The Empire State Native Pollinator Survey

2017 - 2021

New York
Natural Heritage
Program

The Empire State Native Pollinator Survey 2017-2021

Erin L. White
Matthew D. Schlesinger
Timothy G. Howard

New York Natural Heritage Program

June 30, 2022

This document contains significant contributions from
Jeffrey D. Corser

State University of New York
College of Environmental Science and Forestry

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Suggested Citation: White, E.L., M. D. Schlesinger, and T.G. Howard. 2022. The Empire State Native Pollinator Survey (2017-2021). New York Natural Heritage Program, Albany, NY.

Cover Photos (left to right, top to bottom): Red-shouldered pine borer (*Stictoleptura canadensis*) by Sue Gregoire; Hairy flower scarab beetle (*Trichiotinus affinis*) by Sue Feustel; Elderberry longhorn beetle (*Desmocerus palliatus*) by Matthew Schlesinger; Golden northern bumble bee (*Bombus fervidus*) by Susan Hewitt; flower longhorn beetle (*Judolia montivagans*) by Katie Hietala-Henschell; a flower fly (*Mallota posticata*) by erikabee; Bedstraw hawk moth (*Hyles gallii*) by Stick Lapan; Two-spotted longhorn bee (*Melissodes bimaculatus*) by karalyn; Milwaukee miner bee (*Andrena milwaukeensis*) by Chris Kreussling; a bee fly (*Bombylius incanus*) by Paweł Pieluszyński; Broad-handed leafcutter bee (*Megachile latimanus*) by Laura Shappell; Short-haired forest fly (*Chalcosyrphus piger*) by Alan Wells; Broad-banded hornet fly (*Spilomyia alcimus*) by Alan Wells; Three-lined flower moth (*Schinia trifascia*) by karalyn; Primrose moth (*Schinia florida*) by Maya Shikhman; Hummingbird clearwing (*Hemaris thysbe*) by Scott Stoner.

Project logo by Anna Droege.

The New York Natural Heritage Program

The New York Natural Heritage Program (www.nynhp.org) is a program of the State University of New York College of Environmental Science and Forestry that is administered through a partnership between SUNY ESF and the NYS Department of Environmental Conservation. We are a sponsored program within the Research Foundation for State University of New York.

The mission of the New York Natural Heritage Program is to facilitate conservation of rare animals, rare plants, and significant New York ecosystems. We accomplish this mission by combining thorough field inventories, scientific analyses, expert interpretation, and a comprehensive database on New York's distinctive biodiversity to deliver high-quality information for natural resource planning, protection, and management.

Established in 1985, our program is staffed by over 30 scientists and specialists with expertise in ecology, zoology, botany, information technology, and geographic information systems. Collectively, the scientists in our program have over 300 years of experience finding, documenting, monitoring, and providing recommendations for the protection of some of the most critical components of biodiversity in New York State. With funding from a number of state and federal agencies and private organizations, we work collaboratively with partners inside and outside New York to support stewardship of New York’s rare animals, rare plants, and significant natural communities, and to reduce the threat of invasive species to native ecosystems.

In addition to tracking recorded locations, NY Natural Heritage has developed models of the areas around these locations important for conserving biodiversity, and models of the distribution of suitable habitat for rare species across New York State.

NY Natural Heritage has developed two notable online resources: Conservation Guides include the biology, identification, habitat, and management of many of New York’s rare species and natural community types; and NY Nature Explorer lists species and communities in a specified area of interest.

NY Natural Heritage also houses *i*MapInvasives, an online tool for invasive species reporting and data management.

In 1990, NY Natural Heritage published *Ecological Communities of New York State*, an all-inclusive classification of natural and human-influenced communities. From 40,000-acre beech-maple mesic forests to 40-acre maritime beech forests, sea-level salt marshes to alpine meadows, our classification quickly became the primary source for natural community classification in New York and a fundamental reference for natural community classifications in the northeastern United States and southeastern Canada. This classification, which is continually updated as we gather new field data, has also been incorporated into the National Vegetation Classification.

NY Natural Heritage is an active participant in NatureServe (www.natureserve.org), the international network of biodiversity data centers. NatureServe’s network of independent data centers collects and analyzes data about the plants, animals, and ecological communities of the Western Hemisphere. The programs in the NatureServe Network, known as natural heritage programs or conservation data centers, operate throughout all of the United States and Canada, and in many countries and territories of Latin America. Network programs work with NatureServe to develop biodiversity data, maintain compatible standards for data management, and provide information about rare species and natural communities that is consistent across many geographic scales.

New York Natural Heritage Program
A Partnership between the
NYS Department of Environmental Conservation and the
SUNY College of Environmental Science and Forestry
625 Broadway, 5th Floor, Albany, NY 12233-4757
www.nynhp.org

Table of Contents

Table of Tables

Table of Figures

Executive Summary

Insect pollinators have been a primary conservation concern for New York's land managers in recent years, but little has been known about the status of individual species. The Empire State Native Pollinator Survey (ESNPS) began in 2017 with a pilot year following development of project objectives, sampling design, and field methods. We conducted surveys statewide in 2018-2020 with the help of New York Natural Heritage Program staff, partners, and community (or citizen) scientists. The primary goal was to determine the conservation status of a wide array of native insect pollinators in nonagricultural habitats. This project was funded through the New York State Environmental Protection Fund via a contract between New York State Department of Environmental Conservation Division of Fish and Wildlife and SUNY College of Environmental Science and Forestry. SUNY-ESF's New York Natural Heritage Program coordinated and managed the project.

We worked closely with an Advisory Committee of taxonomic and sampling design experts throughout the project to guide our goals, focal taxa, survey design, field protocol, and analyses. ESNPS participants were trained at workshops held throughout the state during the summers of 2018 and 2019. Due to the COVID-19 pandemic, in-person workshops were cancelled in 2020, but a virtual training was offered to partners and was recorded and sent to others interested in learning how to participate. We trained over 200 community scientists through workshops, several of whom participated in the Survey, primarily through posting photos of their observations to our iNaturalist platform. We provided participants with a Participant Handbook as a companion guide to material presented at the workshop. This handbook contained everything they needed to know in order to participate in the Survey.

We assessed the current and historical distribution of native pollinators with three field sampling strategies (extensive surveys, target habitat surveys, and target species surveys) and compilation of museum collection data. We completed surveys annually from April through October and extensive surveys consisted of four broad habitat stations of meadow/grassland, wetland, forest, and roadside. Target habitat surveys were in alpine meadows, barrens, coastal dunes, peatlands, and late-successional forests. The survey protocol for these sampling strategies included 30 minutes of targeted hand-netting for focal taxa and five hours of bowl-trapping at each station at a given site, and in four stations of the same habitat type for the targeted habitat surveys. Specimen vouchers were verified by taxonomic experts and curated at the Cornell University Insect Collection and the NYS Museum. We were able to verify over 34,000 individual specimen records to species level identification during the ESNPS. While our priority was to identify focal taxa collected, this number includes many non-focal taxa that were easily identified. Photo observations were reviewed and confirmed by the iNaturalist community and we included Research Grade observations in our analyses. Our ESNPS iNaturalist project participants submitted over 22,000 photographic pollinator records with confirmed identifications (research grade) in our broad taxonomic groups. Our compiled database of partner and community science data contained 171,200 records of 864 species, which includes some non-focal taxa.

We completed 50 extensive surveys in 2018, 49 in 2019, and 52 in 2020, stratified by ecoregion, with a total of 151 extensive surveys during the three years. Field crews of two technicians each year completed most of the surveys and specimen pinning, supplemented with help from other NYNHP staff. We conducted target habitat surveys (extensive model with four transects within a target habitat type) at 10 alpine sites, about 25 barrens sites, 8 coastal dune sites, 15 peatland sites, and 16 late-successional forest sites. Partner organizations assisted us in

completing these surveys. We performed at least 18 target species surveys in 2018, 17 in 2019, and 12 in 2020.

Our sampling effort yielded many significant finds. Notably, eight focal bees appear to have been added to the list of known bee species for New York based on our efforts. We were unable to confirm the presence of 42 focal bee species during ESNPS that were previously known in the state. However, other studies have extant (2000 to present) records for 17 of these bee species; therefore, 25 bee species have historical records for the state, but no extant records. It is quite likely that some of these rare and/or elusive species were missed by our sampling protocol, and some were never represented by established breeding populations. Eight focal fly species appear to have been added to the list of known species for New York based on our efforts, while we were unable to confirm the presence of 23 historical records for the state. Likewise, nine focal moth species have had no extant records (2000 to present) and 22 focal beetle species have no extant records.

We found that, using conservative criteria, 38% of New York's native pollinators (of our focal taxa only) are at risk of extirpation from NY. In the worst-case scenario, as much as 60% of the native insect pollinator fauna may be at risk. Flies and bees were the groups with the greatest proportion of species at risk. For just 13% of species did we not have enough information to generate an S-rank.

ESNPS results provide an important baseline of the distribution and status of native pollinators in New York to help inform conservation efforts. Many focal species appear to be rare or declining and may warrant listing as Endangered or Threatened in the future by the U.S. or the State of New York. Therefore, habitat preservation and restoration efforts should weigh requirements of the rare species present (or potentially present) in a habitat to ensure that management practices and actions will not adversely affect the most vulnerable species and their habitats.

Although our survey was not designed as a long-term monitoring effort, the rigorous sampling design and standardized field protocols are repeatable and should be valuable for assessing changes in native pollinator distributions. Monitoring our native pollinators using standard protocols may be the only way to know whether we are maintaining New York's important pollinators in the face of continuing global change.

Introduction

Background: Rising Buzz and a Swarm of Pollinator Plans

A longstanding concern for pollinator populations and their importance to native ecosystems and agriculture worldwide (Buchmann and Nabhan 1996, Allen-Wardell et al. 1998, Kearns et al. 1998) ratcheted up in the early 2000s with news-making reports of declines in honey bees (vanEngelsdorp et al. 2009) and native pollinators (National Research Council 2007, Colla and Packer 2008, Cameron et al. 2011, Brower et al. 2012). The Federal Pollinator Task Force was established by President Obama in 2014, leading to two national strategies on pollinator management and research (Pollinator Health Task Force 2015a, 2015b). In New York, several species of bumble bees (*Bombus* spp.) were designated as High-priority Species of Greatest Conservation Need in the revised State Wildlife Action Plan (NYS DEC 2015). Also in 2015, New York Governor Andrew Cuomo assembled a Pollinator Task Force to recommend management practices, education, and research and monitoring strategies aimed at conserving wild and managed pollinator populations in New York. The resulting New York State Pollinator Protection Plan (NYS DEC and AGM 2016) included the following action item under Research: *"DEC…will begin a multi-year evaluation of New York's myriad native pollinator species. This assessment will show the current state and distribution of native pollinators and serve as the foundation for developing and implementing future conservation practices."*

In October 2016, the New York Natural Heritage Program (NYNHP), a program of the State University of New York College of Environmental Science and Forestry (SUNY ESF), began work under a Memorandum of Understanding with the NYS DEC to design the native pollinator study described above. Our first step was to assemble an advisory committee to help us design the study.

Advisors and Taxonomic Experts

Our advisory committee consisted of 14 scientists and managers from the federal government, state government, academia, and non-profits:

Dr. Bryan Danforth, Cornell University
Maria Van Dyke, Cornell University
Sam Droege, Patuxent Wildlife Research Center, USGS
Dr. Melissa Fierke, SUNY ESF
Dr. Carmen Greenwood, SUNY Cobleskill
Rich Hatfield, Xerces Society for Invertebrate Conservation
Katie Hietala-Henschell, Xerces Society for Invertebrate Conservation
Dr. Tim Howard, NY Natural Heritage Program
Dr. Jonathan Mawdsley, Association of Fish and Wildlife Agencies
Dr. Tim McCabe, NYS Museum
Kent McFarland, Vermont Center for Ecostudies
Robyn Niver, US Fish and Wildlife Service
Kathy O'Brien, NYS DEC
Dr. Jerry Rozen, American Museum of Natural History (retired)

This group helped shape the project from the beginning, starting with regular conference calls in fall 2016. In a two-day, in-person workshop in winter 2017, we refined the project goals, sampling design, and field methods. While we sought the input of the committee for all major decisions, their participation does not suggest their or their organizations' endorsement of this report.

Project Goal

Together we came up with a goal statement to ensure a common understanding of the aims of the project:

The goal of the Empire State Native Pollinator Survey is to determine the conservation status of a wide array of native insect pollinators in nonagricultural habitats.

"Conservation status" is typically determined from data on a species' rarity, trends, and threats. For the Natural Heritage network overseen by NatureServe, this is the S-rank for states and G-rank for the global population. Determining this status (Figure 1) ideally entails collecting current distributional data from recent field observations and new field surveys (rarity), historical distributional data from museums and other sources (trend), and reviews of literature and discussions with experts (threats). Status can be determined with a subset of this information when, for instance, information on historical distribution is unavailable. We determined this was an appropriate end goal for the project because it has implications for future inventory and monitoring by Natural Heritage programs and others, as well as state and federal listing under endangered species laws.

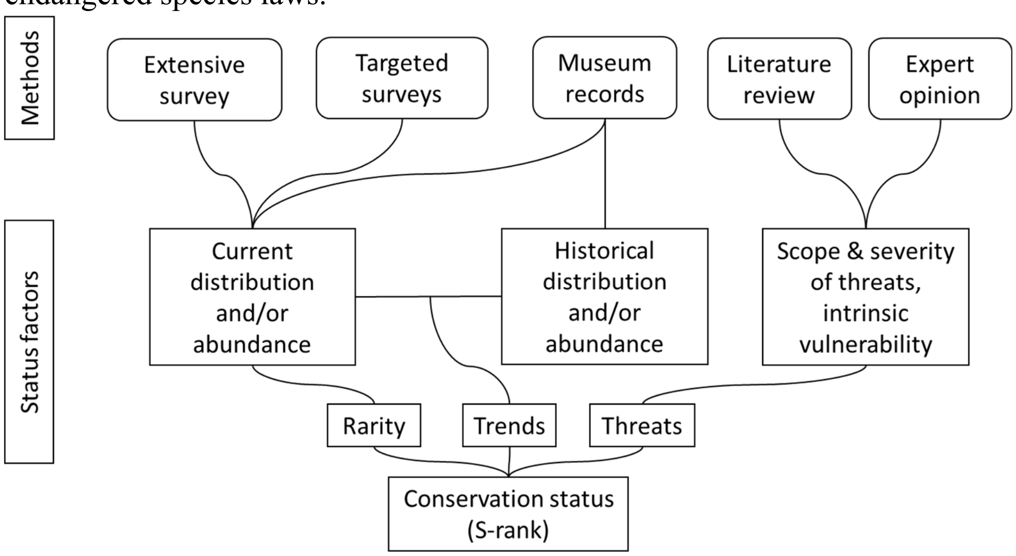

Figure 1. Approach for determining conservation status rank (S-rank) for native pollinators in New York, based on NatureServe methodology (Master et al. 2012, Faber-Langendoen et al. 2012).

"Native insect pollinators" are insect species native to the northeastern United States known to pollinate native plants. We specified this mainly to distinguish the targets of this survey from the European honey bee (*Apis mellifera*), a managed pollinator in agricultural systems that is the focus of many other research efforts. It can be argued that confusion about honey bees as a suitable focus of "conservation" efforts (as opposed to their being a valid agricultural concern) has caused misdirection of public attention and resources from efforts to protect native species (Colla and MacIvor 2017, Geldmann and González-Varo 2018, Ford et al. 2021, Iwasaki and Hogendoorn 2021).

Our funders, the NYS DEC, were interested in the potential value of community (a.k.a. "citizen") science for biodiversity inventory. Thus, another goal of the project was to compare the distribution and conservation status of insects based solely on community science versus that based on surveys by trained biologists, as well as looking at the two methods in combination.

Methods

Focal Taxa

Determining the conservation status of all native pollinators in one four-year project would have been an untenable goal. We therefore developed a set of "focal taxa"—species or groups of species on which to concentrate our efforts. To highlight the important role a variety of native insects play in pollination, we wished to include at least one species group from each of the primary insect orders known to pollinate native plants: Hymenoptera (bees, ants, and wasps), Diptera (flies), Coleoptera (beetles), and Lepidoptera (butterflies and moths). Within these orders, we selected groups of species that 1) had been documented or are suspected to be important pollinators; 2) had poorly understood conservation status (although some knowledge of regional or global status is helpful for context, and see #3); 3) contained known or suspected at-risk species in the Northeast or elsewhere, including those that are naturally rare and those whose populations had declined or distributions had decreased; 4) were not so diverse that determining the conservation status of most of the species would have been an unreachable goal; 5) could feasibly be identified to species by trained biologists, experts who may be project partners, and/or citizen scientists; and 6) would be appealing for a community-science effort. In addition, we identified individual species of known or suspected conservation concern for targeted surveys. Sometimes these focal species were also members of species groups selected as focal taxa, but for whom the Extensive Survey would not likely provide sufficient information. Final selection of focal taxa relied on literature review, conversations with taxonomic experts, and the input of our advisory committee.

We identified 10 insect groups that lacked basic distributional information that would be studied through both the Extensive Survey and Target Habitat Surveys: four groups of bees, two groups of flies, two groups of beetles, and two groups of moths (Table 1). The conservation status of most butterflies has previously been assessed (i.e., they have S-ranks) so that group was not selected for the statewide surveys. Known rare species from any of the focal taxa that were not expected to be detected with sufficient frequency using the widespread approaches, particularly those needing resurveys of specific locations, were the focus of Target Species Surveys (below).

Designating specific focal taxa within the sampled groups informed which specimens will be prioritized for identification to species, as the sorting and identification of specimens represents the great majority of the time and costs involved in our project. Such prioritization was needed because sampling methods for many of the focal taxa resulted in considerable "bycatch" of non-target insects. We do not take the killing of large numbers of insects lightly, but we are aware that specimen collection is necessary for the identification of many species, is critical for taxonomic and other investigations (Rocha et al. 2014), and has been shown, in limited studies, to have negligible effects on insect populations (Pohl 2009, Gezon et al. 2015). Small, isolated populations of rare species that have life histories susceptible to the loss of reproducing individuals from the population may be treated differently, especially with large-scale declines in insects being reported (e.g., Vogel 2017). We retained all bycatch and will work with partners in academia or other sectors that are interested in identifying the non-target insects and accessioning them to natural history collections. Hymenoptera bycatch resides at Cornell and has been sorted to family for wasps and genus for bees and all specimens have been individually labeled.

Table 1. Focal taxa selected for the Empire State Native Pollinator Survey.

Common name	Scientific name
Coleoptera	
Flower longhorn beetles	Cerambycidae: Lepturinae
Hairy flower scarabs	Scarabaeidae: *Trichiotinus*
Diptera	
Bee flies	Bombyliidae: *Bombylius*
Saproxylic (decaying wood) hover flies	Syrphidae: ~80 species in two subfamilies
Hymenoptera	
Bumble bees and long-horned bees	Apidae: *Bombus*, *Melissodes*
Mining bees	Andrenidae: *Andrena, Calliopsis*
Leafcutter bees	Megachilidae: *Megachile, Osmia*
Oil bees	Melittidae: *Macropis*, *Melitta*
Lepidoptera	
Hawk (sphinx) moths	Sphingidae: 26 species that feed as adults
Flower moths	Noctuidae: *Schinia*

Survey Design and Methodology

The current and historical distribution of native pollinators was assessed with three field sampling strategies and compilation of collection data.

Extensive Survey

The goal of the Extensive Survey is to provide data on the distribution of individual species of pollinators within broad taxonomic or functional groups whose conservation status is poorly known. Multiple options existed for designing an extensive survey—for instance, in New York's most recent Breeding Bird Atlas (McGowan and Corwin 2008), citizen scientists were deployed over five years to document bird species and attempt to confirm breeding in over 5,332 "blocks" of 25 km^2 covering the state. In the New York Dragonfly and Damselfly Survey (NYDDS; White et al. 2010), an early example of building insect atlases, professional and citizen scientists were allowed to select their own survey sites, and effort was uncontrolled. Over

4,000 locations were surveyed over five years. Both efforts were highly successful at determining the current distributions of target taxa at the time, but the results did have certain limitations due to the sampling design. During the Breeding Bird Atlas, effort was documented as time spent per block, but citizen scientists vary widely in their skill level and dedication, so comparisons among individual blocks are challenging. In the NYDDS, site-by-site comparisons were not possible due to the methodology. Our Extensive Survey was designed to determine the distribution of focal taxa throughout New York to allow a rigorous statistical comparison across time and space using a standard field protocol with consistent effort at a network of representative sampling locations.

Sampling Design

We concentrated our sampling on protected lands, including those owned by universities, land trusts, and federal, state, and local governments. This strategy had a number of advantages over a purely systematic or random approach: 1) These lands are typically of higher biodiversity value to pollinators than random places in the landscape; 2) We suspected that owners and managers of protected lands would be more likely interested in data on their pollinator fauna, and most likely to implement pollinator-friendly management; 3) They had staff who could assist with sampling; 4) Access for sampling was more straightforward in most cases than contacting individual landowners; and 5) For the last two reasons, costs were substantially lower than in a truly random design. Disadvantages included 1) Reduced ability to extrapolate to the entire state; 2) Greater likelihood of sampling in better habitats and areas already managed for pollinators, thus potentially overestimating the assessed health of the state's pollinator community.

Two facets of our sampling design served the purpose of ensuring that we sampled in many different kinds of habitats in all of New York's diverse landscapes. First, we stratified our sampling by TNC terrestrial ecoregion (http://maps.tnc.org/gis_data.html). Ecoregions—large areas with similar geology, soils, climate, and vegetation (Bailey 1998)—are a coarse-scale reflection of habitat diversity, and ensuring that all ecoregions are represented adequately in the sampling design goes a long way toward ensuring that insects associated with a broad array of environmental conditions are sampled. Importantly, protected lands are well distributed throughout New York State in every major ecoregion (Table 2, Figure 2).

Second, at each sample site, we sampled each of the following habitat types at every sample site: 1) Meadow/grassland; 2) Forest; and 3) Wetland. We called these places sampling "stations." Land cover data layers such as the National Land Cover Database (Fry et al. 2011) and Northeast Terrestrial Habitat Map (Ferree and Anderson 2013), combined with aerial photography interpretation and field reconnaissance, were used to determine station locations within sites (Figure 3), but the final selection was made in the field. Less well distributed habitat types important for our focal taxa, which we expected would not be well covered by the Extensive Survey, were the focus of Target Habitat Surveys (below).

Table 2. Area of each TNC terrestrial ecoregion and percent protected from the New York Protected Areas Database (NYPAD).

Ecoregion	Area (km^2)	Percent of state	Area protected (km^2)	Percent protected
North Atlantic Coast	3827	3%	508	13%
Northern Appalachian / Acadian	27053	21%	12003	44%
Great Lakes	29922	24%	1273	4%
High Allegheny Plateau	35248	28%	4124	12%
Lower New England / Northern Piedmont	15362	12%	1272	8%
St. Lawrence - Champlain Valley	11514	9%	1033	9%
Western Allegheny Plateau	3010	2%	114	4%

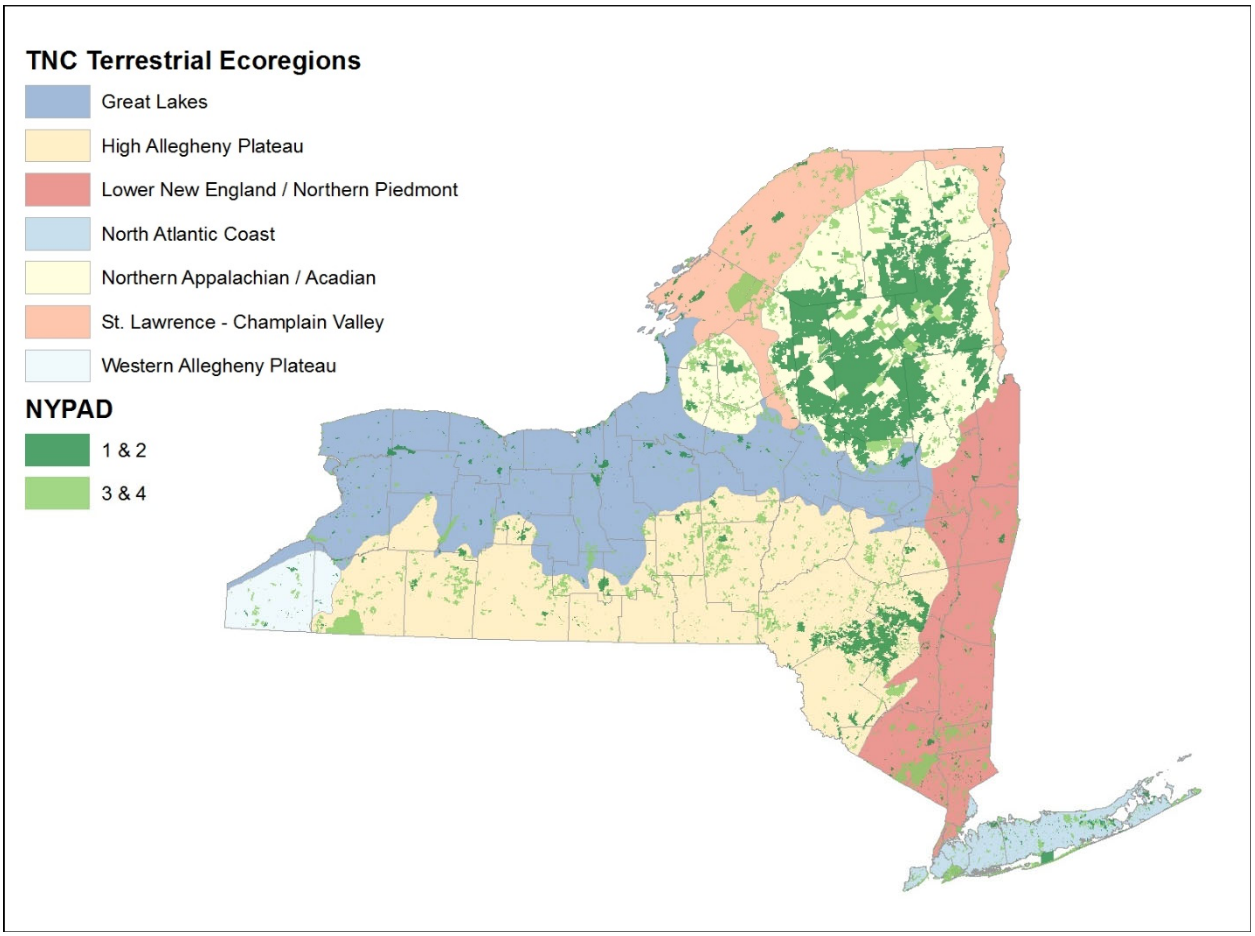

Figure 2. Protected land by GAP Status (1,2 = protected with conservation mandate; 3,4 = protected without conservation mandate) and TNC Terrestrial Ecoregion.

In addition to these three habitat types to be sampled at each Extensive Survey site, we sampled a roadside habitat as a fourth station. Roadsides are notably productive for pollinator sampling, in part because they are often kept open by mowing, creating miniature meadows, and in most cases they are easy to access without special permission.

While we aimed to sample in all four habitat types at each site, in some areas of the state, like the Adirondacks, habitat diversity was limited. In practice, we allowed a site to be sampled if at least two of the habitat types were available, and allowed sampling multiple representatives of certain habitat types (e.g., two meadow stations) in these situations.

Figure 3. Example of sample site selection and sampling station locations. (Left) Grafton Lakes State Park in eastern New York, with a yellow dot marking a random sample point located within the park boundary. (Center) Land cover surrounding the sample point and within a 250-m radius; blue=wetlands; green=forests; brown=open, pink=developed. (Right) Aerial photo of same location, with red stars indicating potential sampling points in wetland, forest, open cover, and roadside.

We used the Environmental Protection Agency's Generalized Random Tessellation Stratified spatially explicit sampling methodology (Stevens and Olsen 2003, 2004) to maximize the geographic spread of sample locations throughout each ecoregion. We generated 150 spatially balanced random points, stratified by ecoregion, within protected area polygons for the entire study, with 50 sites to be subsampled each year for temporal balance and 300 "overdraw" sites to be available for choosing if selected sites were not able to be sampled.

Target Habitat Surveys

Target habitats were those expected to contain unique species whose distribution (and therefore, conservation status) would not likely be adequately documented using the Extensive Survey sample design: alpine meadows, barrens, coastal dunes, peatlands, and late-successional forests. Maps of the best examples of these habitat types in New York were generated from three primary sources: our element occurrence database (New York Natural Heritage Program 2017), which included mapped occurrences of significant natural communities as defined by our state classification (Edinger et al. 2014), the Northeast Terrestrial Habitat Map (NETHM; Ferree and Anderson 2013), and the classification prepared for the New York State Wildlife Action Plan (Howard et al. 2015). Specific sample sites were chosen for accessibility and convenience, and to maximize their geographic spread.

The available pool of sample sites for target habitat surveys varied (Figure 4). The open alpine community of the Adirondack High Peaks is mapped in 20 occurrences ranging from 0.49 ac to 62.8 ac, totaling 235 ac (New York Natural Heritage Program 2017). Barrens are unvegetated or sparsely vegetated communities with large areas of bare rock or sand. They are grouped in the state classification (Edinger et al. 2014) with woodlands, which are sparsely treed communities but that may still have unvegetated openings. We included 12 natural community types comprising 63 patches ranging from 3 ac to 4935 ac (New York Natural Heritage Program 2017), totaling 27,782 ac. Coastal dunes in New York include the Great Lakes dunes bordering Lake Ontario and the maritime dunes bordering Long Island Sound and Atlantic Ocean. Great Lakes dunes are mapped in nine patches ranging from 5 to 253 ac, totaling 797 ac. Maritime dunes are mapped in 10 patches ranging from 11.32 ac to 905 ac, totaling 2175 ac. Open peatlands are present throughout New York State, and in consultation with our advisory committee and NYNHP ecologists, we focused on seven natural community types: Black spruce-tamarack bog, Dwarf shrub bog, Highbush blueberry bog thicket, Inland poor fen, Medium fen, Patterned peatland, and Perched bog. These peatlands are mapped in 215 patches ranging from 0.2 to 5848 ac, totaling 17,397 ac statewide.

Late-successional ("old growth") forests are centered primarily in three regions in New York—Allegany, Adirondacks, and Catskills—but smaller, more isolated examples are scattered around the state. No comprehensive map of late-successional forests exists for New York. Our element occurrence database (New York Natural Heritage Program 2022) contains approximately 50 old growth occurrences ranging from 10-70,000 acres in many different forest community types, including Maple-basswood rich mesic forest, Hemlock-northern hardwood forest, Spruce-fir swamp, Floodplain forest, Spruce flats, Mountain spruce-fir forest, Maritime holly forest, Limestone woodland, Northern white cedar swamp, Coastal oak-laurel forest, Oaktulip tree forest, Pine-northern hardwood forest, Balsam flats, Beech-maple mesic forest, and Hemlock-hardwood swamp. These total at least 166,350 acres, with about one-third in Hemlock-northern hardwood stands. In addition, our files and other resources (e.g., McMartin 1994, McGee et al. 1999, Kudish 2000, Davis 2003, Kershner and Leverett 2004) contain leads for at least this much more acreage at many additional locations around the state.

Figure 4. Open alpine communities (blue triangles) in the Adirondack High Peaks (top left); barrens communities from the NYNHP element occurrence database (sand-colored circles) and coastal barrens grid cells from the Northeast Terrestrial Habitat Map (brown) (top right); Lake Ontario dunes, including early post-glacial dunes east of the lake, as red hexagons (middle left); Long Island dunes as red hexagons (middle right); Open peatlands from the

NYNHP significant natural community layer (bottom left); late-successional forests (green squares) (bottom right).

Field Methods

Two field protocols, pan trapping and a timed search (Droege 2015), were employed at each Extensive Survey and Target Habitat Survey sampling station during an April-October sampling window. Field crews first scouted for the four sampling stations, then deployed a transect of bee bowls at each station, conducted timed searches at each of the stations, and retrieved the bowls.

Final Selection of Habitats

To the degree possible, the four stations in the Extensive Survey—grassland/meadow, forest, wetland, and roadside—were identified in advance using land cover GIS data and aerial photography (Figure 3). However, the age of available imagery and some inaccuracy in land-cover classification meant that final selection of specific locations happened in the field. If all the habitat types were not available at a given site, field staff used their judgment to place a transect in a habitat that "looked good" for pollinators. For Target Habitat Surveys, station locations were chosen in the field to maximize the diversity of floral resources and substrates in the target habitat. Wetland habitats were sampled along edges to minimize turning traps into tiny sampling boats.

Bee Bowls

Bee bowls (also called "pan traps") were used primarily to sample focal bees and flies. Simply put, they are pretend flowers that drown insects. We used 3.25-oz. plastic bowls, alternating white, fluorescent blue, and fluorescent yellow, and filled with soapy water. Fifteen bowls per habitat type (60 per site) were arrayed on the ground in a transect contained within the habitat type, with bowls spaced 3 m apart (Droege 2015), for a transect length of 42 m. Bowl transects were deployed for at least the warmest part of the day, typically between 10 a.m. and 3 p.m. We transferred captured specimens to Whirl-Pak bags containing 70% ethanol.

Timed Search

We conducted a timed search around each of the four stations at each sample site. Observers spent 30 minutes walking throughout the sampling location with no defined radius, targeting flowering plants and looking for bees, flies, moths, and beetles. They used aerial insect nets to capture insects from the air and from flowers. This part of the protocol was often referred to as "netting" or "hand-netting."

Malaise Trapping

In late-successional forests, we employed an additional survey protocol, malaise trapping, which is known to yield copious amounts of Diptera and some additional Hymenoptera. As focal taxa in the saproxylic functional group of hoverflies were our primary targets in these habitats and yields are small with bowl-trapping, we enhanced sampling for this group with malaise traps. Two small-scale cursory studies employed malaise traps in Atlantic Canada (Klymko and

Robinson 2012, Klymko 2015) detected 20 hoverflies new to the Maritimes in addition to many new provincial records.

We sampled the three general concentrations of late-successional forest (Catskills, Adirondacks, Allegany) for enhanced saproxylic hoverfly surveys, which are coincidentally located near the NY state border where new arrivals to New York or rare species on the edges of their ranges might be expected. We worked with Dr. Carmen Greenwood of SUNY Cobleskill and interns from her lab (Liam Somers, Zach Jacobson, Jayson Maxwell, Gloria Keal, Allie Eastman, and John Pipino) to place and check traps from May to early July each year, timed with peak syrphid activity. We sought assistance from OPRHP staff, primarily Aaron Hemingway, to check traps at Allegany State Park. We set paired traps along an ecotone adjacent to the forest stand, or within a forest gap having good floral resources. We emptied traps approximately once a week throughout the trap period. On-site handling was minimized because the specimens were stored in alcohol within collecting jars. On good weather days, collection was supplemented with targeted hand-netting on floral resources at the sites. Specimens were stored in ethanol until focal taxa could be sorted, pinned, and identified to species level by the Greenwood Lab and Jeff Corser (formerly NYNHP). Challenging taxa, rare species, and a reference collection of focal syrphids were confirmed by expert John Klymko of the Atlantic Canada Conservation Data Centre. Bycatch was also retained.

Target Species Surveys

We identified several at-risk species and taxonomic groups (Table 1) that we expected would not be captured well by the Extensive Survey and Target Habitat Surveys.

Apidae: *Bombus* spp.

While the Extensive Survey will provide a statewide effort of netting in appropriate habitats for many bumble bees (*Bombus* spp.), additional survey effort for SH and S1 species was warranted. Appropriate meadow and roadside habitats with flowering plants in or near previously documented sites (although some locations are vague) were surveyed for the following rare species: Rusty-patched Bumble Bee (*B. affinis*), Ashton Cuckoo Bumble Bee (*B. ashtoni* [= *bohemicus*]), Indiscriminate Cuckoo Bumble Bee (*B. insularis*), Fernald Cuckoo Bumble Bee (*B. fernaldae/flavidus*), and the following rare species: Yellow-banded Bumble Bee (*B. terricola*), American Bumble Bee (*B. pensylvanicus*), Yellow Bumble Bee (*B. fervidus*), Black and Gold Bumble Bee (*B. auricomus*), and Northern Amber Bumble Bee (*B. borealis*). We surveyed 10 or more previously known locations for each target species. Specimens captured via hand-netting were collected for later identification.

Taxonomic note: *Bombus ashtoni* has been included in *B. bohemicus* in Williams *et al.* (2014) based on morphology and DNA barcoding. Some bumble bee taxonomists keep *B. ashtoni* as a separate species. The same is true for *B. fernaldae*, which is combined with *B. flavidus* in Williams *et al* (2014).

Melittidae: Macropis, Melitta and Apidae: Epeoloides pilosula

Melitta americana specialize on pollen from blueberry and cranberry (Cariveau et al. 2013, Payette, A. 2013, Wilson and Carril 2015) and are known from just a single location in central NY. We surveyed in areas of appropriate habitat within the distributional range for the species, which appears to be central and eastern NY. *Melitta eickworti* has also been documented from at least three locations in central NY and we surveyed for this species at a site in Albany with deerberry (*Vaccinium stamineum*) which is the known host plant for this species (Cane et al. 1985, Wilson and Carril 2015).

The oil bees *Macropis ciliata, M. nuda,* and *M. patellata* specialize in collecting oil from native loosestrife (*Lysimachia*). Previously known sites with historical locations were surveyed where possible and we surveyed in appropriate habitat with native loosestrifes during bloom in early July. *Epeoloides pilosula* is an extremely rare cleptoparasite not known from the state since 1942 until it was recently documented at the Hyuck Preserve in 2014. We extended our search to other areas where *Macropis nuda*, a host species, is known from as well as additional sites with native *Lysimachia* to look for both the host and cleptoparasite.

For these rare NY groups, we used a combination of bowl traps and hand-netting, but mostly hand-netting, and specimens were retained for later identification.

Syrphids and bee flies

Coastal dune habitats were targeted on the shore of Lake Ontario for Ghost bee fly (*Bombylius incanus*) in 2019 after the species was documented in surveys in 2018 at Sandy Pond State Park. Rare saproxylic syrphids from our focal fly list were targeted in late-successional forest habitats, especially along ecotones, forest gaps, and hilltops at sites other than those targeted with malaise trapping.

Processing and Identification

NYNHP staff, technicians, and volunteers completed lab processing of the bowl-trapped and hand-netted specimens from staff surveys including drying, pinning, individually labeling, and sorting specimens to taxonomic group. The work was completed in our lab at the NYS Museum and also in the lab of Dr. Melissa Fierke, SUNY ESF. We followed procedures for pinning outlined in the ESNPS participant handbook (White et al. 2018, www.nynhp.org/pollinators). During the COVID-19 pandemic, some of this work was completed at employee homes and specimens were frozen when brought back to the lab setting to minimize the risk of the spread of dermestid beetles. Erin White and Katie Hietala-Henschell (formerly Xerces Society, now NYNHP) identified and verified most *Bombus*. Other bees were conveyed to the Danforth Lab at Cornell University, where Dr. Bryan Danforth, Maria Van Dyke and their students and volunteers completed identification of other focal bees to the lowest taxonomic level possible. Some *Andrena* and *Melissodes* specimens, which are especially challenging to identify to species, underwent DNA barcoding at the Danforth Lab to confirm identifications. Focal beetles and moths were identified by Matt Schlesinger using Yanega (1996), Lingafelter (2007), and bugguide.net and focal flies were identified by Jeff Corser (formerly NYNHP) and the Greenwood Lab of SUNY Cobleskill using Skevington et al. (2019). Many syrphids were identified or verified by John Klymko of Atlantic Canada Conservation Data Centre, often on short timelines.

All survey information and specimen identifications were loaded into a custom database for data tracking and quality control. We archived snapshot versions of the database to enhance data recovery and built scripts to ensure data uploads were as consistent, efficient, and error free as possible.

iNaturalist

We set up a "traditional project" in iNaturalist, one that requires people to join to submit observations, in early 2018. Having people join a project allowed for regular communication with project participants and leader boards to motivate naturalists. Observations needed a location, date, and a photograph, and were limited to Coleoptera, Diptera, Hymenoptera, and Lepidoptera in New York State. Because this filter allowed records of many species that were not focal (deliberate so as not to stem enthusiasm), we used a "collection project" more finely tuned to our focal taxa for downloading and analysis. We downloaded data from this collection project on December 29, 2021 and used Research Grade observations (plus ones we could confirm independently) in our analyses.

Partner Data and Museum Records

The third major source of pollinator records after specimen collection and photographic surveys was existing collections and datasets. We compiled more recent data from a variety of academic, not-for-profit, and government partners and scientific papers (3). We also visited insect collections at several museums (3), databasing unique combinations of species, date, and locality for our focal taxa. Time and lack of expertise in identification led us to accepting specimen determinations in these collections in most cases. Finally, we digitized records from published works including books and the primary scientific literature (Leonard 1928, MacKenzie and Eickwort 1996, Matteson et al. 2008, Fetridge et al. 2008, Bried and Dillon 2012, Ascher et al. 2014, Tumminello et al. 2018, Graystock et al. 2020).

Table 3. Data partners and museums visited for obtaining pollinator records.

Data partners and resources	*Museum collections visited*
Paul Smiths College	American Museum of Natural History
Albany Pine Bush Preserve	Staten Island Museum
Hawthorne Valley Farmscape Ecology	Cornell University Insect Collection
American Museum of Natural History	Carnegie Museum of Natural History
Cornell University	SUNY ESF
SUNY ESF	New York State Museum
NatureServe	Buffalo Museum of Science
Butterflies And Moths Of North America	Yale Peabody Museum
New York State Museum	
NYSM & McCabe	
BugGuide	
GBIF	
Huyck Preserve	
iNaturalist	

Data partners and resources	*Museum collections visited*
Facebook--Moths of New York State group	
Facebook--Moths of Eastern US and Canada	
Leif Richardson Bombus data 2022	
Sharp-Eatman Nature Photography	
Bumble bee watch, Xerces Society	

Volunteer Recruitment and Participation

During initial stages of the project, we reached out to partner organizations, colleagues, and previous volunteers for the NY Natural Heritage Program to announce the ESNPS and recruit volunteers. Individuals who are interested in doing outdoor activities with friends and family while contributing to a scientific study showed a strong interest in assisting with this Survey. We built upon the volunteer base that we had established with the New York Dragonfly and Damselfly Survey (2005-2010). This allowed us to collect information on native pollinators over a larger scale geographically than we would have been able to otherwise and obtain records on nocturnal focal moths which staff diurnal surveys did not target.

As mentioned previously, we chose focal taxa that were charismatic and could easily be identified through photography (i.e., bumble bees, sphinx moths, and long-horned and scarab beetles). Surveys for these groups lent themselves to volunteer participation through the use of iNaturalist to capture photographic records with location information. As with many citizen or community science projects, ESNPS did not require participants to have a scientific background or specialized experience. We provided the necessary training to participate in our effort, including native pollinator biology, general taxonomy, survey methodology (practice capturing in the field), specimen preservation or photo submission, and record collection. We offered day-long workshops on weekends in various regions of the State in 2018 and 2019. Due to the pandemic, in-person workshops were cancelled in 2020, but a virtual training was offered to partners and was recorded and sent to those interested in training. While many who completed the training did not collect Survey data, we trained over 200 community scientists through workshops, several of whom participated, primarily through our iNaturalist platform. Volunteers were provided with a Participant Handbook that was their companion guide to material presented at the workshop and contained everything they would need to know to participate in the Survey (https://www.nynhp.org/documents/23/ESNPS_participant_handbook.pdf). The handbook included information on selecting places to survey, when to conduct surveys, what to collect during the survey, and how to report information back to us. We required either a photographic or specimen voucher for each field observation to ensure verification of records, and participants were encouraged to use a standardized protocol with high data quality.

In 2019, Dr. Bryan Danforth and Maria Van Dyke hosted a bee identification course at Cornell University. The course was attended by 22 participants who learned how to recognize bees to genus level. Some participants were able to explore identification to species level. Our interns and volunteers learned to recognize target taxa which helped them during their survey work. The course included lecture, field survey and collection, pinning specimens, and identification labs.

Data QC, Analysis, Mapping, and Ranking

Quality control of our datasets required several steps. While it was straightforward enough to use a consistent taxonomy for the ESNPS survey data and iNaturalist, the museum and partner data were far more challenging to reconcile. Museum specimens were often still labeled with the taxonomy in place at the time of accessioning, which may have changed several times through the years. And there was no guarantee that partners from whom we obtained data used the same taxonomy we were using. We came up with a project species list that used current taxonomy and compared our datasets to this standard. When we found discrepancies, we consulted a variety of sources to help us reconcile them, including the Integrated Taxonomic Information System (https://www.itis.gov/), NatureServe Explorer (https://explorer.natureserve.org/) , Discover Life (https://discoverlife.org/), Wikipedia (https://en.wikipedia.org/wiki/Main_Page), the Systema Diptorum Nomenclator (http://www.diptera.org/Nomenclator), and the New World Cerambycidae Catalog (http://bezbycids.com/).

Occurrence data from both the ESNPS data and the Compiled database formed the basis for species maps, phenology charts, and most of the "rank factors" used in NatureServe's conservation status ranking methodology (Master et al. 2012, Faber-Langendoen et al. 2012). We used January 1st, 2000 as our cutoff for "recent" versus "historical" records; the cutoff is arbitrary but we chose it as a means to better capture known declines in bumble bees in the 1990s (Colla and Packer 2008). Below we detail our process for generating these results.

Maps and phenology charts

We created three maps for each species: 1) historical distribution at the county level overlain by ESNPS specimen records, iNaturalist observations, and partner records; 2) the same recent records from the three sources on top of ecoregions; and 3) historical (1999 and earlier) and current (2000 to present) distribution by county.

Phenology charts display the proportion of occurrence records by half months, again plotted separately for the two time periods.

Conservation status ranking

NatureServe's conservation status ranks are used throughout the western hemisphere as measures of species' degree of imperilment or security. They are calculated at global, national, and subnational levels and range from 1 to 5. In the U.S., state natural heritage programs maintain subnational ranks (S-ranks) for a wide variety of animals, plants, and natural communities.

The ranking methodology (Master et al. 2012, Faber-Langendoen et al. 2012) involves assessments of three main factor groups: rarity, threats, and trends. Rarity factors include Range Extent (areal extent of all recent records), Area of Occupancy (area within the range that's actually occupied by the species), and Number of Occurrences (number of discrete populations). Other rarity factors exist in the methodology, but we did not use them. Threats are assessed by one of three methods: 1) complex calculation of overall Threat Impact via enumeration of the scope and severity of all threats; 2) assignment of overall Threat Impact based on expert opinion, or 3) assignment Intrinsic Vulnerability as high, moderate, or low based on life-history characteristics. Finally, Trends are assessed as short-term (over the last 10 years, or three generations) or long-term. We assessed Long-term Trend. Rank factor values are in Table 4.

Table 4. Select rank factor values from NatureServe's (Master et al. 2012, Faber-Langendoen et al. 2012) conservation status ranking methodology used in this study.

Range Extent
A = <100 square km (< about 40 square mi)
B = 100-250 square km (about 40-100 square mi)
C = 250-1,000 square km (about 100-400 square mi)
D = 1,000-5,000 square km (about 400-2,000 square mi)
E = 5,000-20,000 square km (about 2,000-8,000 square mi)
F = 20,000-200,000 square km (about 8,000-80,000 square mi)
G = 200,000-2,500,000 square km (about 80,000-1,000,000 square mi)
H = >2,500,000 square km (> 1,000,000 square mi)
U = Unknown

Area of Occupancy (number of 4-km^2 grid cells)
A = 1
B = 2
C = 3-5
D = 6-25
E = 26-125
F = 126-500
G = 501-2,500
H = 2,501-12,500
I = >12,500
U = Unknown

Number of Occurrences
A = 1 - 5
B = 6 - 20
C = 21 - 80
D = 81 - 300
E = >300
U = Unknown

Overall Threat Impact
A = Very High
B = High
C = Medium
D = Low
U = Unknown

Intrinsic Vulnerability
(Only used if Overall Threat is Unknown or Null)
A = Highly vulnerable
B = Moderately vulnerable
C = Not intrinsically vulnerable

Long-term Trend
A = Decline of >90%
B = Decline of 80 - 90%
C = Decline of 70 - 80%
D = Decline of 50 - 70%
E = Decline of 30 - 50%
F = Decline of 10 - 30%
G = Relatively Stable (<=10% change)
H = Increase of 10 - 25%
I = Increase of >25%
U = Unknown

We used the NatureServe rank "calculator" (NatureServe 2020), an Excel workbook, to generate S-ranks. This approach allows for consistency among species and is repeatable and transparent.

Ultimately, conservation status ranks have to pass a "gut check" and for this reason our process was iterative. We aimed for a set of ranks that we felt fairly reflected each species' imperilment or security but that were also appropriately distributed across rank values. To these ends we made adjustments to the rank factor values suggested by strict calculation and in some cases included or excluded rank factors to arrive at ranks that reflected the status of the species based on our own and our partners' expertise.

Range Extent

We estimated Range Extent by calculating both a minimum convex polygon (MCP) and an alpha hull (AH) around all recent records. Calculations were done in R (R Core Team 2021), with the AH methods generally following the guidance in Master et al. (2012). The MCP yields larger Range Extent estimates since it includes all the area in between records, while the AH excludes large unoccupied areas. The AH method considerably underestimated Range Extent in cases with highly clustered records and was ignored. When these two methods yielded different values of Range Extent, we selected a final value that reflected this uncertainty. When the raw value for Range Extent was within 10% of the lowest bound of the next highest bin, we included both bins to represent the uncertainty in the calculation.

Area of Occupancy

We counted 4-km^2 grid cells with recent records and assigned Area of Occupancy values accordingly. When the raw value for AOO was within 10% of the lowest bound of the next highest bin, we included both bins to represent the uncertainty in the calculation. The most common species appeared to be more broadly distributed than the calculated AOO suggested, so we widened the range of uncertainty for these species to include the largest category.

Number of Occurrences

We estimated the number of occurrences (in the Heritage network sense of discrete populations, rather than individual records) by grouping records according to standard "separation distances" that were based on NatureServe's existing such distances for other taxa and expert opinion. When the raw value for Number of Occurrences was within 10% of the lowest bound of the next highest bin, we included both bins to represent the uncertainty in the calculation. The most common species seemed to us very likely more broadly distributed than the calculated number of occurrences suggested, so we widened the range of uncertainty for these species to include the largest category. For some other species it appeared that including this rank factor was artificially lowering their ranks, so in those cases we excluded it.

Threats

For some species, we retained the Threat Impact value that arose from the threat-by-threat calculation of scope and severity, while for others we determined that threats were unknown and we assigned Intrinsic Vulnerability. In some instances, we used values from NatureServe.

Long-term Trend

Lacking data on absolute population decline or increase, we followed Telfer et al. (2002) in calculating the relative change in range based on county occupancy historically (1999 and earlier) and post-2000. Some of us used this methodology previously for dragonflies and damselflies in the northeastern U.S. (White et al. 2015). To calculate the relative change in range, the proportions of counties occupied in each time period are log transformed and the later time period's values regressed on the former's. The residuals from the regression are an index of a species' change relative to other species. The method accounts for unequal survey effort in each time period (as we know to be true) but cannot account for variation in collection or survey focus; that is, if mining bees were all the rage in the 1950s but other bees were ignored, whereas since 2000 all bees have been given equal attention (a dubious claim), the method could not account for that bias. Despite this shortcoming we believe this method can detect real signals in the data. Only species that were present in 5 or more counties pre-2000 were included. We calculated the change index twice, once including all taxa, and once separately for each of the four insect orders.

To translate this relative change index to Long-term Trend factor categories, we took the following approach, calibrating based on known declines in *Bombus* and the raw numbers of counties occupied in the two time periods. Species with values of relative change -2.5 and smaller were assigned AB (≥80% decline), those with values between -2.5 and -1.0 were assigned AD (≥50% decline), those with values between -1.0 and -0.5 were assigned AF (≥10% decline), those between -0.5 and 1.0 were assigned G (relatively stable), and those with values >1.0 were assigned HI (≥10% increase). Species that declined from 5 occupied counties or more to 0 were assigned a value of AB (≥80% decline). Species for which the relative change index could not be calculated, but that increased from 0 to 5 counties occupied or for which the number of counties at least tripled were assigned a value of HI (≥10% increase). All other species were assigned U (unknown). Species for which the two calculations of relative change conflicted were assigned a final value reflecting that uncertainty.

Final S-rank

Calculated ranks were adopted in most cases, with some adjustments made based on expert opinion. Species that had no recent (since 2000) records were assigned an SH (Historical). S-rank definitions are in Table 5.

Table 5. S-rank definitions. Adapted from Master et al. (2012).

RANK	DEFINITION
SX	**Presumed Extirpated** — Species or ecosystem is believed to be extirpated from the jurisdiction (i.e., nation, or state/province). Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered. [equivalent to "Regionally Extinct" in IUCN Red List terminology]
SH	**Possibly Extirpated** — Known from only historical records but still some hope of rediscovery. There is evidence that the species or ecosystem may no longer be present in the jurisdiction, but not enough to state this with certainty. Examples of such evidence include (1) that a species has not been documented in approximately 20-40 years despite some searching and/or some evidence of significant habitat loss or degradation; (2) that a species or ecosystem has been searched for unsuccessfully, but not thoroughly enough to presume that it is no longer present in the jurisdiction.
S1	**Critically Imperiled** — At very high risk of extirpation in the jurisdiction due to very restricted range, very few populations or occurrences, very steep declines, severe threats, or other factors.
S2	**Imperiled** — At high risk of extirpation in the jurisdiction due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors.
S3	**Vulnerable** — At moderate risk of extirpation in the jurisdiction due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors.
S4	**Apparently Secure** — At a fairly low risk of extirpation in the jurisdiction due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats, or other factors.

RANK	DEFINITION
S5	**Secure** — At very low or no risk of extirpation in the jurisdiction due to a very extensive range, abundant populations or occurrences, with little to no concern from declines or threats.
SU	**Unrankable** — Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.
SNA	**Not Applicable** — A conservation status rank is not applicable because the species or ecosystem is not a suitable target for conservation activities. This rank is given to nonnative species and vagrants without regular occurrences in New York.

Results

Species Distribution Maps

Our primary project goal was to assess the conservation status of our focal native pollinator taxa. As a first step to this process, we compiled historical (1999 and earlier) and current (2000 to present) records for our focal taxa to inform rarity and trend analyses for the status assessment. We depicted this location information spatially as species distributional maps and phenology charts in Appendix A. In all, we collected, identified, and cataloged over 34,000 records in our ESNPS database and gathered over 171,000 records in the Compiled database.

Each focal pollinator species is represented by a single page of four figures in Appendix A. Header information on each species page includes scientific and common name, global rank, taxonomic information, native status (there are a few non-native species in our broader focal groups), and habitat description, when available. If ESNPS specimens were collected for a given species, all habitat information recorded on site survey forms was collated and included in the header. There were cases where our Advisors or taxonomic experts questioned the validity of certain species being recorded in NY, based on records from our Compiled database. As we did not have the capacity to track down and verify each of these records at this time, these are noted on the appropriate map in the header as "Verification needed to confirm presence in NY." These are also noted in species lists (Appendices B-E).

Figure 1 in Appendix A displays a species map with counties shaded in green, representing those New York counties with records from 1999 and earlier. This information was gleaned from our Compiled database (see 3 above). In cases where the location was designated by two or more counties (e.g., a location bordering counties or with locality denoted as a region like "Catskills"), the possible counties are denoted with light green shading as "historical possible." Regions appearing in collection information that could be attributed to a group of counties included Long Island (Counties: Nassau, Suffolk, Queens, Kings), NYC (Bronx, Kings, New York, Queens, Richmond), Catskills (Sullivan, Delaware, Greene, Ulster), and Adirondacks (Essex, Hamilton, Saratoga, Franklin, Washington, Warren, Clinton, Herkimer, Lewis, Fulton, Oneida, St. Lawrence).

Every effort was made to determine precise coordinates for locations of ESNPS surveys completed; specimens determined to species level from ESNPS are represented as blue dots on the species maps. Occasionally, coordinates represented approximate locations if the information on a survey form was vague; any discrepancies will be indiscernible at this scale. Any records that could not be confirmed to the species level were not included in the species maps. Dark blue dots represent records from iNaturalist verified to species level and thus designated as research grade. Other records for which we have the precise location from the Compiled database are depicted as gray dots on the species maps.

Figure 2 of the species maps displays current distribution (ESNPS specimen records as blue dots, iNaturalist research grade photos as dark blue dots, and other partner data as gray dots) overlaying TNC's ecoregions, which was part of our sample frame stratification for the extensive surveys.

Figure 3 displays county differences between historical and current sampling with color shadings depicting observations by County. Counties shaded in gray are historical records (1999 and earlier). Those shaded blue have records from 2000 to present, but no historical records. Those shaded purple have records from both time periods. Lighter shades of gray and purple indicate historical records where the observation could be attributed to more than one County, or "historical possible". While most counties with current time period designations (blue or purple) have associated dots in Figures 1 and 2, it is also possible for counties to be assigned these colors and not have associated dots. This occurred when records from the Compiled database only had location information at the county level.

Phenology charts are found in Figure 4 of the species maps. A bar plot depicts the proportion, by time period, of records (ESNPS, iNaturalist, and other records for which the collection or observation date was known) in half-month increments throughout the season for current (2000 to present) and historical (1999 and earlier) confirmed observations. The 1st half of the month includes the 15th and the 2nd half of the month includes the 16th to the end of that month. The number of records displayed may include multiple specimens from a given site rather than solely unique records from various sites.

We do not include maps for a handful of species as either date or county information was lacking in our Compiled database. These species have been collected in or at least reported from NY, but we are uncertain of specifics on when or where (though likely 1999 or earlier): *Brachypalpus cyanogaster*, *Etorofus deletus*, *Lepturopsis dolorosa*, *Manduca brontes*, *Osmia calaminthae*, and *Schinia thoreaui.* Some may represent identification errors in older museum collections.

The species maps and charts are organized in Appendix A taxonomically by order and family, and alphabetically within taxonomic group.

Highlights

The three-year ESNPS sampling effort (2018-2020) and pilot year (2017) yielded many excellent finds. Notably, eight focal bee species appear to have been added to the list of known bee species for New York based on our efforts (Appendix B). To the best of our knowledge, this table reflects the known NY bee species within our focal groups based on specimen and photographic vouchers after compiling data from various sources (see 3 above). Those species with a "new" designation in the table are those we documented during the Survey, but do not appear to be otherwise recorded in the state. If a species was newly documented as part of the 2021 Fort Drum pollinator survey (but not during ESNPS), these are noted as new FD 2021 in the right column. We cannot necessarily claim we were the first to record these species as part of our efforts, as our Compiled database may not be comprehensive; however, in checking data sources we have access to, they do not appear to be documented elsewhere. As this table includes project focal taxa only, and these native bee species were our main focus for identification, there may be additional new finds among non-focal taxa. “Pre” species designations in the table are those previously documented in the state but were not documented as part of our Survey (and no post-2000 records exist in our Compiled database). We were unable to confirm the presence of 42 focal bee species during ESNPS that were previously known in the state. However, other studies have extant records for 17 of these species (“partner” below); therefore, 25 species have historical records for the state (“pre” below), but no extant (2000 to present) records. If the species was found to be extant in the state based on our Compiled database, but no ESNPS records exist, they are highlighted below with a “partner” designation.

Likewise, a focal fly list for New York with the same designations of “new” and “pre” as above can be found in Appendix C. Again, to the best of our knowledge, this table reflects the known NY fly species within our focal groups based on specimen and photographic vouchers after compiling data from various sources, though we are still in the process of verifying additional fly specimen records. Eight focal fly species appear to have been added to the list of known species for New York based on our efforts, while we were unable to confirm the presence of 35 historical records for the state. However, other studies have extant records for 12 of these species (“partner” below); therefore, 23 species have historical records for the state (“pre” below), but no extant (2000 to present) records.

A list of focal beetles is in Appendix D and shows that 22 focal species that have had no records since 2000. While moths were not a focus of ESNPS collection efforts, we were able to gather many records from iNaturalist and partners for focal moth species shown in Appendix E. Nine focal moth species have had no records since 2000.

We were able to verify over 34,000 individual specimen records to species level identification during the ESNPS. While our priority was to identify focal taxa collected, this number includes many non-focal taxa that were easily identified. Our ESNPS iNaturalist project participants submitted over 22,000 photographic pollinator records with confirmed identifications (research grade) in our broad taxonomic groups.

Survey Participants and Workshops

Over the course of the project, 201 volunteers became registered participants. An additional 98 requested to stay informed on the project’s happenings. Eight volunteer participants submitted specimen records to the project. In addition, the following partner organizations conducted surveys and submitted specimens without designated project funding: Adirondack Summit Stewards, Central Pine Barrens Commission, Croton-Harmon High School, Department of Environmental Protection, Mianus River Gorge, Office of Parks, Recreation, and Historic Preservation, Roberts Wesleyan College, Siena College. About 700 people participated by entering at least one observation on our project iNaturalist page (https://www.inaturalist.org/projects/empire-state-native-pollinator-survey), documenting over 31,700 pollinator observations.

Our trainings and workshops were a huge success in recruiting volunteers. In 2018, we trained about 125 people. We conducted five trainings for the public in different regions of the state and trainings for partners including NYC Parks, NYC DEP and Central Pine barrens commission staff. In 2019, we did six public workshops each with about 20 attendees, a training for Adirondack Summit Stewards, Allegany State Park staff, the Central Pine Barrens commission, and Roosevelt Island Community Garden. Bryan Danforth and Maria VanDyke of Cornell gave their bee course to 22 project participants to learn bee ID. In 2020, we gave a virtual workshop to the Central Pine Barrens commission that we recorded and passed around to others who had signed up for an in-person workshop that was cancelled due to COVID.

Sites Visited and Surveys Conducted

We completed 50 extensive surveys in 2018, 49 in 2019, and 52 in 2020, stratified by ecoregion (Figure 5), with a total of 151 extensive surveys during the three years. Field crews of two technicians each year completed most of the surveys and specimen pinning, supplemented with help from other NYNHP staff. The target habitat surveys (extensive model with four transects within a target habitat type) were conducted at 10 alpine sites, about 25 barrens sites, 8 coastal dune sites, 15 peatland sites, and 16 late-successional forest sites. Partner organizations assisted us in completing these surveys. Adirondack Summit Stewards completed alpine surveys, Central Pine Barrens Commission completed several barrens and dune surveys, and Department of Environmental Protection assisted with wetland surveys. In addition, Bryn Giambona, an ESF student at the Adirondack Ecological Center, conducted peatland surveys in the Adirondacks in spring of 2019. Other types of surveys, such as targeted species surveys, where the full protocol was not conducted, are captured as “incidental” surveys in our pollinator database. Figure 6 shows a breakdown of survey type and locations of surveys completed statewide.

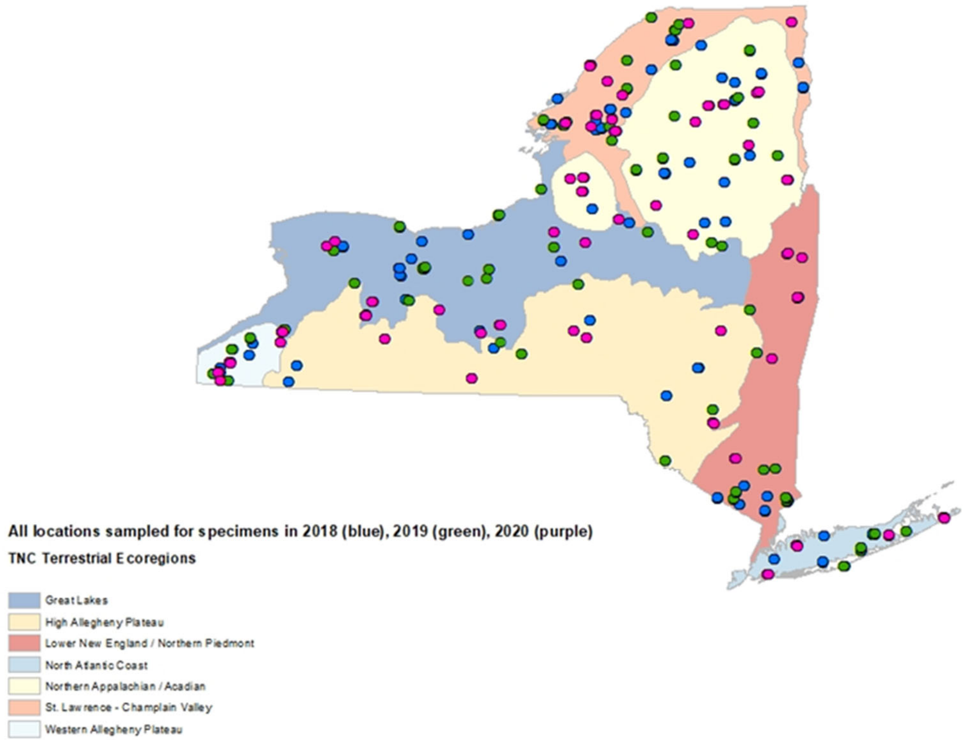

Figure 5. Extensive surveys for ESNPS in 2018 (blue), 2019 (green), and 2020 (purple) by Ecoregion.

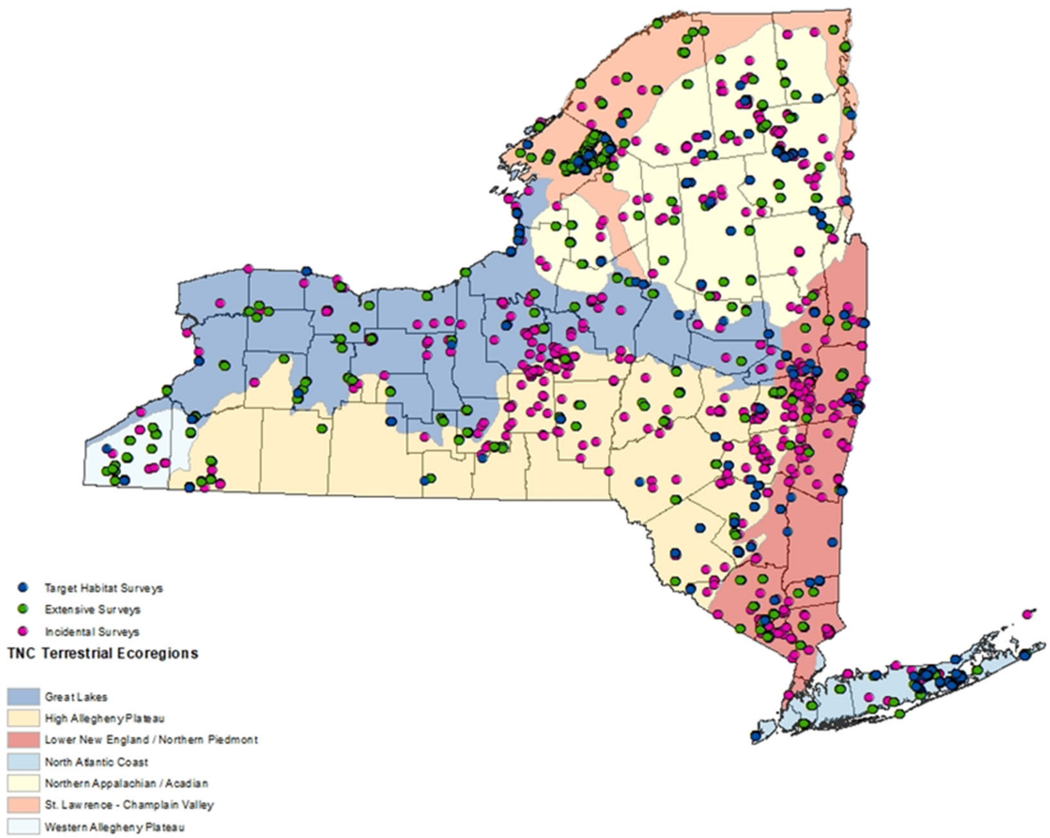

Figure 6. Survey locations during ESNPS by type. Target habitat surveys are displayed in blue, Extensive surveys in green, and incidental surveys in purple.

To illustrate the importance of unfunded participation of partner organizations and volunteer participants, Figure 7 illustrates the significant contributions made toward filling in gaps of specimen records for the state. Specimens collected by NYNHP staff with project funding are displayed in blue (all survey types). Additional specimens collected by partners and community/citizen scientists are displayed in dark blue. However, it is important to demonstrate that most of our community scientists involved with the project contributed photographic records rather than specimens. Figure 8 shows extant record locations gained by the photographic efforts of our ESNPS project participants compared to specimen locations, further increasing our ability to reach additional locations in the state.

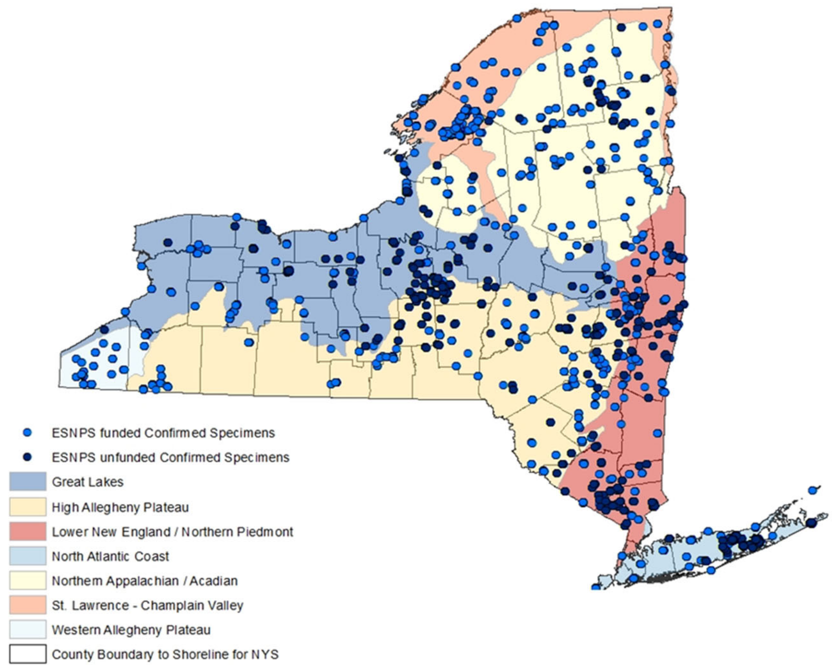

Figure 7. ESNPS specimens collected. Specimens collected by NYNHP staff with project funding are displayed in blue (all survey types). Additional specimens collected by partners and community/citizen scientists are displayed in dark blue.

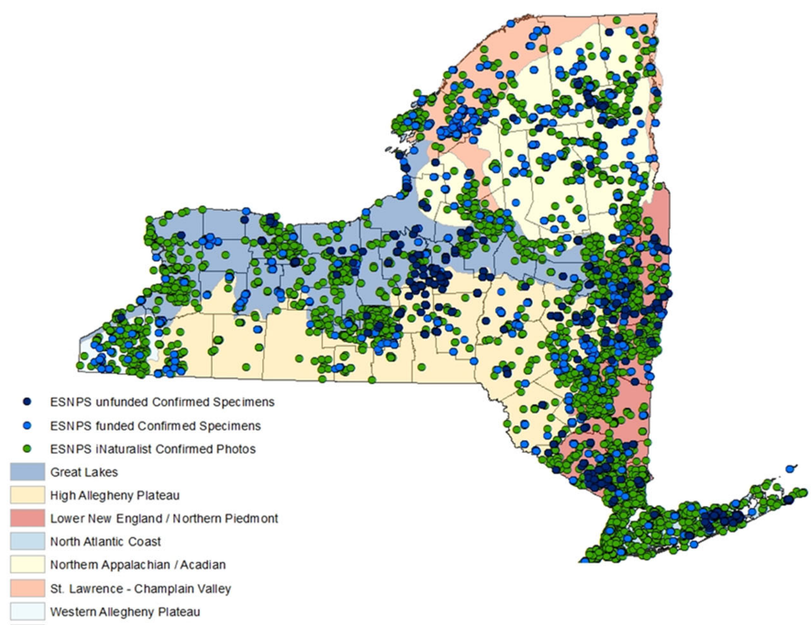

Figure 8. ESNPS confirmed records. Specimens collected by NYNHP staff with project funding are displayed in blue (all survey types). Additional specimens collected by partners and community/citizen scientists are displayed in dark blue. ESNPS participant-collected photographic vouchers from iNaturalist are displayed in green.

Malaise Trapping

Sites and sampling periods for the late-successional forest malaise sampling effort are outlined in Table 6 below. We sampled in three locations in the 2017 pilot year, five locations in 2018, three locations in 2019, and five locations in 2020. In 2018, we set malaise traps at French Creek WMA near Clayton, Minnewaska State Park, and Allegany State Park in May. Due to black bear damage to the traps at Minnewaska and Allegany parks, traps at these locations were removed and re-set in two new locations of Condon Hollow (Catskills) and Marion River.

Table 6. Target habitat survey sites for late-successional forest malaise trapping by year and sampling period.

Site	Year	Start Date	End Date
Condon Gap, Phoencia-Mt. Tobias Wild Forest, Ulster County	2017	May 11	July 19
Goldmine Ck, Ferris Lake Wild Forest, Hamilton County	2017	June 8	Aug 15
Goose Egg State Forest, Washington County	2017	June 8	Aug 15
Condon Gap, Halcott Mtn. Wild Forest, Greene County	2018	June 11	July 11
French Creek WMA, Jefferson County	2018	May 25	July 13
Marion River, Sargent Ponds Wild Forest, Hamilton County	2018	June 25	July 26
Palmagahatt Kill, Minnewaska State Park, Ulster County	2018	May 24	June 8
Rounds/Misery Mountain, Rensselaer County	2018	May 16	Aug 31
Wolf Run, Allegany State Park, Cattaraugus County	2018	May 17	June 14
Black Rock Forest, Orange County	2019	June 1	July 11
Camillus Unique Area, Onondaga County	2019	May 20	July 17
Lake George Wild Forest, Warren County	2019	May 22	July 19
Ampersand, High Peaks Wilderness, Franklin County	2020	May 28	July 16
Letchworth State Park, Livingston County	2020	June 1	July 20
Sols Island, Raquette-Jordan Boreal Primitive Area, St. Lawrence County	2020	May 28	July 23
West Canada Lake Wilderness, Hamilton County	2020	May 28	July 16
Zoar Valley Multiple Use Area, Cattaraugus County	2020	May 25	July 7

Target Species Surveys

We conducted targeted species surveys for several focal at-risk species and taxonomic groups in addition to the Extensive Surveys and Target Habitat Surveys.

In 2018, we surveyed for focal bumble bees and syrphids at Bare Hill Unique Area, Capital District WMA, Dement Creek at Montezuma WMA, Cranberry Lake Wild Forest, Harriet Hollister Spencer State Park, Iroquois NWR, Mt. Defiance near Ticonderoga, Oquaga Creek State Park, Robert Riddell State Park, Rounds Mountain hilltop in Rensselaer County, Rush Oak Openings Unique Area, Sargent Ponds Wild Forest, Shandaken Wild Forest, Steege

Hill near Elmira, Taconic State Park, Toothaker Creek State Forest, and Vanderbilt Mansion NPA and Montgomery Place in Dutchess County.

In 2019, we conducted surveys for rare bumble bees, bee flies, and syrphids on the hilltops of Rounds Mountain and Harvey Mountain in the Taconic Highlands and dunes at State Parks and WMAs in Oswego and Jefferson County. One notable find was the confirmation of the Ghost bee fly at Deer Creek WMA (*Bombylius incanus*) on June 27, initially found in 2018 at nearby Sandy Pond State Park. In addition, we surveyed at Battenkill State Forest, Bennington Battlefield State Park, Black River Wild Forest, FDR State Park, Louise Keir WMA, Normanskill Preserve, Rome Sand Plains, Schodack Island State Park, Silver Lake bog (Clinton Co.), Thacher State Park, Taconic Ridge State Forest, Taconic State Park, and Walloomsac River.

In 2020, we queried our NYNHP field forms database to find locations of known host plant species for rare specialist bees in the *Macropis* and *Melitta* genera to inform targeted species surveys. Targeted species surveys were conducted at Battenkill State Forest, Black Creek Marsh WMA, Capital District WMA, Gee Brook State Forest, Grafton Lakes State Park, Highland Lakes State Park, Independence River Wild Forest, Moreau Lake State Park, Mount Pleasant State Forest, Saratoga Sandplains WMA, Thacher State Park, and Westcott Beach State Park. Our target habitat peatland survey at Sundown Wild Forest was well timed for *Macropis* in July in appropriate habitat and we documented *Macropis patellata* there.

iNaturalist and Compiled database

Our traditional (joined) iNaturalist project ended up with 357 members, who contributed 31,705 observations of 2,008 species. Some of these species were not focal (e.g., butterflies, honey bees), and many observations of focal species were not submitted to the project, so the collection project (essentially a set of filters on the entire iNaturalist dataset) was the source of our iNaturalist data for analysis. Our collection project had 58,399 observations of 427 species by 6,936 observers. There were 917 records of focal beetles, 4,892 records of focal moths, 11,198 records of syrphid and *Bombylius* flies, and 25,390 records of bees. (Note the syrphid and bee tallies include nonfocal species.)

Our compiled database contained 171,200 records of 849 species. Note that these totals include some non-focal taxa.

Conservation Status Ranking

We were able to assign conservation status ranks (S-ranks) to 457 species: 81 beetles, 117 flies, 191 bees, and 68 moths (Table 7). In typical assessments, species ranked S1, S2, S3, and SH are grouped together as being “at risk.” To be cautious, here we include only S1 and S2 as “at risk” and treat historical species separately.

Despite this conservative approach, less than half (48%) of these species, excluding nonnatives and vagrants, were ranked as S3 or more secure. Over 23% of species were ranked as at risk, plus over 15% of species ranked as historical – not observed in New York since the year 2000. Just 14% of species were ranked as SU or spanned the boundary between at risk and not at risk (S2S3, S2S4). Flies were the group with the greatest proportion of species at risk (26%), followed by bees (25%, excluding nonnatives), beetles (19%), and moths (15%, excluding vagrants).

A more typical framework for determining the number of species at risk includes S1-S3 plus SH species. Using this approach, 261 species (60%, again excluding nonnatives and vagrants) may be at risk in New York.

Table 7. Conservation status of select pollinating insects of New York State. "At risk" = S1, S2; "Historical" = SH; "Not at risk" = S3, S4, S5; "Unk" = SU, S2S3, S2S4; "NA" = nonnative or vagrant species.

Taxon	At risk	Historical	Not at risk	Unk	NA*	Total
Coleoptera	**15**	**22**	**34**	**10**	**0**	**81**
Long-horned beetles (Cerambycidae: Lepturinae)	14	19	32	10	0	75
Hairy flower scarabs (Scarabaeidae: *Trichiotinus*)	1	3	2	0	0	6
Diptera	**31**	**22**	**46**	**18**	**0**	**117**
Bee flies (Bombyliidae: *Bombylius*)	2	1	2	5	0	10
Flower flies (Syrphidae)	29	21	44	13	0	107
Hymenoptera	**46**	**20**	**91**	**26**	**8**	**191**
Mining bees (Andrenidae)	19	9	48	17	1	94
Apid bees (Apidae: *Bombus*, *Epeoloides*, *Melissodes*)	8	8	19	3		38
Leafcutter bees (Megachilidae: *Megachile*, *Osmia*)	15	2	24	6	7	54
Oil bees (Melittidae: *Macropis*, *Melitta*)	4	1	0	0	0	5
Lepidoptera	**8**	**2**	**39**	**6**	**13**	**68**
Flower moths (Noctuidae: *Schinia*)	1	1	8	4	0	14
Sphinx moths (Sphingidae)	7	1	31	2	13	54
Grand Total	**100**	**66**	**210**	**60**	**21**	**457**

*Excluded from totals for calculating % of species at risk.

Potentially Lost Species

Species ranked as SH deserve a deeper dive. Some of these are species that have been reported a single time in NY and may never have had an established population here. They could even be misidentifications. Others may be species that are so hard to detect that even a multi-year survey of hundreds of locations, plus community science, couldn't detect them despite their being present. Yet others represent real extirpations from the state. The estimated number of database records gives an indication of the likelihood of each of these scenarios. This number is an estimate because some records may represent the same occurrences or multiple specimens from a single location.

Of the 66 species ranked SH, 17 were represented by a single database record, 20 were represented by 2-4 database records, 20 were represented by 5-24 database records, and 9 were represented by 25 or more records. Here we list the 29 species with 5 or more records as most likely extirpations from New York (Table 8). There may be others with few prior records in New York that are truly extirpated.

Table 8. SH-ranked species (have not been observed recently in New York) with the estimated number of database records prior to 2000.

Scientific name	**Common name**	**Number of records**
Coleoptera		
Acmaeops proteus	Shapeless Flower Longhorn Beetle	31
Brachyleptura circumdata	Dark-shouldered Long-horned Beetle	31
Brachysomida bivittata	Double-lined Long-horned Beetle	41
Gnathacmaeops pratensis	Meadow Flower Longhorn Beetle	7
Grammoptera exigua	Confined Long-horned Beetle	26
Lepturobosca chrysocoma	Golden-haired Flower Longhorn Beetle	17
Neoalosterna capitata	Helmet Long-horned Beetle	37
Pidonia aurata	a longhorned beetle	10
Pseudostrangalia cruentata	Cruel Long-horned Beetle	6
Pygoleptura nigrella	Rusty Flower Longhorn Beetle	11
Sachalinobia rugipennis	Rough-winged Long-horned Beetle	5
Stenocorus cylindricollis	a longhorned beetle	9
Stenocorus trivittatus	Three-striped Long-horned Beetle	14
Strangalia bicolor	Bicoloured Long-horned Beetle	5
Trichiotinus bibens	a scarab beetle	10
Trichiotinus viridans	Greenish Flower Chafer	7
Diptera		
Temnostoma bombylans	a hoverfly	7
Teuchocnemis bacuntius	a hoverfly	9
Xylota ejuncida	Polished Leafwalker	53
Xylota ouelleti	Black-haired Leafwalker	14
Hymenoptera		
Andrena ceanothifloris	Ceanothus Flower Miner Bee	5
Andrena illinoiensis	Tufted Miner Bee	10
Andrena rehni	Rehn's Miner Bee	14
Andrena ziziaeformis	an andrenid bee	14

Scientific name	Common name	Number of records
Bombus affinis	Rusty-patched Bumble Bee	874
Bombus ashtoni (= bohemicus)	Ashton's Cuckoo Bumble Bee	498
Bombus insularis	Indiscriminate Cuckoo Bumble Bee	7
Epeoloides pilosula	Macropis Cuckoo Bee	12
Melitta americana	Cranberry Oil Bee	7
Lepidoptera		
Schinia septentrionalis	Northern Flower Moth	26

A list of all conservation status ranks for focal taxa, along with all factors used in S-rank calculations can be found in Appendix F. NYNHP maintains two lists of rare animals: an "active inventory" list, which typically includes S1, S2, and SH species and includes species for which we survey and keep detailed database records, and a "watch" list, which typically includes S3 species to keep an eye on. Some of the species we've recently ranked are already on one of these lists (e.g., *Bombus*), but we are likely adding many more based on the results of this study.

Comparison of Data Sources

We wished to compare using specimen data only, photographic data only, and the two sources combined plus partner data to yield an understanding of the values (and shortcomings) of taking one survey approach over another. We calculated three rank factors—Range Extent, Area of Occupancy, and number of occurrences—using all data sources combined, ESNPS data only, and iNaturalist data only for the 314 focal beetles, flies, and bees for which these values were calculated for the full study. We didn't include moths because they were not the focus of collection efforts during the ESNPS. We used the same criteria to calculate rank factors as with the S-ranking effort. Below we summarize the number of species assigned each rank factor value using the two data sources individually and all data sources.

Unsurprisingly, estimates of Range Extent and the accompanying rank factor values varied tremendously depending on the data used (Table 9). Fewer species had large Range Extent values with iNaturalist data only, and more species had small values with ESNPS specimen data only. Importantly, the number of species for which Range Extent could not be calculated at all, resulting from a lack of records, was far higher using iNaturalist data only.

Table 9. Number of species with each Range Extent rank factor value calculated using all data sources, ESNPS specimen data only, and iNaturalist data only. Range Extent values from A to G represent increasing estimates of Range Extent. Definitions of factor values are in Table 4. N/A indicates that Range Extent could not be calculated.

Range Extent Rank	ESNPS only	iNat only	All sources
A	87	57	64
AB	1	0	1
B	1	2	2
C	2	4	4
CD	1	1	2
D	2	7	12
DE	1	0	1
E	29	10	22
EF	3	0	5
F	144	80	196
FG	1	2	4
G	0	1	1
N/A	42	150	0

Of course, Area of Occupancy values were higher with multiple data sources (Table 10), but the number of species in different AOO categories was not drastically different when just ESNPS or just iNaturalist data were used. Of greatest interest, again, is the number of species for which AOO could not be calculated using just iNaturalist data.

Table 10. Number of species with each Area of Occupancy rank factor value calculated using all data sources, ESNPS specimen data only, and iNaturalist data only. Area of Occupancy values from A to H represent increasing estimates of AOO. Definitions of factor values are in Table 4. N/A indicates that AOO could not be calculated.

AOO Rank	ESNPS only	iNat only	All sources
A	45	36	34
B	40	21	31
C	56	23	53
D	88	46	100
DE	7	4	6
E	33	25	67
EF	0	2	4
F	3	5	16
FG	0	1	0
G	0	1	2
GH	0	0	1
N/A	42	150	0

Likewise, combining data sources yields higher numbers of occurrences (Table 11). Using either ESNPS or iNaturalist data alone would suggest that species are far less common than they actually are.

Table 11. Number of species with each Number of Occurrences (EOs) rank factor value calculated using all data sources, ESNPS specimen data only, and iNaturalist data only. Number of Occurrences values from A to D represent increasing estimates of Number of Occurrences. Definitions of factor values are in Table 4. N/A indicates that Number of Occurrences could not be calculated.

EO Rank	ESNPS only	iNat only	All sources
A	118	74	107
AB	26	7	16
B	77	45	90
BC	8	5	8
C	39	25	64
CD	2	1	5
D	2	7	24
N/A	42	150	0

These summaries mask, to some degree, the huge differences seen in some individual species. For example, Range Extent for the beetle *Xestoleptura octonotata* would have been A if just using specimen data, D if just iNaturalist data, and E using all sources. For the fly *Sphegina lobulifera*, Range Extent would have been D using just specimen data, A using just iNaturalist data, and EF using all sources (Figure 9).

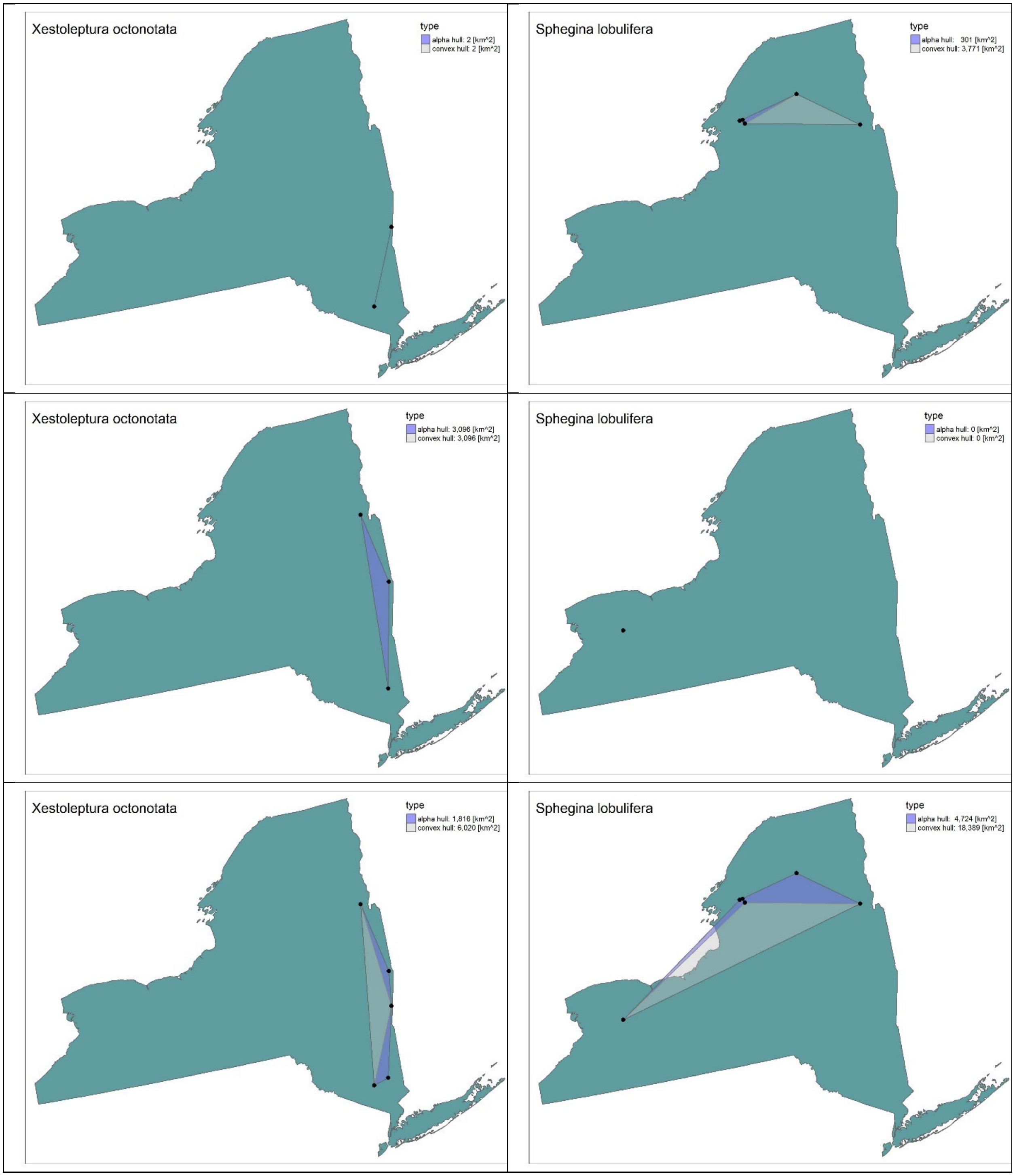

Figure 9. Range Extent comparisons (both minimum convex polygon and alpha hull methods are shown) for a beetle, *Xestoleptura octonotata* (left) and a fly, *Sphegina lobulifera* (right) using just specimen data (top), just iNaturalist data (middle) and all sources (bottom).

Discussion

Inventory Needs

We believe we have reached our goal of assessing the status of a wide array of native insect pollinators in nonagricultural habitats and now have a better understanding of which focal taxa are of conservation concern. We met our goals for extensive, target habitat, and target species surveys (see Surveys Visited and Surveys Conducted above). In addition, our community scientist participation allowed us to document far more focal species records for the state than we would have otherwise (see Figure 8). Our sampling was also designed to ensure that we sampled in all types of natural habitats known to harbor focal taxa, stratifying by ecoregion and sampling in three broad types of meadow, wetland, and forest, supplementing with additional target habitat and species surveys. That said, with New York's vast area to cover with limited time and funding, we have recommendations below for additional inventory which could further improve the understanding of NY's native pollinators:

- Most focal moth observations came from our volunteer participants through iNaturalist as our survey protocols were diurnal. We recommend timed nocturnal surveys with blacklights to detect focal moth and beetle species that are much less likely to be encountered diurnally.
- Additional sampling during shoulder seasons (early spring and late fall) in a variety of habitats including grasslands, wetlands with willows, and late-successional deciduous forests to document species with corresponding phenology and short windows for detection.
- Additional targeted efforts for bees of the family Melittidae. No *Melitta* were documented in our survey work, despite targeted searching. Further survey effort should be devoted to sites with known *Vaccinium* host plants timed with early season blooms. In addition, while no *Melitta mellitoides* NY records are currently known, searches in habitat with *Lyonia* (such as *L. ligustrina*) is recommended. Few records for *Macropis* were obtained during our effort and additional targeted efforts in wetlands with known locations of native *Lysimachia* species in July may be productive for these rare bees. Predictive distribution models developed by Buckner and Danforth (2022) should be consulted for *Macropis nuda* and other *Macropis* species surveys.
- Surveys for additional native bee taxa including *Pseudopanurgus* mining bees, *Anthophora* and *Habropoda* digger bees, *Philothrix*, *Colletes* cellophane bees, halictid sweat bees, other genera in Megachilidae, and other cuckoo bee genera in Apidae should be conducted. Surveys for additional pollinating fly taxa including *Empis*, *Rhamphomyia*, *Anthalia* dance flies in alpine habitats are recommended.
- Identification of less common non-focal syrphid flies captured during the ESNPS and additional malaise trapping could prove fruitful for documenting further records for syrphid flies and mining bees. Malaise trapping was limited to sites in Table 6.

- Additional analysis of the data to determine the completeness of pollinator sampling for the state. In other words, what proportion of New York's species have been detected? Species accumulation curves can be generated to estimate the number of species that occur in the state, and how far along the curve our surveys have brought us.
- Sampling on private lands with permission of the owners is recommended as our survey effort focused primarily on protected public lands.
- Comparisons of data sources confirmed that the strongest datasets for assessing conservation status include specimen collection and community science. The two types of data have complementary benefits—while some species cannot be identified from photographs, community scientists can cover more ground than paid technicians. Combining these approaches in future inventories is recommended.

Management, Conservation, Monitoring

ESNPS results combined with that of our partners (see 3), provide an excellent baseline on the distribution and status of native pollinators in New York to help inform conservation efforts. Although our survey was not designed as a long-term monitoring effort, our use of a rigorous sampling design and standardized field protocols are repeatable and valuable for assessing changes in native pollinator distributions. Monitoring our native pollinators using standard protocols may be the only way to know whether we are maintaining New York's important pollinators in the face of continuing global change.

We found that between 38% and 60% of New York's native pollinators (of our focal taxa only) are potentially imperiled or critically imperiled. At the same time, we were unable to confirm 42 focal bee species during ESNPS that were previously known in the state. However, there are records for 17 of those species in our Compiled partner database, so 25 focal bee species have historical records for the state (i.e. have no extant post-1999 records). It is quite likely that some of these rare and/or elusive species were missed by our sampling protocol, or that some were never represented by established breeding populations.

Our focal taxa have a wide variety of life histories and habitat requirements, depending on the group. Many of NY's native bees are ground-nesting, some are cavity dwellers, and most are solitary (with the exception of bumble bees and some halictid bees, which are social, Danforth et al. 2019). Many bees are generalists, such as bumble bees, feeding on a variety of plants, while other bees are specialists, such as oil bees which require oil-producing native loosestrife plants to construct their nests in wetland habitats (Wilson and Carril 2015). Saproxylic beetles and flies are dependent on dead wood for at least a portion of their life cycle and therefore inhabit older forests.

As aforementioned, many focal species included in this study appear to be rare or declining and may warrant listing as Endangered or Threatened in the future by the U.S. or the state of New York. Therefore, habitat preservation and restoration efforts should weigh requirements of the rare species present (or potentially present) in a habitat to ensure that management practices and actions will not adversely affect the most vulnerable species and their habitats.

In place of species-specific management strategies, we offer the following summary of management actions that have been shown to benefit the pollinator guild more generally. A full treatment of these actions is beyond the scope of this project and our expertise, but we can offer suggestions to address significant threats known to focal taxa. Habitat preservation is typically cited as a key management action, but the quality and character of available habitat matters considerably. We recommend online resources such as those available from the Xerces Society for Invertebrate Conservation if management strategies for pollinators are being considered (https://www.xerces.org/pollinator-conservation). When caring for specialist bees on properties, we recommend referring to Jarrod Fowler and Sam Droege's Pollen specialist bees of the Eastern U.S. (https://jarrodfowler.com/specialist_bees.html) and guidance from Maria van Dyke et al. on native specialist bees (https://issuu.com/cornellbotanicgardens/docs/creating_a_pollinator_garden_for_specialist_bees_f).

- **Reduce the use of pesticides and herbicides.** Pesticides and other chemical poisons have known negative effects on nontarget species like native pollinators. A recent report on the costs and benefits of pesticides containing neonicotinoids in New York State (Grout et al. 2020) constitutes the most complete review of studies to date. While neonicotinoids do not always appear to affect bees, the precautionary principle suggests that their use should be avoided when possible for the conservation of native species.
- **Control invasive species.** Although some invasive plants provide nectar sources for pollinators, our native pollinators have co-evolved with native plants over thousands of years and many will not forage on invasives. Invasive plants can also outcompete native plants and create a monoculture. These monocultures provide a short-lived pulse of floral resources whereas many pollinators require nectar sources throughout the spring, summer, and into the fall. Most of the species using invasives are habitat generalists and tend to be more widespread.
- **Reimagine mowing and burning regimes**. Roadside mowing can be curtailed to a great degree and timed for seasons with lower pollinator activity (e.g., late fall). Additionally, staggering mowing to maintain floral resources year-round will benefit pollinators. Raising the mower bed or otherwise allowing vegetation to remain higher will protect nesting habitat for ground-nesters. If using fire to maintain open habitat, it is generally beneficial to leave some areas unburned during prescribed burns, to provide refugia for species. This is especially important for early life stages of moths and ground-nesting bees.
- **Convert lawns and other biological deserts into pollinator habitat**. This is one strategy, along with provision of nest sites, that could be pursued in developed areas or natural habitats surrounded by development.
- **Discourage high densities of honey bee hives.** A growing body of research is showing that European honey bees (*Apis mellifera*) may outcompete, and transmit disease or parasites to, native bees. With backyard hives this issue is localized, but when hives are in high densities and forage in natural habitats, the native bee fauna may be depauperate. We observed many honey bees foraging in natural habitats during the Survey, suggesting the potential for impacts on wild bees.
- **Retain coarse woody material – snags and logs – in forested ecosystems.** Many pollinating flies and beetles are saproxylic, meaning they rely on dead wood, particularly

in the larval stage. Further, some bees are cavity nesters, and need the softer tissue of dead wood to bore into (both standing old trees and coarse woody debris on the ground). Saproxylic insects are of conservation concern in parts of Europe where forests are highly managed and dead wood is lacking. This material will benefit some rare natives such as leafcutter bees as well. Many remaining late-successional (old-growth) forests outside the Adirondacks and Catskills exist in small patches; maintaining large forest blocks, increasing the size and number of patches of late-successional forests within these forest blocks, and improving connections among these patches will benefit dependent species.

- **Maintain spring ephemeral understory and improve habitat nearby.** In deciduous forest habitats with native pollinators, maintain a native spring ephemeral plant understory to provide early season resources to these forest dwellers. In addition, maintaining and improving native floral resource availability in adjacent habitats throughout the season (spring-late summer) will benefit these pollinators. Overbrowsing by deer in some parts of New York has degraded the forest understory, which now consists only of invasive herbaceous plants and shrubs, which have limited value for pollinators.
- **Maintain hydrology and natural vegetation regimes of wetlands.** For pollinators requiring wetland habitat, maintain the natural hydrological regime of the wetland to favor natural structure and native floral resources. A large, forested buffer should be maintained surrounding the wetland and invasive plants should be controlled (see Control Invasive Species).
- **Minimize lighting to maintain dark skies.** Many native moths are attracted to artificial lights, which change normal travel and foraging behaviors. Minimize lighting to maintain dark sky conditions. In areas where artificial lighting is necessary, use sodium lights or other low ultraviolet lamps or consider motion sensor lights if appropriate.

Climate change is one threat facing native pollinators that may not necessarily be curtailed by management at currently occupied sites but should be recognized as a factor in native pollinator species persistence. Our Advisory Committee recognized climate change as a threat facing all of our focal groups. Kammerer et al. (2021) found lower abundance of native *Andrena* and *Osmia* with warmer winter temperatures, lower abundance of some wild bees with increasing precipitation, and solitary bees as more sensitive to drought conditions. As suggested by Buckner and Danforth (2022), regional pollinator conservation should consider habitat protection between current ranges and predicted future ranges of modeled climate scenarios.

Pathogens are another threat facing many native pollinators, such as *Nosema* which spread from commercial bee facilities into wild bumble bee populations in the 1990s and caused rapid decline of subgenera *Bombus* and *Thoracobombus*. Some species appear to be recovering since, as evidenced by *B. terricola* and *B. fervidus* recorded during our Survey, but other pathogens continue to threaten native pollinators.

Acknowledgements

We wish to thank the New York State Department of Environmental Conservation's Division of Fish and Wildlife for contracting with NY Natural Heritage to coordinate and manage this project. Funding for this project was through New York State's Environmental Protection Fund. We also thank our Advisory Committee members for their guidance on focal taxa priorities, survey methodology, taxonomic and sampling frame expertise, and ranking review: Dr. Bryan Danforth (Cornell University), Sam Droege (USGS), Dr. Melissa Fierke (SUNY ESF), Dr. Carmen Greenwood (SUNY Cobleskill), Rich Hatfield and Katie Hietala-Henschell (Xerces Society), Dr. Tim Howard (NY Natural Heritage Program), Dr. Jonathan Mawdsley (Fish & Wildlife Agencies), Dr. Tim McCabe (NYS Museum), Kent McFarland (VT Center for Ecostudies), Robyn Niver (US Fish and Wildlife Service), Kathy O'Brien (NYS DEC), Dr. Jerry Rozen (AMNH, retired), Maria Van Dyke (Cornell University).

Special thanks to Bryan Danforth, Maria Van Dyke and others from the Danforth Lab of Cornell University for bee identification and curation and Carmen Greenwood and the Greenwood Lab of SUNY Cobleskill for fly identification. Thanks to John Klymko of the Atlantic Canada Conservation Data Centre for verifying fly identifications. Thanks to Rachel Fordyce who performed DNA barcoding on challenging bee specimens to obtain species level identifications.

NYNHP staff and former staff deserve thanks for their work on this project. Thanks to Abbey Jago, Lorenzo Natalie, Kaylee Fierke, Joe Giulian, Chris Wilson, Julia Rushton, and Shianne Lindsay for conducting extensive surveys statewide and processing specimens; and special remembrance to field technician Beth Newkirk who passed away in a house fire the summer of 2019. SUNY Cobleskill technicians Liam Somers, Zach Jacobson, Jayson Maxwell, Gloria Keal, Allie Eastman, and John Pipino deserve thanks for their hard work surveying syrphids statewide and identifying them to species.

We highlight the contributions of former staff member Jeff Corser who spear-headed syrphid work from 2017-spring of 2020. Jeff researched pollinating flies to focus our efforts, settling on *Bombylius* and saproxylic hover flies, worked with Carmen Greenwood to determine appropriate habitats to do malaise trapping for syrphids each of the survey years, and contributed many hours to pollinator surveys, fly identification of specimens and photos, and mentoring fly technicians.

Thanks to Ashley Ballou, Katie Hietala-Henschell, Amy Conley, Laura Shappell, Lydia Sweeney, Andrea Chaloux, for all of their help with field surveys, data entry, specimen labeling, and transcription of rare records into the element occurrence database. Thanks to Katie Hietala-Henschell and Laura Shappell for assistance with bumble bee and bee fly identification. Thanks to Matt Buff for his development and administration of the ESNPS database and project website maintenance. Thanks to DJ Evans and Fiona McKinney for their administrative support of this project and thanks to other NYNHP staff for their assistance with field surveys and observations.

Thanks to Jeremy Kirchman, Tim McCabe, John Hart, and Bob Ferenac for the use of lab space at the NYS Museum to house and process project specimens. Thanks to Tim McCabe of the NYS Museum and Jason Dombroskie and Bryan Danforth of Cornell University Insect Collection for accepting ESNPS specimens into their collections. Thanks to volunteers Shawn

Leatherman for field surveys and Alison Van Keuren and Caitlin Markus for their assistance with data entry and specimen pinning and labeling.

We thank the many curators and managers of insect collections and their colleagues and assistants for their hospitality during our museum visits. American Museum of Natural History: Lee Herman, David Grimaldi, Jerry Rozen, Corey Smith, Christine Lebeau, Courtney Richenbacher, Sarfraz Lodhi, Suzanne Greene; Cornell University Insect Collection: Jason Dombroskie, Loren Jones, Emily Jernigan, Bryan Danforth; Staten Island Museum: Colleen Evans, Audrey Malachowsky; SUNY ESF collection: Stephen Teale, Melissa Fierke and Chris Wilson; Carnegie-Mellon University; Buffalo Museum of Science; Yale Peabody Museum.

We would like to thank the following partner organizations and their staff who contributed to our survey effort and documented specimen records: Adirondack Summit Stewards, Central Pine Barrens Commission, Croton-Harmon High School, Department of Environmental Protection, Mianus River Gorge, Office of Parks, Recreation, and Historic Preservation, Roberts Wesleyan College, and Siena College. We also thank the following individuals for contributing specimen records and survey effort to the project: Barbara Hager, Linda "Stick" LaPan, Alan and Della Wells, Alison Van Keuren, Janet Mihuc, Sue Fuestel, Troy Tetreault, and Carlin Wakefield. We offer a huge thanks to our colleagues and friends in NY State Parks for their support of additional surveys, specimen processing, labeling and curation, related to records that benefitted both projects; and we specifically want to thank Julie Lundgren who plans and coordinates our work with State Parks.

Thanks to Jason Wagner, Ray Rainbolt, and Fred Ossman from Fort Drum's Natural Resources Branch for supporting survey work at Fort Drum Military Installation. We thank Jason Hamidi, Chris Wilson, Jack Memmer, McKenzie Wybron, Eva Hanan, Molly Jacobson, and Chapin Czarnecki for their survey work on Fort Drum's pollinators in 2019 and 2021. While most work on the military installation was completed with Department of Defense funding, there were extensive surveys completed in 2018 and 2020 with the support of ESNPS funding.

We would like to thank the following partners for contributing data to this study (included in our Compiled database): Amanda Dillon of the Albany Pine Bush; Dylan Cipkowski and Conrad Vispo of Hawthorne Valley Farmscape Ecology Program; Janet Mihuc of Paul Smiths College; Sarah Kornbluth of AMNH; Bryan Danforth, Maria Van Dyke, Mark Buckner and Kass Urban-Mead of Cornell University; Molly Jacobson and Melissa Fierke of SUNY ESF; Tim McCabe of New York State Museum; Leif Richardson and Rich Hatfield of Xerces Society; Paula Sharp and Ross Eatman of Sharp-Eatman Nature Photography; the Huyck Preserve; Bruce Young and Margaret Ormes from NatureServe; and online data sources including Butterflies and Moths of North America, BugGuide, GBIF, iNaturalist and Facebook.

We would like to thank the following establishments for the use of their facilities for training workshops: Beaver Meadow Audubon Center, Brookhaven National Laboratory, Connetquot River State Park Preserve, Dana Discovery Center, Five Rivers Environmental Education Center, Huyck Preserve, Montezuma Audubon Center, New York Botanical Garden, New York City Parks Department, Roger Tory Peterson Institute of Natural History, and The Wild Center.

We extend special recognition and thanks to iNaturalist identifiers who verified photographs on our iNaturalist project page (https://www.inaturalist.org/projects/empire-state-native-pollinator-survey), including, but not limited to, John Ascher, Brian Dagley, Rusty Burlew, Trina Roberts, Laura Shappell, Hugh McGuinness, Wayne Fidler, Even Dankowicz, Sandy Wolkenberg, Joel Neylon, Ben Cacace, John Klymko, Jason Dombroskie, Zachary Dankowicz, Casey Hale, Heather Holm, Caleb Scholtens, Matthias Buck, Arturo Santos, Susanna Heideman, Roberto Calderon, Rob Westerduijn, Nick Block, Doug Bruce, and “hadel”.

Most importantly, we extend great gratitude to our ESNPS registered participants (Appendix G) and ESNPS iNaturalist contributors for completing native pollinator surveys throughout New York. We truly could not have done this study without all of their hard work. Thanks to others who may have gone on a survey and contributed data, but not officially registered, and please forgive us if we have overlooked anyone.

Literature Cited

Allen-Wardell, G., P. Bernhardt, R. Bitner, A. Burquez, S. Buchmann, J. Cane, P. A. Cox, V. Dalton, P. Feinsinger, M. Ingram, D. Inouye, C. E. Jones, K. Kennedy, P. Kevan, H. Koopowitz, R. Medellin, S. Medellin-Morales, G. P. Nabhan, B. Pavlik, V. Tepedino, P. Torchio, and S. Walker. 1998. The potential consequences of pollinator declines on the conservation of biodiversity and stability of food crop yields. Conservation Biology 12:8–17.

Ascher, J. S., S. Kornbluth, and R. G. Goelet. 2014. Bees (Hymenoptera: Apoidea: Anthophila) of Gardiners Island, Suffolk County, New York. Northeastern Naturalist 21:47–71. Eagle Hill Institute.

Bailey, R. G. 1998. Ecoregions: The ecosystem geography of the oceans and continents. Springer-Verlag, New York.

Bried, J. T., and A. M. Dillon. 2012. Bee diversity in scrub oak patches 2 years after mow and herbicide treatment. Insect Conservation and Diversity 5:237–243.

Brower, L. P., O. R. Taylor, E. H. Williams, D. A. Slayback, R. R. Zubieta, and M. I. Ramírez. 2012. Decline of monarch butterflies overwintering in Mexico: is the migratory phenomenon at risk? Insect Conservation and Diversity 5:95–100.

Buchmann, S. L., and G. P. Nabhan. 1996. The forgotten pollinators. Island Press, Washington D.C.

Buckner, M. A. and Danforth, B. N. 2022. Climate-driven range shifts of a rare specialist bee, Macropis nuda (Melittidae), and its host plant, Lysimachia ciliata (Primulaceae). Global Ecology and Conservation e02180.

Cameron, S. A., J. D. Lozier, J. P. Strange, J. B. Koch, N. Cordes, L. F. Solter, and T. L. Griswold. 2011. Patterns of widespread decline in North American bumble bees. Proceedings of the National Academy of Sciences 108:662–667.

Cane, J. H., G. C. Eickwort, F. R. Wesley, and J. Spielholz. 1985. Pollination ecology of *Vaccinium stamineum* (Ericaceae: Vaccinioideae). American Journal of Botany 72:135–142.

Cariveau, D. P., N. M. Williams, F. E. Benjamin, and R. Winfree. 2013. Response diversity to land use occurs but does not consistently stabilise ecosystem services provided by native pollinators. Ecology Letters 16:903–911.

Colla, S. R., and J. S. MacIvor. 2017. Questioning public perception, conservation policy, and recovery actions for honeybees in North America. Conservation Biology 31:1202–1204.

Colla, S. R., and L. Packer. 2008. Evidence for decline in eastern North American bumblebees (Hymenoptera: Apidae), with special focus on Bombus affinis Cresson. Biodiversity and Conservation 17:1379–1391.

Danforth, B. N., R. L. Minkley, and J. L. Neff. 2019. The Solitary Bees: Biology, Evolution, Conservation. Princeton University Press.

Davis, M. B. 2003. Old growth in the East: A survey. Revised edition. Appalachia-Science in the Public Interest, Georgetown, KY.

Droege, S. 2015. The very handy manual: How to catch and identify bees and manage a collection. United States Geological Survey.

Edinger, G. J., D. J. Evans, S. Gebauer, T. G. Howard, D. M. Hunt, and A. M. Olivero. 2014. Ecological communities of New York State, second edition. New York Natural Heritage Program, Albany, New York. 136 pages.

Faber-Langendoen, D., J. Nichols, L. Master, K. Snow, A. Tomaino, R. Bittman, G. Hammerson, B. Heidel, L. Ramsay, A. Teucher, and B. Young. 2012. NatureServe conservation status assessments: methodology for assigning ranks. NatureServe, Arlington, Virginia. 44 pages.

Ferree, C. E., and M. G. Anderson. 2013. A map of terrestrial habitats of the northeastern United States: Methods and approach. The Nature Conservancy, Eastern Conservation Science, Eastern Regional Office, Boston, MA.

Fetridge, E. D., J. S. Ascher, and G. A. Langellotto. 2008. The bee fauna of residential gardens in a suburb of New York City (Hymenoptera: Apoidea). Annals of the Entomological Society of America 101:1067–1077.

Ford, A. T., A. H. Ali, S. R. Colla, S. J. Cooke, C. T. Lamb, J. Pittman, D. S. Shiffman, and N. J. Singh. 2021. Understanding and avoiding misplaced efforts in conservation. FACETS 6:252–271. Canadian Science Publishing.

Fry, J. A., G. Xian, S. Jin, J. A. Dewitz, C. G. Homer, L. Yang, C. A. Barnes, N. D. Herold, and J. D. Wickham. 2011. Completion of the 2006 National Land Cover Database for the conterminous United States. Photogrammetric Engineering and Remote Sensing 77:858–864.

Geldmann, J., and J. P. González-Varo. 2018. Conserving honey bees does not help wildlife. Science 359:392–393.

Gezon, Z. J., E. S. Wyman, J. S. Ascher, D. W. Inouye, and R. E. Irwin. 2015. The effect of repeated, lethal sampling on wild bee abundance and diversity. Methods in Ecology and Evolution 6:1044–1054.

Graystock, P., W. H. Ng, K. Parks, A. D. Tripodi, P. A. Muñiz, A. A. Fersch, C. R. Myers, Q. S. McFrederick, and S. H. McArt. 2020. Dominant bee species and floral abundance drive parasite temporal dynamics in plant-pollinator communities. Nature Ecology & Evolution 4:1358–1367. Nature Publishing Group.

Grout, T. A. K., J. K. Kapuvari, and S. H. McArt. 2020. Neonicotinoid Insecticides in New York State. Economic benefits and risk to pollinators. Cornell University, Ithaca, NY.

Howard, T. G., M. D. Schlesinger, and G. J. Edinger. 2015. Extent and condition of habitats for New York's Species of Greatest Conservation Need. New York Natural Heritage Program, State University of New York College of Environmental Science and Forestry, Albany, NY.

Iwasaki, J. M., and K. Hogendoorn. 2021. How protection of honey bees can help and hinder bee conservation. Current Opinion in Insect Science 46:112–118.

Kammerer, M., Goslee, S.C., Douglas, M.R., Tooker, J.F., and Grozinger, C.M. 2021. Wild bees as winners and losers: Relative impacts of landscape composition, quality, and climate. Global Change Biology 27:1250–1265.

Kearns, C. A., D. W. Inouye, and N. M. Waser. 1998. Endangered mutualisms: the conservation of plant-pollinator interactions. Annual Review of Ecology and Systematics 29:83–112.

Kershner, B., and R. T. Leverett. 2004. Sierra Club guide to the ancient forests of the Northeast. Sierra Club Books.

Klymko, J. 2015. Atlantic Coastal Plain pollinator surveys. Atlantic Canada Conservation Data Centre, Sackville, New Brunswick, Canada.

Klymko, J., and S. Robinson. 2012. Improving baseline knowledge of selected New Brunswick insects: dragonflies of the Restigouche River and bees and flower flies of southwestern New Brunswick. Report to New Brunswick Wildlife Trust Fund # B001-035. Atlantic Canada Conservation Data Centre, Sackville, New Brunswick, Canada.

Kudish, M. 2000. The Catskill forest: a history. Purple Mountain Press, Fleischmanns, NY.

Leonard, M. D. 1928. A list of the insects of New York. Cornell University, Ithaca, New York.

Lingafelter, S. W. 2007. Illustrated Key to the Longhorned Woodboring Beetles of the Eastern United States. Coleopterists Society.

MacKenzie, K. E., and G. C. Eickwort. 1996. Diversity and abundance of bees (Hymenoptera: Apoidea) foraging on highbush blueberry (*Vaccinium corymbosum* L) in central New York. Journal of the Kansas Entomological Society 69, Iss 4, Suppl:185–194.

Master, L. L., D. Faber-Langendoen, R. Bittman, G. Hammerson, B. Heidel, L. Ramsay, K. Snow, A. Teucher, and A. Tomaino. 2012. NatureServe conservation status assessments: Factors for evaluating species and ecosystem risk. NatureServe, Arlington, VA.

Matteson, K. C., J. S. Ascher, and G. A. Langellotto. 2008. Bee richness and abundance in New York City urban gardens. Annals of the Entomological Society of America 101:140–150.

McGee, G. G., D. J. Leopold, and R. D. Nyland. 1999. Structural characteristics of old-growth, maturing, and partially cut northern hardwood forests. Ecological Applications 9:1316–1329.

McGowan, K. J., and K. Corwin. 2008. The second atlas of breeding birds in New York State. Cornell University Press, Cornell, NY.

McMartin, B. 1994. The great forest of the Adirondacks. North Country Books, Utica, NY.

National Research Council. 2007. Status of pollinators in North America. National Academies Press, Washington D.C.

NatureServe. 2020. NatureServe conservation status assessments: Rank calculator version 3.2. Arlington, VA.

New York Natural Heritage Program. 2017. Element occurrence database. Albany, NY.
New York Natural Heritage Program. 2022. Element occurrence database. Albany, NY.
NYS DEC. 2015. New York State wildlife action plan. New York State Department of Environmental Conservation, Albany, NY.
NYS DEC and AGM. 2016. New York State pollinator protection plan. NYS Departments of Environmental Conservation and Agriculture and Markets, Albany, NY.
Payette, A. 2013. First record of the bee Melitta americana (Smith) (Hymenoptera: Melittidae) for Quebec and Canada. Canadian Field - Naturalist 127:60–63.
Pohl, G. R. 2009. Why we kill bugs–the case for collecting insects. Ontario Lepidoptera 2008:7.
Pollinator Health Task Force. 2015a. Pollinator research action plan. The White House, Washington, D.C.
Pollinator Health Task Force. 2015b. National strategy to promote the health of honey bees and other pollinators. The White House, Washington, D.C.
R Core Team. 2021. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria.
Rocha, L. A., A. Aleixo, G. Allen, F. Almeda, C. C. Baldwin, M. V. L. Barclay, J. M. Bates, A. M. Bauer, F. Benzoni, C. M. Berns, M. L. Berumen, D. C. Blackburn, S. Blum, F. Bolaños, R. C. K. Bowie, R. Britz, R. M. Brown, C. D. Cadena, K. Carpenter, L. M. Ceríaco, P. Chakrabarty, G. Chaves, J. H. Choat, K. D. Clements, B. B. Collette, A. Collins, J. Coyne, J. Cracraft, T. Daniel, M. R. de Carvalho, K. de Queiroz, F. D. Dario, R. Drewes, J. P. Dumbacher, A. Engilis, M. V. Erdmann, W. Eschmeyer, C. R. Feldman, B. L. Fisher, J. Fjeldså, P. W. Fritsch, J. Fuchs, A. Getahun, A. Gill, M. Gomon, T. Gosliner, G. R. Graves, C. E. Griswold, R. Guralnick, K. Hartel, K. M. Helgen, H. Ho, D. T. Iskandar, T. Iwamoto, Z. Jaafar, H. F. James, D. Johnson, D. Kavanaugh, N. Knowlton, E. Lacey, H. K. Larson, P. Last, J. M. Leis, H. Lessios, J. Liebherr, M. Lowman, D. L. Mahler, V. Mamonekene, K. Matsuura, G. C. Mayer, H. Mays, J. McCosker, R. W. McDiarmid, J. McGuire, M. J. Miller, R. Mooi, R. D. Mooi, C. Moritz, P. Myers, M. W. Nachman, R. A. Nussbaum, D. Ó. Foighil, L. R. Parenti, J. F. Parham, E. Paul, G. Paulay, J. Pérez-Emán, A. Pérez-Matus, S. Poe, J. Pogonoski, D. L. Rabosky, J. E. Randall, J. D. Reimer, D. R. Robertson, M.-O. Rödel, M. T. Rodrigues, P. Roopnarine, L. Rüber, M. J. Ryan, F. Sheldon, G. Shinohara, A. Short, W. B. Simison, W. F. Smith-Vaniz, V. G. Springer, M. Stiassny, J. G. Tello, C. W. Thompson, T. Trnski, P. Tucker, T. Valqui, M. Vecchione, E. Verheyen, P. C. Wainwright, T. A. Wheeler, W. T. White, K. Will, J. T. Williams, G. Williams, E. O. Wilson, K. Winker, R. Winterbottom, and C. C. Witt. 2014. Specimen collection: An essential tool. Science 344:814–815.
Skevington, J. H., M. M. Locke, A. D. Young, K. Moran, W. J. Crins, and S. A. Marshall. 2019. Field Guide to the Flower Flies of Northeastern North America. Princeton University Press.
Stevens, D. L., and A. R. Olsen. 2003. Variance estimation for spatially balanced samples of environmental resources. Environmetrics 14:593–610.
Stevens, D. L., and A. R. Olsen. 2004. Spatially balanced sampling of natural resources. Journal of the American Statistical Association 99:262–278.

Telfer, M. G., C. Preston, and P. Rothery. 2002. A general method for measuring relative change in range size from biological atlas data. Biological Conservation 107:99–109.

Tumminello, G., T. A. Volk, S. H. McArt, and M. K. Fierke. 2018. Maximizing pollinator diversity in willow biomass plantings: A comparison between willow sexes and among pedigrees. Biomass and Bioenergy 117:124–130.

vanEngelsdorp, D., J. D. Evans, C. Saegerman, C. Mullin, E. Haubruge, B. K. Nguyen, M. Frazier, J. Frazier, D. Cox-Foster, Y. Chen, R. Underwood, D. R. Tarpy, and J. S. Pettis. 2009. Colony collapse disorder: A descriptive study. PLOS ONE 4:e6481.

Vogel, G. 2017. Where have all the insects gone? Science 356:576–579.

White, E., J. D. Corser, and M. D. Schlesinger. 2010. The New York dragonfly and damselfly survey: Distribution and status of the odonates of New York. New York Natural Heritage Program, Albany, NY.

White, E. L., P. D. Hunt, M. D. Schlesinger, J. D. Corser, and P. G. deMaynadier. 2015. Prioritizing Odonata for conservation action in the northeastern USA. Freshwater Science 34:1079–1093.

White, E. L., M. D. Schlesinger, and J. D. Corser. 2018. Empire State Native Pollinator Survey Participant Handbook. New York Natural Heritage Program, SUNY College of Environmental Science and Forestry, Albany, NY.

Williams, P. H., R. W. Thorp, L. L. Richardson, and S. R. Colla. 2014. Bumble bees of North America: An identification guide. Princeton University Press, Princeton, NJ.

Wilson, J. S., and O. J. M. Carril. 2015. The bees in your backyard: A guide to North America's bees. Princeton University Press, Princeton, NJ.

Yanega, D. 1996. Field Guide to Northeastern Longhorned Beetles (Coleoptera:Cerambycidae). Illinois Natural History Survey.

Appendix A. Species Accounts, Distributional Maps, Phenology Charts

See Appendix A as separate pdf

Appendix B. Native bee ESNPS focal species known to occur in New York State

“Pre” species designations in the right column are those previously documented in the state, but no records from 2000 to present are known. If the species was found to be extant in the state based on our Compiled database, but no ESNPS specimen records exist, they are highlighted below with a “partner” designation. Those species with a “new” designation are those we documented during the Survey, but do not appear to be otherwise recorded in the state. If a species was newly documented as part of the 2021 Fort Drum pollinator survey (but not during ESNPS), these are noted as new FD 2021 in the right column. ^No map due to unknown date of collection. # Non-native species. *Verification needed to confirm presence in NY.

Species	Common name	Global Rank	State Rank	
Andrena accepta	Two-spotted Miner Bee	GNR	SH	pre
Andrena algida	Icy Miner Bee	G5	S3?	
Andrena aliciae	Yellow-faced Miner Bee	GNR	S1	pre
Andrena alleghaniensis	Appalachian Miner Bee	G5	S3S4	
Andrena andrenoides	Colourful Willow Miner Bee	GNR	SH	pre
Andrena arabis	Mustard Miner Bee	GNR	S2S3	
Andrena asteris	Aster Miner Bee	GNR	S3?	
Andrena banksi	an andrenid bee	GNR	S1	pre
Andrena barbara	Barbara's Miner	GNR	S3	
Andrena barbilabris	Bearded Miner Bee	G5	S2S4	
Andrena bisalicis	Eastern Willow Miner Bee	GNR	S3?	
Andrena braccata	a mining bee	GNR	S2?	
Andrena bradleyi	Bradley's Miner Bee	GNR	S3?	
Andrena brevipalpis	Short-tongued Miner Bee	GNR	S2S3	
Andrena canadensis	Canada Miner Bee	GNR	S2S3	
Andrena carlini	Carlinville Miner Bee	G5	S3S5	
Andrena carolina	Carolina Miner Bee	GNR	S3S4	
Andrena ceanothi	Ceanothus Miner Bee	G5	S3?	
Andrena ceanothifloris	Ceanothus Flower Miner Bee	GNR	SH	pre
Andrena chromotricha	Pigmented Miner Bee	GNR	S2S3	
Andrena clarkella	Clark's Miner Bee	GNR	S2S3	pre
Andrena commoda	Advantaged Miner Bee	GNR	S3S4	
Andrena confederata	an andrenid bee	GNR	S2S3	
Andrena cornelli	a mining bee	GNR	S1	partner
Andrena crataegi	Hawthorn Miner Bee	G5	S3S5	
Andrena cressonii	Yellow-legged Miner Bee	G5	S3S4	
Andrena distans	Distant Miner Bee	GNR	S3?	
Andrena dunningi	Dunning's Miner Bee	G5	S3S4	

Species	Common name	Global Rank	State Rank	
Andrena duplicata	a mining bee	GNR	S1	new, FD 2021
Andrena erigeniae	Spring Beauty Miner Bee	GNR	S3S4	
Andrena erythrogaster	Red-bellied Miner Bee	GNR	S2?	
Andrena erythronii	Trout Lily Miner Bee	GNR	S2S3	
Andrena forbesii	Forbes's Miner Bee	G5	S3S4	
Andrena fragilis	Fragile Miner Bee	GNR	S2S4	
Andrena frigida	Cold Miner Bee	GNR	S3S4	
Andrena fulvipennis	an andrenid bee	GNR	SH	pre
Andrena geranii	Geranium Miner Bee	GNR	S3	
Andrena helianthi	Sunflower Miner Bee	GNR	S1S2	partner
Andrena heraclei	an andrenid bee	GNR	S1	
Andrena hilaris	an andrenid bee	GNR	S1	
Andrena hippotes	Hippotes's Miner Bee	G5	S3S4	
Andrena hirticincta	Hairy-belted Miner Bee	GNR	S3S4	
Andrena ilicis	an andrenid bee	GNR	S2S3	
Andrena illinoiensis	Tufted Miner Bee	GNR	SH	pre
Andrena imitatrix	Imitator Miner Bee	G5	S3S4	
Andrena integra	Intact Miner Bee	GNR	S2S3	
Andrena krigiana	an andrenid bee	GNR	S1	
Andrena mandibularis	Toothed Miner Bee	G5	S3S4	
Andrena mariae	Maria Miner Bee	GNR	S3?	
Andrena melanochroa	Rose Miner Bee	GNR	S2	
Andrena milwaukeensis	Milwaukee Miner Bee	G5	S3S4	
Andrena miranda	Singular Miner Bee	G5	S2S3	
Andrena miserabilis	Smooth-faced Miner Bee	G5	S3S4	
Andrena morrisonella	Morrison's Miner Bee	GNR	S3	partner
Andrena nasonii	Bumped Miner Bee	G5	S3S4	
Andrena neonana	an andrenid bee	GNR	S2S3	
Andrena nida	a mining bee	GNR	S1	partner
Andrena nigrae	Black Miner Bee	GNR	S2	
Andrena nigrihirta	Black-haired Miner Bee	G5	S3?	
Andrena nivalis	Snow Miner Bee	G5	S3S4	
Andrena nubecula	Cloudy-winged Miner Bee	GNR	S3S4	
Andrena nuda	Naked Miner Bee	GNR	S3S5	
Andrena peckhami	Pechkham’s Mining Bee	GNR	S2S3	
Andrena perplexa	Perplexed Miner Bee	GNR	S3S4	
Andrena persimulata	Protuberance Miner Bee	GNR	S2	
Andrena personata	An andrenid Bee	GNR	S1	pre
Andrena placata	Peaceful Miner Bee	GNR	S3?	
Andrena platyparia	Plated Miner Bee	GNR	S3S4	
Andrena pruni	an andrenid bee	GNR	S3S4	
Andrena regularis	Regular Miner Bee	G5	S3S4	
Andrena rehni*	Rehn's Miner Bee	GNR	SH	
Andrena robertsonii	Robertson's Miner Bee	G5	S3S4	

Species	Common name	Global Rank	State Rank	
Andrena robervalensis	a miner bee	GNR	SH	pre
Andrena rufosignata	Red-faced Miner Bee	G5	S3S4	
Andrena rugosa	Wrinkled Miner Bee	G5	S3S4	
Andrena runcinatae	Planed Miner Bee	G5	S1	partner
Andrena salictaria	Small Willow Miner Bee	GNR	S1S2	partner
Andrena sigmundi	Sigmund's Miner Bee	GNR	S2S3	
Andrena simplex	Simple Miner Bee	GNR	S3?	
Andrena sola*	Lonely Miner Bee	GNR	SH	pre
Andrena spiraeana	Goatsbeard Miner Bee	GNR	S3S4	
Andrena thaspii	Parsnip Miner Bee	G5	S3S4	
Andrena tridens	Trident Miner Bee	G5	S3S4	
Andrena uvulariae	a mining bee	GNR	S1	partner
Andrena vicina	Neighbouring Miner Bee	G5	S3S5	
Andrena violae	an andrenid bee	GNR	S3	
Andrena virginiana	Virginia Miner Bee	G5	S3?	
Andrena wheeleri	Wheeler's Miner Bee	G5	S3?	
Andrena wilkella #	European Legume Miner Bee	GNR	SNA	
Andrena w-scripta	W-marked Miner Bee	G5	S2S3	
Andrena ziziae	Golden Alexanders Miner Bee	GNR	S2S3	
Andrena ziziaeformis	an andrenid bee	GNR	SH	pre
Calliopsis andreniformis	Eastern Miner Bee	G5	S3S4	
Panurginus potentillae	A Miner Bee	GNR	S1	new
Bombus affinis	Rusty-patched Bumble Bee	G2	SH	pre
Bombus ashtoni (=bohemicus)	Ashton Cuckoo Bumble Bee	G3G5	SH	pre
Bombus auricomus	Black-and-gold Bumble Bee	G5	S2	
Bombus bimaculatus	Two-spotted Bumble Bee	G5	S4S5	
Bombus borealis	Northern Amber Bumble Bee	G4G5	S3	
Bombus citrinus	Lemon Cuckoo Bumble Bee	G4	S2S3	
Bombus fernaldae (=flavidus)	Yellow Bumble Bee	G5?	S2	
Bombus fervidus	Fernald's Cuckoo Bumble Bee	G3G4	S3	
Bombus griseocollis	Brown-belted Bumble Bee	G5	S4S5	
Bombus impatiens	Common Eastern Bumble Bee	G5	S5	
Bombus insularis	Indiscriminate Cuckoo Bumble Bee	G3	SH	pre
Bombus pensylvanicus	American Bumble Bee	G3G4	S2	
Bombus perplexus	Confusing Bumble Bee	G5	S3	
Bombus rufocinctus	Red-belted Bumble Bee	G5	S3	
Bombus sandersoni	Sanderson's Bumble Bee	G5	S3	
Bombus suckleyi	Suckley's Cuckoo Bumble Bee	G2G3	SH	pre
Bombus ternarius	Tri-colored Bumble Bee	G5	S4S5	
Bombus terricola	Yellow-banded Bumble Bee	G3G4	S3	
Bombus vagans	Half-black Bumble Bee	G4	S5	
Bombus variabilis	Variable Cuckoo Bumble Bee	G1G2	SH	pre

Species	Common name	Global Rank	State Rank	
Epeoloides pilosula	Macropis Cuckoo Bee	GU	S1	partner
Melissodes agilis	Agile Long-horned Bee	GNR	S2S3	
Melissodes apicatus	Pickerelweed Long-horned Bee	unknown	S3?	
Melissodes bidentis	Two-toothed Long-horned Bee	GNR	S2	
Melissodes bimaculatus	Two-spotted Long-horned Bee	unknown	S3S5	
Melissodes boltoniae	a callirhoe bee	GNR	S1	partner
Melissodes denticulatus	Denticulate Long-horned Bee	GNR	S3S4	
Melissodes dentiventris	Tooth-bellied Long-horned Bee	GNR	S2S3	
Melissodes desponsus	Thistle Long-horned Bee	unknown	S3S4	
Melissodes druriellus	Drury's Long-horned Bee	unknown	S3S4	
Melissodes fumosus	a callirhoe bee	unknown	S1	partner
Melissodes glenwoodensis*	a callirhoe bee	GNR	SH	pre
Melissodes illata	Valiant Long-horned Bee	unknown	S3S4	
Melissodes lustrus*	a callirhoe bee	unknown	SH	pre
Melissodes niveus	a callirhoe bee	unknown	S2	
Melissodes subillatus	Vigorous Long-horned Bee	unknown	S3S4	
Melissodes trinodis	Three-knotted Long-horned Bee	GNR	S3S4	
Melissodes vernoniae	a callirhoe bee	GNR	SH	pre
Megachile addenda	Cranberry Leafcutter Bee	G5	S3?	
Megachile apicalis #	Apical Leafcutter Bee	G4G5	SNA	
Megachile brevis	Short Leafcutter Bee	G5	S3?	
Megachile campanulae	Bellflower Leafcutter Bee	G5	S3S4	
***Megachile centuncularis* #possible**	Common Leafcutter Bee	G5	S3S4	
Megachile ericetorum	a leafcutter bee	unknown	S1	partner
Megachile frigida	Frigid Leafcutter Bee	G5	S3S4	
Megachile frugalis	a leafcutter bee	G4G5	S1	
Megachile gemula	Small-handed Leafcutter Bee	G5	S3S4	
Megachile gentilis	Gentle Leafcutter Bee	G5	S1	new
Megachile georgica	a leafcutter bee	G4	S1	new
Megachile inermis	Unarmed Leafcutter Bee	G5	S3S4	
Megachile inimica	Hostile Leaf-cutter Bee	G5	S2S3	
Megachile lapponica	Lapland Leafcutter Bee	G5	S3	new
Megachile latimanus	Broad-handed Leafcutter Bee	G5	S3S4	
Megachile lippiae	Lippia Leafcutter Bee	G5	S2S3	new
Megachile melanophaea	Black-and-gray Leafcutter Bee	G5	S2S3	
Megachile mendica	Beggar Leafcutter Bee	G5	S3S5	
Megachile montivaga	Hills Leafcutter Bee	G5	S3	
Megachile mucida	a leafcutter bee	G4	S2	
Megachile petulans	Petulant Leaf-cutter Bee	G5	S1	partner
Megachile pugnata	Pugnacious Leafcutter Bee	G5	S3S5	
***Megachile pusilla* (was *concinna*)#**	a leaf-cutter bee	G5	SNA	partner
Megachile relativa	Relative Leafcutter Bee	G5	S3S4	
Megachile rotundata #	Alfalfa Leafcutter Bee	G5	SNA	

Species	Common name	Global Rank	State Rank	
Megachile rugifrons	a leafcutter bee	G2G3	SH	pre
***Megachile sculpturalis* #**	Giant Leafcutter Bee	G5	SNA	
Megachile texana	Texas Leafcutter Bee	G5	S3S4	
Osmia albiventris	White-bellied Mason Bee	G4?	S3?	
Osmia albolateralis*	White-sided Mason Bee	G5	SH	pre
Osmia atriventris	Maine Blueberry Bee	G5	S3S4	
Osmia bucephala	Bufflehead Mason Bee	G5	S3S4	
***Osmia caerulescens* #**	Blue Mason Bee	G5	SNA	
Osmia calaminthae*^	Blue Calamintha Bee	G1	SU	pre
Osmia chalybea	a mason bee	G4G5	S1	partner
Osmia collinsiae	Collins's Mason Bee	G5	S3?	
Osmia conjuncta	Eastern Snail Shell Mason Bee	G5	S2S3	
***Osmia cornifrons* #**	Hornfaced Bee	G5	SNA	
Osmia distincta	Distinct Mason Bee	G5	S3?	
Osmia felti	Felt's Mason Bee	G2G4	S1	
Osmia georgica	Georgia Mason Bee	G5	S2S3	
Osmia inermis	Unarmed Mason Bee	G5	S3	
Osmia inspergens	Shiny-faced Mason Bee	G5	S3?	
Osmia laticeps	Holarctic Blueberry Mason Bee	G5	S1	new
Osmia lignaria	Blue Orchard Bee	G5	S3	
Osmia nigriventris*	Large Black-bellied Mason Bee	G5	S1	partner
Osmia proxima	Friendly Mason Bee	G4G5	S1	partner
Osmia pumila	Dwarf Mason Bee	G5	S3S5	
Osmia simillima	Similar Mason Bee	G5	S1S2	
Osmia subarctica	a mason bee	G2G4Q	S1	new
***Osmia taurus* #**	a mason bee	G5	SNA	
Osmia tersula	Wide-banded Mason Bee	G5	S2	
Osmia texana	Texas Mason Bee	G5	S1	
Osmia virga	Twig Mason Bee	G5	S3	
Macropis ciliata	Fringed Loosestrife Oil-collecting Bee	GNR	S1	partner
Macropis nuda	Common Loosestrife Oil Bee	GNR	S2?	
Macropis patellata	Patellar Oil-collecting Bee	GNR	S1S2	
Melitta americana	Cranberry Oil Bee	GNR	SH	pre
Melitta eickworti	Deerberry Melitta	GNR	S1	pre

Appendix C. Native fly ESNPS focal species known to occur in New York State

“Pre” species designations in the right column are those previously documented in the state, but no records from 2000 to present are known. If the species was found to be extant in the state based on our Compiled database, but no ESNPS specimen records exist, they are highlighted below with a “partner” designation. Those species with a “new” designation are those we documented during the Survey, but do not appear to be otherwise recorded in the state. ^ No map due to unknown date of collection. *Verification needed to confirm presence in NY.

Species	Common Name	Global Rank	State Rank	
Bombylius atriceps	Black-headed Bee Fly	GNR	S1	
Bombylius comanche	Comanche Bee Fly	GNR	SU	partner
Bombylius fraudulentus	Deceitful Bee Fly	GNR	SU	
Bombylius fulvibasoides	a bee fly	unknown	S1	partner
Bombylius incanus	Ghost Bee Fly	GNR	S4	
Bombylius major	Major Bee Fly	G5	S4S5	
Bombylius mexicanus	Mexican Bee Fly	GNR	SU	partner
Bombylius pulchellus	Beautiful Bee Fly	GNR	SH	pre
Bombylius pygmaeus	Pygmy Bee Fly	G5	SU	partner
Bombylius varius	a bee fly	unknown	SU	
Blera analis	Orange-tailed Wood Fly	G5	S3	
Blera armillata	Orange-faced Wood Fly	G5	S1	
Blera badia	Common Wood Fly	G5	S4	
Blera confusa	Confusing Wood Fly	G5	S3	
Blera nigra	Golden-haired Wood Fly	G5	S4	
Blera notata	Ornate Wood Fly	GNR	SH	pre
Blera pictipes	Painted Wood Fly	G4G5	S1	
Blera umbratilis	Hairy Wood Fly	G4G5	S1	partner
Brachyopa caesariata	Plain-winged Sapeater	G5	SH	pre
Brachyopa daeckei	Black-tailed Sapeater	G4G5	SH	pre
Brachyopa flavescens	Yellow Sapeater	G5	SU	
Brachyopa notata	Black-banded Sapeater	G5	S4	
Brachyopa perplexa	Hairy-striped Sapeater	G4G5	SU	
Brachyopa vacua	Yellow-spotted Sapeater	G5	S1	
Brachypalpus cyanogaster^	Bluebottle Catkin Fly	GNR	SU	pre
Brachypalpus oarus	Eastern Catkin Fly	G5	S4	
Ceriana abbreviata	Northern Wasp Fly	G5	S1	partner
Ceriana willistoni	Williston's Wasp Fly	G5	S3	
Chalcosyrphus anomalus	Long-tailed Leafwalker	G4G5	SH	pre
Chalcosyrphus anthreas	Yellow-banded Leafwalker	G5?	S4	
Chalcosyrphus chalybeus	Violet Leafwalker	G5	S4	
Chalcosyrphus curvaria	Yellow-haltered Leafwalker	G5	S1S2	
Chalcosyrphus femoratus	a leafwalker fly	Unknown	SH	pre

Species	Common Name	Global Rank	State Rank	
Chalcosyrphus inarmatus	Yellow-haired Leafwalker	G5	SH	pre
Chalcosyrphus libo	Long-haired Leafwalker	G5	S4	
Chalcosyrphus metallifer	Orange-horned Leafwalker	G4G5	S1	
Chalcosyrphus nemorum	Dusky-banded Leafwalker	G5	S4S5	
Chalcosyrphus piger	Short-haired Leafwalker	G5	S4	
Chalcosyrphus plesia	Black-hipped Leafwalker	G4G5	SU	
Chalcosyrphus vecors	Orange-hipped Leafwalker	G4G5	S4	
Criorhina nigriventris	Bare-cheeked Bumblefly	G5	S2S3	
Criorhina verbosa	Hairy-cheeked Bumblefly	G5	S1S3	
Cynorhinella longinasus	Eastern Longnose	G4G5	S1	partner
Doros aequalis	Canadian Potterfly	G5	S1	
Ferdinandea buccata	Common Copperback	G5	S3	
Hammerschmidtia rufa	Black-bristled Logsitter	G5	S1	
Hammerschmidtia sedmani	Pale-bristled Logsitter	G5	S1	
Lejota aerea	Golden Trunksitter	G5?	S4	
Lejota cyanea	Cobalt Trunksitter	G3G5	S1	new
Mallota bautias	Bare-eyed Mimic	G5	S4S5	
Mallota cimbiciformis*	a mimic fly	Unknown	SH	pre
Mallota mississipensis	Eastern Mimic	GNR	SH	pre
Mallota posticata	Hairy-eyed Mimic	G5	S4S5	
Microdon abditus	Broad-footed Ant Fly	G5?	SU	
Microdon abstrusus	an ant fly	G1G3	SH	pre
Microdon adventitius*	Southeastern Ant Fly	GNR	SH	pre
Microdon aurulentus	Golden-haired Ant Fly	G4?	S1	
Microdon cothurnatus	Orange-legged Ant Fly	G4G5	S1	
Microdon craigheadii	Large Metallic Ant Fly	G4G5	S1	
Microdon fuscipennis	Short-horned Ant Fly	GH	SH	pre
Microdon globosus	Globular Ant Fly	G5	S1	partner
Microdon manitobensis	Greater Ant Fly	G5	SU	
Microdon megalogaster	Black-bodied Ant Fly	G5?	SH	pre
Microdon ocellaris	Hairy-legged Ant Fly	G4G5	SH	pre
Microdon ruficrus	Spiny-shield Ant Fly	G5	S1	
Microdon tristis	Long-horned Ant Fly	G5	S4	
Milesia virginiensis	Virginia Giant	G5	S4	partner
Myolepta nigra	Black Pegleg	G5	S3	
Myolepta pretiosa	Dusted Pegleg	GU	S1	new
Myolepta strigilata	Scaled Pegleg	G5	S1	
Myolepta varipes	Orange-banded Pegleg	G4G5	SU	
Pterallastes thoracicus	Goldenback	G5	S3?	
Somula decora	Spotted Wood Fly	G5	S4	

Species	Common Name	Global Rank	State Rank	
Sphecomyia vittata	Long-horned Yellowjacket Fly	G5	S4	
Sphegina albipes*	Spotted Pufftail	GNR	SH	pre
Sphegina appalachiensis	Appalachian Pufftail	GU	SH	pre
Sphegina brachygaster	Thick-waisted Pufftail	G5	S1	partner
Sphegina campanulata	Orange-horned Pufftail	G5?	S4	
Sphegina flavimana	Tuberculate Pufftail	G4G5	S3	
Sphegina flavomaculata	Tooth-legged Pufftail	G3G5	SU	
Sphegina keeniana	Peg-legged Pufftail	G4G5	S4	
Sphegina lobata	Yellow-lobed Pufftail	G4G5	S4	
Sphegina lobulifera	Black-lobed Pufftail	G4G5	SU	
Sphegina petiolata	Long-spined Pufftail	G5	SU	
Sphegina rufiventris	Black-horned Pufftail	G5	S4	
Spilomyia alcimus	Broad-banded Hornet Fly	G5	S4S5	
Spilomyia fusca	Bald-faced Hornet Fly	G5	S4S5	
Spilomyia longicornis	Eastern Hornet Fly	G5	S4S5	
Spilomyia sayi	Four-lined Hornet Fly	G5	S4	
Temnostoma alternans	Wasp-like Falsehorn	G5	S4	
Temnostoma balyras	Yellow-haired Falsehorn	G5	S4S5	
Temnostoma barberi	Bare-bellied Falsehorn	G5	S4	
Temnostoma bombylans*	a falsehorn fly	unknown	SH	pre
Temnostoma daochus	Yellow-spotted Falsehorn	G5	S1	partner
Temnostoma excentrica	Black-spotted Falsehorn	G5	S4	
Temnostoma trifasciatum	Three-lined Falsehorn	G5?	S4	
Temnostoma venustum	Black-banded Falsehorn	G4G5	SH	pre
Teuchocnemis bacuntius	a spur fly	Unknown	SH	pre
Teuchocnemis lituratus	Black Spur Fly	G5	S3	partner
Xanthogramma flavipes	American Harlequin	G5	S4	
Xylota angustiventris	Two-spotted Leafwalker	G5?	S1	
Xylota annulifera	Longspine Leafwalker	G5	S4	
Xylota barbata*	Black Leafwalker	GNR	SH	pre
Xylota bicolor	Eastern Orange-tailed Leafwalker	G5	S1	
Xylota confusa	Confusing Leafwalker	G5	S4	
Xylota ejuncida	Polished Leafwalker	G4G5	SH	pre
Xylota flavifrons	Northern Leafwalker	G5	S1	new
Xylota flukei	Fringeless Leafwalker	G4	S1	new
Xylota hinei	Hine's Leafwalker	G5	S4	
Xylota naknek	Naknek Leafwalker	G3G5	S1	new
Xylota ouelleti	Black-haired Leafwalker	G5	SH	pre
Xylota quadrimaculata	Four-spotted Leafwalker	G5	S4S5	

Species	Common Name	Global Rank	State Rank	
Xylota segnis	Brown-toed Leafwalker	GNR	SU	
Xylota subfasciata	Large-spotted Leafwalker	G5	S3S4	
Xylota tuberculata	Short-spined Leafwalker	GU	S1	new
Xylota undescribed sp. 78-1	a leafwalker fly	unknown	SU	new
Xylota undescribed sp. 78-3	a leafwalker fly	unknown	S1	new

Appendix D. Native beetle ESNPS focal species known to occur in New York State

"Pre" species designations in the right column are those previously documented in the state, but no records from 2000 to present are known. If the species was found to be extant in the state based on our Compiled database, but no ESNPS specimen records exist, they are highlighted below with a "partner" designation. Those species with a "new" designation are those we documented during the Survey, but do not appear to be otherwise recorded in the state. ^No map due to unknown date of collection.

Species	Common Name	Global Rank	State Rank	
Acmaeops discoideus	Discoid Long-horned Beetle	GNR	S1	partner
Acmaeops proteus	Shapeless Flower Longhorn Beetle	G5	SH	pre
Alosternida chalybaea	a long-horned beetle		SH	pre
Analeptura lineola	Lined Long-horned Beetle	G5	S4S5	
Anastrangalia sanguinea	Bloody Flower Longhorn Beetle	G5	S1	
Anoplodera pubera	Downy Long-horned Beetle	G5	S2	
Anthophylax attenuatus	Mottled Longhorned Beetle	G5	S3	partner
Anthophylax cyaneus	Red-footed Long-horned Beetle	G5	S4	
Anthophylax viridis	Green Long-horned Beetle	G5	S3	
Bellamira scalaris	Ladder-marked Long-horned Beetle	G5	S4	partner
Brachyleptura champlaini	Champlain's Long-horned Beetle	G5	S3	
Brachyleptura circumdata	Dark-shouldered Long-horned Beetle	GNR	SH	pre
Brachyleptura rubrica	Red-winged Long-horned Beetle	G5	S3	
Brachyleptura vagans	a long-horned beetle	GNR	S3	
Brachysomida bivittata	Double-lined Long-horned Beetle	GNR	SH	pre
Centrodera decolorata	Discoloured Long-horned Beetle	G5	S4	partner
Charisalia americana	America Long-horned Beetle	GNR	SU	
Desmocerus palliatus	Elderberry Borer	G5	S3S5	
Encyclops caerulea	Cerulean Long-horned Beetle	GNR	S2	
Etorofus deletus	Deleted Long-horned Beetle	GNR	SU	
Etorofus plebejus	Plebeian Long-horned Beetle	G5	S1	
Etorofus subhamatus	Hemlock Long-horned Beetle	G5	S3?	
Evodinus monticola	Flower Longhorn Beetle	G5	S4	
Gaurotes cyanipennis	Cyan Long-horned Beetle	G5	S3	
Gaurotes thoracica	a long-horned beetle		SH	pre

Species	Common Name	Global Rank	State Rank	
Gnathacmaeops pratensis	Meadow Flower Longhorn Beetle	G5	SH	pre
Grammoptera exigua	Confined Long-horned Beetle	GNR	SH	pre
Grammoptera haematites	Dogwood Long-horned Beetle	G5	S1	
Grammoptera molybdica	Metallic Long-horned Beetle	G5	SH	pre
Grammoptera subargentata	Silver Flower Longhorn Beetle	G5	S1	partner
Idiopidonia pedalis	Tawny-legged Long-horned Beetle	G5	S1	partner
Judolia cordifera	Chestnut Long-horned Beetle	GNR	S4S5	
Judolia montivagans	Mountain Flower Longhorn Beetle	G5	S1	
Leptorhabdium pictum	a long-horned beetle		S4	
Leptura abdominalis	a long-horned beetle		S1	
Lepturobosca chrysocoma	Golden Flower Longhorn Beetle	G5	SH	pre
Lepturopsis biforis	Two-spotted Long-horned Beetle	G5	S3	
Lepturopsis dolorosa^	Sorrowful Long-horned Beetle	GNR	SU	
Metacmaeops vittata	Striped Long-horned Beetle	GNR	S3	
Necydalis mellita	Slender Long-horned Beetle	GNR	SU	
Neoalosterna capitata	Helmet Long-horned Beetle	G5	SH	pre
Pidonia aurata	a long-horned beetle		SH	pre
Pidonia ruficollis	Stripe-legged Long-horned Beetle	G5	S3	
Pidonia vibex	Dented Long-horned Beetle	GNR	SU	partner
Pseudogaurotina abdominalis	Orange-bellied Long-horned Beetle	GNR	S2S3	
Pseudostrangalia cruentata	Cruel Long-horned Beetle	GNR	SH	pre
Pygoleptura nigrella	Rusty Flower Longhorn Beetle	G5	SH	pre
Rhagium inquisitor	Ribbed Pine Borer	G5	S3	partner
Sachalinobia rugipennis	Rough-winged Long-horned Beetle	G5	SH	pre
Stenelytrana emarginata	Black-tipped Long-horned Beetle	GNR	S3?	partner
Stenocorus cinnamopterus	a longhorned beetle	GNR	S1	partner
Stenocorus cylindricollis	a longhorned beetle	GNR	SH	pre
Stenocorus schaumii	Schaum's Longhorn Beetle	GNR	S4	
Stenocorus trivittatus	Three-striped Long-horned Beetle	GNR	SH	pre
Stenocorus vittiger	Shrub Long-horned Beetle	GNR	S1	partner
Stictoleptura canadensis	Red-shouldered Long-horned Beetle	G5	S4S5	

Species	Common Name	Global Rank	State Rank	
Strangalepta abbreviata	Abbreviated Long-horned Beetle	G5	S3S5	
Strangalia acuminata	Pointed Long-horned Beetle	GNR	S3	
Strangalia bicolor	Bicoloured Long-horned Beetle	GNR	SH	pre
Strangalia famelica	a longhorned beetle	GNR	S3S4	partner
Strangalia luteicornis	Pale-horned Long-horned Beetle	GNR	S4S5	partner
Strangalia sexnotata	Six-spotted Flower Strangalia		SU	
Strophiona nitens	Chestnut Bark Long-horned Beetle	G5	S3	
Trachysida aspera	Rough Flower Longhorn Beetle	G5	SH	pre
Trachysida mutabilis	Variable Flower Longhorn Beetle	G5	S3	
Trigonarthris atrata	a flower longhorn beetle		SU	
Trigonarthris minnesotana	Minnesota Long-horned Beetle	G5	S1	
Trigonarthris proxima	Proximal Long-horned Beetle	G5	S3	
Typocerus acuticauda	Thin-tailed Long-horned Beetle	GNR	S4	
Typocerus deceptus	a longhorned beetle		SU	
Typocerus lugubris	Mournful Long-horned Beetle	GNR	S3	
Typocerus sinuatus	a longhorned beetle		SH	pre
Typocerus velutinus	Banded Longhorn	G5	S4S5	
Typocerus zebra	a longhorned beetle	GNR	S1	partner
Xestoleptura octonotata	Long-winged Long-horned Beetle	GNR	S2S3	
Trichiotinus affinis	Hairy Flower Scarab	G5	S3S5	
Trichiotinus assimilis	Bee-mimic Beetle	G5	S3	
Trichiotinus bibens	a scarab beetle	G4	SH	pre
Trichiotinus piger	Bee-like Flower Scarab	G5	S1	
Trichiotinus texanus	Texas Flower Scarab	G5	SH	pre
Trichiotinus viridans	Greenish Flower Chafer	G4	SH	pre

Appendix E. Native moth ESNPS focal species known to occur in New York State

"Pre" species designations in the right column are those previously documented in the state, but no records from 2000 to present are known. If the species was found to be extant in the state based on our Compiled database, but no ESNPS specimen records exist, they are highlighted below with a "partner" designation. Those species with a "new-partner" designation are those newly documented by partner data from 2000 to present. ^No map due to unknown date of collection. # Non-native species. % Vagrants.

Species	Common Name	Global Rank	State Rank	
Schinia arcigera	Arcigera Flower Moth	G5	S4S5	partner
Schinia florida	Evening Primrose Moth	G5	S4S5	partner
Schinia gracilenta	Slender Flower Moth	G4G5	SU	partner
Schinia lynx	Lynx Flower Moth	G5	S4	partner
Schinia nubila	Camphorweed Flower Moth	G5	S3	partner
Schinia nundina	Goldenrod Flower Moth	G5	S3?	partner
Schinia obscurata	Erigeron Flower Moth	G4	S3	partner
Schinia rivulosa	Ragweed Flower Moth	G5	S4	partner
Schinia saturata	Brown Flower Moth	G5	SU	partner
Schinia septentrionalis	Northern Flower Moth	G3G4	SH	pre
Schinia spinosae	Spinose Flower Moth	G4	SU	partner
Schinia thoreaui^	Thoreau's Flower Moth	G5	SU	pre
Schinia trifascia	Three-lined Flower Moth	G5	S3S4	partner
Schinia tuberculum	Golden Aster Flower Moth	G4	S1	partner
Aellopos tantalus %	Tantalus Sphinx	G4G5	SNA	pre
Aellopos titan %	Titan Sphinx	G5	SNA	partner
Agrius cingulata %	Pink-spotted Hawk Moth	G5	SNA	partner
Amorpha juglandis	Walnut Sphinx Moth	G5	S4S5	partner
Amphion floridensis	Nessus Sphinx Moth	G5	S4S5	
Cautethia grotei %	Grote's Sphinx	G4	SNA	pre
Ceratomia amyntor	Elm Sphinx Moth	G5	S4S5	partner
Ceratomia catalpae	Catalpa Hornworm	G5	SU	partner
Ceratomia undulosa	Waved Sphinx Moth	G5	S3S4	
Darapsa choerilus	Azalea Sphinx Moth	G5	S3S5	partner
Darapsa myron	Virginia Creeper Sphinx	G5	S4S5	partner
Darapsa versicolor	Hydrangea Sphinx	G4?	S2	partner
Deidamia inscripta	Lettered Sphinx	G5	S4S5	partner
Dolba hyloeus	Pawpaw Sphinx Moth	G5	S4	partner
Enyo lugubris %	Mournful Sphinx	G5	SNA	pre
Erinnyis ello %	Ello Sphinx	G5	SNA	pre
Eumorpha achemon %	Achemon Sphinx	G5	SNA	partner
Eumorpha fasciatus	Banded Sphinx	G5	S3	partner

Species	Common Name	Global Rank	State Rank	
Eumorpha pandorus	Pandorus Sphinx	G5	S4S5	partner
Eumorpha satellitia %	Satellite Sphinx	G5	SNA	partner
Eumorpha vitis %	Vine Sphinx	G5	SNA	pre
Hemaris aethra	a bumblebee clearwing	G4	S1	partner
Hemaris diffinis	Snowberry Clearwing	G5	S4S5	
Hemaris gracilis	Slender Clearwing	G3G4	S4	partner
Hemaris thysbe	Hummingbird Clearwing	G5	S5	
Hyles euphorbiae #	Leafy Spurge Hawkmoth	G5	SNA	partner
Hyles gallii	Galium Sphinx	G5	S4S5	partner
Hyles lineata	White-lined Sphinx Moth	G5	S3S5	partner
Lapara bombycoides	Northern Pine Sphinx Moth	G5	S4S5	partner
Lapara coniferarum	Southern Pine Sphinx	G5	S3	partner
Lintneria eremitus	Hermit Sphinx Moth	G4G5	S4S5	partner
Manduca brontes^%	Cuban Sphinx Moth	GNR	SNA	pre
Manduca jasminearum	Ash Sphinx	G4G5	S1	partner
Manduca quinquemaculata	Five-spotted Hawk Moth	G5	S3	partner
Manduca rustica %	Rustic Sphinx	G5	SNA	partner
Manduca sexta	Carolina Sphinx	G5	S4S5	partner
Pachysphinx modesta	Big Poplar Sphinx Moth	G5	S4S5	partner
Paonias astylus	Huckleberry Sphinx	G4G5	S3	partner
Paonias excaecata	Blinded Sphinx Moth	G5	S4S5	partner
Paonias myops	Small-eyed Sphinx Moth	G5	S4S5	partner
Paratrea plebeja	Trumpet Vine Sphinx	G5	S3	partner
Proserpinus flavofasciata	Yellow-banded Day Sphinx Moth	G4G5	SH	pre
Smerinthus cerisyi	One-eyed Sphinx Moth	G5	S4S5	partner
Smerinthus jamaicensis	Twin-spotted Sphinx Moth	G5	S3S5	partner
Sphecodina abbottii	Abbott's Sphinx Moth	G5	S4S5	partner
Sphinx canadensis	Canadian Sphinx Moth	G4	S2	partner
Sphinx chersis	Great Ash Sphinx Moth	G4	S2S4	partner
Sphinx drupiferarum	Wild Cherry Sphinx Moth	G3G5	S1S2	partner
Sphinx franckii	Franck's Sphinx	G4G5	S1	new-partner
Sphinx gordius	Apple Sphinx Moth	G4G5	S3	partner
Sphinx kalmiae	Fawn Sphinx Moth	G5	S3S4	partner
Sphinx luscitiosa	Clemens' Sphinx	G5	S1	partner
Sphinx poecila	Northern Apple Sphinx Moth	G5	S4	partner
Xylophanes tersa %	Tersa Sphinx	G5	SNA	partner

Appendix F. Rank Factor Values Used in S-rank Calculations, by Species

Definitions of rank factor values are in Table 4.

Scientific name	Common Name	Number of Records	Range Extent	AOO	# Occur	Threat Impact	Intrins Vuln	Long-term Trend	G-rank	S-rank
Coleoptera: Cerambycidae										
Acmaeops discoideus	Discoid Long-horned Beetle	5-24	A	A		U	C	U	GNR	S1
Acmaeops proteus	Shapeless Flower Longhorn Beetle	25-49				U	C	AB	G5	SH
Alosternida chalybaea	a long-horned beetle	5 or fewer				U	C	U		SH
Analeptura lineola	Lined Long-horned Beetle	500 or more	F	EI		U	C	G	G5	S4S5
Anastrangalia sanguinea	Bloody Flower Longhorn Beetle	5-24	A	A		U	C	AF	G5	S1
Anoplodera pubera	Downy Long-horned Beetle	100-499	B	C		U	C	AD	G5	S2
Anthophylax attenuatus	Mottled Longhorned Beetle	50-99	CE	D		U	C	G	G5	S3
Anthophylax cyaneus	Red-footed Long-horned Beetle	25-49	F	D		U	C	G	G5	S4
Anthophylax viridis	Green Long-horned Beetle	25-49	E	C		U	C	G	G5	S3
Bellamira scalaris	Ladder-marked Long-horned Beetle	50-99	F	D		U	C	G	G5	S4
Brachyleptura champlaini	Champlain's Long-horned Beetle	5-24	E	C		U	C	G	G5	S3
Brachyleptura circumdata	Dark-shouldered Long-horned Beetle	25-49				U	C	AB	GNR	SH
Brachyleptura rubrica	Red-winged Long-horned Beetle	100-499	EF	D		U	C	AF	G5	S3
Brachyleptura vagans	a long-horned beetle	50-99	EF	D		U	C	AF	GNR	S3
Brachysomida bivittata	Double-lined Long-horned Beetle	25-49				U	C	AB	GNR	SH
Centrodera decolorata	Discoloured Long-horned Beetle	50-99	F	D		U	C	G	G5	S4
Charisalia americana	America Long-horned Beetle	5-24	D	C		U	C	U	GNR	SU
Desmocerus palliatus	Elderberry Borer	100-499	F	EI		U	C	AF	G5	S3S5
Encyclops caerulea	Cerulean Long-horned Beetle	25-49	B	C		U	C	AF	GNR	S2
Etorofus deletus	Deleted Long-horned Beetle	5 or fewer							GNR	SU
Etorofus plebejus	Plebeian Long-horned Beetle	5-24	A	B		U	C	G	G5	S1
Etorofus subhamatus	Hemlock Long-horned Beetle	50-99	EF	D		U	C	G	G5	S3?
Evodinus monticola	Flower Longhorn Beetle	100-499	F	DE		U	C	G	G5	S4
Gaurotes cyanipennis	Cyan Long-horned Beetle	100-499	F	D		U	C	AF	G5	S3
Gaurotes thoracica	a long-horned beetle	5 or fewer				U	C	U		SH

Scientific name	Common Name	Number of Records	Range Extent	AOO	# Occur	Threat Impact	Intrins Vuln	Long-term Trend	G-rank	S-rank
Gnathacmaeops pratensis	Meadow Flower Longhorn Beetle	5-24				U	C	U	G5	SH
Grammoptera exigua	Confined Long-horned Beetle	25-49				U	C	AB	GNR	SH
Grammoptera haematites	Dogwood Long-horned Beetle	50-99	A	B		U	C	AF	G5	S1
Grammoptera molybdica	Metallic Long-horned Beetle	5 or fewer				U	C	U	G5	SH
Grammoptera subargentata	Silver Flower Longhorn Beetle	25-49	A	A		U	C	AD	G5	S1
Idiopidonia pedalis	Tawny-legged Long-horned Beetle	5-24	A	A		U	C	AF	G5	S1
Judolia cordifera	Chestnut Long-horned Beetle	100-499	F	EI		U	C	G	GNR	S4S5
Judolia montivagans	Mountain Flower Longhorn Beetle	5-24	A	B		U	C	U	G5	S1
Leptorhabdium pictum	a long-horned beetle	50-99	F	D		U	C	G		S4
Leptura abdominalis	a long-horned beetle	5 or fewer	A	B		U	C	U		S1
Lepturobosca chrysocoma	Golden Flower Longhorn Beetle	5-24				U	C	U	G5	SH
Lepturopsis biforis	Two-spotted Long-horned Beetle	50-99	F	D		U	C	AF	G5	S3
Lepturopsis dolorosa	Sorrowful Long-horned Beetle	5 or fewer							GNR	SU
Metacmaeops vittata	Striped Long-horned Beetle	100-499	F	D		U	C	AF	GNR	S3
Necydalis mellita	Slender Long-horned Beetle	5-24	D	C		U	C	U	GNR	SU
Neoalosterna capitata	Helmet Long-horned Beetle	25-49				U	C	AB	G5	SH
Pidonia aurata	a long-horned beetle	5-24				U	C	AB		SH
Pidonia ruficollis	Stripe-legged Long-horned Beetle	100-499	EF	D		U	C	AF	G5	S3
Pidonia vibex	Dented Long-horned Beetle	25-49	CD	D		U	C	U	GNR	SU
Pseudogaurotina abdominalis	Orange-bellied Long-horned Beetle	25-49	D	C		U	C	AF	GNR	S2S3
Pseudostrangalia cruentata	Cruel Long-horned Beetle	5-24				U	C	U	GNR	SH
Pygoleptura nigrella	Rusty Flower Longhorn Beetle	5-24				U	C	AB	G5	SH
Rhagium inquisitor	Ribbed Pine Borer	100-499	DE	D		U	C	AF	G5	S3
Sachalinobia rugipennis	Rough-winged Long-horned Beetle	5-24				U	C	U	G5	SH
Stenelytrana emarginata	Black-tipped Long-horned Beetle	25-49	EF	D		U	C	G	GNR	S3?
Stenocorus cinnamopterus	a longhorned beetle	5-24	A	A		U	C	U	GNR	S1
Stenocorus cylindricollis	a longhorned beetle	5-24				U	C	AB	GNR	SH
Stenocorus schaumii	Schaum's Longhorn Beetle	25-49	F	D		U	C	G	GNR	S4
Stenocorus trivittatus	Three-striped Long-horned Beetle	5-24				U	C	AB	GNR	SH

Scientific name	Common Name	Number of Records	Range Extent	AOO	# Occur	Threat Impact	Intrins Vuln	Long-term Trend	G-rank	S-rank
Stenocorus vittiger	Shrub Long-horned Beetle	25-49	A	B		U	C	AF	GNR	S1
Stictoleptura canadensis	Red-shouldered Long-horned Beetle	100-499	F	EI		U	C	G	G5	S4S5
Strangalepta abbreviata	Abbreviated Long-horned Beetle	100-499	F	EI		U	C	AF	G5	S3S5
Strangalia acuminata	Pointed Long-horned Beetle	50-99	D	C		U	C	G	GNR	S3
Strangalia bicolor	Bicoloured Long-horned Beetle	5-24				U	C	U	GNR	SH
Strangalia famelica	a longhorned beetle	100-499	EF	DE		U	C	G	GNR	S3S4
Strangalia luteicornis	Pale-horned Long-horned Beetle	100-499	F	EI		U	C	G	GNR	S4S5
Strangalia sexnotata	Six-spotted Flower Strangalia	5 or fewer	F	C		U	C	U		SU
Strophiona nitens	Chestnut Bark Long-horned Beetle	50-99	F	C		U	C	AD	G5	S3
Trachysida aspera	Rough Flower Longhorn Beetle	5 or fewer				U	C	U	G5	SH
Trachysida mutabilis	Variable Flower Longhorn Beetle	100-499	E	C		U	C	AD	G5	S3
Trigonarthris atrata	a flower longhorn beetle	5 or fewer	E	C		U	C	U		SU
Trigonarthris minnesotana	Minnesota Long-horned Beetle	25-49	BC	B		U	C	AF	G5	S1
Trigonarthris proxima	Proximal Long-horned Beetle	100-499	DF	D		U	C	AF	G5	S3
Typocerus acuticauda	Thin-tailed Long-horned Beetle	25-49	F	D		U	C	G	GNR	S4
Typocerus deceptus	a longhorned beetle	5 or fewer	CD	C		U	C	U		SU
Typocerus lugubris	Mournful Long-horned Beetle	5-24	E	C		U	C	AF	GNR	S3
Typocerus sinuatus	a longhorned beetle	5 or fewer				U	C	U		SH
Typocerus velutinus	Banded Longhorn	500 or more	F	FI		U	C	G	G5	S4S5
Typocerus zebra	a longhorned beetle	5-24	A	B		U	C	U	GNR	S1
Xestoleptura octonotata	Long-winged Long-horned Beetle	25-49	DE	C		U	C	AF	GNR	S2S3
<u>Coleoptera: Scarabaeidae</u>										
Trichiotinus affinis	Hairy Flower Scarab	100-499	EF	EI		U	C	AF	G5	S3S5
Trichiotinus assimilis	Bee-mimic Beetle	50-99	E	D		U	C	AF	G5	S3
Trichiotinus bibens	a scarab beetle	5-24				U	C	U	G4	SH
Trichiotinus piger	Bee-like Flower Scarab	50-99	A	B		U	C	AF	G5	S1
Trichiotinus texanus	Texas Flower Scarab	5 or fewer				U	C	U	G5	SH
Trichiotinus viridans	Greenish Flower Chafer	5-24				U	C	U	G4	SH

Scientific name	Common Name	Number of Records	Range Extent	AOO	# Occur	Threat Impact	Intrins Vuln	Long-term Trend	G-rank	S-rank
<u>Diptera: Bombyliidae</u>										
Bombylius atriceps	Black-headed Bee Fly	5 or fewer	A	A		U	C	U	GNR	S1
Bombylius comanche	Comanche Bee Fly	5 or fewer	C	C		U	C	U	GNR	SU
Bombylius fraudulentus	Deceitful Bee Fly	5 or fewer	BE	C		U	C	U	GNR	SU
Bombylius fulvibasoides	a bee fly	5 or fewer	A	A		U	C	U		S1
Bombylius incanus	a bee fly	25-49	F	D		U	C	HI	GNR	S4
Bombylius major	Major Bee Fly	100-499	F	EI		U	C	HI	G5	S4S5
Bombylius mexicanus	Mexican Bee Fly	5-24	AC	C		U	C	U	GNR	SU
Bombylius pulchellus	Beautiful Bee Fly	5 or fewer				U	C	U	GNR	SH
Bombylius pygmaeus	Pygmy Bee Fly	25-49	F	D		U	C	U	G5	SU
Bombylius varius	a bee fly	5-24	C	C		U	C	U		SU
<u>Diptera: Syrphidae</u>										
Blera analis	Orange-tailed Wood Fly	25-49	E	C		U	C	AD	G5	S3
Blera armillata	Orange-faced Wood Fly	5 or fewer	A	A		U	C	U	G5	S1
Blera badia	Common Wood Fly	25-49	F	D		U	C	G	G5	S4
Blera confusa	Confusing Wood Fly	5-24	D	C		U	C	G	G5	S3
Blera nigra	Golden-haired Wood Fly	5-24	F	D		U	C	G	G5	S4
Blera notata	Ornate Wood Fly	5 or fewer				U	C	U	GNR	SH
Blera pictipes	Painted Wood Fly	5-24	AB	B		U	C	U	G4G5	S1
Blera umbratilis	Hairy Wood Fly	5-24	A	A		U	C	U	G4G5	S1
Brachyopa caesariata	Plain-winged Sapeater	5 or fewer				U	C	U	G5	SH
Brachyopa daeckei	Black-tailed Sapeater	5 or fewer				U	C	U	G4G5	SH
Brachyopa flavescens	Yellow Sapeater	5-24	F	C		U	C	U	G5	SU
Brachyopa notata	Black-banded Sapeater	5-24	F	D		U	C	G	G5	S4
Brachyopa perplexa	Hairy-striped Sapeater	5-24	F	C		U	C	U	G4G5	SU
Brachyopa vacua	Yellow-spotted Sapeater	5-24	A	A		U	C	AF	G5	S1
Brachypalpus cyanogaster	Bluebottle Catkin Fly	5 or fewer							GNR	SU

Scientific name	Common Name	Number of Records	Range Extent	AOO	# Occur	Threat Impact	Intrins Vuln	Long-term Trend	G-rank	S-rank
Brachypalpus oarus	Eastern Catkin Fly	25-49	F	D		U	C	G	G5	S4
Ceriana abbreviata	Northern Wasp Fly	5 or fewer	A	A		U	C	U	G5	S1
Ceriana willistoni	Williston's Wasp Fly	5-24	E	C		U	C	HI	G5	S3
Chalcosyrphus anomalus	Long-tailed Leafwalker	5 or fewer				U	C	U	G4G5	SH
Chalcosyrphus anthreas	Yellow-banded Leafwalker	5-24	F	D		U	C	G	G5?	S4
Chalcosyrphus chalybeus	Violet Leafwalker	50-99	F	D		U	C	G	G5	S4
Chalcosyrphus curvaria	Yellow-haltered Leafwalker	5-24	A	B		U	C	AF	G5	S1S2
Chalcosyrphus femoratus	a leafwalker fly	5 or fewer				U	C	U		SH
Chalcosyrphus inarmatus	Yellow-haired Leafwalker	5 or fewer				U	C	U	G5	SH
Chalcosyrphus libo	Long-haired Leafwalker	50-99	F	D		U	C	HI	G5	S4
Chalcosyrphus metallifer	Orange-horned Leafwalker	5-24	A	A		U	C	U	G4G5	S1
Chalcosyrphus nemorum	Dusky-banded Leafwalker	100-499	F	EI		U	C	G	G5	S4S5
Chalcosyrphus piger	Short-haired Leafwalker	25-49	F	D		U	C	G	G5	S4
Chalcosyrphus plesia	Black-hipped Leafwalker	5 or fewer	F	C		U	C	U	G4G5	SU
Chalcosyrphus vecors	Orange-hipped Leafwalker	5-24	F	D		U	C	G	G4G5	S4
Criorhina nigriventris	Bare-cheeked Bumblefly	5-24	F	D		U	C	HI	G5	S2S3
Criorhina verbosa	Hairy-cheeked Bumblefly	5-24	F	C		U	C	G	G5	S1S3
Cynorhinella longinasus	Eastern Longnose	5 or fewer	A	A		U	C	U	G4G5	S1
Doros aequalis	Canadian Potterfly	5-24	A	B		U	C	U	G5	S1
Ferdinandea buccata	Common Copperback	5-24	F	C		U	C	G	G5	S3
Hammerschmidtia rufa	Black-bristled Logsitter	5 or fewer	A	B		U	C	U	G5	S1
Hammerschmidtia sedmani	Pale-bristled Logsitter	5 or fewer	A	B		U	C	U	G5	S1
Lejota aerea	Golden Trunksitter	5-24	F	D		U	C	HI	G5?	S4
Lejota cyanea	Cobalt Trunksitter	5 or fewer	A	B		U	C	U	G3G5	S1
Mallota bautias	Bare-eyed Mimic	100-499	F	EI		U	C	G	G5	S4S5
Mallota cimbiciformis	a bumblebee mimic	5 or fewer				U	C	U		SH
Mallota mississipensis	Eastern Mimic	5 or fewer				U	C	U	GNR	SH
Mallota posticata	Hairy-eyed Mimic	100-499	F	EI		U	C	G	G5	S4S5
Microdon abditus	Broad-footed Ant Fly	5-24	D	C		U	C	U	G5?	SU

Scientific name	Common Name	Number of Records	Range Extent	AOO	# Occur	Threat Impact	Intrins Vuln	Long-term Trend	G-rank	S-rank
Microdon abstrusus	Hidden Ant Fly	5 or fewer				U	C	U	G1G3	SH
Microdon adventitius	Southeastern Ant Fly	5 or fewer				U	C	U	GNR	SH
Microdon aurulentus	Golden-haired Ant Fly	5 or fewer	A	A		U	C	U	G4?	S1
Microdon cothurnatus	Orange-legged Ant Fly	5 or fewer	A	A		U	C	U	G4G5	S1
Microdon craigheadii	Large Metallic Ant Fly	5 or fewer	A	B		U	C	U	G4G5	S1
Microdon fuscipennis	Short-horned Ant Fly	5 or fewer				U	C	U	GH	SH
Microdon globosus	Globular Ant Fly	5-24	A	A		U	C	AD	G5	S1
Microdon manitobensis	Greater Ant Fly	5-24	F	C		U	C	U	G5	SU
Microdon megalogaster	Black-bodied Ant Fly	5 or fewer				U	C	U	G5?	SH
Microdon ocellaris	Hairy-legged Ant Fly	5 or fewer				U	C	U	G4G5	SH
Microdon ruficrus	Spiny-shield Ant Fly	5 or fewer	A	B		U	C	U	G5	S1
Microdon tristis	Long-horned Ant Fly	5-24	F	D		U	C	G	G5	S4
Milesia virginiensis	Virginia Giant	50-99	F	D		U	C	G	G5	S4
Myolepta nigra	Black Pegleg	5-24	F	C		U	C	G	G5	S3
Myolepta pretiosa	Dusted Pegleg	5 or fewer	A	A		U	C	U	GU	S1
Myolepta strigilata	Scaled Pegleg	5 or fewer	A	A		U	C	U	G5	S1
Myolepta varipes	Orange-banded Pegleg	5-24	EF	C		U	C	U	G4G5	SU
Pterallastes thoracicus	Goldenback	5-24	EF	D		U	C	G	G5	S3?
Somula decora	Spotted Wood Fly	50-99	F	D		U	C	G	G5	S4
Sphecomyia vittata	Long-horned Yellowjacket Fly	25-49	F	D		U	C	G	G5	S4
Sphegina albipes	Spotted Pufftail	5 or fewer				U	C	U	GNR	SH
Sphegina appalachiensis	Appalachian Pufftail	5 or fewer				U	C	U	GU	SH
Sphegina brachygaster	Thick-waisted Pufftail	5 or fewer	A	A		U	C	U	G5	S1
Sphegina campanulata	Orange-horned Pufftail	5-24	F	D		U	C	G	G5?	S4
Sphegina flavimana	Tuberculate Pufftail	5-24	EF	C		U	C	G	G4G5	S3
Sphegina flavomaculata	Tooth-legged Pufftail	5-24	E	C		U	C	U	G3G5	SU
Sphegina keeniana	Peg-legged Pufftail	5-24	F	D		U	C	HI	G4G5	S4
Sphegina lobata	Yellow-lobed Pufftail	25-49	F	D		U	C	G	G4G5	S4
Sphegina lobulifera	Black-lobed Pufftail	5-24	F	D		U	C	U	G4G5	SU

Scientific name	Common Name	Number of Records	Range Extent	AOO	# Occur	Threat Impact	Intrins Vuln	Long-term Trend	G-rank	S-rank
Sphegina petiolata	Long-spined Pufftail	5-24	F	D		U	C	U	G5	SU
Sphegina rufiventris	Black-horned Pufftail	5-24	F	D		U	C	G	G5	S4
Spilomyia alcimus	Broad-banded Hornet Fly	50-99	EF	EI		U	C	G	G5	S4S5
Spilomyia fusca	Bald-faced Hornet Fly	100-499	F	EI		U	C	G	G5	S4S5
Spilomyia longicornis	Eastern Hornet Fly	100-499	F	EI		U	C	G	G5	S4S5
Spilomyia sayi	Four-lined Hornet Fly	50-99	F	D		U	C	G	G5	S4
Temnostoma alternans	Wasp-like Falsehorn	50-99	F	D		U	C	G	G5	S4
Temnostoma balyras	Yellow-haired Falsehorn	50-99	F	EI		U	C	G	G5	S4S5
Temnostoma barberi	Bare-bellied Falsehorn	5-24	F	D		U	C	G	G5	S4
Temnostoma bombylans	a hoverfly	5-24				U	C	AB		SH
Temnostoma daochus	Yellow-spotted Falsehorn	5 or fewer	A	A		U	C	U	G5	S1
Temnostoma excentrica	Black-spotted Falsehorn	25-49	F	D		U	C	G	G5	S4
Temnostoma trifasciatum	Three-lined Falsehorn	5-24	F	D		U	C	HI	G5?	S4
Temnostoma venustum	Black-banded Falsehorn	5 or fewer				U	C	U	G4G5	SH
Teuchocnemis bacuntius	a syrphid fly	5-24				U	C	U		SH
Teuchocnemis lituratus	Black Spur Fly	25-49	E	C		U	C	AD	G5	S3
Xanthogramma flavipes	American Harlequin	50-99	F	DE		U	C	G	G5	S4
Xylota angustiventris	Two-spotted Leafwalker	25-49	A	B		U	C	G	G5?	S1
Xylota annulifera	Longspine Leafwalker	5-24	F	D		U	C	HI	G5	S4
Xylota barbata	Black Leafwalker	5 or fewer				U	C	U	GNR	SH
Xylota bicolor	Eastern Orange-tailed Leafwalker	5-24	A	A		U	C	U	G5	S1
Xylota confusa	Confusing Leafwalker	5-24	F	D		U	C	HI	G5	S4
Xylota ejuncida	Polished Leafwalker	50-99				U	C	AB	G4G5	SH
Xylota flavifrons	Northern Leafwalker	5 or fewer	A	A		U	C	U	G5	S1
Xylota flukei	Fringeless Leafwalker	5 or fewer	A	B		U	C	U	G5	S1
Xylota hinei	Hine's Leafwalker	5-24	F	D		U	C	HI	G5	S4
Xylota naknek	Naknek Leafwalker	5 or fewer	A	B		U	C	U	G3G5	S1
Xylota ouelleti	Black-haired Leafwalker	5-24				U	C	AB	G5	SH
Xylota quadrimaculata	Four-spotted Leafwalker	100-499	F	EI		U	C	G	G5	S4S5

Scientific name	Common Name	Number of Records	Range Extent	AOO	# Occur	Threat Impact	Intrins Vuln	Long-term Trend	G-rank	S-rank
Xylota segnis	Brown-toed Leafwalker	5-24	E	C		U	C	U	GNR	SU
Xylota subfasciata	Large-spotted Leafwalker	25-49	F	D		U	C	HI	G5	S3S4
Xylota tuberculata	Short-spined Leafwalker	5 or fewer	A	A		U	C	U	GU	S1
Xylota undescribed sp. 78-1	a leafwalker fly	5 or fewer	EF	C		U	C	U		SU
Xylota undescribed sp. 78-3	a leafwalker fly	5 or fewer	A	B		U	C	U		S1
<u>Hymenoptera: Andrenidae</u>										
Andrena accepta	Two-spotted Miner Bee	5 or fewer				BC		U	GNR	SH
Andrena algida	Icy Miner Bee	50-99	F	D		BC		G	G5	S3?
Andrena aliciae	Yellow-faced Miner Bee	5-24	A	A		BC		U	GNR	S1
Andrena alleghaniensis	Appalachian Miner Bee	100-499	F	EI		BC		G	G5	S3S4
Andrena andrenoides	Colourful Willow Miner Bee	5 or fewer				BC		U	GNR	SH
Andrena arabis	Mustard Miner Bee	500 or more	DF	D		BC		AF	GNR	S2S3
Andrena asteris	Aster Miner Bee	100-499	F	D		BC		G	GNR	S3?
Andrena banksi	an andrenid bee	5 or fewer	A	B		BC		U	GNR	S1
Andrena barbara	Barbara's Miner	25-49	F	D		BC		HI	GNR	S3
Andrena barbilabris	Bearded Miner Bee	100-499	EF	EI		BC		AF	G5	S2S4
Andrena bisalicis	Eastern Willow Miner Bee	100-499	F	D		BC		G	GNR	S3?
Andrena braccata	a mining bee	100-499	F	C		BC		AF	GNR	S2?
Andrena bradleyi	Bradley's Miner Bee	100-499	F	D		BC		G	GNR	S3?
Andrena brevipalpis	Short-tongued Miner Bee	100-499	F	D		BC		AF	GNR	S2S3
Andrena canadensis	Canada Miner Bee	50-99	F	D		BC		AF	GNR	S2S3
Andrena carlini	Carlinville Miner Bee	500 or more	F	FI		BC		G	G5	S3S5
Andrena carolina	Carolina Miner Bee	100-499	F	EI		BC		G	GNR	S3S4
Andrena ceanothi	Ceanothus Miner Bee	50-99	F	D		BC		G	G5	S3?
Andrena ceanothifloris	Ceanothus Flower Miner Bee	5-24				BC		U	GNR	SH
Andrena chromotricha	Pigmented Miner Bee	5-24	EF	D		BC		HI	GNR	S2S3
Andrena clarkella	Clark's Miner Bee	50-99	EF	D		BC		G	GNR	S2S3
Andrena commoda	Advantaged Miner Bee	100-499	EF	EI		BC		G	GNR	S3S4

Scientific name	Common Name	Number of Records	Range Extent	AOO	# Occur	Threat Impact	Intrins Vuln	Long-term Trend	G-rank	S-rank
Andrena confederata	an andrenid bee	5-24	F	C		BC		U	GNR	S2S3
Andrena cornelli	a mining bee	5-24	A	A		BC		AD	GNR	S1
Andrena crataegi	Hawthorn Miner Bee	500 or more	F	FI		BC		G	G5	S3S5
Andrena cressonii	Yellow-legged Miner Bee	500 or more	F	EI		BC		G	G5	S3S4
Andrena distans	Distant Miner Bee	50-99	F	D		BC		G	GNR	S3?
Andrena dunningi	Dunning's Miner Bee	100-499	EF	EI		BC		G	G5	S3S4
Andrena duplicata	a mining bee	5-24	A	A		BC		U	GNR	S1
Andrena erigeniae	Spring Beauty Miner Bee	100-499	F	EI		BC		G	GNR	S3S4
Andrena erythrogaster	Red-bellied Miner Bee	100-499	EF	C		BC		AF	GNR	S2?
Andrena erythronii	Trout Lily Miner Bee	50-99	EF	D		BC		G	GNR	S2S3
Andrena forbesii	Forbes's Miner Bee	500 or more	F	EI		BC		G	G5	S3S4
Andrena fragilis	Fragile Miner Bee	100-499	F	EI		BC		AF	GNR	S2S4
Andrena frigida	Cold Miner Bee	100-499	F	EI		BC		G	GNR	S3S4
Andrena fulvipennis	an andrenid bee	5 or fewer				BC		U	GNR	SH
Andrena geranii	Geranium Miner Bee	50-99	F	D		BC		HI	GNR	S3
Andrena helianthi	Sunflower Miner Bee	25-49	BD	C		BC		AF	GNR	S1S2
Andrena heraclei	an andrenid bee	5-24	A	B		BC		U	GNR	S1
Andrena hilaris	an andrenid bee	5-24	A	B		BC		U	GNR	S1
Andrena hippotes	Hippotes's Miner Bee	500 or more	F	EI		BC		G	G5	S3S4
Andrena hirticincta	Hairy-belted Miner Bee	500 or more	F	EI		BC		G	GNR	S3S4
Andrena ilicis	an andrenid bee	5-24	EF	C		BC		U	GNR	S2S3
Andrena illinoiensis	Tufted Miner Bee	5-24				BC		U	GNR	SH
Andrena imitatrix	Imitator Miner Bee	500 or more	F	EI		BC		G	G5	S3S4
Andrena integra	Intact Miner Bee	100-499	EF	DE		BC		AF	GNR	S2S3
Andrena krigiana	an andrenid bee	25-49	A	B		BC		AF	GNR	S1
Andrena mandibularis	Toothed Miner Bee	100-499	F	EI		BC		G	G5	S3S4
Andrena mariae	Maria Miner Bee	50-99	F	D		BC		U	GNR	S3?
Andrena melanochroa	Rose Miner Bee	50-99	F	C		BC		AF	GNR	S2
Andrena milwaukeensis	Milwaukee Miner Bee	100-499	F	EI		BC		G	G5	S3S4

Scientific name	Common Name	Number of Records	Range Extent	AOO	# Occur	Threat Impact	Intrins Vuln	Long-term Trend	G-rank	S-rank
Andrena miranda	Singular Miner Bee	100-499	F	D		BC		AD	G5	S2S3
Andrena miserabilis	Smooth-faced Miner Bee	500 or more	F	EI		BC		G	G5	S3S4
Andrena morrisonella	Morrison's Miner Bee	50-99	F	D		BC		HI	GNR	S3
Andrena nasonii	Bumped Miner Bee	500 or more	F	F		BC		G	G5	S3S4
Andrena neonana	an andrenid bee	5-24	F	C		BC		U	GNR	S2S3
Andrena nida	a mining bee	25-49	A	A		BC		U	GNR	S1
Andrena nigrae	Black Miner Bee	50-99	E	C		BC		G	GNR	S2
Andrena nigrihirta	Black-haired Miner Bee	25-49	F	D		BC		G	G5	S3?
Andrena nivalis	Snow Miner Bee	100-499	F	EI		BC		G	G5	S3S4
Andrena nubecula	Cloudy-winged Miner Bee	100-499	F	EI		BC		G	GNR	S3S4
Andrena nuda	Naked Miner Bee	100-499	F	EI		BC		GI	GNR	S3S5
Andrena peckhami	Peckham's Miner Bee	5-24	F	C		BC		U	GNR	S2S3
Andrena perplexa	Perplexed Miner Bee	500 or more	F	EI		BC		G	GNR	S3S4
Andrena persimulata	Protuberance Miner Bee	100-499	D	D		BC		AD	GNR	S2
Andrena personata	an andrenid bee	5 or fewer	A	A		BC		U	GNR	S1
Andrena placata	Peaceful Miner Bee	100-499	F	D		BC		G	GNR	S3?
Andrena platyparia	Plated Miner Bee	100-499	F	EI		BC		G	GNR	S3S4
Andrena pruni	an andrenid bee	100-499	EF	EI		BC		G	GNR	S3S4
Andrena regularis	Regular Miner Bee	500 or more	EF	EI		BC		G	G5	S3S4
Andrena rehni	Rehn's Miner Bee	5-24				BC		U	GNR	SH
Andrena robertsonii	Robertson's Miner Bee	100-499	F	EI		BC		G	G5	S3S4
Andrena robervalensis	a miner bee	5 or fewer				BC		U	GNR	SH
Andrena rufosignata	Red-faced Miner Bee	100-499	F	EI		BC		G	G5	S3S4
Andrena rugosa	Wrinkled Miner Bee	500 or more	F	EI		BC		G	G5	S3S4
Andrena runcinatae	Planed Miner Bee	25-49	A	A		BC		U	G5	S1
Andrena salictaria	Small Willow Miner Bee	100-499	CD	C		BC		AF	GNR	S1S2
Andrena sigmundi	Sigmund's Miner Bee	100-499	EF	D		BC		AF	GNR	S2S3
Andrena simplex	Simple Miner Bee	100-499	F	D		BC		G	GNR	S3?
Andrena sola	Lonely Miner Bee	5 or fewer				BC		U	GNR	SH

Scientific name	Common Name	Number of Records	Range Extent	AOO	# Occur	Threat Impact	Intrins Vuln	Long-term Trend	G-rank	S-rank
Andrena spiraeana	Goatsbeard Miner Bee	100-499	F	EI		BC		G	GNR	S3S4
Andrena thaspii	Parsnip Miner Bee	100-499	F	EI		BC		G	G5	S3S4
Andrena tridens	Trident Miner Bee	100-499	EF	EI		BC		G	G5	S3S4
Andrena uvulariae	a mining bee	5-24	A	A		BC		U	GNR	S1
Andrena vicina	Neighbouring Miner Bee	500 or more	F	FI		BC		G	G5	S3S5
Andrena violae	an andrenid bee	5-24	F	D		BC		HI	GNR	S3
Andrena virginiana	Virginia Miner Bee	25-49	F	D		BC		G	G5	S3?
Andrena wheeleri	Wheeler's Miner Bee	50-99	F	D		BC		G	G5	S3?
Andrena wilkella	European Legume Miner Bee	500 or more	F	FI		BC		G	GNR	SNA
Andrena w-scripta	W-marked Miner Bee	100-499	EF	D		BC		AF	G5	S2S3
Andrena ziziae	Golden Alexanders Miner Bee	100-499	E	D		BC		G	GNR	S2S3
Andrena ziziaeformis	an andrenid bee	5-24				BC		U	GNR	SH
Calliopsis andreniformis	Eastern Miner Bee	100-499	F	EI		BC		G	G5	S3S4
Panurginus potentillae	a miner bee	5 or fewer	A	A		BC		U	GNR	S1
<u>Hymenoptera: Apidae</u>										
Bombus affinis	Rusty-patched Bumble Bee	500 or more				B		AB	G2	SH
Bombus ashtoni (= *bohemicus*)	Ashton Cuckoo Bumble Bee	100-499				B		AB	G3G5	SH
Bombus auricomus	Black-and-gold Bumble Bee	100-499	F	E	B	B		G	G5	S2
Bombus bimaculatus	Two-spotted Bumble Bee	500 or more	FG	G	D		C	HI	G5	S4S5
Bombus borealis	Northern Amber Bumble Bee	100-499	F	F	C	B		G	G4G5	S3
Bombus citrinus	Lemon Cuckoo Bumble Bee	500 or more	F	E	C	B		AF	G4	S2S3
Bombus fervidus	Yellow Bumble Bee	500 or more	F	F	D	B		G	G3G4	S3
Bombus flavidus	Fernald's Cuckoo Bumble Bee	50-99	F	D	B	B		G	G5?	S2
Bombus griseocollis	Brown-belted Bumble Bee	500 or more	FG	G	D		C	HI	G5	S4S5
Bombus impatiens	Common Eastern Bumble Bee	500 or more	FG	GH	D		C	HI	G5	S5
Bombus insularis	Indiscriminate Cuckoo Bumble Bee	5-24				B		U	G3	SH
Bombus pensylvanicus	American Bumble Bee	100-499	F	DE	B	B		AD	G3G4	S2
Bombus perplexus	Confusing Bumble Bee	500 or more	F	F	D	B		G	G5	S3

Scientific name	Common Name	Number of Records	Range Extent	AOO	# Occur	Threat Impact	Intrins Vuln	Long-term Trend	G-rank	S-rank
Bombus rufocinctus	Red-belted Bumble Bee	100-499	F	E	C	B		G	G5	S3
Bombus sandersoni	Sanderson's Bumble Bee	100-499	F	E	C	B		G	G5	S3
Bombus suckleyi	Suckley's Cuckoo Bumble Bee	5 or fewer				B		U	G2G3	SH
Bombus ternarius	Tri-colored Bumble Bee	500 or more	F	FI	D		C	G	G5	S4S5
Bombus terricola	Yellow-banded Bumble Bee	500 or more	F	F	D	B		G	G3G4	S3
Bombus vagans	Half-black Bumble Bee	500 or more	FG	FI	D		C	G	G4	S5
Bombus variabilis	Variable Cuckoo Bumble Bee	5 or fewer				B		U	G1G2	SH
Epeoloides pilosula	Macropis Cuckoo Bee	5-24	A	A		BC		AD	GU	S1
Melissodes agilis	Agile Long-horned Bee	100-499	EF	D		BC		G	GNR	S2S3
Melissodes apicatus	Pickerelweed Long-horned Bee	5-24	F	D		BC		G		S3?
Melissodes bidentis	Two-toothed Long-horned Bee	5-24	E	C		BC		U	GNR	S2
Melissodes bimaculatus	Two-spotted Long-horned Bee	500 or more	F	FI		BC		G		S3S5
Melissodes boltoniae	a callirhoe bee	5 or fewer	A	B		BC		U	GNR	S1
Melissodes denticulatus	Denticulate Long-horned Bee	100-499	F	EI		BC		G	GNR	S3S4
Melissodes dentiventris	Tooth-bellied Long-horned Bee	25-49	E	D		BC		U	GNR	S2S3
Melissodes desponsus	Thistle Long-horned Bee	500 or more	F	EI		BC		G		S3S4
Melissodes druriellus	Drury's Long-horned Bee	100-499	F	EI		BC		G		S3S4
Melissodes fumosus	a callirhoe bee	5 or fewer	A	A		BC		U		S1
Melissodes glenwoodensis	a callirhoe bee	5 or fewer				BC		U	GNR	SH
Melissodes illatus	Valiant Long-horned Bee	100-499	F	EI		BC		G		S3S4
Melissodes lustrus	a callirhoe bee	5 or fewer				BC		U		SH
Melissodes niveus	a callirhoe bee	5 or fewer	E	C		BC		U		S2
Melissodes subillatus	Vigorous Long-horned Bee	50-99	F	EI		BC		G		S3S4
Melissodes trinodis	Three-knotted Long-horned Bee	100-499	EF	EI		BC		G	GNR	S3S4
Melissodes vernoniae	a callirhoe bee	5 or fewer				BC		U	GNR	SH
Hymenoptera: Megachilidae										
Megachile addenda	Cranberry Leafcutter Bee	25-49	F	D		BC		U	G5	S3?
Megachile apicalis	Apical Leafcutter Bee	5-24	D	D		BC		U	G4G5	SNA

Scientific name	Common Name	Number of Records	Range Extent	AOO	# Occur	Threat Impact	Intrins Vuln	Long-term Trend	G-rank	S-rank
Megachile brevis	Short Leafcutter Bee	50-99	F	DE		BC		G	G5	S3?
Megachile campanulae	Bellflower Leafcutter Bee	100-499	F	EI		BC		G	G5	S3S4
Megachile centuncularis	Common Leafcutter Bee	100-499	EF	EI		BC		G	G5	S3S4
Megachile ericetorum	a leafcutter bee	5 or fewer	A	B		BC		U		S1
Megachile frigida	Frigid Leafcutter Bee	50-99	F	EI		BC		G	G5	S3S4
Megachile frugalis	a leafcutter bee	5-24	A	B		BC		U	G4G5	S1
Megachile gemula	Small-handed Leafcutter Bee	100-499	F	EI		BC		G	G5	S3S4
Megachile gentilis	Gentle Leafcutter Bee	5 or fewer	A	A		BC		U	G5	S1
Megachile georgica	a leafcutter bee	5-24	A	B		BC		U	G4	S1
Megachile inermis	Unarmed Leafcutter Bee	100-499	F	EI		BC		G	G5	S3S4
Megachile inimica	Hostile Leaf-cutter Bee	25-49	EF	D		BC		HI	G5	S2S3
Megachile lapponica	Lapland Leafcutter Bee	25-49	F	E		BC		HI	G5	S3
Megachile latimanus	Broad-handed Leafcutter Bee	100-499	F	EI		BC		G	G5	S3S4
Megachile lippiae	Lippia Leafcutter Bee	5-24	CF	D		BC		U	G5	S2S3
Megachile melanophaea	Black-and-gray Leafcutter Bee	25-49	F	D		BC		AF	G5	S2S3
Megachile mendica	Beggar Leafcutter Bee	500 or more	FG	FI		BC		G	G5	S3S5
Megachile montivaga	Hills Leafcutter Bee	25-49	F	D		BC		HI	G5	S3
Megachile mucida	a leafcutter bee	5-24	DE	C		BC		U	G4	S2
Megachile petulans	Petulant Leaf-cutter Bee	100-499	A	A		BC		U	G5	S1
Megachile pugnata	Pugnacious Leafcutter Bee	100-499	EF	EI		BC		GI	G5	S3S5
Megachile pusilla	a leaf-cutter bee	25-49	C	D		BC		U	G5	SNA
Megachile relativa	Relative Leafcutter Bee	100-499	F	EI		BC		G	G5	S3S4
Megachile rotundata	Alfalfa Leafcutter Bee	100-499	EF	EI		BC		G	G5	SNA
Megachile rugifrons	a leafcutter bee	5 or fewer				BC		U	G2G3	SH
Megachile sculpturalis	Giant Leafcutter Bee	500 or more	F	FI		BC		HI	G5	SNA
Megachile texana	Texas Leafcutter Bee	100-499	EF	EI		BC		G	G5	S3S4
Osmia albiventris	White-bellied Mason Bee	50-99	F	D		BC		G	G4?	S3?
Osmia albolateralis	White-sided Mason Bee	5 or fewer				BC		U	G5	SH
Osmia atriventris	Maine Blueberry Bee	100-499	F	EI		BC		G	G5	S3S4

Scientific name	Common Name	Number of Records	Range Extent	AOO	# Occur	Threat Impact	Intrins Vuln	Long-term Trend	G-rank	S-rank
Osmia bucephala	Bufflehead Mason Bee	100-499	F	EI		BC		G	G5	S3S4
Osmia caerulescens	Blue Mason Bee	100-499	F	C		BC		AF	G5	SNA
Osmia calaminthae	Blue Calamintha Bee	5 or fewer							G1	SU
Osmia chalybea	a mason bee	5-24	A	A		BC		U	G4G5	S1
Osmia collinsiae	Collins's Mason Bee	5-24	F	D		BC		U	G5	S3?
Osmia conjuncta	Eastern Snail Shell Mason Bee	25-49	D	D		BC		U	G5	S2S3
Osmia cornifrons	Hornfaced Bee	500 or more	F	EI		BC		HI	G5	SNA
Osmia distincta	Distinct Mason Bee	50-99	F	D		BC		G	G5	S3?
Osmia felti	Felt's Mason Bee	5-24	A	B		BC		U	G2G4	S1
Osmia georgica	Georgia Mason Bee	25-49	EF	D		BC		HI	G5	S2S3
Osmia inermis	Unarmed Mason Bee	5-24	F	D		BC		HI	G5	S3
Osmia inspergens	Shiny-faced Mason Bee	5-24	F	D		BC		U	G5	S3?
Osmia laticeps	Holarctic Blueberry Mason Bee	5 or fewer	A	A		BC		U	G5	S1
Osmia lignaria	Blue Orchard Bee	100-499	F	E		BC		G	G5	S3
Osmia nigriventris	Large Black-bellied Mason Bee	5 or fewer	A	A		BC		U	G5	S1
Osmia proxima	Friendly Mason Bee	5-24	A	A		BC		AF	G4G5	S1
Osmia pumila	Dwarf Mason Bee	500 or more	F	FI		BC		G	G5	S3S5
Osmia simillima	Similar Mason Bee	25-49	AE	C		BC		AF	G5	S1S2
Osmia subarctica	a mason bee	5 or fewer	A	A		BC		U	G2G4Q	S1
Osmia taurus	a mason bee	25-49	F	D		BC		HI	G5	SNA
Osmia tersula	Wide-banded Mason Bee	5-24	D	C		BC		U	G5	S2
Osmia texana	Texas Mason Bee	5-24	A	B		BC		U	G5	S1
Osmia virga	Twig Mason Bee	25-49	F	D		BC		HI	G5	S3
<u>Hymenoptera: Melittidae</u>										
Macropis ciliata	Fringed Loosestrife Oil-collecting Bee	50-99	A	B	A	BC		AF	GNR	S1
Macropis nuda	Common Loosestrife Oil Bee	500 or more	F	D	B	BC		AF	GNR	S2?
Macropis patellata	Patellar Oil-collecting Bee	50-99	D	C	A	BC		AF	GNR	S1S2
Melitta americana	Cranberry Oil Bee	5-24				BC		U	GNR	SH

Scientific name	Common Name	Number of Records	Range Extent	AOO	# Occur	Threat Impact	Intrins Vuln	Long-term Trend	G-rank	S-rank
Melitta eickworti	Deerberry Melitta	25-49	A	A	A	BC		U	GNR	S1
Lepidoptera: Noctuidae										
Schinia arcigera	Arcigera Flower Moth	100-499	F	EI		U	C	G	G5	S4S5
Schinia florida	Evening Primrose Moth	100-499	F	EI		U	C	G	G5	S4S5
Schinia gracilenta	Slender Flower Moth	25-49	D	D		U	C	U	G4G5	SU
Schinia lynx	Lynx Flower Moth	50-99	F	D		U	C	G	G5	S4
Schinia nubila	Camphorweed Flower Moth	5-24	C	D		U	C	HI	G5	S3
Schinia nundina	Goldenrod Flower Moth	50-99	EF	D		U	C	G	G5	S3?
Schinia obscurata	Erigeron Flower Moth	5-24	F	C		U	C	G	G4	S3
Schinia rivulosa	Ragweed Flower Moth	100-499	F	E		U	C	G	G5	S4
Schinia saturata	Brown Flower Moth	5-24	C	D		U	C	U	G5	SU
Schinia septentrionalis	Northern Flower Moth	25-49				U	C	AB	G3G4	SH
Schinia spinosae	Spinose Flower Moth	25-49	D	D		U	C	U	G4	SU
Schinia thoreaui	Thoreau's Flower Moth	5 or fewer							G5	SU
Schinia trifascia	Three-lined Flower Moth	100-499	EF	DE		U	C	G	G5	S3S4
Schinia tuberculum	Golden Aster Flower Moth	25-49	A	A		U	C	U	G4	S1
Lepidoptera: Sphingidae										
Aellopos tantalus	Tantalus Sphinx	5 or fewer				U	C	U	G4G5	SNA
Aellopos titan	Titan Sphinx	5 or fewer	A	A		U	C	U	G5	SNA
Agrius cingulata	Pink-spotted Hawk Moth	25-49	F	D		U	C	G	G5	SNA
Amorpha juglandis	Walnut Sphinx Moth	100-499	F	EI		U	C	G	G5	S4S5
Amphion floridensis	Nessus Sphinx Moth	500 or more	F	FI		U	C	G	G5	S4S5
Cautethia grotei	Grote's Sphinx	5 or fewer				U	C	U	G4	SNA
Ceratomia amyntor	Elm Sphinx Moth	100-499	F	EI		U	C	G	G5	S4S5
Ceratomia catalpae	Catalpa Hornworm	25-49	DE	D		U	C	U	G5	SU
Ceratomia undulosa	Waved Sphinx Moth	500 or more	F	FI		B	C	G	G5	S3S4
Darapsa choerilus	Azalea Sphinx Moth	100-499	F	EI		U	C	AF	G5	S3S5

Scientific name	Common Name	Number of Records	Range Extent	AOO	# Occur	Threat Impact	Intrins Vuln	Long-term Trend	G-rank	S-rank
Darapsa myron	Virginia Creeper Sphinx	500 or more	F	FI		U	C	G	G5	S4S5
Darapsa versicolor	Hydrangea Sphinx	50-99	F	D		U	B	AD	G4?	S2
Deidamia inscripta	Lettered Sphinx	100-499	F	EI		D	C	G	G5	S4S5
Dolba hyloeus	Pawpaw Sphinx Moth	50-99	F	E		D	C	G	G5	S4
Enyo lugubris	Mournful Sphinx	5 or fewer				D	C	U	G5	SNA
Erinnyis ello	Ello Sphinx	5-24				D	C	AB	G5	SNA
Eumorpha achemon	Achemon Sphinx	50-99	D	C		C	C	AD	G5	SNA
Eumorpha fasciatus	Banded Sphinx	5-24	D	D		U	C	HI	G5	S3
Eumorpha pandorus	Pandorus Sphinx	500 or more	F	FI		D	C	GI	G5	S4S5
Eumorpha satellitia	Satellite Sphinx	5 or fewer	A	A		U	C	U	G5	SNA
Eumorpha vitis	Vine Sphinx	5 or fewer				U	C	U	G5	SNA
Hemaris aethra	a bumblebee clearwing	5 or fewer	A	B		U	C	U	G4	S1
Hemaris diffinis	Snowberry Clearwing	500 or more	F	FI		U	C	GI	G5	S4S5
Hemaris gracilis	Slender Clearwing	25-49	F	D		U	C	G	G3G4	S4
Hemaris thysbe	Hummingbird Clearwing	500 or more	FG	GI		U	C	GI	G5	S5
Hyles euphorbiae	Leafy Spurge Hawkmoth	5-24	F	D		U	C	U	G5	SNA
Hyles gallii	Galium Sphinx	500 or more	F	FI		D	C	G	G5	S4S5
Hyles lineata	White-lined Sphinx Moth	100-499	EF	EI		D	C	AF	G5	S3S5
Lapara bombycoides	Northern Pine Sphinx Moth	100-499	F	EI		U	C	G	G5	S4S5
Lapara coniferarum	Southern Pine Sphinx	50-99	F	D		U	C	AF	G5	S3
Lintneria eremitus	Hermit Sphinx Moth	100-499	F	EI		U	C	G	G4G5	S4S5
Manduca brontes	Cuban Sphinx Moth	5 or fewer							GNR	SNA
Manduca jasminearum	Ash Sphinx	25-49	C	C		B	C	AF	G4G5	S1
Manduca quinquemaculata	Five-spotted Hawk Moth	100-499	F	D		U	C	AD	G5	S3
Manduca rustica	Rustic Sphinx	5 or fewer	A	A		U	C	U	G5	SNA
Manduca sexta	Carolina Sphinx	100-499	F	FI		U	C	G	G5	S4S5
Pachysphinx modesta	Big Poplar Sphinx Moth	100-499	F	EI		U	C	G	G5	S4S5
Paonias astylus	Huckleberry Sphinx	50-99	E	D		U	C	G	G4G5	S3
Paonias excaecata	Blinded Sphinx Moth	500 or more	F	FI		U	C	G	G5	S4S5

Scientific name	Common Name	Number of Records	Range Extent	AOO	# Occur	Threat Impact	Intrins Vuln	Long-term Trend	G-rank	S-rank
Paonias myops	Small-eyed Sphinx Moth	500 or more	F	FI		U	C	G	G5	S4S5
Paratrea plebeja	Trumpet Vine Sphinx	5-24	D	C		D	C	G	G5	S3
Proserpinus flavofasciata	Yellow-banded Day Sphinx Moth	5 or fewer				U	BC	U	G4G5	SH
Smerinthus cerisyi	One-eyed Sphinx Moth	100-499	EF	EI		U	C	G	G5	S4S5
Smerinthus jamaicensis	Twin-spotted Sphinx Moth	100-499	F	EI		U	C	AF	G5	S3S5
Sphecodina abbottii	Abbott's Sphinx Moth	100-499	F	EI		D	C	G	G5	S4S5
Sphinx canadensis	Canadian Sphinx Moth	5-24	D	C		B	C	U	G4	S2
Sphinx chersis	Great Ash Sphinx Moth	100-499	F	EI		B	C	AD	G4	S2S4
Sphinx drupiferarum	Wild Cherry Sphinx Moth	50-99	C	C		BC	C	AD	G3G5	S1S2
Sphinx franckii	Franck's Sphinx	5 or fewer	A	A		0	C	U	G4G5	S1
Sphinx gordius	Apple Sphinx Moth	50-99	F	D		U	C	AD	G4G5	S3
Sphinx kalmiae	Fawn Sphinx Moth	100-499	F	EI		B	C	G	G5	S3S4
Sphinx luscitiosa	Clemens' Sphinx	25-49	A	A		U	C	AD	G5	S1
Sphinx poecila	Northern Apple Sphinx Moth	50-99	F	DE		U	C	G	G5	S4
Xylophanes tersa	Tersa Sphinx	50-99	DE	D		D	C	G	G5	SNA

Appendix G. ESNPS Registered Participants

Alyssa Depaula
Adele Wellman
Adriana Buller
Alan and Della Wells
Alexandra Perrin
Alison McGee
Alison Van Keuren
Alixandra Prybyla
Allison Haynes
Allison Menendez
Alyssa Johnson
Amie Reisinger
Ann Swanson
Anna Kuhne
Anna Van Fleet
Anne Benware
Ariane Harrison
Ashley Gambardella
Autumn Syracuse
Avery Gilbert
Barbara Demalderis
Barbara Hager
Bill Preston
Bill Rhodes
Brian Dagley
Brian Hardiman
Bryan Nothdurft
Budd Veverka
C. Ben Schwamb
Carley McMullen
Carol Budd
Carrick Palmer
Casey Zillman
Catherine Klatt
Celeste Seltenreich
Charlie Ippolito
Chelsea Moore
Chelsea Sheridan
Cheryld Emmons
Chris Kreussling
Chrissy Word
Christina Palmero
Christine Schlagter
Ciara Scully
Clara Holmes
Coby Klein
Courtney Whiteside
Danielle Knott
Darcy McDowell
Dave Taft
David Charles Poteet
David Wallace
Diana VanBuren
Edward Boatman-Guillan
Elise DeSantis
Elizabeth A. Janes
Emily Becker
Emily Fano
Emily Timkey
Erik Danielson
Erik Schellenberg
Evelyn Manlove
Faith Carlson
Frederica L Miller
Grace Davis
Haley Palmateer
Harold Citron
Heather MGaston
Hildur Palsdottir
Iris Cohen
Jacqueline Roytman
Jaidyn Bencivenga
Jake Stephens
Jamie Greenwood
Janet Chen
Janet Mihuc
Jay Holmes
Jen Carchidi
Jennifer Apple
Jennifer Dean
Jennifer W. Palmer
Jeremiah LaBarbera
Joanne Morrison
Johanna
John and Sue Gregoire
John Chamberlain
John Omohundro
John Wernet
Jordan Goguler
Joseph and Shonah Hayden
Joseph Okeniewski
Joshua Konovitz
Joy Pople
Judi Bogardus
Julie Eberhart
Julie Lundgren
Karalyn Lamb
Karina Cascione
Katharine Glenn
Kathy Drouin-Keith
Kathy Rooney
Kelley Wallace
Ken Zidell
Keri VanCamp
Kerissa Battle
Kerri Dikun
Kerry Crowningshield
Kevin Hemeon
Kira Broz
Kira Wesron
Kristen Whitbeck
Laurel Cardellichio
Leala Farnsworth
Lem Hegwood
Lindsay Dombroskie
Lisa Salamon
Lisa Scheppke

Logan West
Louis Ciaccio
Lydia Sweeney
M Joanne Strauss
Mark Chao
Mary Beth Kolozsvary
Mary Lee
Mary Yuen
Maryke Petruzzi
Matt Kelly
Matthew M. Kaelin
Matthew Montalto
Max Henschell
Max Proctor
Meagan Fastuca
Melanie Smith
Melissa Toussaint
Michael Keller
Michael Klepp
Michele Elyachar
Michelle Del Pin
Michelle Novak
Michelle Vanstrom
Mike Wasilco
Nadia Durante
Nancy Alessi
Olivia McLoughlin
Pam Ciaccio
Pamela Golben
Pamela Price
Pat Garber
Patricia Herbst
Patricia Martonis
Peter Clancy
Priscilla Titus
Rachel Graham
Rebecca McMackin
Renee Ruhl
Renee Stephenson
Rev. Steve Aschmann
Richard
Ro Woodard
Rob Rieb
Rosellen Hardt
Roxanne Beecher
Ryan W Hamlet
Samantha Zimmer
S. Anderson
Sandra Power
Sara Hetherington
Sara Spoden
Sarah Birnberg
Sarah Wild
Sharon Smith
Sharon Stapleton
Sonya Lauer
Sonya Marker
Stacie Bartolotta
Stephanie Minarik
Stephen Diehl
Steve Carleton
Steve Melcher
Sue Feustel
Sue Grimm Hanley
Sunghee Lee
Susan Harden
Susan Maresca
Tamika Murray
Tasha Guatney
Thomas DeVantier
Thomas LeBlanc
Thomas Winner
Tim Stanley
Tracy Willey
Trailside Museums and Zoo
Valerie Holmes
Valerie Mammoser
Vici Diehl
Vicky Skorodinsky
Wanda Moccio
Westmoreland Sanctuary
William Preston
Yemi Abioye

Lists and leader boards of iNaturalist observers and identifiers can be found here:

https://www.inaturalist.org/projects/empire-state-native-pollinator-survey
https://www.inaturalist.org/projects/esnps-collection-project