgiva*
- Sepsidae
  - *Sepsis*
- Simuliidae
  - *Simulium*
- Stratiomyidae
  - *Microchrysa*
- Syrphidae
  - *Blera*
  - *Dasysyrphus*
  - *Didea*

*Didea alneti* (Triangular Lucent)

*Eristalis*

*Eristalis dimidiata (*Black-shouldered Drone Fly)

*Eristalis hirta*

*Eristalis stipator* (Yellow-shouldered Drone Fly)

*Eristalis tenax* (Common Drone Fly)

*Eupeodes*

*Eupeodes fumipennis* (Western Aphideater)

*Eupeodes volucris* (Bird Hover Fly)

*Helophilus*

*Helophilus latifrons* (Broad-headed Marsh Fly)

*Lapposyrphus*

*Lapposyrphus lapponicus* (Common Loopwing Aphideater)

*Parasyrphus*

*Platycheirus*

*Scaeva*

*Scaeva affinis* (White-bowed Smoothwing)

*Sericomyia*

*Sericomyia militaris* (Narrow-banded Pond Fly)

*Sphaerophoria*

*Spilomyia*

*Spilomyia sayi*

*Syritta*

*Syritta pipiens* (Thick-legged Hover Fly)

*Syrphus*

*Syrphus opinator*

*Syrphus ribesii*

*Toxomerus*

*Toxomerus marginatus* (Margined Calligrapher)

Tabanidae

Tachinidae (Bristle Flies)

Tephritidae

*Campiglossa*

*Chetostoma*

*Chetostoma californicum*

Tipulidae

*Nephrotoma*

*Tipula*

Ulidiidae

*Ceroxys*

*Ceroxys latiusculus*

**Ephemeroptera**

Baetidae

*Callibaetis*

Ephemeridae

*Hexagenia*

Heptageniidae
Leptohyphidae
*Tricorythodes*

**Hemiptera**
Acanthosomatidae
*Elasmostethus*
*Elasmostethus cruciatus*
Alydidae (Broad headed Bugs)
*Alydus*
*Alydus conspersus*
*Alydus eurinus*
*Megalotomus*
*Megalotomus quinquespinosus*
Anthocoridae
Aphididae
Aphrophoridae
*Philaenus*
*Philaenus spumarius* (Meadow Spittlebug)
Aradidae (Flat Bugs)
*Aradus*
Belostomatidae
*Lethocerus*
*Lethocerus americanus* (American Giant Water Bug)
Caliscelidae
Cicadellidae (Leafhoppers)
*Athysanus*
*Athysanus argentarius* (Silver Leafhopper)
*Cuerna*
*Cuerna striata*
*Doratura*
*Doratura stylata*
*Draeculacephala*
*Draeculacephala robinsoni*
*Gyponana*
*Graphocephala*
*Graphocephala gothica*
*Kybos*
*Psammotettix*
Cicadidae
Coreidae
*Leptoglossus*
*Leptoglossus occidentalis*
Corixidae (Water Boatmen)
Geocoridae
*Geocoris*
Gerridae (Water Striders)

*Aquarius*
*Aquarius remigis*
*Gerris*
Lygaeidae
*Lygaeus*
*Lygaeus kalmii* (Small Milkweed Bug)
*Kleidocerys*
Membracidae
Miridae (Plant Bugs)
*Lopidea*
*Lygus*
*Lygus elisus*
*Lygus lineolaris*
*Stenodema*
*Stenodema trispinosum* (Three-spined Grass Bug)
Nabidae
*Nabis*
Notonectidae (Backswimmers)
*Notonecta*
Pentatomidae (Stink Bugs)
*Banasa*
*Banasa dimidiata*
*Chlorochroa*
*Cosmopepla*
*Cosmopepla lintneriana* (Twice-stabbed Stink Bug)
*Euschistus*
*Euschistus tristigmus*
*Holcostethus*
*Holcostethus abbreviatus*
*Perillus*
*Perillus bioculatus* (Two-spotted Stink Bug)
Reduviidae
Rhopalidae
*Boisea*
*Boisea trivittata* (Eastern Boxelder Bug)
Rhyparochromidae
Saldidae (Shore Bugs)
Scutelleridae (Jewel Bugs)
*Homaemus*
*Homaemus aeneifrons*
Tingidae (Lace Bugs)
*Corythucha*
*Corythucha cydoniae*

**Hymenoptera**
Andrenidae
*Andrena*

- *Andrena milwaukeensis*
- *Andrena nivalis*
- *Andrena vicina*
- *Panurginus*
- *Pseudopanurgus*
  - *Pseudopanurgus parvus*

Apidae

- *Anthophora*
  - *Anthophora bomboides*
  - *Anthophora occidentalis*
  - *Anthophora terminalis*
- *Apis*
  - *Apis mellifera* (Western Honey Bee)
- *Bombus*
  - *Bombus bifarius* (Two-Form Bumble Bee)
  - *Bombus bohemicus* (Bohemian Cuckoo Bumble Bee)
  - *Bombus borealis* (Northern Amber Bumble Bee)
  - *Bombus centralis* (Central Bumble Bee)
  - *Bombus cryptarum* (Cryptic Bumble Bee)
  - *Bombus flavifrons* (Yellow Fronted Bumble Bee)
  - *Bombus huntii* (Hunt's Bumble Bee)
  - *Bombus insularis* (Indiscriminate Cuckoo Bumble Bee)
  - *Bombus mixtus* (Fuzzy-Horned Bumble Bee)
  - *Bombus nevadensis* (Nevada Bumble Bee)
  - *Bombus occidentalis* (Western Bumble Bee)
  - *Bombus perplexus* (Perplexing Bumble Bee)
  - *Bombus rufocinctus* (Red-belted Bumble Bee)
  - *Bombus ternarius* (Orange-belted Bumble Bee)
  - *Bombus vagans* (Half Black Bumble Bee)
  - *Bombus vancouverensis* (Vancouver Bumble Bee)
- *Melissodes*
  - *Melissodes confusus*
- *Nomada*
- *Triepeolus* (Cuckoo Bee)

Braconidae

Chrysididae (Cuckoo Wasp)

Colletidae

- *Colletes*
- *Hylaeus*
  - *Hylaeus affinis*
  - *Hylaeus annulatus*
  - *Hylaeus gaigei*
  - *Hylaeus illinoisensis*
  - *Hylaeus modestus*

Crabronidae

- *Pemphredon*
- *Philanthus* (Beewolf)

- Cynipidae
  - *Diplolepis*
    - *Diplolepis polita* (Spiny Leaf Gall Wasp)
- Formicidae
  - *Camponotus*
    - *Camponotus herculeanus* (Hercules Carpenter Ant)
  - *Formica*
    - *Formica argentea*
    - *Formica neoclara*
    - *Formica neorufibarbis*
    - *Formica obscuripes*
    - *Formica podzolica*
  - *Lasius*
    - *Lasius neoniger* (Turgrass Ant)
    - *Lasius pallitarsis* (Subterranean Aphid-tending Ant)
  - *Myrmica*
    - *Myrmica brevispinosa*
- Halictidae
  - *Agapostemon*
    - *Agapostemon texanus*
  - *Halictus*
    - *Halictus confusus* (Confusing Furrow Bee)
    - *Halictus rubicundus*
  - *Lasioglossum*
    - *Lasioglossum leucozonium*
    - *Lasioglossum paraforbesii*
    - *Lasioglossum zonulum*
  - *Sphecodes*
- Ichneumonidae
  - *Ophion*
- Megachilidae
  - *Coelioxys* (Cuckoo Leaf-cutter Bee)
    - *Coelioxys funeraria*
    - *Coelioxys porterae*
    - *Coelioxys rufitarsis*
  - *Hoplitis*
    - *Hoplitis spoliata*
  - *Megachile*
    - *Megachile centuncularis*
    - *Megachile frigida*
    - *Megachile inermis*
    - *Megachile latimanus*
    - *Megachile melanophaea*
    - *Megachile perihirta*
    - *Megachile pugnata*
    - *Megachile relativa*
    - *Megachile rotundata*

- *Osmia*
  - *Osmia simillima*
- Pompilidae
- Sphecidae
  - *Sceliphron*
    - *Sceliphron caementarium* (Yellow-legged Mud-dauber Wasp)
- Tenthredinidae
  - *Cladius*
    - *Cladius grandis* (Hairy Poplar Sawfly)
  - *Tenthredo*
- Vespidae
  - *Ancistrocerus*
  - *Dolichovespula*
    - *Dolichovespula albida* (Arctic Aerial Yellowjacket)
    - *Dolichovespula arenaria* (Common Aerial Yellowjacket)
    - *Dolichovespula maculata* (Bald-faced Hornet)
  - *Polistes*
    - *Polistes dominula* (European Paper Wasp)
  - *Pseudepipona*
    - *Pseudepipona herrichii* ssp. *aldrichi*
  - *Stenodynerus*
    - *Stenodynerus anormis*
  - *Vespula*
    - *Vespula alascensis* (Alaskan Yellowjacket)
    - *Vespula atropilosa* (Prairie Yellowjacket)
    - *Vespula consobrina* (Blackjacket)
    - *Vespula germanica* (German Yellowjacket)
    - *Vespula pensylvanica* (Western Yellowjacket)

**Lepidoptera**

- Alucitidae
  - *Alucita*
    - *Alucita montana*
- Argyresthiidae
  - *Argyresthia*
- Coleophoridae
  - *Coleophora*
- Cossidae
- Crambidae
  - *Agriphila*
  - *Chrysoteuchia*
    - *Chrysoteuchia topiarius* (Topiary Grass-Veneer)
  - *Loxostege*
    - *Loxostege munroealis*
- Depressariidae
- Erebidae
  - *Caenurgina*

- *Catocala*
  - *Catocala unijuga* (Once-married Underwing)
- *Gnophaela*
  - *Gnophaela vermiculata* (Police Car Moth)
- *Leucoma*
  - *Leucoma salicis* (White Satin Moth)
- *Lophocampa*
  - *Lophocampa maculata*
- *Zale*

Gelechiidae

Geometridae

- *Alsophila*
  - *Alsophila pometaria* (Fall Cankerworm Moth)
- *Aplocera*
- *Dysstroma*
- *Ennomos*
  - *Ennomos magnaria* (Maple Spanworm Moth)
- *Erannis*
  - *Erannis tiliaria* (Linden Looper Moth)
- *Eulithis*
  - *Eulithis testata* (Chevron Moth)
- *Eupithecia*
- *Hesperumia*
  - *Hesperumia sulphuraria*
- *Horisme*
  - *Horisme intestinata*
- *Plemyria*
  - *Plemyria georgii* (George's Carpet Moth)
- *Scopula*
  - *Scopula junctaria*
- *Thera*
  - *Thera juniperata* (Juniper Carpet)

Gracillariidae

- *Caloptilia*
  - *Caloptilia fraxinella*
- *Phyllocnistis*
  - *Phyllocnistis populiella*

Hepialidae

- *Sthenopis*
  - *Sthenopis purpurascens* (Four-spotted Ghost Moth)

Hesperiidae

- *Ochlodes*
  - *Ochlodes sylvanoides* (Woodland Skipper) - Endangered
- *Polites*
  - *Polites mystic* (Long Dash)
- *Thymelicus*
  - *Thymelicus lineola* (European Skipper)

- Lasiocampidae
  - *Malacosoma*
    - *Malacosoma disstria* (Forest Tent Caterpillar Moth)
- Lycaenidae
  - *Glaucopsyche*
    - *Glaucopsyche lygdamus* (Silvery Blue)
  - *Icaricia*
    - *Icaricia saepiolus* (Greenish Blue)
  - *Plebejus*
    - *Plebejus idas* (Northern Blue)
    - *Plebejus melissa* (Melissa Blue)
  - *Tharsalea*
    - *Tharsalea helloides*
- Noctuidae
  - *Actebia*
    - *Actebia fennica* (Finnish Dart)
  - *Anagrapha*
    - *Anagrapha falcifera* (Celery Looper Moth)
  - *Apamea*
    - *Apamea niveivenosa* (Snowy-veined Apamea Moth)
  - *Autographa*
    - *Autographa californica* (Alfalfa Looper)
  - *Caradrina*
    - *Caradrina montana*
  - *Dargida*
    - *Dargida procinctus* (Girdler Moth)
  - *Enargia*
    - *Enargia decolor* (Pale Enargia)
  - *Euxoa*
    - *Euxoa messoria* (Reaper Dart)
  - *Feltia*
    - *Feltia jaculifera* (Dingy Cutworm Moth)
  - *Mythimna*
    - *Mythimna unipuncta* (Armyworm Moth)
  - *Nephelodes*
    - *Nephelodes minians*
  - *Noctua*
  - *Xylena*
- Nymphalidae
  - *Aglais*
    - *Aglais milberti* (Milbert's Tortoiseshell)
  - *Caligo*
    - *Caligo telamonius*
  - *Cercyonis*
    - *Cercyonis pegala* (Common Wood-Nymph)
  - *Coenonympha*
    - *Coenonympha california*

*Coenonympha tullia* (Common Ringlet)

*Danaus*

*Danaus plexippus* (Monarch Butterfly)

*Euphydryas*

*Euphydryas anicia*

*Euptoieta*

*Euptoieta claudia* (Variegated Fritillary)

*Limenitis*

*Limenitis arthemis* (Red-spotted Admiral)

*Limenitis arthemis ssp. rubrofasciata* (Western White Admiral)

*Nymphalis*

*Nymphalis antiopa* (Mourning Cloak)

*Nymphalis l-album*

*Phyciodes*

*Phyciodes cocyta*

*Polygonia*

*Polygonia faunus*

*Polygonia gracilis*

*Polygonia satyrus*

*Speyeria*

*Speyeria cybele*

*Speyeria hesperis* (Northwestern Fritillary)

*Vanessa*

*Vanessa atalanta* (Red Admiral)

*Vanessa cardui* (Painted lady)

Oecophoridae

*Brymblia*

*Brymblia quadrimaculella*

Papilionidae

*Papilio*

*Papilio canadensis* (Canadian Tiger Swallowtail)

*Papilio zelicaon*

Pieridae

*Colias*

*Colias eurytheme* (Orange Sulfur)

*Colias philodice* (Clouded Sulfur)

*Pieris*

*Pieris rapae* (Cabbage White)

*Pontia*

*Pontia occidentalis* (Western White)

Plutellidae

*Plutella*

*Plutella xylostella*

Psychidae

*Dahlica*

*Dahlica triquetrella* (Narrow Lichen Case-Bearer)

Pterophoridae

- Pyralidae
  - *Dioryctria*
- Satyridae
- Sphingidae
  - *Ceratomia*
    - *Ceratomia undulosa* (Waved Sphinx)
  - *Hyles*
    - *Hyles gallii* (Bedstraw Hawkmoth)
  - *Smerinthus*
    - *Smerinthus jamaicensis* (Twin-spotted Sphinx)
  - *Sphinx*
- Tineidae
- Tortricidae
  - *Acleris*
    - *Acleris fuscana* (Small Aspen Leaftier Moth)
  - *Choristoneura*
    - *Choristoneura fumiferana*
  - *Epinotia*
    - *Epinotia radicana*
  - *Pelochrista*
    - *Pelochrista derelicta* (Derelict Pelochrista Moth)

**Mantodea**

- Mantidae
  - *Mantis*
    - *Mantis religiosa* (European Mantis)
  - *Tenodera*
    - *Tenodera sinensis*

**Neuroptera**

- Chrysopidae (Green Lacewings)
  - *Chrysopa*
    - *Chrysopa chi*
    - *Chrysopa coloradensis*
    - *Chrysopa nigricornis*
    - *Chrysopa oculata*
  - *Chrysoperla*
- Hemerobiidae (Brown Lacewings)
  - *Hemerobius*
  - *Micromus*
  - *Wesmaelius*

**Odonata**

- Aeshnidae (Darners)
  - *Aeshna*
    - *Aeshna eremita*
    - *Aeshna interrupta* (Variable Darner)
    - *Aeshna palmata*

*Aeshna umbrosa* (Shadow Darner)
Coenagrinoidae (Narrow-winged/Pond Damselfly)
*Enallagma* (Bluets)
Cordullidae (Emerald dragonflies)
*Epitheca* (Baskettails)
Gomphidae (Clubtails)
*Ophiogomphus*
*Ophiogomphus severus* (Pale Snaketail)
Lestidae (Spreadwings)
*Lestes*
*Lestes congener* (Spotted Spreadwing)
Libellulidae (Skimmers)
*Libellula*
*Libellula pulchella* (Twelve-spotted Skimmer)
*Libellula quadrimaculata* (Four-spotted Skimmer)
*Sympetrum*
*Sympetrum corruptum* (Variegated Meadowhawk)
*Sympetrum costiferum* (Saffron-winged Meadowhawk)
*Sympetrum danae* (Black Meadowhawk)
*Sympetrum internum*
*Sympetrum semicinctum* (Band-winged Meadowhawk)

**Orthoptera**
Acrididae
*Arphia*
*Arphia conspersa*
*Camnula*
*Camnula pellucida* (Clear-winged Grasshopper)
*Chloealtis*
*Chloealtis abdominalis*
*Chloealtis conspersa* (Sprinkled Locust)
*Chortophaga*
*Chortophaga viridifasciata* (Green-striped Grasshopper)
*Circotettix*
*Circotettix rabula* (Wrangler Grasshopper)
*Dissosteira*
*Dissosteira carolina* (Carolina Grasshopper)
*Encoptolophus*
*Encoptolophus costalis* (Dusky Grasshopper)
*Melanoplus*
*Melanoplus bivittatus* (Two-striped Grasshopper)
*Melanoplus dawsoni* (Dawson's Spur-throat Grasshopper)
*Melanoplus fasciatus* (Huckleberry Spur-throat Grasshopper)
*Melanoplus femurrubrum* (Red-legged Grasshopper)
*Phoetaliotes*
*Phoetaliotes nebrascensis* (Large-headed Grasshopper)
*Pseudo Chorthippus*

*Pseudochorthippus curtipennis* (Marsh meadow grasshopper)
*Trimerotropis*
*Trimerotropis verruculata* (Crackling Forest Grasshopper)
Gryllidae
Rhaphidophoridae
*Ceuthophilus*
Tettigonidae
*Conocephalus*
*Conocephalus fasciatus* (Slender Meadow Katydid)
*Conocephalus saltans* (Prairie Meadow Katydid)
*Scudderia*
*Scudderia pistillata* (Broad-winged Bush Katydid)
Trigonidiidae
*Allonemobius*

**Plecoptera**
Chloroperlidae (Green stoneflies)
*Alloperla*
Leuctridae (Rolled wing stoneflies)
Perlidae
*Calineuria*
*Calineuria californica*
*Claassenia*
*Claassenia sabulosa*
Perlodidae

**Psocodea**

**Siphonaptera**

**Thysanoptera**

**Trichoptera**
Hydropsychidae
Leptoceridae
Limnephilidae
*Limnephilus*
*Nemotaulius*
*Nemotaulius hostilis*
Phryganeidae

**Zygentoma**

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## Threatened species in Calgary

iNaturalist uses different databases and guides to assign threatened species status to taxa, and the source used can be found on each species page. See this iNaturalist forum for more information. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) provides assessments specifically for Albertan insects.

**Hymenoptera**

*Bombus bohemicus* (Bohemian Cuckoo Bumble Bee) – **COSEWIC Status: Endangered**
*Bombus occidentalis* (Western Bumble Bee) – **COSEWIC Status: Threatened**

**Lepidoptera**

*Danaus plexippus* (Monarch Butterfly) – **COSEWIC Status: Endangered**
*Ochlodes sylvanoides* (Woodland Skipper) - apparently secure in Alberta; imperiled (Saskatchewan)

**Odonata**

*Libellula pulchella* (Twelve-spotted Skimmer) - iNaturalist Endangered
*Sympetrum corruptum* (Variegated Meadowhawk) - iNaturalist Vulnerable
*Sympetrum costiferum* (Saffron-winged Meadowhawk) - iNaturalist Vulnerable

## Introduced species in Calgary

**Blattodea**
*Blattella germanica* (German Cockroach)
*Periplaneta australasiae* (Australian Cockroach)

**Coleoptera**
*Carabus granulatus* (Granulated Ground Beetle)
*Carabus nemoralis* (Bronze Ground Beetle)
*Coccinella septempunctata* (Seven-Spotted Ladybug)
*Diabrotica balteata* (Banded Cucumber Beetle)
*Hippodamia convergens* (Convergent Lady Beetle)
*Larinus carinae* (Canada Thistle Bud Weevil)
*Lilioceris lilii* (Lily Leaf Beetle)
*Pterostichus melanarius* (Rain Beetle)
*Polydrusus impressifrons* (Pale Green Weevil)
*Otiorhynchus raucus*
*Rhinocyllus conicus* (Nodding Thistle Receptacle Weevil)
*Romualdius scaber* (Crusted Root Weevil)
*Sciaphilus asperatus* (Strawberry Root Weevil)
*Sitona hispidulus* (Clover Weevil)

**Diptera**
*Eristalis tenax* (Common Drone Fly)
*Neomyia cornicina*
*Syritta pipiens* (Thick-legged Hoverfly)

**Hemiptera**
*Athysanus argentarius* (Silver Leafhopper)
*Doratura stylata*
*Philaenus spumarius* (Meadow Spittlebug)

**Hymenoptera**
*Apis mellifera* (Western Honey Bee)
*Cladius grandis* (Hairy Poplar Sawfly)
*Polistes dominula* (European Paper Wasp)
*Vespula germanica* (German Yellowjacket)

**Lepidoptera**
*Dahlica triquetrella* (Narrow Lichen Case-Bearer)
*Leucoma salicis* (White Satin Moth)
*Pieris rapae* (Cabbage White)
*Thera juniperata* (Juniper Carpet)
*Thymelicus lineola* (European Skipper)

**Mantodea**
*Mantis religiosa* (European Mantis)

# VII. Acknowledgements

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# IX. Appendix

Total number of insect diversity observed on iNaturalist and donated in 2022, with a comparison to the 2020 project. Numbers for higher taxonomic levels (e.g., order, family, genus) are inclusive. For example, Blattodea includes two observations, one of *Periplaneta australasiae* and one one of *Blatella.*

| ZOOL 435 2022 Calgary Diversity | Number of iNaturalist Observations | Number of Donated Physical Specimens | Observed in 2020 |
|---|---|---|---|
| **Blattodea** | **2** | **5** | **yes** |
| Blattidae | 1 | | |
| *Periplaneta* | 1 | | |
| *Periplaneta australasiae* | 1 | | |
| Ectobiidae | 1 | | yes |
| *Blattella* | 1 | | yes |
| **Coleoptera** | **379** | **95** | **yes** |
| Attelabidae | 4 | | |
| *Merhynchites* | 4 | | |
| *Merhynchites wickhami* | 4 | | |
| Buprestidae | 4 | 1 | yes |
| *Agrilus* | 2 | | |
| *Agrilus ribesi* | 1 | | |
| *Melanophila* | 1 | | yes |
| *Melanophila acuminata* | 1 | | yes |
| Cantharidae | 1 | | |
| Carabidae | 42 | 23 | yes |
| *Agonum* | 1 | | yes |
| *Amara* | 4 | | yes |
| *Bembidion* | 1 | | |
| *Carabus* | 6 | | yes |
| *Carabus granulatus* | 2 | | yes |
| *Carabus nemoralis* | 4 | | yes |
| *Chlaenius* | 1 | | |
| *Chlaenius sericeus* | 1 | | |
| *Dicheirotrichus* | 1 | | |

| | | | |
|---|---|---|---|
| *Harpalus* | 1 | | |
| *Pterostichus* | 18 | | yes |
| *Pterostichus melanarius* | 11 | | yes |
| Cerambycidae | 13 | 1 | yes |
| *Anthophylax* | 1 | | |
| *Anthophylax cyaneus* | 1 | | |
| *Batyle* | 1 | | |
| *Batyle suturalis* | 1 | | |
| *Monochamus* | 2 | | yes |
| *Monochamus scutellatus* | 2 | | yes |
| *Stictoleptura* | 1 | | yes |
| *Stictoleptura canadensis* | 1 | | yes |
| *Xylotrechus* | 1 | | |
| *Xylotrechus undulatus* | 1 | | |
| Chrysomelidae | 21 | | yes |
| *Lilioceris* | 1 | | yes |
| *Lilioceris lilii* | 1 | | yes |
| Cleridae | 2 | | yes |
| *Trichodes* | 1 | | yes |
| *Trichodes nuttalli* | 1 | | yes |
| Coccinellidae | 205 | 35 | yes |
| *Adalia* | 33 | | yes |
| *Adalia bipunctata* | 32 | | yes |
| *Anatis* | 4 | | yes |
| *Anatis mali* | 4 | | yes |
| *Calvia* | 1 | | yes |
| *Calvia quatuordecimguttata* | 1 | | yes |
| *Coccinella* | 113 | | yes |
| *Coccinella septempunctata* | 113 | | yes |
| *Hippodamia* | 45 | | yes |
| *Hippodamia convergens* | 18 | | yes |
| *Hippodamia parenthesis* | 23 | | yes |
| *Hippodamia sinuata* | 1 | | yes |
| *Hippodamia tredecimpunctata* | 2 | | yes |
| Curculionidae | 26 | | yes |

| | | | |
|---|---|---|---|
| *Cryptorhynchus* | 1 | | yes |
| *Cryptorhynchus lapathi* | 1 | | yes |
| *Diaprepes* | 1 | | |
| *Diaprepes abbreviatus* | 1 | | |
| *Dorytomus* | 1 | | |
| *Larinus* | 1 | | yes |
| *Larinus carlinae* | 1 | | yes |
| *Otiorhynchus* | 13 | | yes |
| *Otiorhynchus ovatus* | 5 | | yes |
| *Otiorhynchus raucus* | 8 | | yes |
| *Polydrusus* | 1 | | yes |
| *Polydrusus impressifrons* | 1 | | yes |
| *Romualdius* | 1 | | |
| *Romualdius scaber* | 1 | | |
| *Sciaphilus* | 1 | | |
| *Sciaphilus asperatus* | 1 | | |
| *Sitona* | 3 | | yes |
| *Sitona hispidulus* | 3 | | yes |
| *Tournotaris* | 1 | | |
| *Tournotaris bimaculatus* | 1 | | |
| Dermestidae | 9 | 2 | yes |
| *Anthrenus* | 4 | | |
| *Dermestes* | 4 | | yes |
| *Dermestes lardarius* | 4 | | yes |
| Dytiscidae | 1 | 1 | yes |
| *Rhantus* | 1 | | yes |
| *Rhantus sericans* | 1 | | yes |
| Elateridae | 5 | | yes |
| *Selatosomus* | 1 | | yes |
| Melandryidae | 1 | 1 | |
| *Enchodes* | 1 | | |
| *Enchodes sericea* | 1 | | |
| Meloidae | 1 | | yes |
| Melyridae | 1 | | yes |
| *Malachius* | 0 | | |

| | | | |
|---|---|---|---|
| *Malachius aeneus* | 0 | 1 | |
| Orsodacnidae | 3 | | |
| *Orsodacne* | 3 | | |
| *Orsodacne atra* | 3 | | |
| Scarabaeidae | 3 | 2 | yes |
| *Aphodius* | 3 | | |
| *Aphodius pedellus* | 1 | | |
| Silphidae | 2 | | yes |
| *Nicrophorus* | 1 | | |
| *Thanatophilus* | 1 | | |
| *Thanatophilus lapponicus* | 1 | | |
| Staphylinidae | 3 | 1 | yes |
| *Aleochara* | 1 | | |
| **Diptera** | **553** | **134** | **yes** |
| Anisopodidae | 5 | | |
| *Sylvicola* | 3 | | |
| Anthomyiidae | 19 | 1 | yes |
| *Anthomyia* | 1 | | |
| *Anthomyia oculifera* | 1 | | |
| *Anthomyia procellaris* | 0 | 1 | |
| Asilidae | 2 | | yes |
| Bombyliidae | 5 | 1 | yes |
| *Villa* | 3 | | |
| *Villa fulviana* | 1 | | |
| Calliphoridae | 118 | 17 | yes |
| *Calliphora* | 18 | | |
| *Calliphora vicina* | 3 | | |
| *Cynomya* | 5 | | yes |
| *Cynomya cadaverina* | 5 | | yes |
| *Lucilia* | 88 | | yes |
| *Lucilia sericata* | 49 | | yes |
| *Phormia* | 2 | | |
| *Phormia regina* | 2 | | |
| Cecidomyiidae | 4 | | |
| *Harmandiola* | 4 | | |

| | | | |
|---|---|---|---|
| Ceratopogonidae | 1 | | |
| Chironomidae | 30 | 7 | yes |
| *Ablabesmyia* | 1 | | |
| Chloropidae | 4 | | |
| Clusiidae | 1 | | |
| Culicidae | 13 | 27 | yes |
| *Aedes* | 1 | | yes |
| *Culex* | 1 | | yes |
| *Culiseta* | 1 | | yes |
| Dixidae | 1 | | |
| Dolichopodidae | 3 | | yes |
| *Condylostylus* | 2 | | |
| *Dolichopus* | 1 | | |
| Drosophilidae | 7 | | yes |
| *Drosophila* | 1 | | yes |
| *Scaptomyza* | 1 | | |
| Ephydridae | 1 | | |
| Limoniidae | 4 | | |
| Muscidae | 37 | 18 | yes |
| *Lispe* | 2 | | |
| *Musca* | 11 | | |
| *Musca domestica* | 11 | | |
| *Neomyia* | 1 | | yes |
| *Neomyia cornicina* | 1 | | |
| Mycetophilidae | 2 | | |
| Pallopteridae | 1 | 1 | yes |
| *Toxonevra* | 0 | 1 | yes |
| *Toxonevra superba* | 0 | 1 | |
| Phoridae | 1 | | |
| Platypezidae | 1 | | |
| Polleniidae | 4 | | |
| *Pollenia* | 4 | | |
| Sarcophagidae | 10 | 10 | yes |
| Scathophagidae | 3 | | yes |
| *Scathophaga* | 2 | | |

| | | | |
|---|---|---|---|
| Sciaridae | 2 | | |
| Sciomyzidae | 2 | | |
| *Elgiva* | 1 | | |
| Sepsidae | 2 | | |
| *Sepsis* | 2 | | |
| Simuliidae | 3 | | |
| *Simulium* | 1 | | |
| Stratiomyidae | 1 | | yes |
| *Microchrysa* | 1 | | |
| Syrphidae | 201 | 29 | yes |
| *Blera* | 1 | | |
| *Dasysyrphus* | 1 | | |
| *Eristalis* | 72 | | yes |
| *Eristalis hirta* | 1 | | |
| *Eristalis stipator* | 1 | | yes |
| *Eristalis tenax* | 70 | | yes |
| *Eupeodes* | 12 | | yes |
| *Eupeodes fumipennis* | 5 | | yes |
| *Eupeodes volucris* | 6 | | yes |
| *Lapposyrphus* | 1 | | yes |
| *Lapposyrphus lapponicus* | 1 | | yes |
| *Parasyrphus* | 1 | | yes |
| *Platycheirus* | 3 | | |
| *Scaeva* | 24 | | yes |
| *Scaeva affinis* | 24 | | yes |
| *Sphaerophoria* | 6 | | yes |
| *Spilomyia* | 1 | | |
| *Spilomyia sayi* | 1 | | |
| *Syritta* | 5 | | yes |
| *Syritta pipiens* | 5 | | yes |
| *Syrphus* | 43 | | yes |
| *Syrphus opinator* | 11 | | yes |
| *Toxomerus* | 4 | | yes |
| *Toxomerus marginatus* | 4 | | yes |
| Tabanidae | 0 | 2 | yes |

| | | | |
|---|---|---|---|
| Tachinidae | 7 | 2 | yes |
| Tephritidae | 0 | 2 | yes |
| Tipulidae | 7 | 2 | yes |
| *Nephrotoma* | 3 | | yes |
| *Tipula* | 1 | | |
| Ulidiidae | 2 | | yes |
| *Ceroxys* | 1 | | yes |
| *Ceroxys latiusculus* | 1 | | yes |
| **Ephemeroptera** | **27** | **5** | **yes** |
| Baetidae | 3 | | yes |
| Ephemeridae | 1 | | |
| *Hexagenia* | 1 | | |
| **Hemiptera** | **537** | **153** | **yes** |
| Acanthosomatidae | 2 | 1 | |
| *Elasmostethus* | 1 | | |
| *Elasmostethus cruciatus* | 1 | | |
| Alydidae | 9 | 7 | yes |
| *Alydus* | 6 | | yes |
| *Alydus conspersus* | 3 | | yes |
| *Megalotomus* | 1 | | yes |
| *Megalotomus quinquespinosus* | 1 | | yes |
| Anthocoridae | 0 | 2 | yes |
| Aphididae | 57 | 4 | yes |
| Aphrophoridae | 6 | 7 | yes |
| *Philaenus* | 3 | | yes |
| *Philaenus spumarius* | 3 | | yes |
| Aradidae | 2 | | yes |
| *Aradus* | 2 | | yes |
| Caliscelidae | 1 | | |
| Cicadellidae | 9 | 20 | yes |
| *Athysanus* | 1 | | yes |
| *Athysanus argentarius* | 1 | | yes |
| *Doratura* | 1 | | yes |
| *Doratura stylata* | 1 | | yes |
| *Gyponana* | 1 | | |

| | | | |
|---|---|---|---|
| *Psammotettix* | 1 | | |
| Coreidae | 2 | 1 | yes |
| *Leptoglossus* | 2 | | yes |
| *Leptoglossus occidentalis* | 2 | | yes |
| Corixidae | 5 | 2 | yes |
| Geocoridae | 0 | 5 | yes |
| Gerridae | 13 | | yes |
| *Aquarius* | 2 | | yes |
| *Aquarius remigis* | 2 | | yes |
| *Gerris* | 8 | | |
| Lygaeidae | 2 | | yes |
| *Kleidocerys* | 2 | | |
| Membracidae | 4 | 1 | yes |
| Miridae | 152 | 44 | yes |
| *Lopidea* | 0 | 1 | |
| *Lygus* | 100 | | |
| *Lygus elisus* | 1 | | |
| *Lygus lineolaris* | 10 | | |
| Nabidae | 9 | 14 | yes |
| *Nabis* | 4 | | |
| Notonectidae | 3 | | yes |
| *Notonecta* | 3 | | yes |
| Pentatomidae | 16 | 7 | yes |
| *Banasa* | 5 | | yes |
| *Banasa dimidiata* | 1 | | |
| *Cosmopepla* | 1 | | yes |
| *Cosmopepla lintneriana* | 1 | | yes |
| *Euschistus* | 3 | | |
| *Euschistus tristigmus* | 1 | | |
| *Holcostethus* | 1 | | |
| *Holcostethus abbreviatus* | 1 | | |
| Reduviidae | 1 | | yes |
| Rhopalidae | 51 | 12 | yes |
| Rhyparochromidae | 0 | 1 | yes |
| *Boisea* | 51 | | yes |

| | | | |
|---|---|---|---|
| *Boisea trivittata* | 48 | 13 | yes |
| Scutelleridae | 3 | 3 | yes |
| *Homaemus* | 1 | | |
| *Homaemus aeneifrons* | 1 | | |
| Tingidae | 9 | 4 | yes |
| *Corythucha* | 2 | | yes |
| *Corythucha cydoniae* | 1 | | |
| **Hymenoptera** | **822** | **146** | **yes** |
| Andrenidae | 1 | | yes |
| Apidae | 283 | 28 | yes |
| *Apis* | 126 | | yes |
| *Apis mellifera* | 126 | 2 | yes |
| *Bombus* | 157 | | yes |
| *Bombus centralis* | 2 | | yes |
| *Bombus cryptarum* | 4 | | yes |
| *Bombus huntii* | 9 | | yes |
| *Bombus nevadensis* | 1 | | yes |
| *Bombus perplexus* | 3 | | yes |
| *Bombus rufocinctus* | 1 | | yes |
| *Bombus vancouverensis* | 1 | | yes |
| Braconidae | 3 | | |
| Colletidae | 1 | | yes |
| *Hylaeus* | 1 | | yes |
| Crabronidae | 2 | | yes |
| *Pemphredon* | 1 | | |
| Formicidae | 152 | 43 | yes |
| *Camponotus* | 5 | | yes |
| *Camponotus herculeanus* | 3 | | yes |
| *Formica* | 96 | | yes |
| *Lasius* | 14 | | yes |
| *Lasius neoniger* | 2 | | yes |
| *Myrmica* | 6 | | yes |
| Halictidae | 11 | 4 | yes |
| *Halictus* | 3 | | yes |
| *Halictus rubicundus* | 2 | | yes |

| | | | |
|---|---|---|---|
| *Lasioglossum* | 7 | | yes |
| Ichneumonidae | 7 | 27 | yes |
| *Ophion* | 1 | | yes |
| Megachilidae | 6 | 1 | yes |
| *Coelioxys* | 1 | | yes |
| *Megachile* | 2 | | yes |
| Sphecidae | 1 | | yes |
| *Sceliphron* | 1 | | yes |
| *Sceliphron caementarium* | 1 | | yes |
| Vespidae | 108 | 30 | yes |
| *Ancistrocerus* | 3 | | yes |
| *Dolichovespula* | 9 | | yes |
| *Dolichovespula arenaria* | 8 | | yes |
| *Dolichovespula maculata* | 1 | | yes |
| *Polistes* | 1 | | yes |
| *Polistes dominula* | 1 | | yes |
| *Pseudepipona* | 1 | | yes |
| *Pseudepipona herrichii* | 1 | | yes |
| *Stenodynerus* | 1 | | |
| *Stenodynerus anormis* | 1 | | |
| *Vespula* | 90 | | yes |
| *Vespula atropilosa* | 18 | | yes |
| *Vespula germanica* | 3 | | yes |
| *Vespula pensylvanica* | 65 | | yes |
| **Lepidoptera** | **277** | **50** | **yes** |
| Alucitidae | 18 | 3 | yes |
| *Alucita* | 18 | | yes |
| *Alucita montana* | 2 | | |
| Coleophoridae | 1 | | |
| *Coleophora* | 1 | | |
| Cossidae | 1 | | |
| Crambidae | 8 | | yes |
| *Agriphila* | 2 | | |
| *Chrysoteuchia* | 1 | | yes |
| *Chrysoteuchia topiarius* | 1 | | yes |

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|---|---|---|---|
| *Loxostege* | 2 | | |
| *Loxostege munroealis* | 1 | | |
| Erebidae | 13 | | yes |
| *Caenurgina* | 1 | | |
| *Gnophaela* | 8 | | yes |
| *Gnophaela vermiculata* | 8 | | yes |
| *Leucoma* | 1 | | yes |
| *Leucoma salicis* | 1 | | yes |
| *Lophocampa* | 2 | | |
| *Lophocampa maculata* | 2 | | |
| *Zale* | 1 | | |
| Geometridae | 14 | 3 | yes |
| *Alsophila* | 1 | | yes |
| *Alsophila pometaria* | 1 | | yes |
| *Aplocera* | 1 | | |
| *Erannis* | 5 | | yes |
| *Erannis tiliaria* | 4 | | yes |
| *Eupithecia* | 1 | | |
| *Hesperumia* | 1 | | |
| *Hesperumia sulphuraria* | 1 | | |
| *Horisme* | 1 | | |
| *Horisme intestinata* | 1 | | |
| *Scopula* | 1 | | |
| *Scopula junctaria* | 1 | | |
| *Thera* | 1 | | yes |
| *Thera juniperata* | 1 | | yes |
| Gracillariidae | 2 | | |
| *Caloptilia* | 1 | | |
| *Caloptilia fraxinella* | 1 | | |
| *Phyllocnistis* | 1 | | |
| *Phyllocnistis populiella* | 1 | | |
| Hesperiidae | 29 | 3 | yes |
| *Ochlodes* | 17 | | yes |
| *Ochlodes sylvanoides* | 17 | 2 | yes |
| *Thymelicus* | 9 | | yes |

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|---|---|---|---|
| *Thymelicus lineola* | 9 | | yes |
| Lasiocampidae | 1 | | yes |
| *Malacosoma* | 1 | | yes |
| *Malacosoma disstria* | 1 | | yes |
| Lycaenidae | 10 | 1 | yes |
| *Glaucopsyche* | 8 | | yes |
| *Glaucopsyche lygdamus* | 8 | | yes |
| *Tharsalea* | 1 | | |
| *Tharsalea helloides* | 1 | | |
| Noctuidae | 35 | | yes |
| *Autographa* | 18 | | yes |
| *Autographa californica* | 14 | | yes |
| *Caradrina* | 2 | | |
| *Caradrina montana* | 2 | | |
| *Dargida* | 1 | | yes |
| *Dargida procinctus* | 1 | | yes |
| *Feltia* | 1 | | yes |
| *Feltia jaculifera* | 1 | | yes |
| *Nephelodes* | 1 | | |
| *Nephelodes minians* | 1 | | |
| *Noctua* | 1 | | |
| Nymphalidae | 28 | 3 | yes |
| *Aglais* | 2 | | yes |
| *Aglais milberti* | 2 | 2 | yes |
| *Caligo* | 1 | | |
| *Caligo telamonius* | 1 | | |
| *Cercyonis* | 3 | | yes |
| *Cercyonis pegala* | 3 | | yes |
| *Coenonympha* | 3 | | yes |
| *Coenonympha california* | 3 | | |
| *Euphydryas* | 1 | | |
| *Euphydryas anicia* | 1 | | |
| *Euptoieta* | 1 | | yes |
| *Euptoieta claudia* | 1 | | yes |
| *Limenitis* | 1 | | yes |

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|---|---|---|---|
| *Limenitis arthemis* | 1 | 1 | yes |
| *Nymphalis* | 6 | | yes |
| *Nymphalis antiopa* | 5 | | yes |
| *Nymphalis l-album* | 1 | | |
| *Phyciodes* | 1 | | yes |
| *Phyciodes cocyta* | 1 | | |
| *Polygonia* | 5 | | yes |
| *Polygonia faunus* | 2 | | |
| *Polygonia gracilis* | 1 | | |
| *Polygonia satyrus* | 2 | | |
| *Speyeria* | 2 | | yes |
| *Speyeria cybele* | 1 | | |
| *Speyeria hesperis* | 1 | | yes |
| *Vanessa* | 1 | | yes |
| *Vanessa cardui* | 1 | | yes |
| Oecophoridae | 1 | | |
| *Brymblia* | 1 | | |
| *Brymblia quadrimaculella* | 1 | | |
| Papilionidae | 1 | | yes |
| *Papilio* | 1 | | yes |
| *Papilio zelicaon* | 1 | | |
| Pieridae | 39 | 9 | yes |
| *Colias* | 10 | | yes |
| *Colias eurytheme* | 1 | | yes |
| *Colias philodice* | 6 | | yes |
| *Pieris* | 16 | | yes |
| *Pieris rapae* | 16 | | yes |
| *Pontia* | 13 | | yes |
| *Pontia occidentalis* | 13 | | yes |
| Plutellidae | 12 | | |
| *Plutella* | 12 | | |
| *Plutella xylostella* | 11 | | |
| Pterophoridae | 1 | | yes |
| Pyralidae | 1 | | |
| *Dioryctria* | 1 | | |

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|---|---|---|---|
| Satyridae | 0 | 1 | |
| Sphingidae | 6 | | yes |
| *Ceratomia* | 1 | | yes |
| *Ceratomia undulosa* | 1 | | yes |
| *Hyles* | 5 | | yes |
| *Hyles gallii* | 5 | | yes |
| Tineidae | 1 | | |
| Tortricidae | 7 | | yes |
| *Choristoneura* | 1 | | |
| *Choristoneura fumiferana* | 1 | | |
| *Epinotia* | 1 | | |
| *Epinotia radicana* | 1 | | |
| **Mantodea** | **1** | | **yes** |
| Mantidae | 1 | | yes |
| *Tenodera* | 1 | | |
| *Tenodera sinensis* | 1 | | |
| **Neuroptera** | **35** | **13** | **yes** |
| Chrysopidae | 25 | | yes |
| *Chrysopa* | 5 | | yes |
| *Chrysopa chi* | 1 | | |
| *Chrysopa coloradensis* | 2 | | |
| *Chrysopa nigricornis* | 1 | | |
| *Chrysopa oculata* | 1 | | yes |
| *Chrysoperla* | 8 | | yes |
| Hemerobiidae | 7 | | yes |
| *Hemerobius* | 2 | | |
| *Wesmaelius* | 1 | | |
| **Odonata** | **157** | **30** | **yes** |
| Aeshnidae | 13 | | yes |
| *Aeshna* | 8 | | yes |
| *Aeshna eremita* | 1 | | |
| *Aeshna interrupta* | 4 | | yes |
| *Aeshna palmata* | 1 | | |
| *Aeshna umbrosa* | 1 | | yes |
| Coenagrionidae | 10 | 2 | yes |

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|---|---|---|---|
| *Enallagma* | 8 | | yes |
| Gomphidae | 2 | | yes |
| *Ophiogomphus* | 2 | | yes |
| *Ophiogomphus severus* | 2 | | yes |
| Lestidae | 25 | 10 | yes |
| *Lestes* | 25 | | yes |
| *Lestes congener* | 4 | | yes |
| Libellulidae | 59 | 18 | yes |
| *Sympetrum* | 57 | | yes |
| *Sympetrum costiferum* | 16 | | yes |
| *Sympetrum danae* | 11 | | yes |
| *Sympetrum internum* | 1 | | |
| *Sympetrum semicinctum* | 8 | | yes |
| **Orthoptera** | **201** | **52** | **yes** |
| Acrididae | 180 | 49 | yes |
| *Arphia* | 1 | | yes |
| *Arphia conspersa* | 1 | | |
| *Camnula* | 4 | | yes |
| *Camnula pellucida* | 4 | | yes |
| *Chloealtis* | 2 | | yes |
| *Chloealtis abdominalis* | 2 | | |
| *Chortophaga* | 2 | | yes |
| *Chortophaga viridifasciata* | 2 | | yes |
| *Dissosteira* | 11 | | yes |
| *Dissosteira carolina* | 11 | | yes |
| *Encoptolophus* | 3 | | yes |
| *Encoptolophus costalis* | 3 | | yes |
| *Melanoplus* | 126 | | yes |
| *Melanoplus bivittatus* | 67 | | yes |
| *Melanoplus dawsoni* | 21 | | yes |
| *Melanoplus fasciatus* | 1 | | yes |
| *Pseudochorthippus* | 13 | | yes |
| *Pseudochorthippus curtipennis* | 13 | | yes |
| Gryllidae | 0 | 1 | yes |
| Rhaphidophoridae | 1 | | yes |

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|---|---|---|---|
| Tettigoniidae | 3 | 2 | yes |
| *Conocephalus* | 3 | | yes |
| *Conocephalus fasciatus* | 1 | | yes |
| *Conocephalus saltans* | 2 | | yes |
| Trigonidiidae | 2 | | yes |
| *Allonemobius* | 2 | | yes |
| **Plecoptera** | **7** | | **yes** |
| Perlidae | 3 | | |
| *Calineuria* | 1 | | |
| *Calineuria californica* | 1 | | |
| *Claassenia* | 1 | | |
| *Claassenia sabulosa* | 1 | | |
| Perlodidae | 2 | | yes |
| **Psocodea** | **2** | **7** | **yes** |
| **Siphonaptera** | **0** | **1** | **yes** |
| **Thysanoptera** | **3** | **1** | **yes** |
| **Trichoptera** | **6** | **1** | **yes** |
| Hydropsychidae | 1 | | yes |
| Phryganeidae | 1 | | |
| **Zygentoma** | **1** | | |