Bumble Bees of the Eastern United States

By
Sheila Colla
Leif Richardson
Paul Williams

A product of the U.S. Forest Service and the Pollinator Partnership with funding from the National Fish and Wildlife Foundation
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Foreword

Home bookshelves, school libraries, nature centers, and museum gift shops are crowded with dozens of recent field guides to the North American fauna and flora. Naturalists, young and old, inexperienced and seasoned professionals, have access to illustrated guides of all types of exciting organisms, living and dead. But where are the bee identification field guides? More than 4,000 species of native bees in the United States and Canada are generally small and lead hidden lives, going mostly unnoticed by almost everyone. Bigger bees, like bumble bees and carpenter bees, get noticed, as do the omnipresent brown and black-striped worker honey bees. Bee identification, including family, genus, and species level, usually involves highly focused specialized training. Bird and butterfly identification are comparatively easy, which is why there are more bird watchers than bug watchers, and why there are almost no guides available for bee identification. The earlier a student of bees adopts professionally recognized scientific names for bee groups, the easier it becomes. Typically in bumble bee identification, voucher specimens must be collected and compared side-by-side with museum specimens. The specimen is identified using complex professional keys buried in old and hard-to-find literature. An anonymous quotation captures the complexity of bee identification: “taxonomic keys are written by individuals who don’t need them for their populations and learn why we are losing these essential pollinators. Students and citizen scientists can help professional entomologists track their populations and learn why we are losing these essential pollinators. The Guide to Eastern Bumble Bees is an indispensible new bumble bee field guide. The field guide will enable people to identify, name and compare side-by-side with museum specimens. Each bee species has information on preferred food plants, nesting biology, similar species, along with the seasonal activity patterns for adults at flowers. Closely-cropped color photographs illustrate key color patterns and floral behaviors, while macro images highlight morphological characters and species level differences. Additionally, there are detailed dot distribution maps and dichotomous identification keys for each of the 21 species. The key refers to diagrammatic “torpedo style” color illustrations of the typical colors for castes of each species. Much of the information is presented together for the first time (e.g. dot distribution maps of species ranges). This new guide is an authoritative tool for learning about our rich and varied bumble bee fauna. This field guide will enable people to identify, name and support them as well. Like the canary in the coal mine, several bumble bees of the East, we can also identify, understand and further explore the colorful and charming bumble bees. This guide encourages exploring nature first hand from a new perspective. As one young scientist said, “I really like bumble bees because they are so fuzzy and cute. It’s hard not to like them.” With the Guide to Eastern Bumble Bees, we not only admire the Bombus of the East, we can also identify, understand and support them as well. Like the canary in the coal mine, several bumble bees of the eastern region (Bombus terricola, Bombus pensylvanicus and especially Bombus affinis) have declined dramatically across their former wide distributions in the past decade. With the proper identification tools, students, and citizen scientists can help professional entomologists track their populations and learn why we are losing these essential pollinators.

Stephen Buchmann, Ph.D.
International Coordinator North American Pollinator Protection Campaign (NAPPC), Co-author of “The Forgotten Pollinators”

Sheila R. Colla has studied various aspects of bumble bee ecology, behaviour and conservation throughout North America. She is currently a doctoral student and recipient of the NSERC Alexander Graham Bell Canadian Graduate Scholarship at York University under the supervision of Dr. Laurence Packer in Toronto, Ontario, Canada. Her dissertation examines changes in bumble bee communities over the past century and looks into some of the causes for observed declines. In addition, she is a member of the North American Pollinator Protection Campaign and her research has been featured in The Washington Post, Canadian Gardening, The Toronto Star, BioScience, CBC’s Quirks and Quarks, and The Daily Planet for Discovery Channel Canada. Email: scolla@yorku.ca

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Leif Richardson is a graduate student at Dartmouth College, where he is doing dissertation research on plants and their pollinators. He holds a Master’s degree from the University of Arizona’s Department of Ecology and Evolutionary Biology, and worked for many years as an ecologist with the Vermont Department of Fish and Wildlife’s Nongame and Natural Heritage Program. He is documenting the distribution and decline of bumble bees in New England, and is involved in efforts to conserve bumble bee populations in eastern North America.

Leif Richardson

Phone: 802-225-6353

About the Authors

Paul Williams studied the distribution and decline in British bumblebees for a PhD at Cambridge (UK) in 1985. Since then he has continued to work on this as a Research Entomologist at the Natural History Museum, London, UK, but is looking increasingly at bumble bee ecology and systematics world-wide, with field work especially in North America, the Himalaya, and China. Larger taxonomic publications have included faunal revisions of the bumble bees of Kashmir and more recently on the bumble bees of Sicuan, on a checklist of bumble bee species of the world, and on a series of papers on bumble bee phylogeny and subgenus. Overview: www.nhm.ac.uk/bombus Publications on bumble bees: www.nhm.ac.uk/bombus/publications.html

Paul	Williams

Website: www.nhm.ac.uk/bombus/publications.html

About the Authors

Authors are listed in alphabetical order. Each contributed equally.
Bumble bees of the Eastern United States

Introduction

Bumble bee taxonomy and biogeography

Phylum Arthropoda, Class Insecta, Subclass Pterygota, Order Hymenoptera, Suborder Apocrita, Infraorder Aculeata, Superfamily Apoidea, Family Apidae, Subfamily Apinae, Genus Bombus

The genus Bombus (bumble bee) includes approximately 250 species found primarily in temperate regions of North America, Central America, South America, Europe and Asia. They are absent from Australia, lowland India, and from most of Africa. In the United States in states whose boundaries are fully east of the 100th meridian there are a total of 21 species.

Natural History

Bumble bees have the rare physiological capability (among insects) to choose to thermoregulate. They are able to generate heat in their thoracic muscles, by shivering, to reach the required minimum temperature for flight (approx. 30°C). Given that bumble bees fly in the spring and fall in temperate regions, this internal temperature can be well above ambient temperature. Bumble bees rely entirely on flowering plants for food. Adults feed primarily on nectar for energy to fuel flight, but feed their larvae primarily on pollen to provide protein for growth. Bumble bees are considered to be generalist foragers. Bumble bees usually need to feed from a variety of plant species because of the length of their colony cycles, including native wild flowers, crop plants and introduced species. As can be seen in the following species pages, there are between species differences in timing of emergence, length of colony cycle, foraging behaviour and habitat selection.

The length of the bumble bee’s tongue governs its food-plant choices, with bees preferring flowers with a similar depth to their own tongue length, as this tends to maximize the rate at which they can gather nectar. Tongue length varies with body size within species, but also varies among species. Therefore different bumble bee species with different tongue lengths tend to visit different food-plant species, resulting in some partitioning of food-plant usage among bumble bee species. This may have the effect of reducing competition between bumble bee species in a community.

The Colony Cycle

Bumble bees are eusocial organisms with annual colonies in North America (i.e. one year = one generation). This means bumble bees live in colonies comprised of several different ‘castes’ who divide the reproductive,
foraging, defense, and other tasks necessary to their survival; reproductive females, or ‘queens’, live with their male and female offspring, and all employ an array of physiological and behavioral adaptations for communication. Mated queens emerge from hibernation in the spring after overwintering and begin feeding. Spring queens search for a suitable nest site where they then begin their colonies. Eggs hatch after approximately four days and the small larva begins to feed on pollen mixed with nectar. The larval stage of bumble bees has four instars. After almost two weeks of development, the larvae spin cocoons and pupate. Pupae develop for another two weeks before emerging as full-sized adults. In total, development takes approximately five weeks but this varies with temperature and food supply. First, female workers emerge and begin foraging for the colony and feeding the brood. As the summer progresses, the colony reaches maximum worker production and begins producing males and potential queens. These reproductive individuals leave the nest and mate. After mating, young queens enter diapause and overwinter. The males and the rest of the colony die with the onset of cold weather in late fall.

Bumble bee species vary according to how they store pollen and feed developing larvae. ‘Pollen storers’ accumulate pollen for later use, often re-using vacated cocoons for this (e.g. *B. terricola*). The queen and workers feed each larva individually, opening their brood cells to regurgitate a mixture of pollen and nectar for them. By contrast, ‘pocket makers’ place pollen directly in a wax pocket on the side of a group of larval cells (e.g. *B. fervidus*). The larvae of these species all feed from the same pocket, which sometimes leads to greater size differences in adult bees of the same caste.

Bumble bee species belonging to the subgenus *Psithyrus* are an exception as they do not produce a worker caste, but are social parasites. Instead, females usurp colonies of other species and reproduce using the host species resources. In the eastern fauna the parasitic species are: *B. ashtoni*, *B. citrinus*, *B. fernaldae*, *B. insularis*, *B. variabilis*.

**Importance in Natural Ecosystems and Agriculture**

Bumble bees are extremely important pollinators for agriculture both in the field and in greenhouses. Unlike honey bees, they are able to forage under cold, rainy and cloudy conditions. This makes them excellent pollinators for a variety of crops in temperate regions. Some crops which bumble bees can pollinate include tomatoes, peppers, raspberry, blueberries, soybeans, sunflower, beans, cherries, apricots, plums, almonds, nectarines, peaches, rosehips, eggplants, and cranberries. Bumble bees are also extremely important pollinators of many flowering plants throughout the native ranges with which they co-evolved mutualisms where they receive food in return for providing pollination. Bumble bees are generalists and have been recorded visiting hundreds of native plant species. The pollination services bumble bees provide for native plants are likely very important for maintaining various ecosystems. In addition other animals, like small mammals and birds, rely on the fruits and seeds of pollinated plants for food.

**Bumble Bee Declines**

We have evidence that in North America some of our bumble bee species are declining and a few are threatened with extinction. One species known from Oregon and California (Franklin’s bumble bee) has recently been listed by the IUCN as Critically Endangered. Species which seem most vulnerable are those with smaller climate tolerances, those at the edge of their climatic niches and later emerging species. In North America, members of the subgenus *Bombus sensu strictu* (i.e. *B. affinis*, *B. occidentalis*, *B. franklini*, *B. terricola*) seem to be declining at a rapid rate. Currently, the suspected threats to wild bumble bees are: habitat loss due to agricultural intensification, urbanization or pollution, pesticide use, pathogen spillover from managed bees, and climate change.
Bumble Bees of the Eastern United States

Bee Body Diagram

Bombus bimaculatus, male

Bombus ternarius, queen

Bee Leg Diagram

Bombus ternarius, queen

Bombus bimaculatus, male
The maps produced for this guide provide two sets of information about the range of each species: points that represent actual bumble bee collections, and generalized range polygons meant to predict bee distribution in areas where we lack specimen collection data. Many institutions and individuals have contributed digitized, georeferenced specimen data to this effort, and dots on each map represent collections held by the following:

- Sheila Colla, York University
- Paul Williams, British Natural History Museum
- Leif Richardson, Vermont Department of Fish and Wildlife
- Caroline Scully, Antioch University New England
- John Ascher, American Museum of Natural History
- Ohio State University Hymenoptera Online Database
- Illinois Natural History Survey
- Yale University, Peabody Museum
- University of Connecticut Insect Collections
- University of Vermont’s Zadock Thompson Zoology Collection
- Rachael Winfree, Rutgers University
- Sam Orme, U.S. Geological Survey, Patuxent Wildlife Research Center
- Michael Arduser, Missouri Department of Conservation
- H.E. Milliron (published records from various collections)
- Kevin Matteson, Fordham University
- Steve Marshall, University of Guelph

Many other insect collections exist that have not been checked for identification accuracy or digitized. These maps can thus be improved upon as more data become available.

Ranges presented for this guide are at a scale of 1:11,000,000. For each species, a range polygon (shown in green) was produced by buffering specimen collection points by 100 kilometers, then merging all buffers together. We chose this as an arbitrary distance from known locations of occurrence (i.e. sites where specimens have been collected) because in general, we believe that it helps to describe a bumble bee species’ range. Minor changes were made to the resulting layer to connect adjacent polygons where we thought it appropriate, to smooth some edges, and to improve the presentation of the map. The range polygon layer was then clipped to the eastern United States. No range polygon was made for *B. frigidus*, because we currently know of just one specimen of this bee collected in the eastern United States.

For each species, the specimen collection points from the eastern U.S. are displayed. Data from most sources listed above are termed ‘Primary Records’, because we have high confidence in the determinations (identifications) of those specimens. Data from the Ohio State University collection are termed ‘Other Records’, because we have not verified the determinations of bees in that collection. In a few cases, we have also displayed points on the maps that represent photographs of bumblebees, not actual collections. We have only done this when accurate identification was possible from a photo.

For three species that have undergone precipitous declines in the last decade—*B. affinis*, *B. terricola*, and *B. ashtoni*—we chose to display the relatively few collections made after 1997 differently from all those made previously. This is intended to give the reader a sense of how much the species’ ranges have shrunk, and where they might still be found.

Range information is shown for all full states east of the 100° longitude line. Users should bear in mind that most of the bumblebees found in this area also occur in parts of adjacent Canada and the western United States.
Long- or square-cheeked bees with a rounded angle on the mid leg

**Bombus impatiens**

Common eastern bumble bee

- Common, possibly expanding range
- Select food plants: *Cirsium* (Thistles), *Eupatorium*, *Gelsemium*, *Solidago* (Goldenrods), *Pontederia* (Pickerel Weeds)
- Tongue length: medium
- Nests underground
- Parasitized by *B. citrinus*
- Can be confused with *B. bimaculatus*

**Phenology Chart**

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**Bombus impatiens**

- Common, possibly expanding range
- Select food plants: *Cirsium* (Thistles), *Eupatorium*, *Gelsemium*, *Solidago* (Goldenrods), *Pontederia* (Pickerel Weeds)
- Tongue length: medium
- Nests underground
- Parasitized by *B. citrinus*
- Can be confused with *B. bimaculatus*

**Butterfly Plus**

- Common, possibly expanding range
- Select food plants: *Cirsium* (Thistles), *Eupatorium*, *Gelsemium*, *Solidago* (Goldenrods), *Pontederia* (Pickerel Weeds)
- Tongue length: medium
- Nests underground
- Parasitized by *B. citrinus*
- Can be confused with *B. bimaculatus*
Females (queens and workers, colors refer to pile or ‘hair’):

- Thorax and T1 predominantly pale yellow, some black hairs intermixed between the wing bases, T2 entirely black, tail black.

- Mid leg basitarsus with the distal posterior corner rounded. Cheek as long as broad. Hair of the face black or with only a few yellow hairs intermixed, black hairs intermixed diffusely between the wing bases, hair of T2 always entirely black. Hair short, metasoma rather long and rectangular.
Two-spotted bumble bee

- Common
- Select food plants: Cirsium (Thistles), Hypericum (St. John’s Wort), Melilotus (Sweet Clovers), Rosa, Solidago (Goldenrods), Vicia (Vetches)
- Tongue length: medium
- Nests underground and on surface
- Can be confused with B. impatiens, B. griseocollis and B. rufocinctus

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**Bombus bimaculatus**

Lateral image of a female Bombus bimaculatus. Photo Sheila Colla

Bombus bimaculatus worker. Photo Sheila Colla

Bombus bimaculatus queen foraging for nectar from cultivated azaleas. Photo Leif Richardson

Bombus bimaculatus face. Photo Sheila Colla

Main Bombus bimaculatus foraging on wild bergamot. Photo Leif Richardson

Bombus bimaculatus on wild bergamot. Photo Leif Richardson
Females (queens and workers, colors refer to pile or ‘hair’):

- Thorax and T1 predominantly yellow, a black spot between the wing bases, T2 usually with a yellow W in the middle, tail black, hair long.
- Mid leg basitarsus with the distal posterior corner rounded. Cheek slightly longer than broad. Hair of face black or with only a few yellow hairs intermixed, black hair of the spot between the wing bases dense and always present, although often with yellow hairs intermixed, the black hairs only occasionally forming a band between the wing bases, T2 always with some yellow hairs present but sometimes with very few, although if the yellow is extensive then black hairs are intermixed posteriorly and medially and the posterior margin of the yellow usually forms a characteristic W-shape (which may be similar in some *B. griseocollis*, although that species usually has some yellow hairs rather than black antero-laterally). Hair long and uneven, metasoma rather short and globular.
Confusing bumble bee

- Common
- Select food plants: Hydrangea, Rhododendron, Rubus, Vaccinium, Lonicera (Honeysuckles), Prunus, Ribes
- Tongue length: medium
- Nests on ground surface and in hollow logs and trees
- Can be confused with *B. vagans*

**Bombus perplexus**

Female *Bombus perplexus* face. Photo Sheila Colla

Bombus perplexus male. Photo Sheila Colla

Bombus perplexus queen. Photo Sheila Colla

Bombus perplexus worker foraging on St. John’s Wort. Photo Leif Richardson

Bombus perplexus worker foraging on St. John’s Wort. Photo Leif Richardson

Bombus perplexus worker foraging on St. John’s Wort. Photo Leif Richardson

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Females (queens and workers, colors refer to pile or ‘hair’):

- Thorax and T1-2 predominantly brown or yellow, sides of the thorax often black, tail black or often with some white hairs.

- Mid leg basitarsus with the distal posterior corner rounded. Cheek slightly longer than broad. Hair of the face black or with yellow hairs intermixed, only a very few inconspicuous black hairs in the centre of the thoracic dorsum between the wing bases, sides of the thorax often but not always extensively black, sometimes entirely yellow. Pale hair often brownish rather than yellow, T5 sometimes with white hair. Hair long.
Half-black bumble bee

- Common
- Select food plants: Penstemon (Beard-Tongues), Asclepias (Milkweeds), Asters, Cirsium (Thistles), Eupatorium, Spirea (Meadowsweet)
- Tongue length: medium
- Nests on ground surface and underground
- Unlike most bumble bees, this species readily forages in heavily shaded areas within forests
- Can be confused with B. sandersoni, B. perplexus, B. affinis
- Parasitized by B. citrinus

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A worker Bombus vagans visits red clover. Photo by Leif Richardson

Lateral image of a Bombus vagans female. Photo by Sheila Colla

Female Bombus vagans face. Photo by Sheila Colla
Females (queens and workers, colors refer to pile or 'hair'):

- Thorax and T1-2 predominantly yellow, a black spot between the wing bases, sides of the thorax yellow, tail black, face long.

- Mid leg basitarsus with the distal posterior corner rounded. Cheek slightly longer than broad. Hair of the face black or with yellow hairs intermixed, the black thoracic spot between the wing bases may be small and intermixed with yellow hairs in queens but is larger and more diffuse in workers, forming a band between the wing bases, T2 yellow or sometimes with black along the posterior margin, sometimes intermixed laterally, but not anteriorly unless the yellow band is very narrow. Hair long. Body size small, but larger than *B. sandersoni*.
**Sanderson bumble bee**

- Uncommon
- Select food plants: _Epilobium_, _Monarda_ (Bee Balms), _Penstemon_ (Beard Tongues), _Rubus_, _Malus_ (Apples)
- Tongue length: short
- Often confused with _B. perplexus_ and _B. vagans_. Difficult to properly identify and this ecology poorly known.

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**Bombus sandersoni**

Birds and bees are often confused, but these insects are distinct. Sanderson bumble bees are not commonly found in the wild and are therefore difficult to spot. They are characterized by their short tongues and unique pollen baskets.

**Phenology Chart**

- **Workers**
- **Queens**
- **Males**

**Bombus sandersoni** female in Newfoundland, Canada. Photo: Cory Sheffield

**Female** _Bombus sandersoni_. Photo: Sheila Colla

**Lateral image of a Bombus sandersoni female.** Photo: Sheila Colla

**Lateral image of _Bombus sandersoni_ female, dark morph.** Photo: Sheila Colla

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**Bombus sandersoni** continued
Bombus sandersoni

Females (queens and workers, colors refer to pile or ‘hair’):

- Thorax and T1-2 predominantly yellow, or with a black spot or band between the wing bases, sides of the thorax yellow, tail black or yellow or occasionally white (not orange), face round.

- Mid leg basitarsus with the distal posterior corner rounded. Cheek as long as, or slightly shorter than, broad. Hair of the face and top of the head black or with yellow hairs, corbicular fringes black or with brownish-orange tips, T2 anterio-laterally often with a few scattered black hairs intermixed, T5 black, brown, yellow, or white, with a few black hairs intermixed. Hair short and even, body size small and smaller than B. vagans.
**Bombus frigidus**

- Rare in the US (recorded only in northern border states)
- Select food plants: *Cirsium* (Thistles), *Epinium* (Geranium), *Mertensia* (Bluebells), *Taraxacum officinale* (Dandelion), *Trifolium* (Clovers)
- Tongue length: short

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The phenology for this species is unknown due to few records in the eastern U.S.

**Bombus frigidus worker on senecio sp.**  
*Photo Jessica Forrest*

**Bombus frigidus**  
*Photo Sheila Colla*
Females (queens and workers, colors refer to pile or ‘hair’):

- Thorax and T1-2 predominantly yellow, with a black band between the wing bases, sides of the thorax yellow, tail orange (occasionally faded to more yellowish).

- Mid leg basitarsus with the distal posterior corner rounded. Cheek as long as broad. Hair of the face black or with some yellow hairs, corbicular fringes extensively pale orange, T2 anterio-laterally without scattered black hairs intermixed. Hair long.
**Bombus ternarius**

**Tri-colored bumble bee**
- Common
- Select food plants: *Asclepias* (Milkweeds), *Rubus*, *Solidago* (Goldenrods), *Rhododendron*, *Vaccinium*
- Tongue length: short
- Nests underground
- Can be confused with the red color morph of *B. rufocinctus*

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**Bombus ternarius**

*Bombus ternarius* queen visits dandelion. Photo: Leif Richardson

*Tri-colored bumble bee* • Common • Select food plants: *Asclepias* (Milkweeds), *Rubus*, *Solidago* (Goldenrods), *Rhododendron*, *Vaccinium* • Tongue length: short • Nests underground • Can be confused with the red color morph of *B. rufocinctus*
Females (queens and workers, colors refer to pile or ‘hair’):

- Thorax and T1 predominantly yellow, with a black band between the wing bases extending posteriorly in the middle of the scutellum, T2-3 orange, T4 yellow, T5 black, and with face round.

- Mid leg basitarsus with the distal posterior corner rounded. Cheek very slightly shorter than broad. Hair of face and top of the head black with patches of yellow, or sometimes with black more extensively intermixed especially for workers, thoracic anterior band usually yellow without black hairs intermixed except in some workers, which have the anterior margin of the black band between the wing bases always sharply defined, scutellum with yellow patches entirely divided by a black posteriorly directed triangle, T2 red, at most with a few black hairs antero-medially, T4 yellow, T5 black. Hair short and even.
**Yellow-banded bumble bee**

- Uncommon, possibly declining since the mid 1990’s
- Select food plants: *Vaccinium, Salix* (Willows), *Rosa* (Roses), *Rubus, Lonicera* (Honeysuckles), *Solidago* (Goldenrods), *Asters*
- Tongue length: short
- Nests underground
- Nectar-robiner
- Parasitized by *B. ashtoni*
- Can be confused with *B. pensylvanicus*

**Phenology Chart**

- **Queens**
  - APR
  - MAY
  - JUNE
  - JULY
  - AUG
  - SEPT
  - OCT
- **Workers**
  - APR
  - MAY
  - JUNE
  - JULY
  - AUG
  - SEPT
  - OCT
- **Males**
  - APR
  - MAY
  - JUNE
  - JULY
  - AUG
  - SEPT
  - OCT

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**Bombus terricola**

**Photo Leif Richardson**

**Female Bombus terricola face.**

**Photo Sheila Colla**

**Bombus terricola male forages on hop clover.**

**Photo Leif Richardson**

**Bombus terricola worker visiting purple flowering raspberry.**

**Photo Leif Richardson**

**Bombus terricola worker collecting nectar from milkweed.**

**Photo Leif Richardson**
Bombus terricola continued

Females (queens and workers, colors refer to pile or “hair”):

- Thorax with yellow band(s), T1 black, T2-3 yellow, tail black or yellow, face round.

- Mid leg basitarsus with the distal posterior corner rounded. Cheek length slightly shorter than breadth, clypeus strongly swollen in the dorsal half, hind basitarsus with the posterior margin strongly and evenly arched. Hair of the head black or with a minority of short pale hairs intermixed. Hair short and even.
Rusty-patched bumble bee

- Rare after 1997, previously common
- Select food plants: Helianthus (Sunflowers), Asters, Solidago (Goldenrods), Lonicera (Honeysuckles), Vaccinium, Prunus, Aesculus
- Tongue length: short
- Nests underground
- Occasional nectar robber
- Parasitized by B. ashtoni
- Can be confused with B. citrinus, B. griseocollis, B. perplexus, B. vagans

Phenology Chart

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Bombus affinis

Lateral image of a queen Bombus affinis.
Photo Sheila Colla

Rusty-patched bumble bee

- Rare after 1997, previously common
- Select food plants: Helianthus (Sunflowers), Asters, Solidago (Goldenrods), Lonicera (Honeysuckles), Vaccinium, Prunus, Aesculus
- Tongue length: short
- Nests underground
- Occasional nectar robber
- Parasitized by B. ashtoni
- Can be confused with B. citrinus, B. griseocollis, B. perplexus, B. vagans

Bombus affinis

Lateral image of Bombus affinis worker.
Photo Sheila Colla

Rusty-patched bumble bee

- Rare after 1997, previously common
- Select food plants: Helianthus (Sunflowers), Asters, Solidago (Goldenrods), Lonicera (Honeysuckles), Vaccinium, Prunus, Aesculus
- Tongue length: short
- Nests underground
- Occasional nectar robber
- Parasitized by B. ashtoni
- Can be confused with B. citrinus, B. griseocollis, B. perplexus, B. vagans

Bombus affinis

Lateral image of Bombus affinis worker.
Photo Sheila Colla

Rusty-patched bumble bee

- Rare after 1997, previously common
- Select food plants: Helianthus (Sunflowers), Asters, Solidago (Goldenrods), Lonicera (Honeysuckles), Vaccinium, Prunus, Aesculus
- Tongue length: short
- Nests underground
- Occasional nectar robber
- Parasitized by B. ashtoni
- Can be confused with B. citrinus, B. griseocollis, B. perplexus, B. vagans

Bombus affinis

Lateral image of Bombus affinis worker.
Photo Sheila Colla

Rusty-patched bumble bee

- Rare after 1997, previously common
- Select food plants: Helianthus (Sunflowers), Asters, Solidago (Goldenrods), Lonicera (Honeysuckles), Vaccinium, Prunus, Aesculus
- Tongue length: short
- Nests underground
- Occasional nectar robber
- Parasitized by B. ashtoni
- Can be confused with B. citrinus, B. griseocollis, B. perplexus, B. vagans

Bombus affinis

Lateral image of Bombus affinis worker.
Photo Sheila Colla
This map, and all subsequent species maps, provide two sets of information about the range of each species: points that represent actual bumble bee collections, and generalized range polygons meant to predict bee distribution in areas where we lack specimen collection data. Many institutions and individuals have contributed digitized, georeferenced specimen data to this effort, and dots on each map represent many collections which are listed on page 13 under Map Methodology along with more information about the maps for each species.

Females (queens and workers, colors refer to pile or ‘hair’):

- Thorax and T1-2 predominantly yellow, or with a black spot or band between the wing bases, T2 often distinctly brown in workers, tail black.

- Mid leg basitarsus with the distal posterior corner rounded. Cheek length slightly shorter than breadth, clypeus strongly swollen in the dorsal half, hind basitarsus with the posterior margin strongly and evenly arched. Hair of the face black, hair of the top of the head black or with only a few yellow hairs intermixed. Hair of medium length and even.
**Brown-belted bumble bee**

- **Common**
- Select food plants: *Asclepias* (Milkweeds), *Cirsium* (Thistles), *Helianthus* (Sunflowers), *Solidago* (Goldenrods), *Rhus* (Sumacs), *Lythrum* (Loosestrifes)
- Tongue length: medium
- Nests on ground surface
- Can be confused with *B. bimaculatus*, *B. affinis*

**Phenology Chart**

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- Male *Bombus griseocollis* foraging at cultivated coneflower.
  Photo: Leif Richardson
- *Bombus griseocollis* worker captured by a crab spider.
  Photo: Sheila Colla
- Lateral image of a female *Bombus griseocollis*.
  Photo: Sheila Colla
- *Bombus griseocollis* workers foraging on prickly pear.
  Photo: Leif Richardson
- *Bombus griseocollis* face.
  Photo: Sheila Colla

**Bombus griseocollis**

Brown-belted bumble bee

- Common
- Select food plants: *Asclepias* (Milkweeds), *Cirsium* (Thistles), *Helianthus* (Sunflowers), *Solidago* (Goldenrods), *Rhus* (Sumacs), *Lythrum* (Loosestrifes)
- Tongue length: medium
- Nests on ground surface
- Can be confused with *B. bimaculatus*, *B. affinis*
Females (queens and workers, colors refer to pile or ‘hair’):

- Thorax and T1 predominantly yellow, or with a black spot between the wing bases, T2 with a yellow or brown crescent anteriorly, tail black, hair short.
- Mid leg basitarsus with the distal posterior corner rounded. Cheek length distinctly shorter than breadth, ocelli large. Hair of the face and of the top of the head black or with only a few yellow hairs intermixed, black thoracic spot between the wing bases often very small and inconspicuous but dense. Sometimes workers have the yellow on T2 extending for three quarters of the length of T2 and forming a W-shape (similar to *B. bimaculatus*, but with few black hairs intermixed medially and some yellow hairs intermixed antero-laterally). Hair very short and even, the metasoma rather rectangular and slightly flattened.
Southern plains bumble bee

- Uncommon
- Select food plants: Hypericum (St. John’s Worts), Monarda (Bee Balms), Rhus (Sumacs), Solanum (Nightshades and relatives), Asters, Cirsium (Thistles)
- Tongue length: short
- Can be confused with *B. affinis*, *B. griseocollis*

**Bombus fraternus**

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Lateral image of a female *Bombus fraternus*. Photo Sheila Colla

Female *Bombus fraternus* face. Photo Sheila Colla

Lateral image of a female *Bombus fraternus* worker. Photo Paul Williams

Southern plains bumble bee

- Uncommon
- Select food plants: Hypericum (St. John’s Worts), Monarda (Bee Balms), Rhus (Sumacs), Solanum (Nightshades and relatives), Asters, Cirsium (Thistles)
- Tongue length: short
- Can be confused with *B. affinis*, *B. griseocollis*
Females (queens and workers, colors refer to pile or ‘hair’):

- Thorax and T1-2 extensively yellow, with a black band between the wing bases, tail black, hair very short.

- Mid leg basitarsus with the distal posterior corner rounded. Cheek length much shorter than breadth, ocelli large, hind basitarsus with the posterior margin almost parallel to the anterior margin. Hair distinctive for being very short and even, and on the metasoma decumbent, the metasoma nearly rectangular and slightly flattened.
Red-belted bumble bee

- Common
- Select food plants: *Trifolium* (Clovers), *Melilotus* (Sweet Clovers), *Cirsium* (Thistles), *Solidago* (Goldenrods), *Eupatorium*, *Asters*
- Tongue length: short
- Nests underground and on ground surface
- Highly variable in coloration and can be confused with many species

**Bom**bu**s** *rufocinctus*

- A black color morph *Bombus rufocinctus* worker forages at teasel. Photo Leif Richardson
- Photo Sheila Colla
- A red color morph *Bombus rufocinctus* worker forages at teasel. Photo Leif Richardson
- Lateral image of a *Bombus rufocinctus* female, red morph. Photo Sheila Colla
- Female *Bombus rufocinctus* face. Photo Sheila Colla

**Phenology Chart**

- Queens
- Workers
- Males

- APR
- MAY
- JUNE
- JULY
- AUG
- SEPT
- OCT
Females (queens and workers, colors refer to pile or ‘hair’):

- Similar to many color patterns shown by the other Eastern North American species, but small bodied, short haired, and with a short face.

- Mid leg basitarsus with the distal posterior corner rounded. Cheek length distinctly shorter than breadth. Many other combinations of these color patterns are known, but the hair of T2 is almost always with at least a yellow crescent anteriorly (only rarely very much reduced). Hind basitarsus with the posterior margin evenly but not strongly arched. Hair short and even, body size small.
Yellow bumble bee

- Uncommon, possibly in decline
- Select food plants: *Lonicera* (Honeysuckles), *Cirsium* (Thistles), *Trifolium* (Clovers), *Penstemon* (Beard-tongues), *Lythrum* (Loosestrifes), *Vicia* (Vetches), *Monarda* (Bee balms)
- Tongue length: long
- Nests on ground surface and underground
- Can be confused with *B. borealis*
- More common in open fields and meadows

Phenology Chart

- **Queens**
- **Workers**
- **Males**

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**Bombus fervidus**

Female *Bombus fervidus*. Photo Sheila Colla

Long-cheeked bees with a sharp angle on the mid leg

Female *Bombus fervidus* face. Photo Sheila Colla

Yellow bumble bee • Uncommon, possibly in decline • Select food plants: *Lonicera* (Honeysuckles), *Cirsium* (Thistles), *Trifolium* (Clovers), *Penstemon* (Beard-tongues), *Lythrum* (Loosestrifes), *Vicia* (Vetches), *Monarda* (Bee balms) • Tongue length: long • Nests on ground surface and underground • Can be confused with *B. borealis* • More common in open fields and meadows

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**Bombus fervidus**

Lateral image of a *Bombus fervidus* female. Photo Leif Richardson

Female *Bombus fervidus* face. Photo Sheila Colla
**Bombus fervidus**

Females (queens and workers, colors refer to pile or ‘hair’):

- Face black, thorax and T1-4 predominantly yellow, usually with a black band between the wing bases, sides of the thorax usually yellow, T5 black.

- Mid leg basitarsus with the distal posterior corner sharply pointed. Cheek distinctly longer than broad, clypeus surface rough with many large punctures. Hair of the head black or with only a minority of short pale hairs intermixed, sides of the thorax yellow at least in the dorsal half (often throughout), black band between the wing bases may be very narrow (anterior to posterior) and may have many yellow hairs intermixed. Hair of medium length and even.
Northern amber bumble bee

- Uncommon
- Select food plants: *Vicia* (Vetches), *Cirsium* (Thistles), Asters, *Prunella*, *Symphytum officinale* (Comfrey), *Eupatorium*
- Tongue length: long
- Nests underground
- Can be confused with *B. fervidus*

### Phenology Chart

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Females (queens and workers, colors refer to pile or ‘hair’):

- Face yellow, thorax and T1-4 extensively yellow, with a black band between the wing bases, lower sides of the thorax usually black, T5 black or yellow.
- Mid leg basitarsus with the distal posterior corner sharply pointed. Cheek distinctly longer than broad, clypeus surface very smooth and shiny with only a few very small punctures near the centre. Hair of the face usually gray-yellow and usually paler than on the rest of the body and only rarely with many black hairs extensively intermixed, sides of the thorax predominantly black with yellow only within the dorsal half. Hair of medium length and even.
American bumble bee

- Uncommon, possibly in decline
- Select food plants: *Vicia* (Vetches), *Lotus corniculata*, *Trifolium* (Clovers), *Solidago* (Goldenrods), *Hypericum* (St. John’s Wort), *Eupatorium*
- Tongue length: long
- Nests on ground surface
- Can be confused with *B. terricola* and *B. auricomus*
- Parasitized by *B. variabilis*

**Bom**bus pensylvanicus

*Bombus pensylvanicus* worker foraging on cow vetch. Photo Paul Williams

- Tongue length: long
- Nests on ground surface
- Can be confused with *B. terricola* and *B. auricomus*
- Parasitized by *B. variabilis*
Females (queens and workers, colors refer to pile or ‘hair’):

- Top of the head black, thorax with yellow band(s), T1 often yellow especially in the middle, T2-3 yellow, tail black, face long.

- Mid leg basitarsus with the distal posterior corner sharply narrowly produced and spinose, hind basitarsus with the proximal posterior process long and pointed (longer than broad). Cheek slightly longer than broad, clypeus with large punctures except on the mid line. Hair on the top of the head always black, T1 with yellow hairs more frequent medially. Hair short and even.
**Bombus auricomus**

**Black and gold bumble bee**

- Uncommon
- Select food plants: *Monarda* (Bee balm), *Solanum* (Nightshades and relatives), *Trifolium* (Clovers), *Hypericum* (St. John’s Wort), *Eupatorium*
- Tongue length: long
- Nests underground
- Can be confused with *B. pensylvanicus, B. terricola*

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*Bombus auricomus* worker foraging on a legume. Photo Paul Williams

*Bombus auricomus* lateral image of a female. Photo Sheila Colla

*Bombus auricomus* female. Photo Sheila Colla

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Bumble Bees of the Eastern United States  74

Bumble Bees of the Eastern United States  75
Females (queens and workers, colors refer to pile or ‘hair’):

- Top of the head yellow, thorax with yellow band(s), T1 often yellow especially laterally, T2-3 yellow, tail black, face long.

- Mid leg basitarsus with the distal posterior corner acute but not narrowly produced, hind basitarsus with the proximal posterior process broad and blunt (shorter than broad). Cheek slightly longer than broad, ocelli large, mandible with anterior keel not reaching the distal margin, clypeus very evenly covered with small punctures. Hair on the face black, occasionally with a few yellow hairs intermixed, top of the head usually yellow, sometimes with black hairs intermixed but occasionally predominantly black, T1 with yellow hairs more frequent laterally. Hair very short and even.
Bees with hind leg outer tibial surface convex and uniformly hairy (cuckoo bumble bees)

**Bombus citrinus**

Lemon cuckoo bumble bee

- Common
- Select food plants: *Asclepias* (Milkweeds), *Rubus*, *Verbena* (Vervains), *Eupatorium*, *Trifolium* (Clovers), *Solidago* (Goldenrods)
- Hosts: *B. impatiens* and *B. vagans*
- Can be confused with *B. affinis*, *B. perplexus*, *B. vagans*

**Phenology Chart**

- **Females**
  - APR
  - MAY
  - JUNE
  - JULY
  - AUG
  - SEPT
  - OCT

**Bombus citrinus male on Woodland Sunflower. Photo Sheila Colla**

**Bombus citrinus female. Photo Sheila Colla**

**Female Bombus citrinus. Photo J. Lucier**

**Bombus citrinus continued**
Females (no workers, colors refer to pile or "hair"):

- Thorax predominantly yellow, including the lower sides, T4-5 black.

- Hind tibia with the outer surface convex and densely hairy. Hair of the face black, usually with only a minority of yellow hairs intermixed, yellow hair above the base of the antenna rarely dense, sides of the thorax entirely yellow, thoracic dorsum usually without black hair, but if present then not forming a band between the wing bases, T4-5 predominately black. Wings light brown, hair on the metasoma short (but longer on T5 than length of last joint of hind tarsus) and even, T6 matte with dense punctures.
Variable cuckoo bumble bee

- Extremely rare, possibly extinct
- Select food plants: *Asclepias* (Milkweeds), *Aster*, *Cirsium* (Thistles), *Solidago* (Goldenrods), *Eupatorium*, *Trifolium* (Clovers)
- Parasitizes *B. pensylvanicus*

Because of the extreme scarcity of this species, natural history and ecology details are not well known. Photos of this species in the wild are also scarce.
Females (no workers, colors refer to pile or ‘hair’):

- Face black, thorax extensively yellow, but the lower sides black, tail usually black, hair very short.

- Hind tibia with the outer surface convex and densely hairy. Hair of the face black with only a minority of pale hairs above the base of the antenna, sides of the thorax predominantly black, thoracic dorsum usually with black hair, hair on the metasoma usually black. Wings dark brown, hair on the metasoma very short (shorter on T5 than the length of the last joint of the hind tarsus) and even, T6 shiny with sparse punctures.
Indiscriminate bumble bee

- Rare in the eastern U.S.
- Select food plants: Solidago (Goldenrods), Melilotus (Sweet Clovers), Vaccinium, Trifolium (Clovers)
- Tongue length: short
- Hosts: B. pensylvanicus, B. rufocinctus, B. ternarius, and B. terricola
- Can be confused with B. fernaldae

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Bombus insularis

Lateral image of a female Bombus insularis.
Photo Sheila Colla

Female Bombus insularis.
Photo Sheila Colla
Females (no workers, colors refer to pile or ‘hair’):

- Face yellow, a black band between the wing bases, tail with some yellow.

- Hind tibia with the outer surface convex and densely hairy. Hair of the face with a dense yellow patch above the base of the antenna, sometimes some yellow below the base of the antenna but predominantly black, black hair forming a band between the wing bases, sides of the thorax yellow anteriorly but black ventrally and posteriorly, T3 always with black hair along the entire midline but yellow laterally, T4 extensively yellow laterally. Wings light brown.
Ashton cuckoo bumble bee

- Rare, possibly in decline since the mid-1990’s
- Select food plants: Vaccinium, Trifolium (Clovers), Rubus, Melilotus (Sweet clover), Solidago (Goldenrods)
- Hosts: B. affinis, B. terricola

Female Bombus ashtoni.
Photo Sheila Colla

Lateral image of a Bombus ashtoni female.
Photo Sheila Colla

Female Bombus ashtoni face.
Photo Sheila Colla

Female Bombus ashtoni lens.
Photo Sheila Colla
Females (no workers, colors refer to pile or ‘hair’):

- Face black, tail with some white.
- Hind tibia with the outer surface convex and densely hairy. Hair of the face and the top of the head black, occasionally with some yellow hairs at the posterior of the top of the head, sides of the thorax predominantly black, hair of T3-5 laterally variable yellowish-white, but usually white at least posteriorly in the middle of T4.
Fernald cuckoo bumble bee

- Uncommon
- Select food plants: Potentilla (Typical Cinquefoils), Rubus, Trifolium (Clovers), Solidago (Goldenrods)
- Hosts: B. perplexus, B. rufocinctus
- Can be confused with B. insularis

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Female Bombus fernaldae

Photo: Sheila Colla

Lateral image of a female Bombus fernaldae.

Photo: Sheila Colla

Male Bombus fernaldae foraging.

Photo: Beatrice Heisard

Fernald cuckoo bumble bee

- Uncommon
- Select food plants: Potentilla (Typical Cinquefoils), Rubus, Trifolium (Clovers), Solidago (Goldenrods)
- Hosts: B. perplexus, B. rufocinctus
- Can be confused with B. insularis

Phenology Chart

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Females (no workers, colors refer to pile or ‘hair’):

- T1 often yellow. Face black, top of the head and T4 yellow or cream, T5 black.
- Hind tibia with the outer surface convex and densely hairy. Hair of the face black. T6 curled very strongly under the metasoma and pointing anteriorly, S6 ending distally with a shiny triangular spine, the lateral keels small. Hair long and uneven.
for the female bumble bees of the Eastern United States

The following dichotomous key designed by Paul Williams will help you identify female bumble bee specimens to species. Starting at the first set of statements, determine which characteristics your specimen has and move to the next appropriate set (numbered at the end of the statement).

Identification Key

1. Pollen baskets present (social species) ... 2
   - Pollen baskets absent (parasitic species) ... 26

2. (1) T1–T4 pile dorsally completely yellow or brown ... 3
   - T1–T4 pile dorsally not completely yellow or brown ... 4

3. (2) Face pile predominantly black; thorax sides with the pile predominantly yellow ... *ferrudius*
   - Face pile predominantly yellow; thorax sides with the pile predominantly black ... * borealis*

4. (2) T2–T3 pile completely yellow, or yellow except T2 with a small amount of black anteriorly in the middle ... 5
   - T2–T3 pile with extensive black, orange, or red ... 8

5. (4) Cheeks as long or shorter than broad (L ≤ B), head round; wings light brown; T5–T6 pile often with a few white, yellow, or orange hairs ... 6
   - Cheeks longer than broad (L > B), head elongate; wings dark brown; T5–T6 pile completely black ... 7

6. (5) Thorax pile with a black band between the wing bases ... *terricola*
   - Thorax pile without a black band between the wing bases ... *perplexus*

7. (5) Top of the head between the ocelli with the pile entirely black; T1 pile yellow or black but often with some yellow, especially in the middle; ocelli located in front of the supraorbital line by less than one ocellar diameter ... *pensylvanicus*
   - Top of the head between the ocelli with the pile with some yellow hairs; T1 pile black but often with some yellow, especially at the sides, fewer yellow hairs in the middle; ocelli located in front of the supraorbital line by more than one ocellar diameter ... *auricomus*

8. (4) T3 pile predominantly orange-red, at least away from the midline ... 9
   - T3 pile predominantly black, yellow, or pale orange ... 10

9. (8) Cheeks as long as broad (L = B); T2 pile predominantly orange-red, often with some black in the middle ... *terrarius*
   - Cheeks shorter than broad (L < B); T2 pile often yellow, at least anteriorly in the middle ... *rufocinctus*

10. (8) T3–T4 pile entirely black ... 11
    - T3–T4 pile with yellow, brown, or orange, or red ... 24

11. (10) T2 pile completely black ... *impatients*
    - T2 pile with yellow or brown, at least with a few pale hairs anteriorly in the middle ... 12

12. (11) T2 pile brown in the middle and darker than T1 ... 13
    - T2 pile yellow or brown in the middle but similar to T1 ... 14

13. (12) T2 pile black on the posterior corners ... *griseocollis*
    - T2 pile yellow on the posterior corners ... *affinis*

14. (12) Sides of the thorax with the pile extensively black ... *perplexus*
    - Sides of the thorax with the pile almost completely yellow ... 15

15. (14) T2 pile not completely yellow dorsally as far as the posterior edge, a patch of entirely black hairs at least on the posterior dorsal corners ... 16
    - T2 pile yellow dorsally as far as the posterior edge, sometimes with a few black hairs but only below where T2 curves ventrally at the sides ... 19

16. (15) Top of the head between ocelli with the pile black, at most with a few yellow hairs intermixed ... *griseocollis*
- Top of the head between ocelli with a patch of pile predominantly yellow ... 17

17 (16) Cheeks longer than broad (L>B), head elongate; T4–T5 pile completely black ... 18
- Cheeks shorter than broad (L<B), head round; T4–T5 pile with or without yellow ... rufocinctus

18 (17) T2 pile anteriorly at the sides entirely black; face pile rarely with yellow ... bimaculatus
- T2 pile anteriorly at the sides yellow; face pile usually with some yellow intermixed ... vagans

19 (15) Wings light brown; cheeks nearly as long as broad or longer (L>B, L>B); T2–T4 pile medium to long and erect ... 20
- Wings dark brown; cheeks very short (L>B), about half as long as broad; T2–T4 pile very short, even, and decumbent ... fraternus

20 (19) Hind basitarsus with the posterior edge evenly arched in the distal three quarters; top of the head between the ocelli with the pile usually predominantly yellow; body size small to medium (length ≤ 19mm) ... 21
- Hind basitarsus with the posterior edge evenly arched in the distal three quarters; top of the head between the ocelli with the pile black with only a few yellow hairs intermixed; body size usually large (length ≥ 20mm) but includes occasional smaller individuals ... affinis

21 (20) Cheeks shorter than or equal to broad (L=B), head round ... 22
- Cheeks longer than broad (L>B), head elongate ... 23

22 (21) Cheeks shorter than broad (L<B); ocelli located slightly in front of the supraorbital line ... rufocinctus
- Cheeks as long as broad (L=B); ocelli located on the supraorbital line ... sandersoni

23 (22) Thorax pile with many black hairs between the wing bases; face pile with few or no yellow hairs; T3 pile black ... vagans
- Thorax pile with few or no black hairs between the wing bases; face pile varying from black to having many yellow hairs; T3 pile black or yellow ... perplexus

24 (10) Cheeks shorter than broad (L<B); ocelli located slightly in the supraorbital line ... rufocinctus
- Cheeks as long as broad (L=B); ocelli located on the supraorbital line ... 25

25 (24) T3 pile at least anteriorly partly yellow or brown; T4 pile often all black, or with some yellow or white hairs, but never orange ... perplexus
- T3 pile predominantly black; T4 pile entirely at least posteriorly orange ... frigidus

26 (1) T2–T5 pile medium to long and strongly overlapping, at least partly obscuring the surface; T1–T6 pile either with yellow, or if entirely black then the sides of thorax with the pile entirely yellow; wings light or medium brown; between the wing bases the pile with or without a black band or spot ... 27
- T2–T5 pile very short, scarcely overlapping, and inconspicuous, the surface very glossy and unobscured, appearing bare; T1–T6 pile entirely black; sides of the thorax with the pile predominantly black; wings dark brown; between the wing bases the pile always with a black band or spot ... varibalis

27 (26) Top of the head between the ocelli with predominantly yellow pile; sides of the thorax with the pile predominantly yellow; T4 pile black and/or yellow or white ... 28
- Top of the head between the ocelli with black pile, at most with a few yellow hairs; sides of the thorax with the pile predominantly black; T4 pile completely pale, usually nearly white medially ... ashtoni

28 (27) T4 pile black; between wing bases the pile without a black band, but sometimes with a black spot ... citrins
- T4 pile with some yellow or white laterally; between the wing bases the pile with a black band present or sometimes with a black spot ... 29

29 (28) Face pile black; T1 pile with yellow hairs laterally; T4 pile predominantly yellow or white; tip of the abdomen strongly recurved, pointing anteriorly; S6 apex extending beyond T6 as a curved spine ... fernaldae
- Face pile with a mixture of yellow and black hairs; T1 pile black; T4 pile predominantly black with yellow laterally; tip of the abdomen weakly recurved, pointing ventrally; S6 and T6 equal in length ... insularis
Acknowledgements

We gratefully acknowledge help and valuable discussion from John Ascher, Laurie Davies Adams, Steve Buchmann, Cory Sheffield, Laurence Packer, Claudia Ratti, Fawziah Gadallah, James Strange, Chris Plowright, Liz Day, Elizabeth Sellers, Sam Droge, Laura Burkle, attendees of the 2009 Bombus Experts Meeting in Washington D.C. and photograph providers.

Additionally, we would like to thank the following for use of data for producing range maps:

- Caroline Scully, Antioch University New England; John Ascher, American Museum of Natural History;
- Ohio State University Hymenoptera Online Database;
- Illinois Natural History Survey; Yale University, Peabody Museum; University of Connecticut Insect Collections;
- University of Vermont’s Zadock Thompson Zoology Collection; Canadian National Collection of Insects;
- Rachael Winfree, Rutgers University; Sam Droge, U.S. Geological Survey, Patuxent Wildlife Research Center;
- Michael Arduser, Missouri Department of Conservation;
- Kevin Matteson, Fordham University; Kurt Pickett, University of Vermont; Helen Young, Middlebury College;
- Ross Bell, University of Vermont; Jeff Freeman, Castleton State College; Don Miller, Lyndon State College; Trish Hanson, Vermont Department of Forests and Parks;
- Vermont Fish and Wildlife Department.

Funding for this project was provided by the Pollinator Partnership, the U.S. Forest Service, and the National Fish and Wildlife Foundation. Funding for the high definition camera was provided by CFI and ORF.

Web and Other Resources

**Colour Key to the Bombus of the World** by Paul Williams [Online]
http://www.nhm.ac.uk/research-curation/research/projects/bombus/_key_colour_world/worldcolourkey.html


http://www.nhm.ac.uk/research-curation/research/projects/bombus/Williams&Osborne09_review.pdf

**Pollinator Partnership** www.pollinator.org for Bombus White Paper

**Xerces Society of Invertebrate Conservation** [Online]
http://www.xerces.org/bumble bees/

**Discover life Bumble bee Key** [Online]
http://www.discoverlife.org/mp/20q?guide=vbees
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