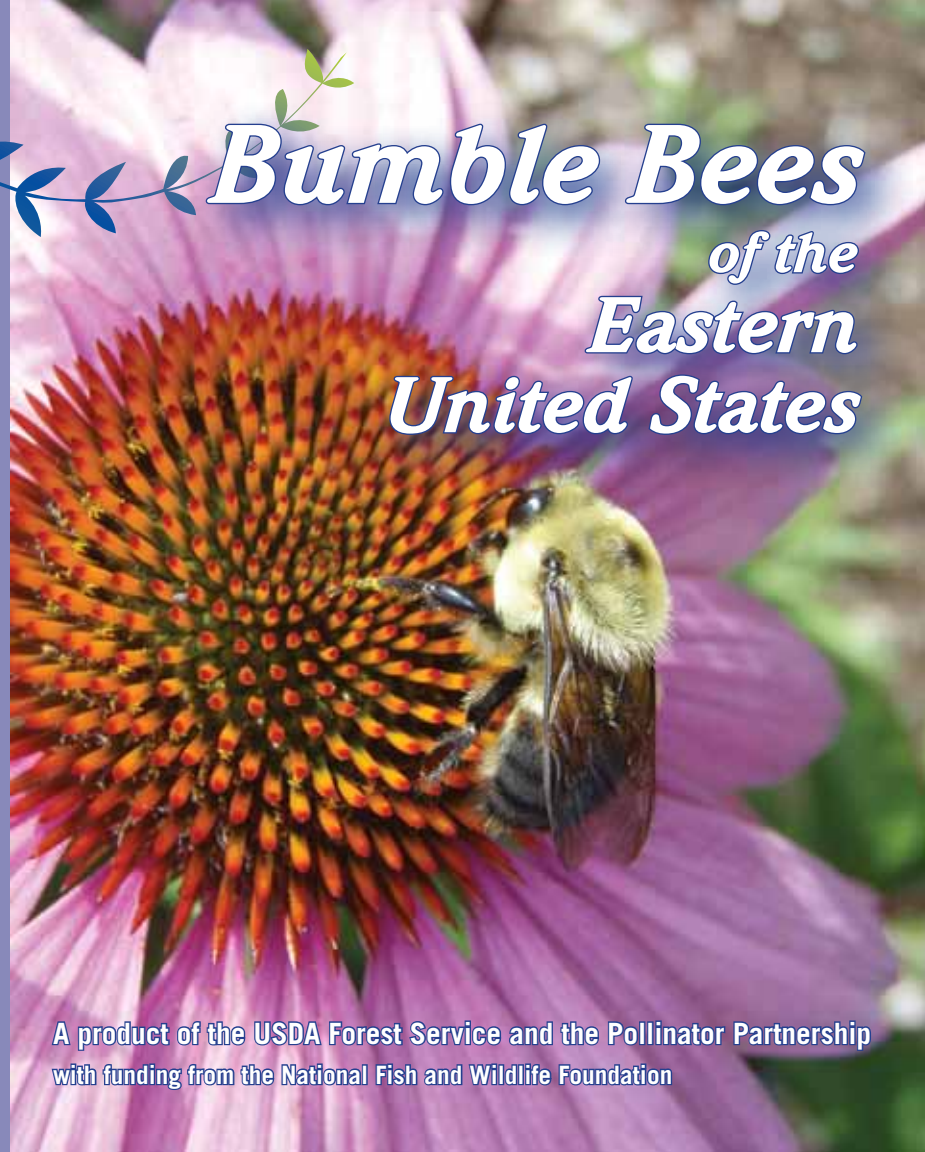


Bumble Bees *of the* *Eastern* *United States*



United States
Department of
Agriculture



By
Sheila Colla
Leif Richardson
Paul Williams

A product of the USDA Forest Service and the Pollinator Partnership
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Cover: Male *Bombus griseocollis*
foraging at cultivated coneflower.
Photo Leif Richardson



Guide to Bumble Bees of the Eastern United States

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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 is 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 others who can’t understand them.”

The Guide to Eastern Bumble Bees is an indispensable new bumble bee identification resource for the Eastern United States. For the first time, melittologists (scientists who study bees) Colla, Richardson, and Williams provide an easy-to-use illustrated and engaging field guide to the most

commonly encountered bumble bees. Each bee species has information on preferred food plants, nesting biology, and 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 characteristics 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 further explore the colorful and charming bumble bees. This guide encourages exploring nature firsthand 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”

About the Authors



Sheila R. Colla has studied various aspects of bumble bee ecology, behavior, and conservation throughout North America. She is currently a doctoral student and recipient of the Natural Sciences and Engineering Research Council 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.
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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.

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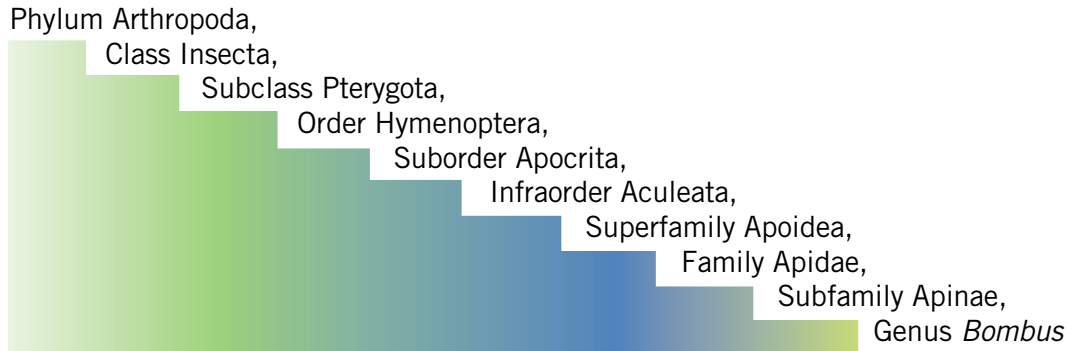
Paul Williams studied the distribution and decline in British bumble bees for a Ph.D. at Cambridge (UK) in 1985. Since then, he has continued to work on this as a research entomologist at the Natural History Museum, London, UK, but is looking increasingly at bumble bee ecology and systematics worldwide, 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 Sichuan, on a checklist of bumble bee species of the world, and on a series of papers on bumble bee phylogeny and subgenera.

Overview: www.nhm.ac.uk/bombus

Publications on bumble bees: www.nhm.ac.uk/bombus/publications.html

Authors are listed in alphabetical order. Each contributed equally.

Bumble bee taxonomy and biogeography



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.

The common and easily recognized bumble bees are large and furry corbiculate (i.e., they have smooth areas on the hindlegs surrounded by stiff bristles for transporting pollen) bees with no jugal lobe to the hindwing. All species are eusocial except for members of the subgenus *Psithyrus*, which are social parasites that invade host bumble bee nests to produce offspring.

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. Because of the length of their colony cycles, bumble bees usually need to feed from a variety of plant species, including native wildflowers, crop plants, and introduced species. As can be seen in the following species pages, there are differences between species in timing of emergence, length of colony cycle, foraging behavior, 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 4 days and the small larvae begin to feed on pollen mixed with nectar. The larval stage of bumble bees has four instars. After almost 2 weeks of development, the larvae spin cocoons and pupate. Pupae develop for another 2 weeks before emerging as full-sized adults. In total, development takes approximately 5 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. 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 that bumble bees can pollinate include tomatoes, peppers, raspberries, blueberries, chives, cucumbers, apples, strawberries, alfalfa, blackberries, soybeans, sunflowers, 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.

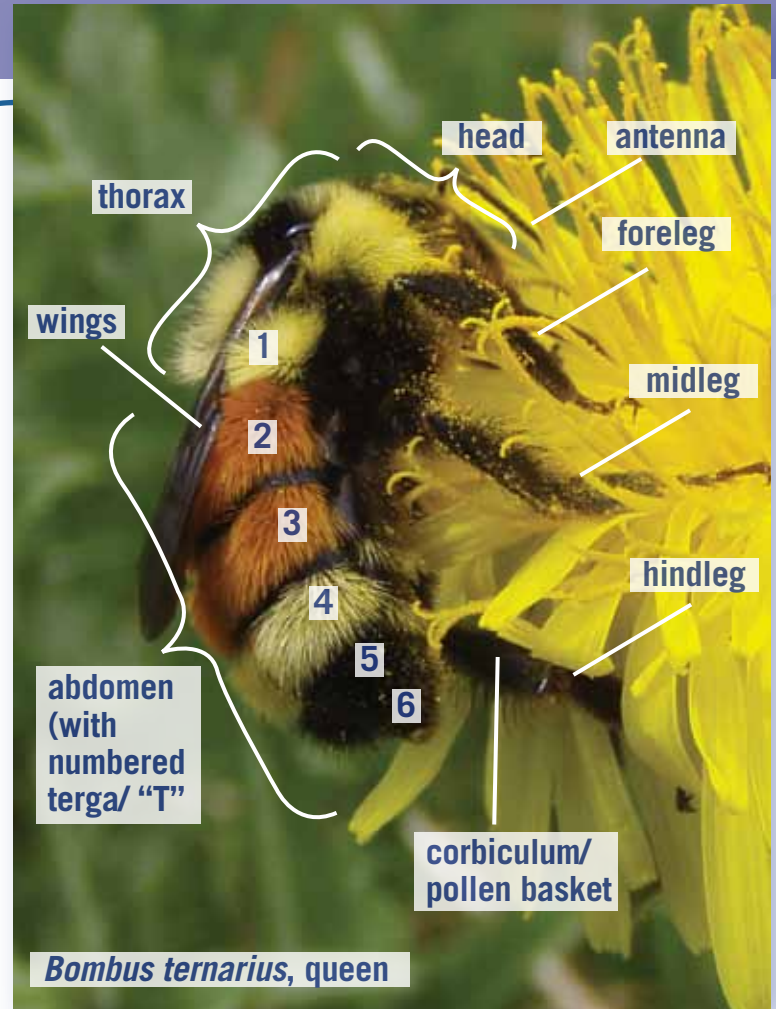
Bumble Bee Declines

We have evidence that in North America some of our bumble bee species are declining and a few are threatened with extinction. One species from Oregon and California (Franklin's bumble bee) has recently been listed by the International Union for Conservation of Nature (IUCN) as Critically Endangered. Species that 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.

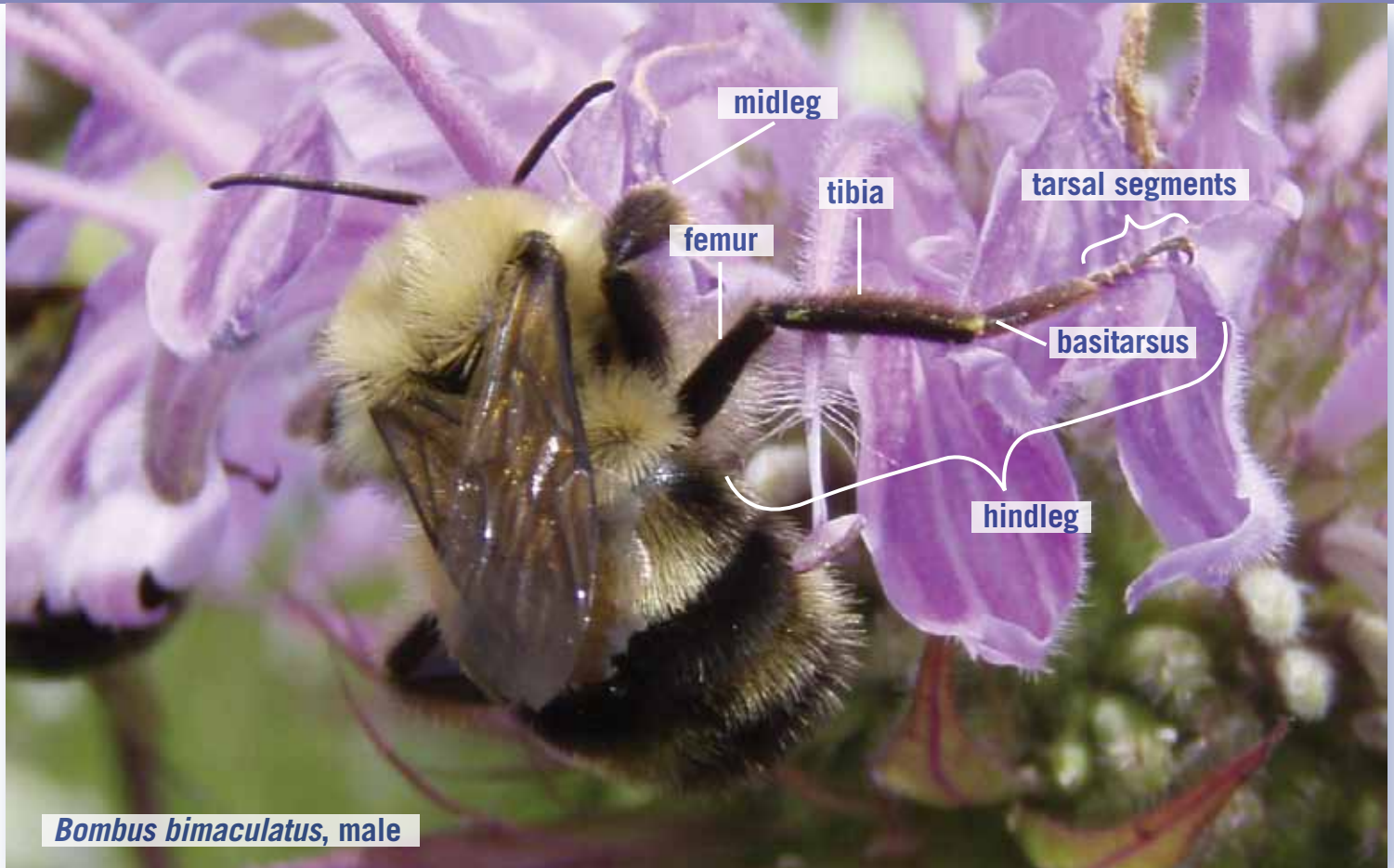
Currently, the suspected threats to wild bumble bees are:

- habitat loss due to agricultural intensification,
- urbanization or pollution,
- pesticide use,
- pathogen spillover from managed bees,
- and climate change.

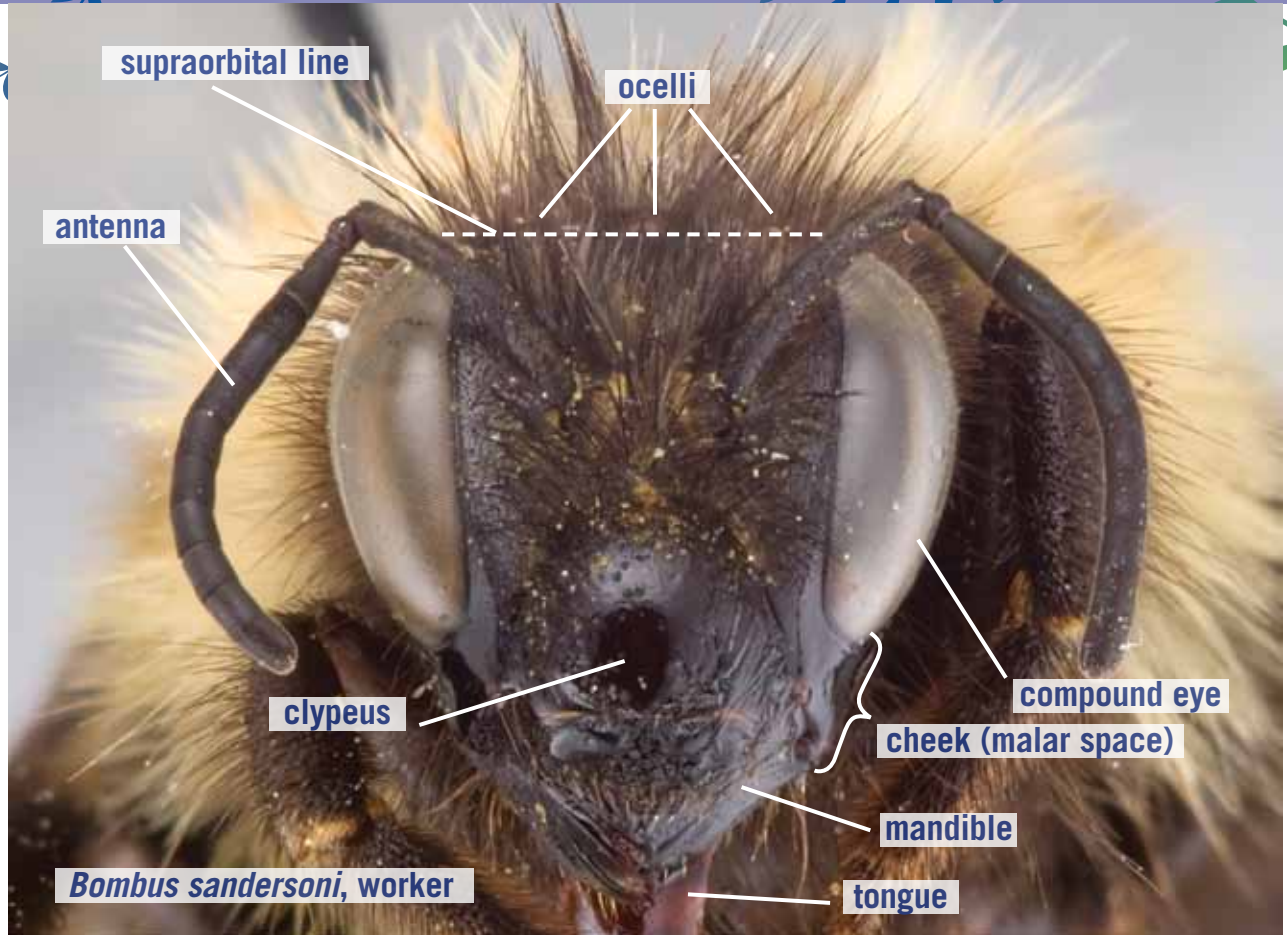
Bee Body Diagram



Bee Leg Diagram



Bee Face Diagram



Map Methodology

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
Canadian National Collection of Insects
Rachael Winfree, Rutgers University
Sam Droege, 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.

Maps 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 United States 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 bumble bees, 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 bumble bees found in this area also occur in parts of adjacent Canada and the Western United States.

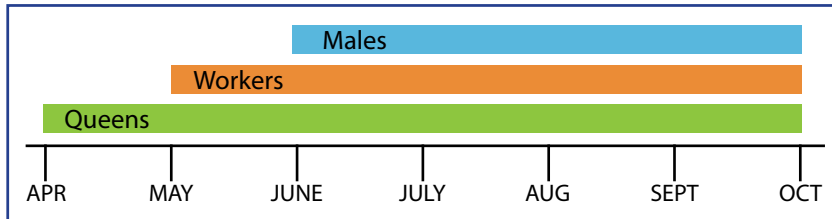
Bombus impatiens



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



Bombus impatiens worker foraging on cultivated sunflower
Photo Leif Richardson

Long- or square-cheeked bees with a rounded angle on the midleg

Bombus impatiens continued

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



Bombus impatiens queen foraging on clover.
Photo Sheila Colla



Bombus impatiens male on oregano.
Photo Leif Richardson



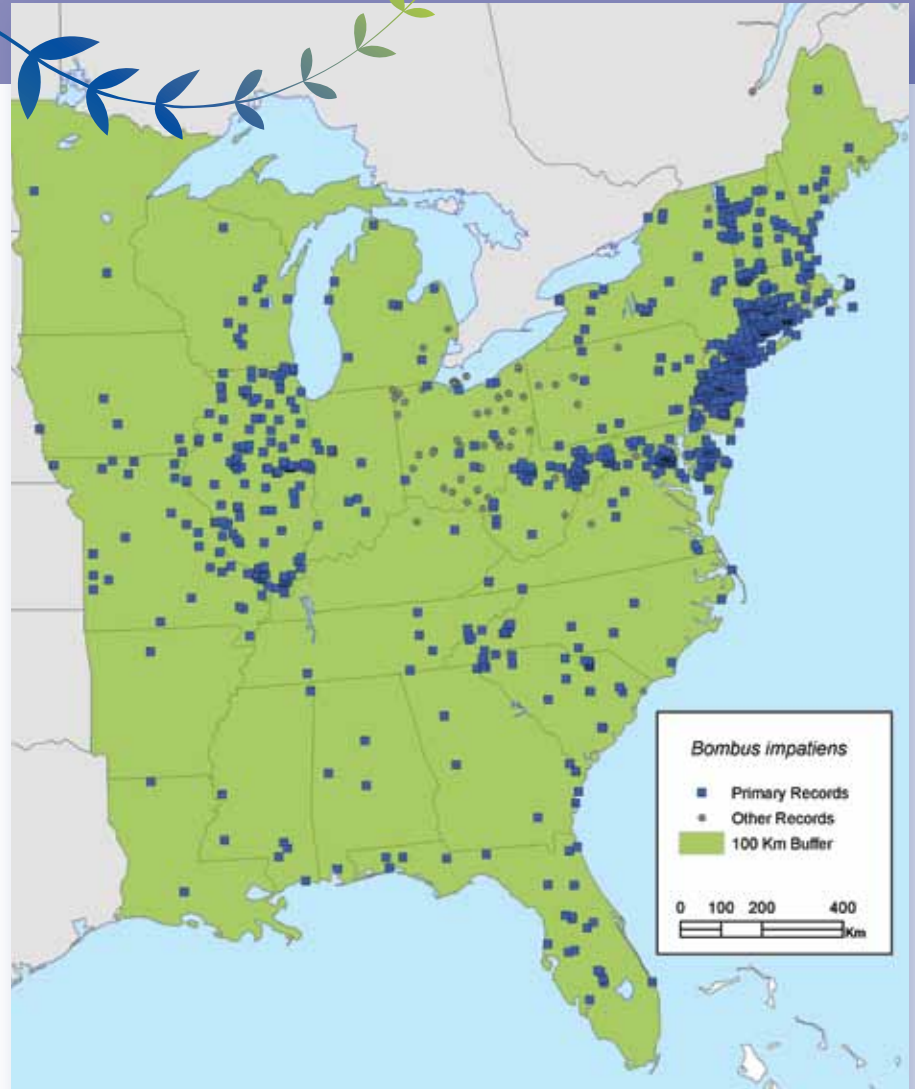
Female *Bombus impatiens*
face. Photo Sheila Colla



Bombus impatiens
male on aster.
Photo Sheila Colla

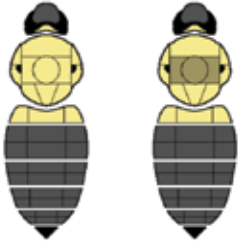


Bombus impatiens continued





queen



worker



male



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.
- Midleg 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.

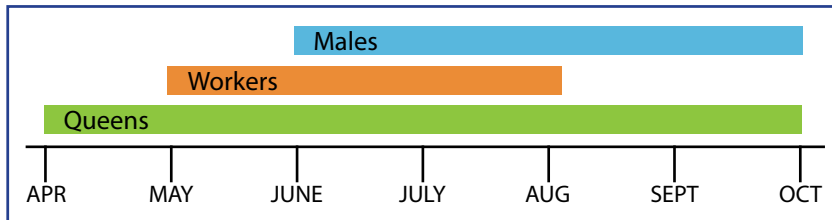
Bombus bimaculatus



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*,

Phenology Chart



Male *Bombus bimaculatus* foraging at wild bergamot.
Photo Leif Richardson

Bombus bimaculatus continued

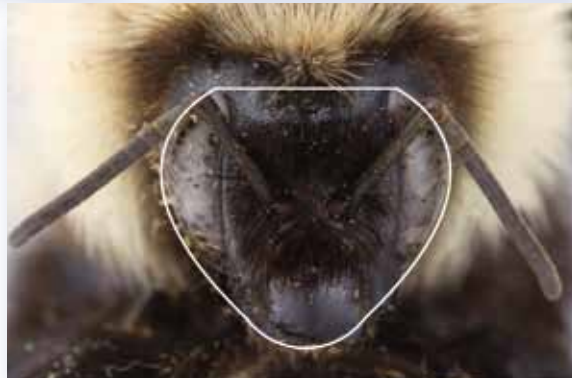
Lateral image of a female
Bombus bimaculatus.
Photo Sheila Colla



Bombus bimaculatus worker.
Photo Sheila Colla



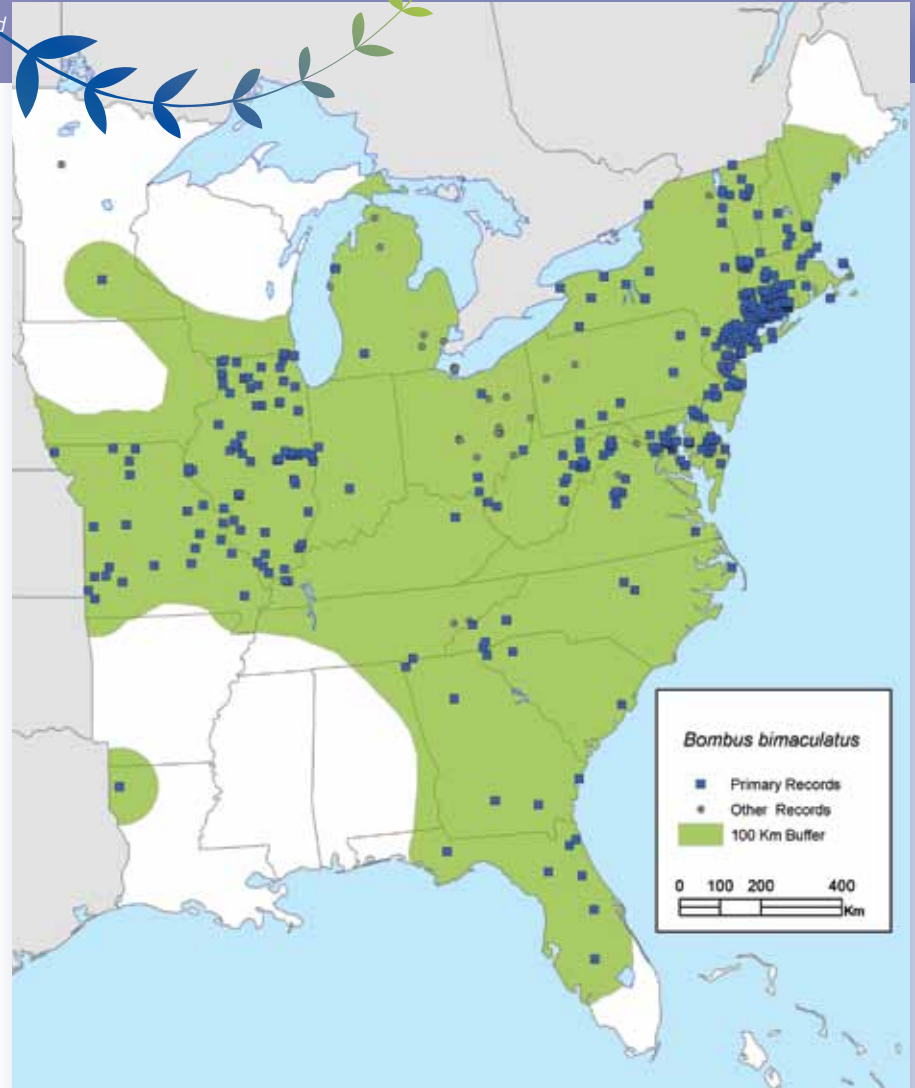
Bombus bimaculatus queen foraging for
nectar from cultivated azaleas.
Photo Leif Richardson



Bombus bimaculatus face.
Photo Sheila Colla

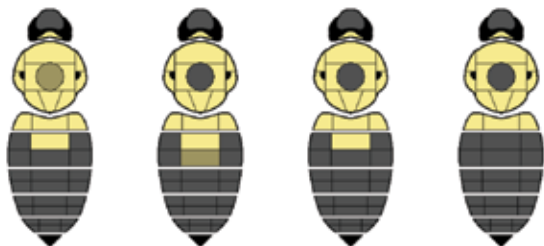


Bombus bimaculatus continued





queen



worker



male



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.
- Midleg 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.

Bombus perplexus



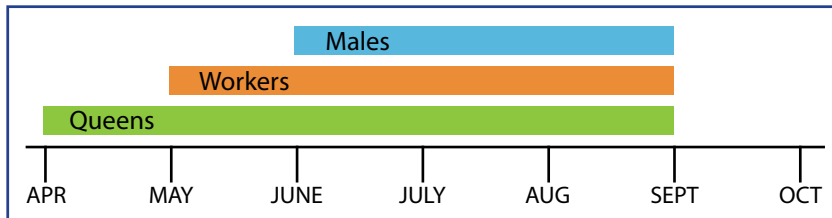
Confusing bumble bee

- 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 worker foraging on St. John's Wort.
Photo Leif Richardson

Phenology Chart



Bombus perplexus continued

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



Bombus perplexus male.
Photo Sheila Colla



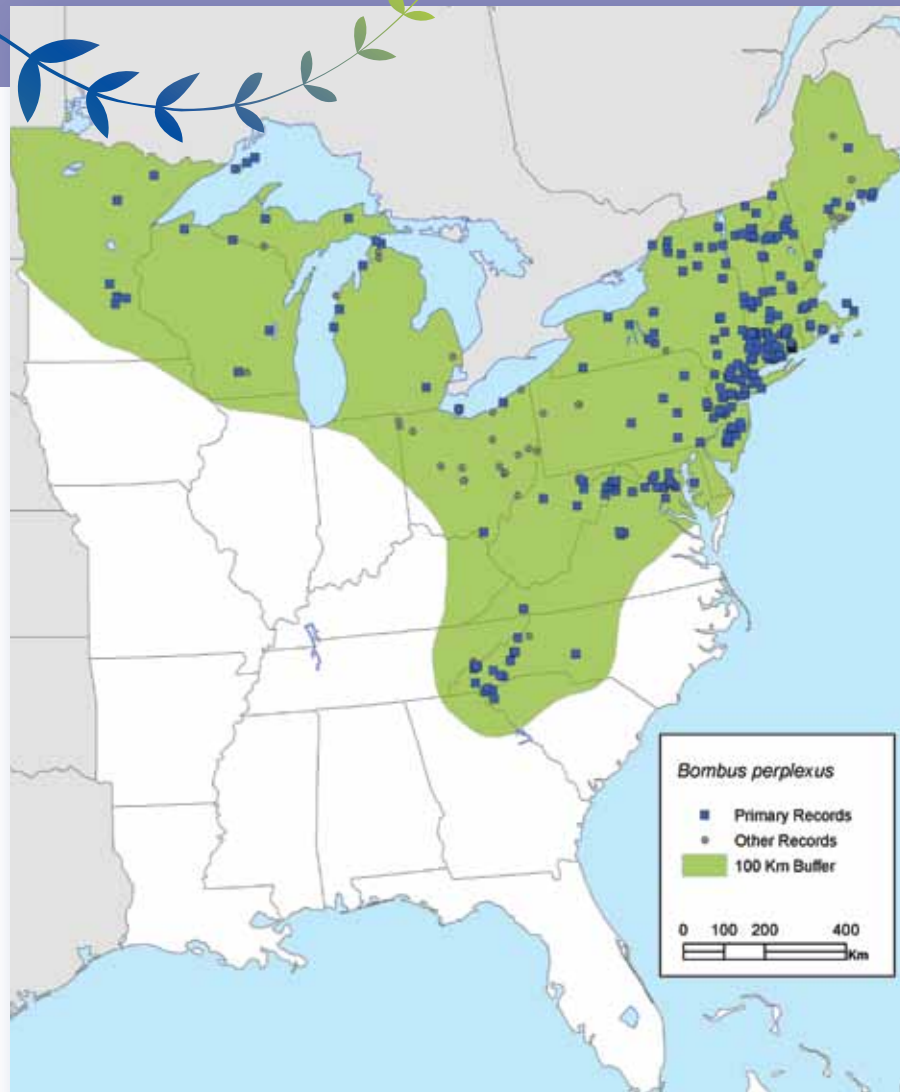
Bombus perplexus queen.
Photo Leif Richardson



Female *Bombus perplexus* face.
Photo Sheila Colla



Bombus perplexus continued





queen



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.
- Midleg 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.

worker



male



Bombus vagans



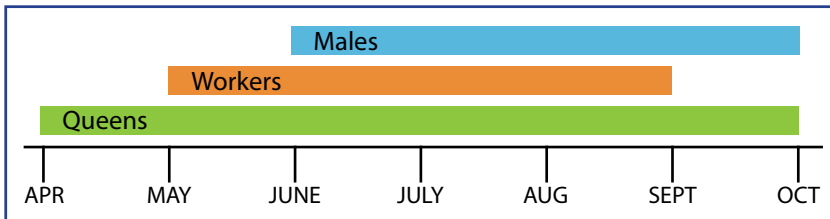
Half-black bumble bee

- 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*



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

Phenology Chart



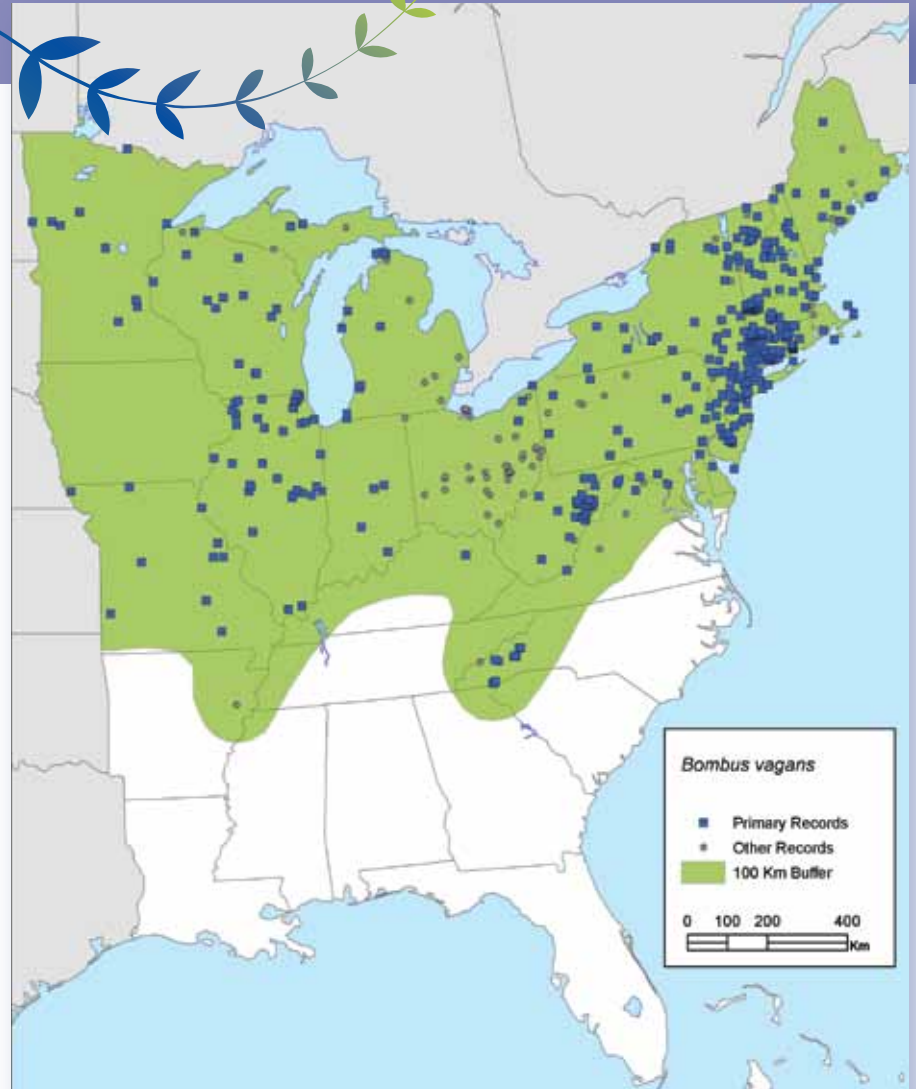
Lateral image of a *Bombus vagans* female.
Photo Sheila Colla



Female *Bombus vagans* face.
Photo Sheila Colla

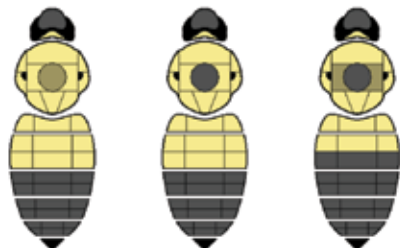


Bombus vagans continued





queen



worker



male



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.
- Midleg 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*.

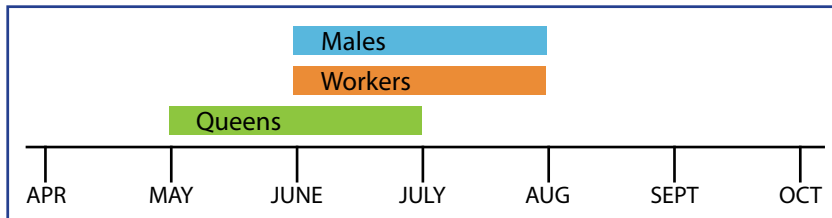
Bombus sandersoni



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.

Phenology Chart



Bombus sandersoni female in Newfoundland, Canada.
Photo Cory Sheffield

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

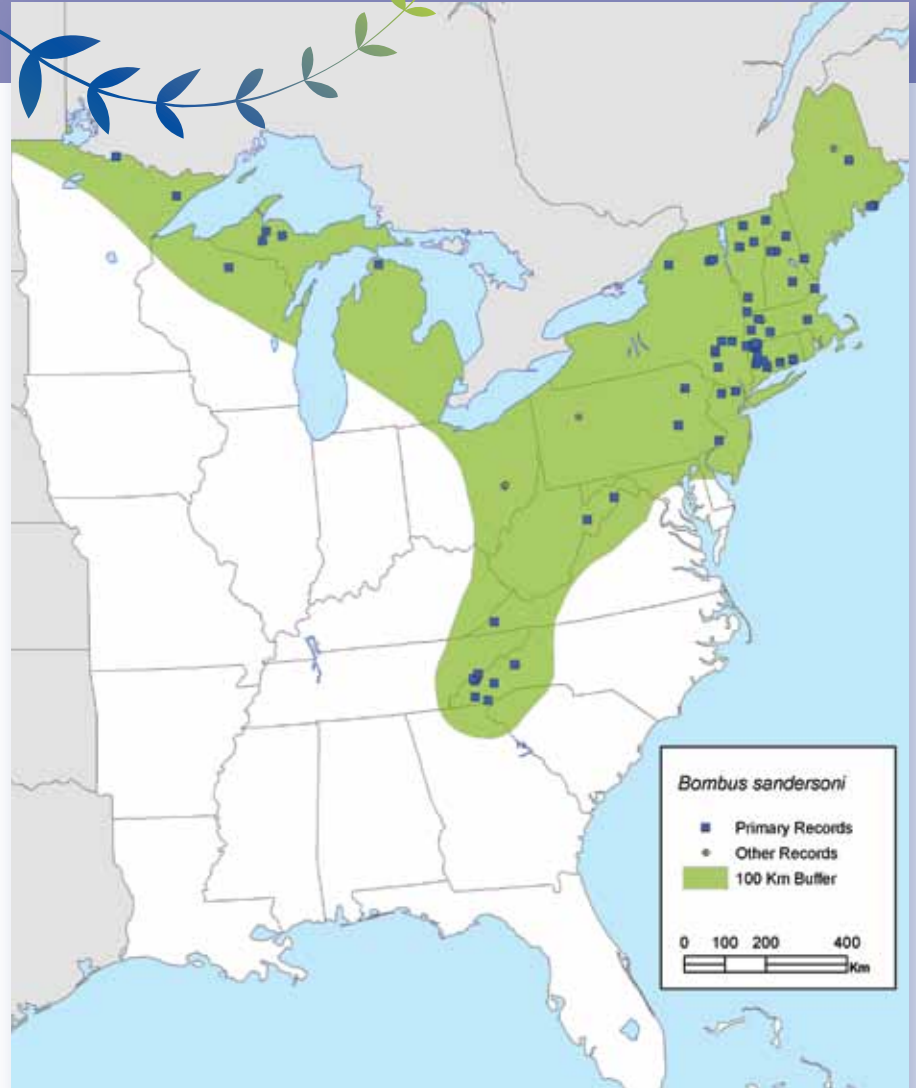


Female *Bombus sandersoni* face.
Photo Sheila Colla



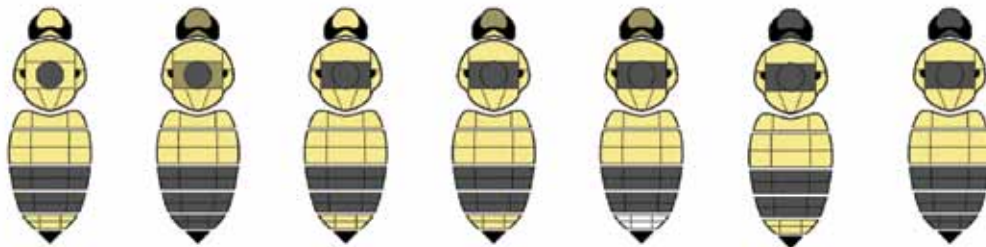
Lateral image of *Bombus sandersoni* female, dark morph.
Photo Sheila Colla

Bombus sandersoni continued





queen



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.

worker



male



- Midleg 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



Bombus frigidus

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

The phenology for this species is unknown due to few records in the Eastern United States.



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

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



Female *Bombus frigidus* face.
Photo Sheila Colla

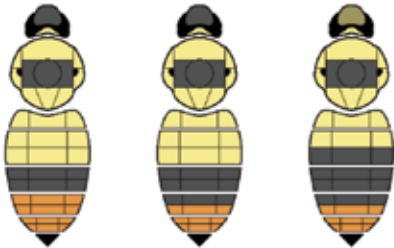


Bombus frigidus continued





queen



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

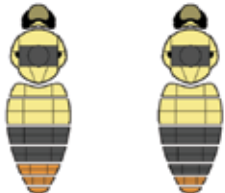
- Thorax and T1-2 predominantly yellow, with a black band between the wing bases, sides of the thorax yellow, tail orange (occasionally faded to more yellowish).

worker



- Midleg 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 antero-laterally without scattered black hairs intermixed. Hair long.

male



Bombus ternarius



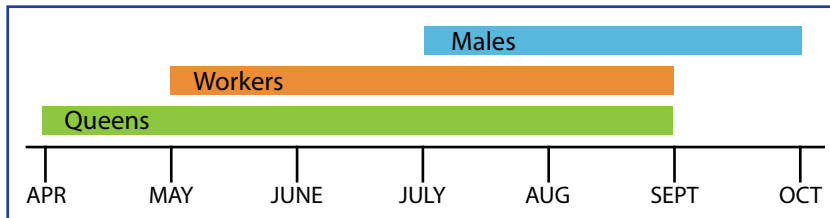
Tri-colored bumble bee

- 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*



Bombus ternarius queen visits dandelion.
Photo Leif Richardson

Phenology Chart



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



Male *Bombus ternarius* on
Canada goldenrod.
Photo Sheila Dumesh



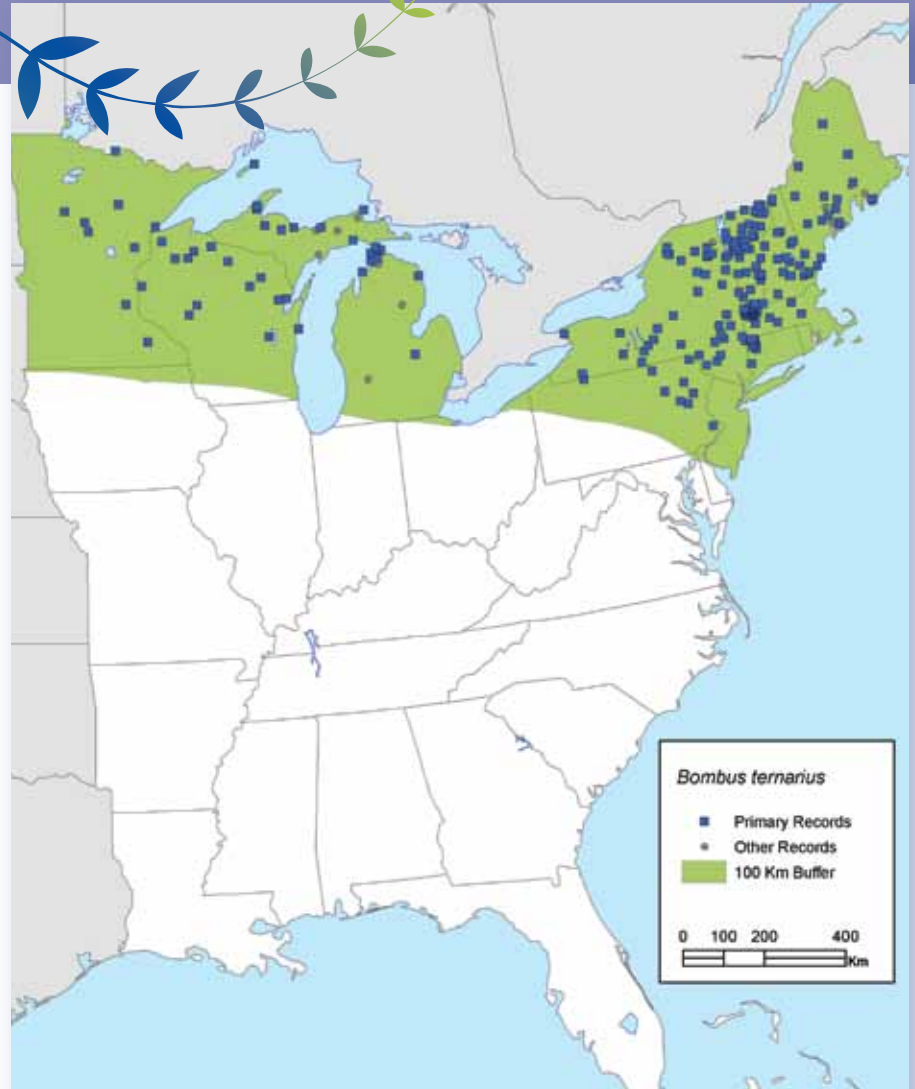
Female *Bombus ternarius* face.
Photo Sheila Colla



A *Bombus ternarius* worker
visits cultivated bush pea.
Photo Leif Richardson

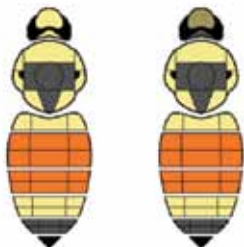


Bombus ternarius continued





queen



worker



male



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.
- Midleg 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.

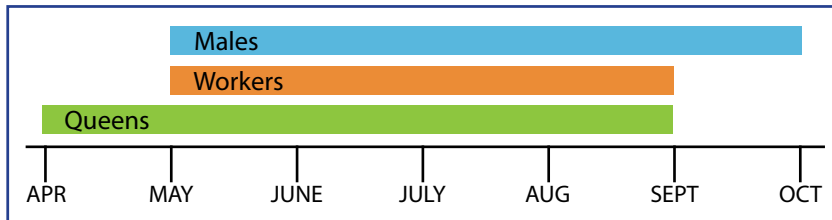
Bombus terricola



Yellow-banded bumble bee

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

Phenology Chart



Bombus terricola worker collecting nectar from milkweed.
Photo Leif Richardson

Short-cheeked bees with a rounded angle on the mid leg

Bombus terricola continued

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



Bombus terricola worker visiting purple flowering raspberry.
Photo Leif Richardson



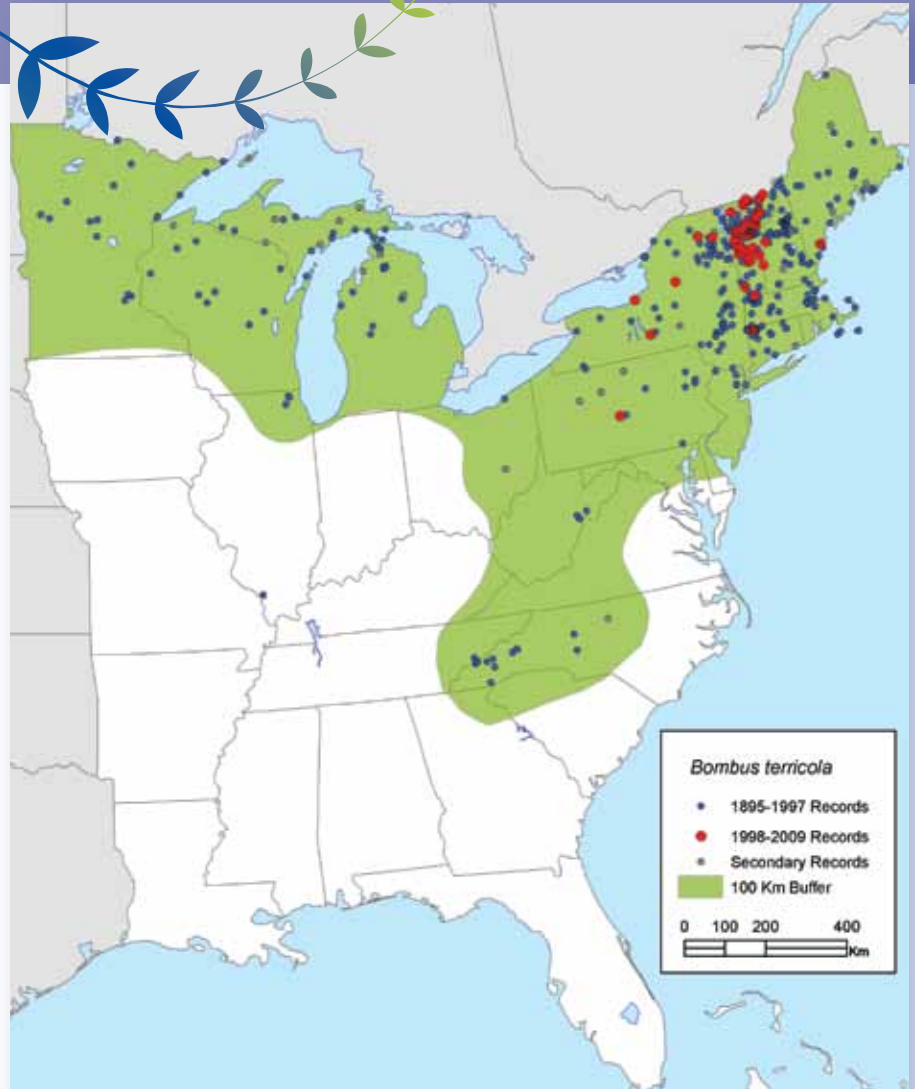
Bombus terricola male forages on hop clover.
Photo Leif Richardson



Female *Bombus terricola* face.
Photo Sheila Colla

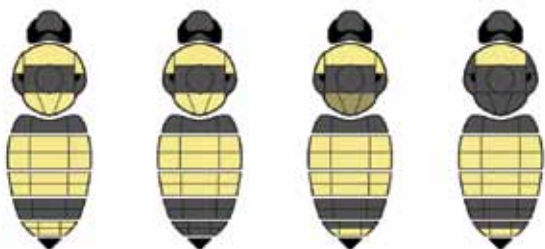


Bombus terricola continued





queen



worker



male



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.
- Midleg 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.

Bombus affinis



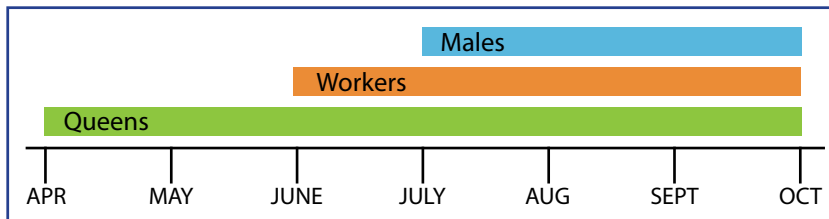
Rusty-patched bumble bee

- 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 worker on spotted knapweed.
Pinery Provincial Park, Ontario.
Photo Sheila Colla

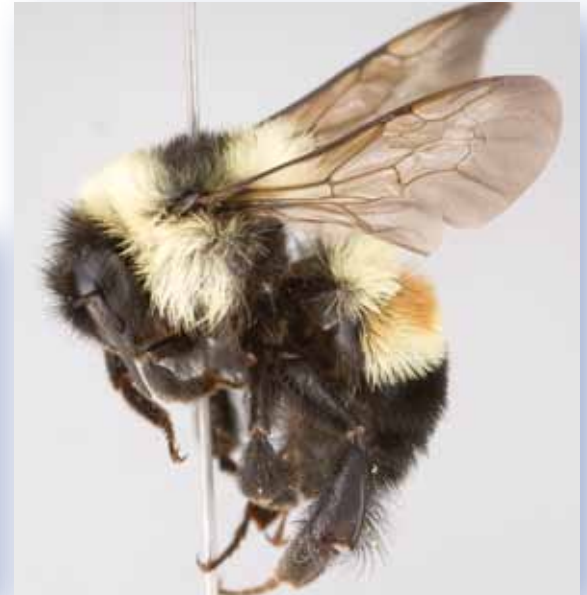
Phenology Chart



Lateral image of a queen *Bombus affinis*.
Photo Sheila Colla



Lateral image of *Bombus affinis* worker.
Photo Sheila Colla

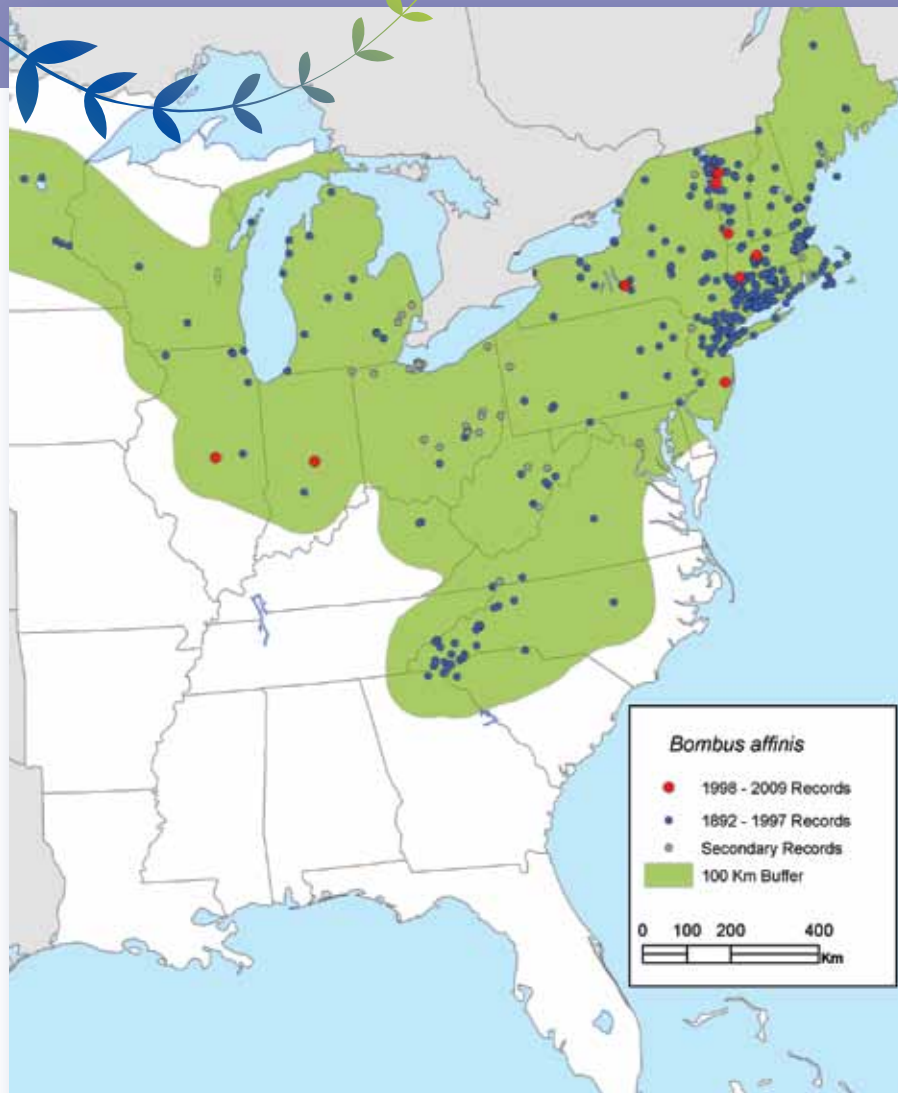


Queen *Bombus affinis* face.
Photo Sheila Colla



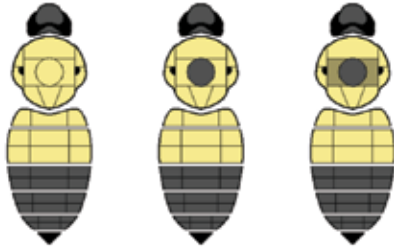
Bombus affinis continued

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.





queen



worker



male



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.
- Midleg 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.

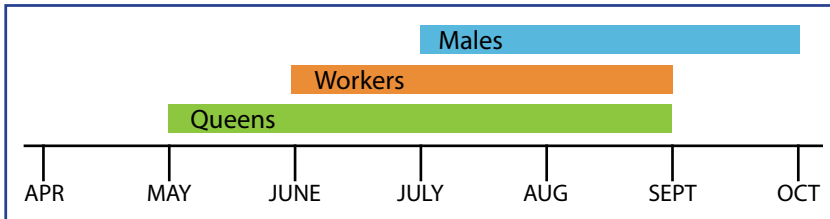
Bombus griseocollis



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*

Phenology Chart



Male *Bombus griseocollis* foraging at cultivated coneflower.
Photo Leif Richardson

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



A *Bombus griseocollis* worker captured by a crab spider.
Photo Sheila Colla

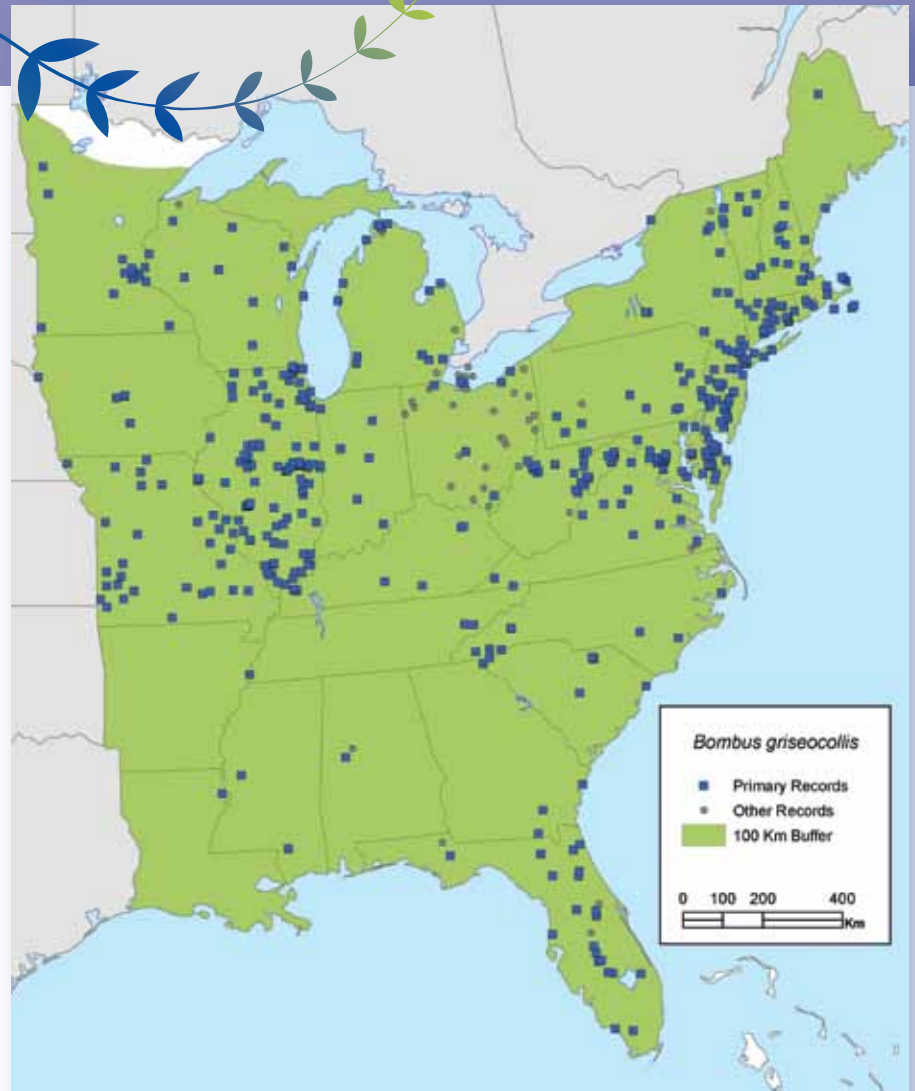


Bombus griseocollis workers foraging on prickly pear.
Photo Leif Richardson

Bombus griseocollis face.
Photo Sheila Colla

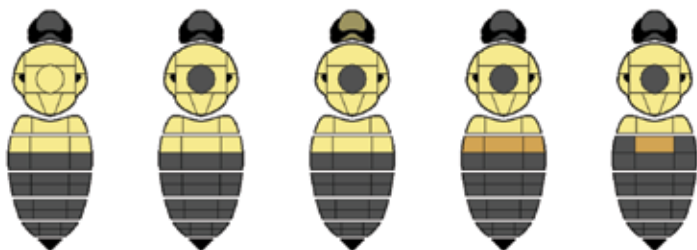


Bombus griseocollis continued





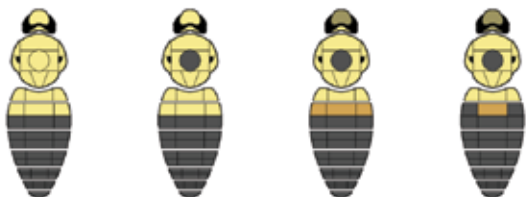
queen



worker



male



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.
- Midleg 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.

Bombus fraternus



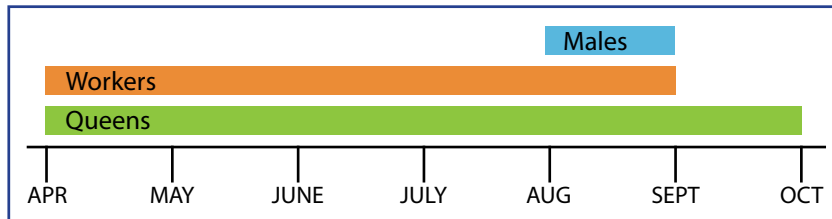
Southern plains bumble bee

- 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 worker.
Photo Paul Williams

Phenology Chart



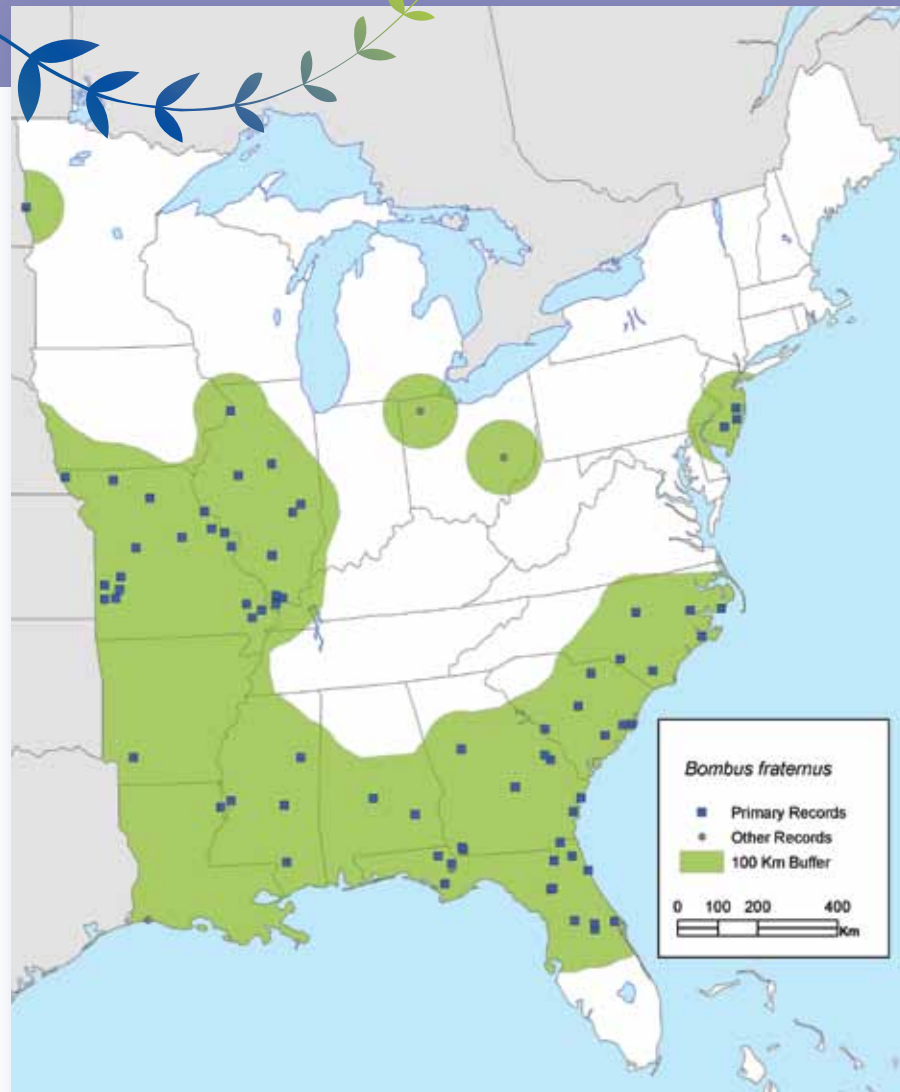
Lateral image of a female *Bombus fraternus*.
Photo Sheila Colla



Female *Bombus fraternus* face.
Photo Sheila Colla



Bombus fraternus continued

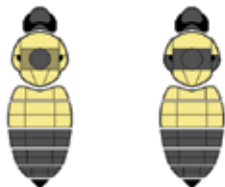




queen



worker



male



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.
- Midleg 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.

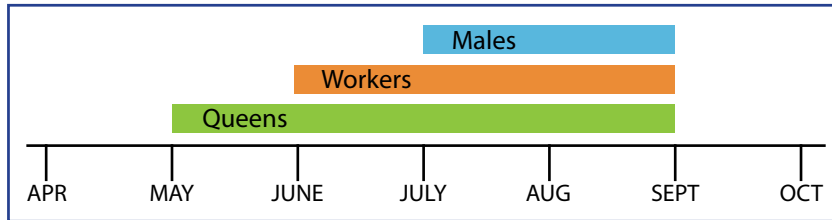
Bombus rufocinctus



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

Phenology Chart



A black color morph *Bombus rufocinctus* worker forages at teasel.
Photo Leif Richardson

Bombus rufocinctus continued

Lateral image of a *Bombus rufocinctus* female, black morph.
Photo Sheila Colla



Lateral image of a *Bombus rufocinctus* female, red morph.
Photo Sheila Colla



A red color morph *Bombus rufocinctus* worker forage
at teasel. Photo Leif Richardson

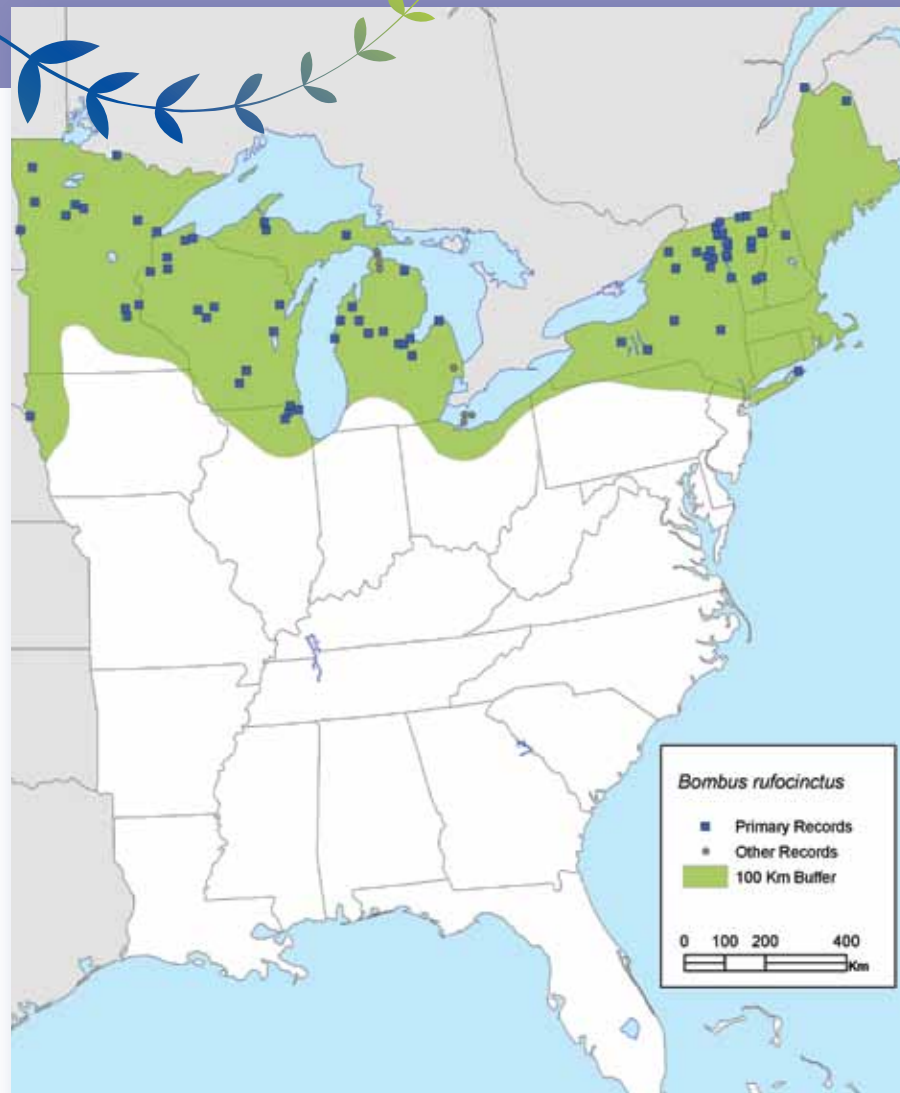


Bombus rufocinctus female.
Photo Leif Richardson

Female *Bombus rufocinctus* face.
Photo Sheila Colla

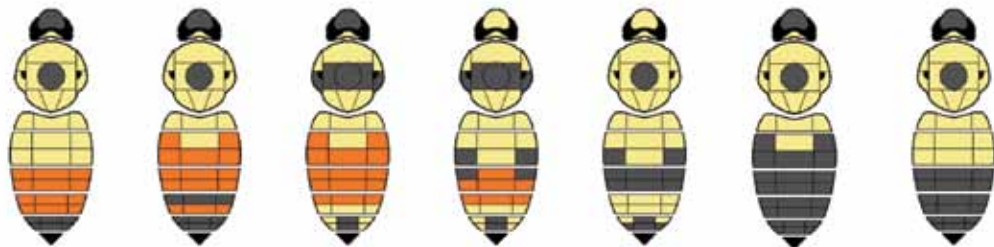


Bombus rufocinctus continued





queen



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.

worker



male



- Midleg 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.

Bombus fervidus



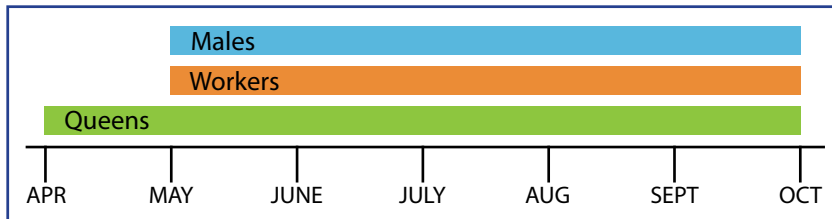
Yellow bumble bee

- 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



Bombus fervidus female.
Photo Leif Richardson

Phenology Chart



Long-cheeked bees with a sharp angle on the midleg

Bombus fervidus continued

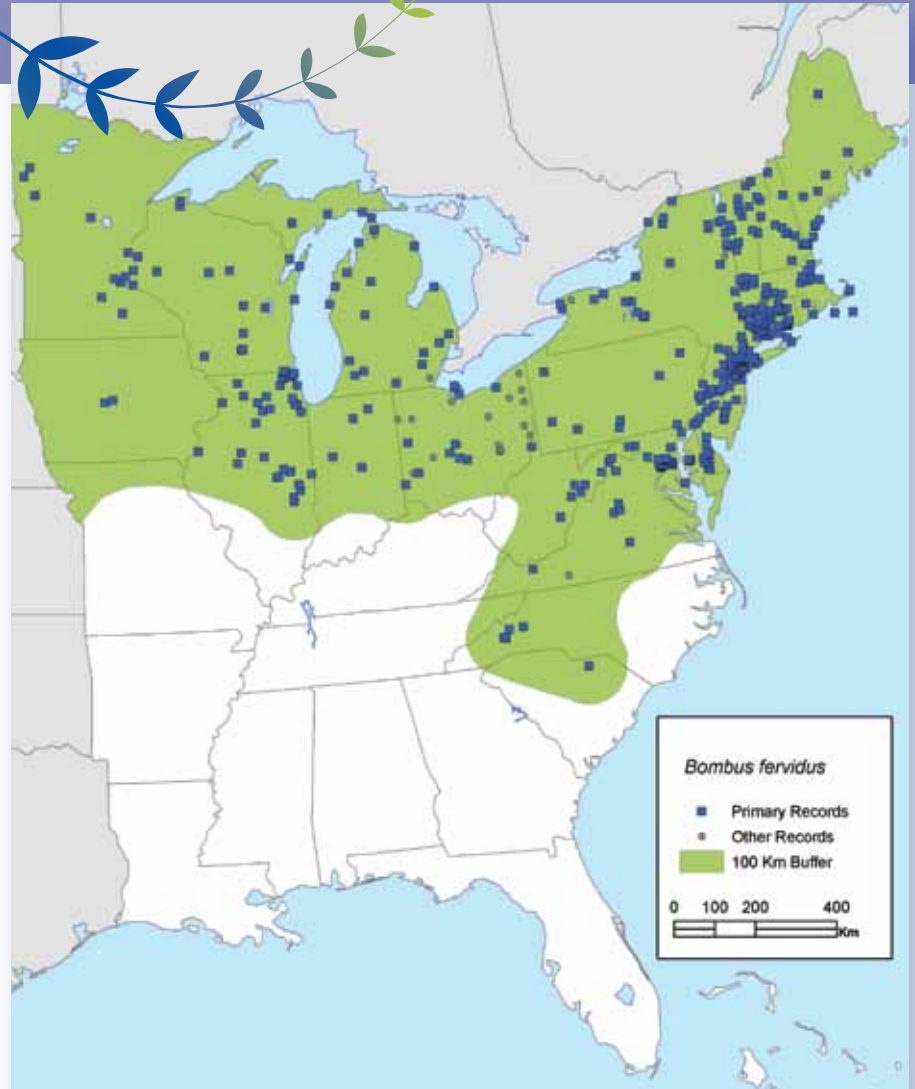
Lateral image of a *Bombus fervidus* female.
Photo Sheila Colla



Female *Bombus fervidus* face.
Photo Sheila Colla

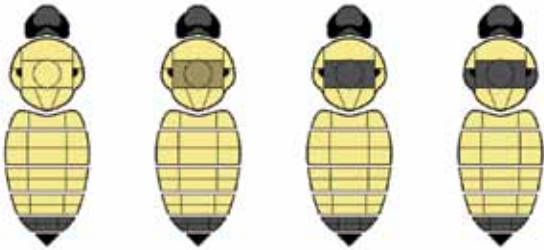


Bombus fervidus continued





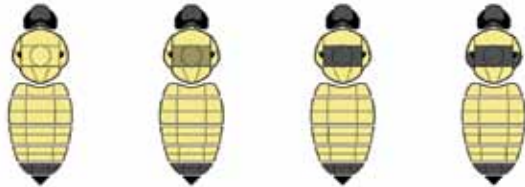
queen



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.
- Midleg 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.

worker



male



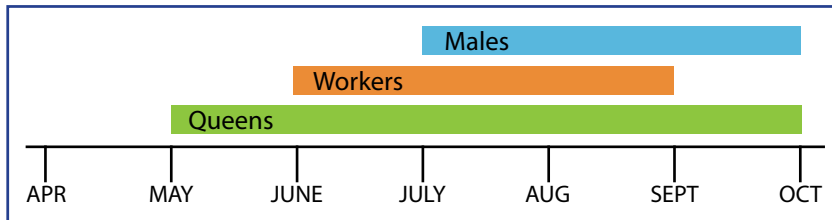
Bombus borealis



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



Bombus borealis male foraging at red clover.
Photo Leif Richardson

Bombus borealis continued

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



Bombus borealis worker foraging at cultivated monkshood.
Photo Leif Richardson



Bombus borealis queen foraging on cow vetch.
Photo Paul Williams



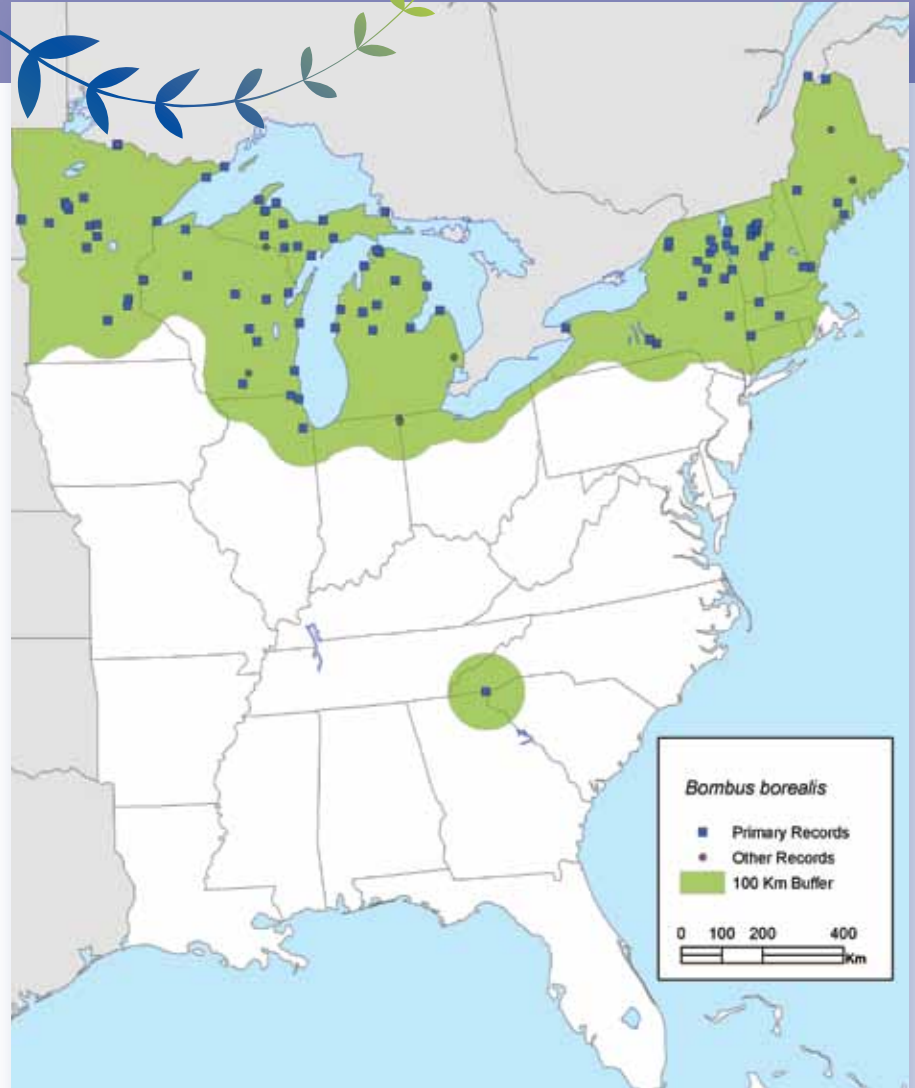
Bombus borealis face.
Photo Sheila Colla



Bombus borealis males
on thistle.
Photo Leif Richardson

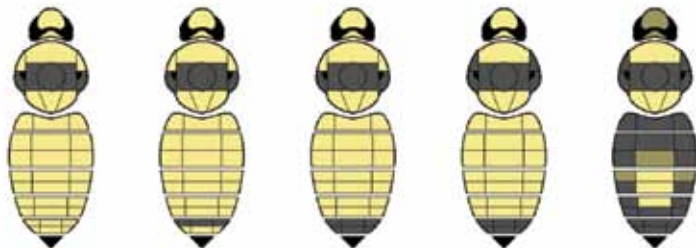


Bombus borealis continued





queen



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.
- Midleg 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 center. 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.

worker



male



Bombus pensylvanicus



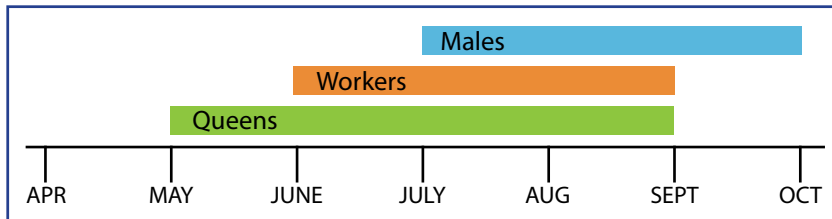
American bumble bee

- 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*



Bombus pensylvanicus worker foraging on cow vetch.
Photo Paul Williams

Phenology Chart



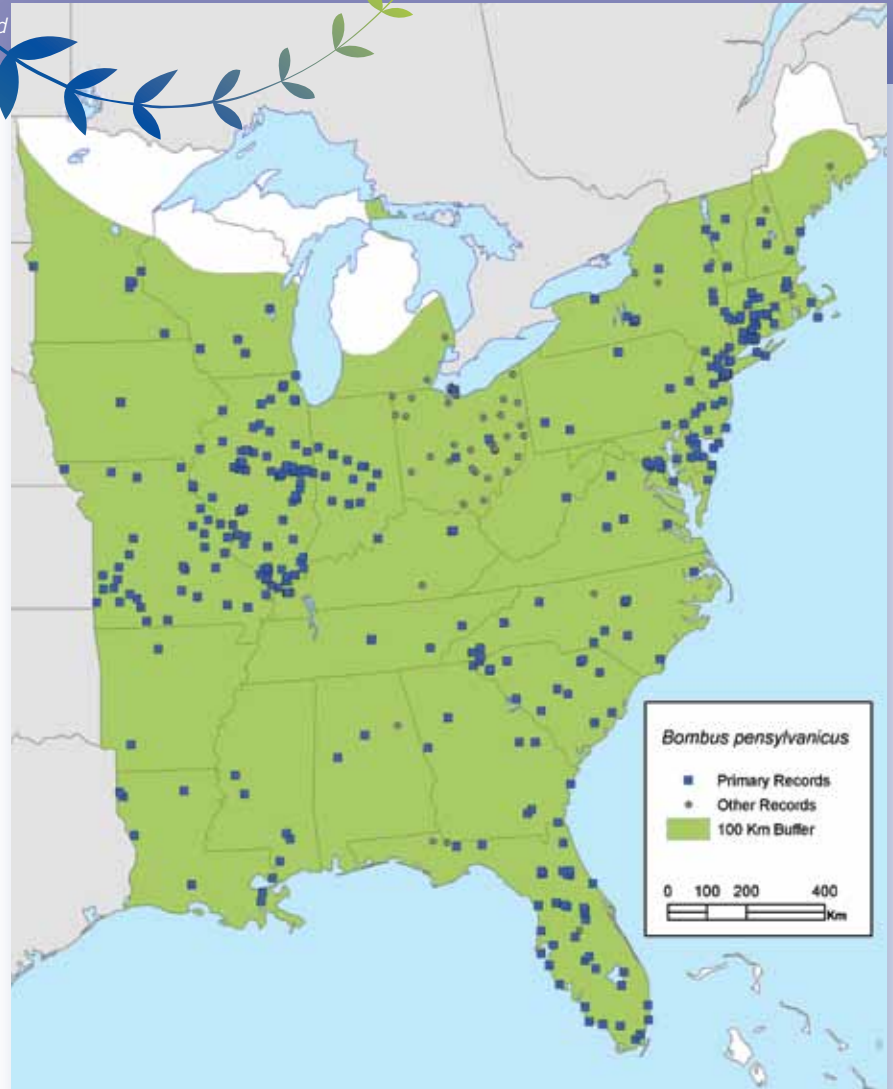
Lateral image of a female *Bombus pensylvanicus*.
Photo Sheila Colla



Female *Bombus pensylvanicus* face.
Photo Sheila Colla

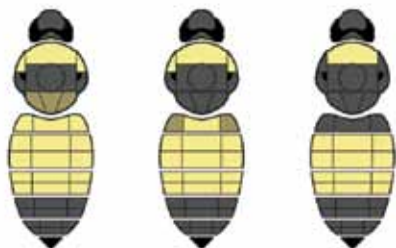


Bombus pensylvanicus continued





queen



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.
- Midleg 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.

worker



male



Bombus auricomus

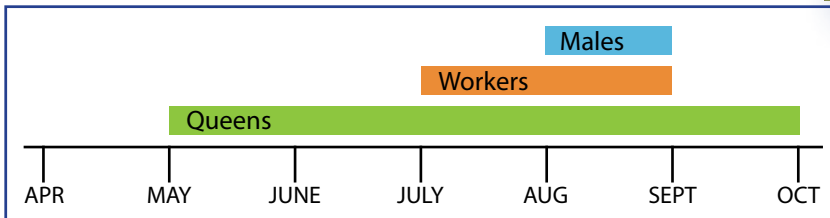


Black and gold bumble bee

- 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*



Phenology Chart



Bombus auricomus worker foraging on a legume.
Photo Paul Williams

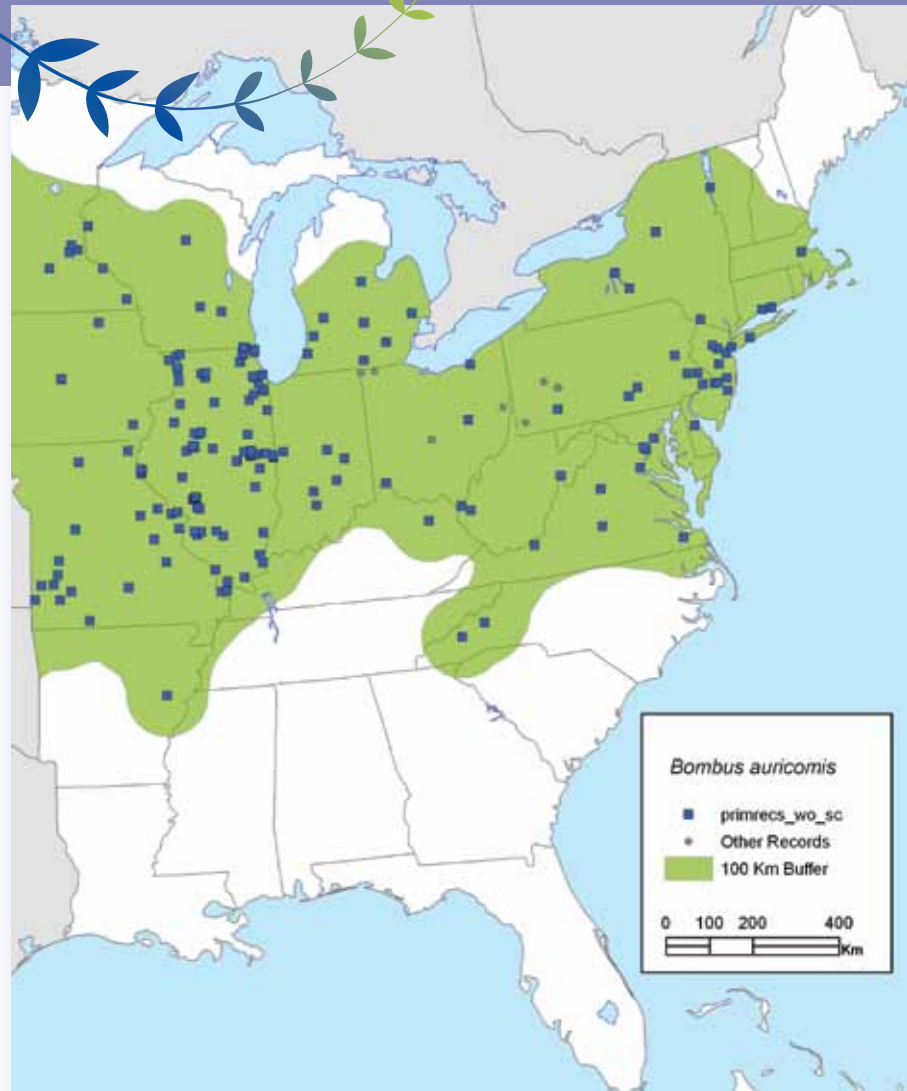
Lateral image of a female *Bombus auricomus*.
Photo Sheila Colla



Female *Bombus auricomus* face.
Photo Sheila Colla

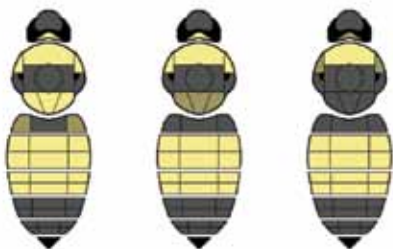


Bombus auricomus continued





queen



worker



male



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.
- Midleg 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.

Bombus citrinus



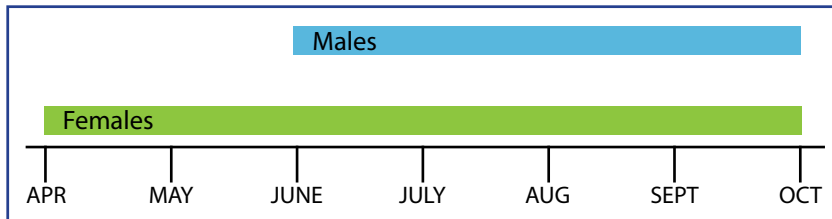
Lemon cuckoo bumble bee

- 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*



Bombus citrinus male on Woodland Sunflower.
Photo Sheila Colla

Phenology Chart



**Bees with hindleg outer tibial surface convex
and uniformly hairy (cuckoo bumble bees)**

Bombus citrinus *continued*

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



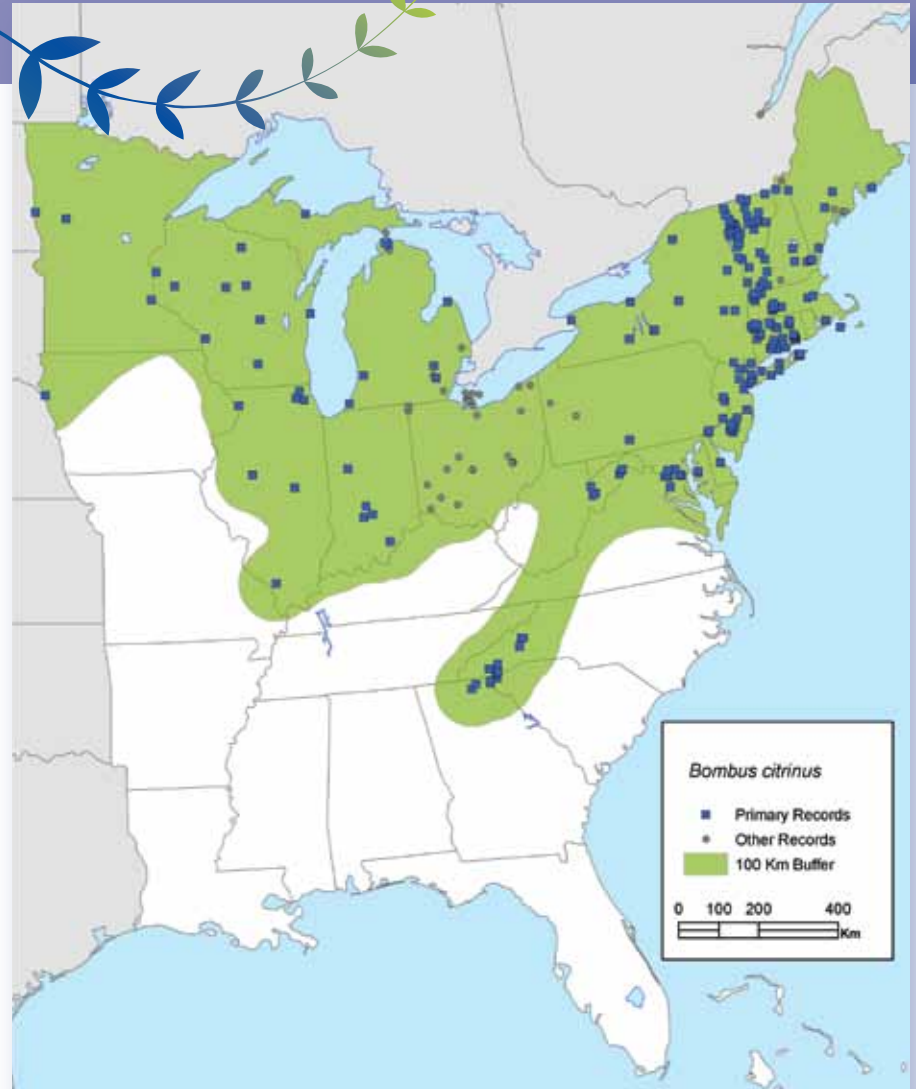
Female *Bombus citrinus*.
Photo J. Lucier



Female *Bombus citrinus* face.
Photo Sheila Colla



Bombus citrinus continued

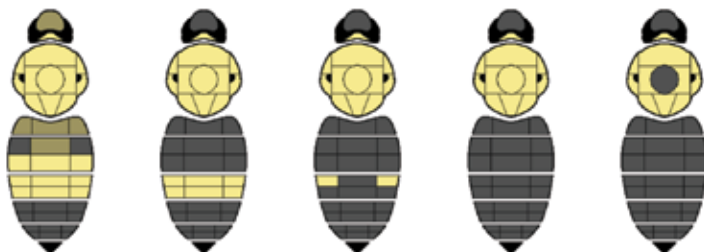




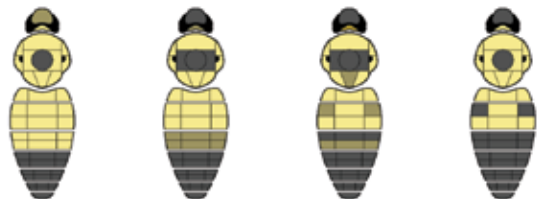
Females (no workers, colors refer to pile or 'hair'):

- 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 predominantly 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.

female



male



Bombus variabilis



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.



Female *Bombus variabilis*.
Photo Sheila Colla

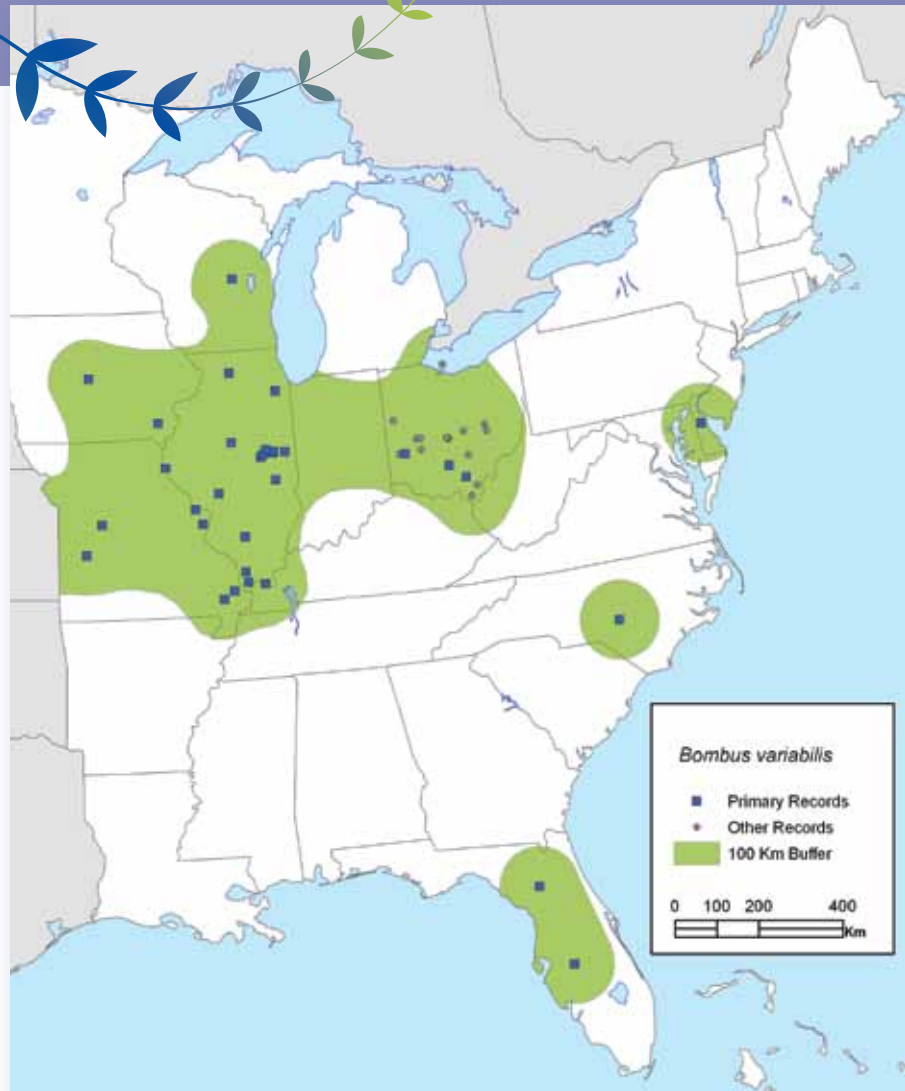
Lateral image of a *Bombus variabilis* female.
Photo Sheila Colla



Female *Bombus variabilis* face.
Photo Sheila Colla



Bombus variabilis continued





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.

female



male



Bombus insularis



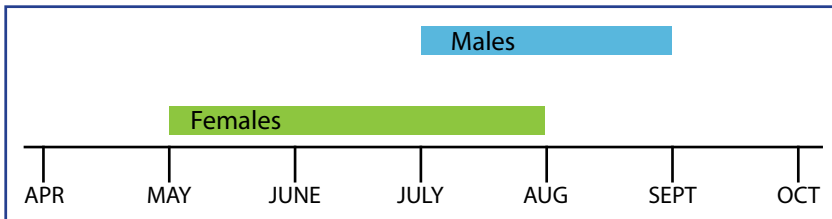
Indiscriminate bumble bee

- Rare in the Eastern United States.
- 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*



Female *Bombus insularis*.
Photo Sheila Colla

Phenology Chart



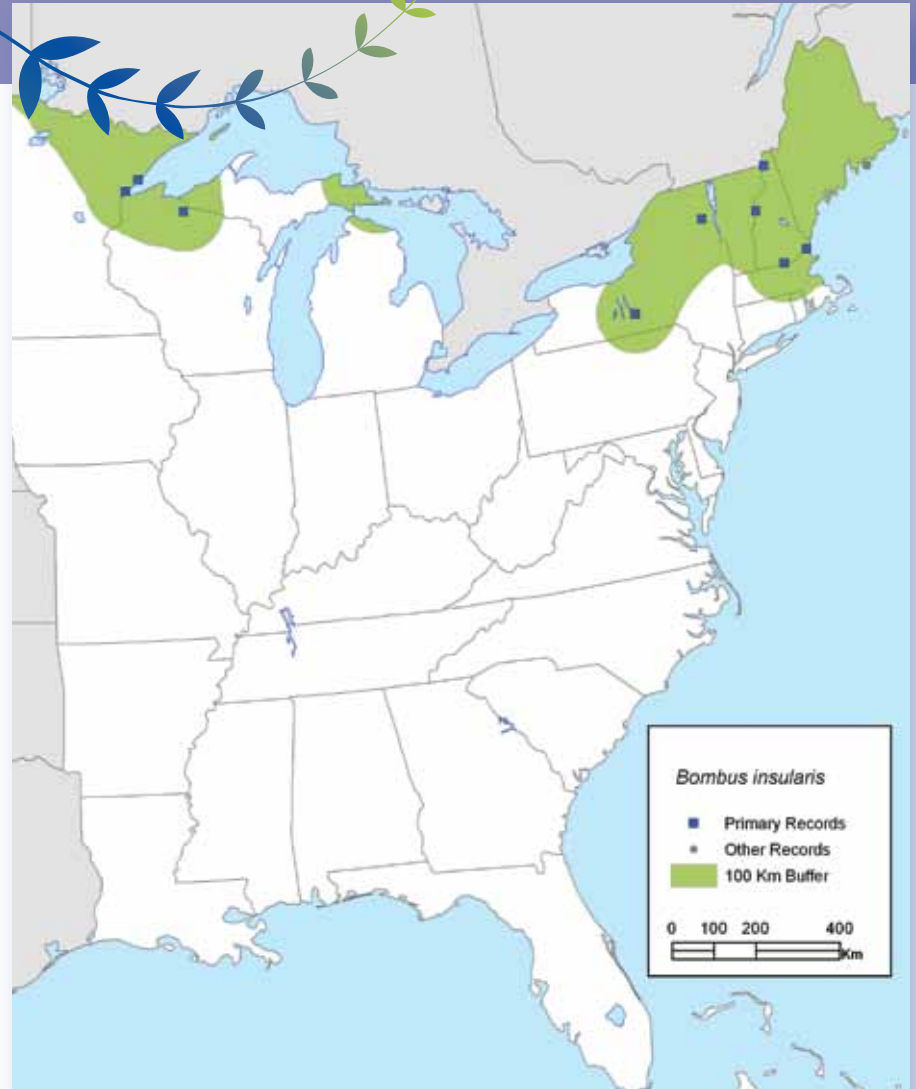
Lateral image of a female *Bombus insularis*.
Photo Sheila Colla



Female *Bombus insularis* face.
Photo Sheila Colla



Bombus insularis continued





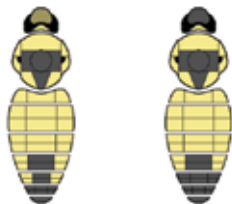
Females (no workers, colors refer to pile or 'hair'):

- 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.

female



male



Bombus ashtoni



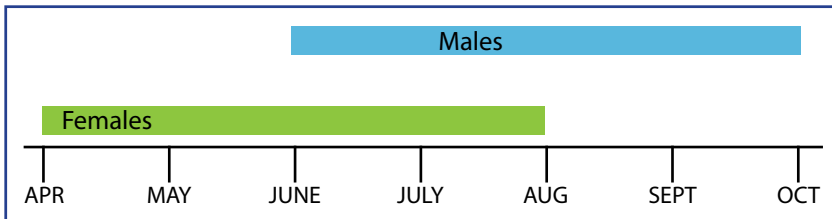
Ashton cuckoo bumble bee

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



Female *Bombus ashtoni*.
Photo Sheila Colla

Phenology Chart



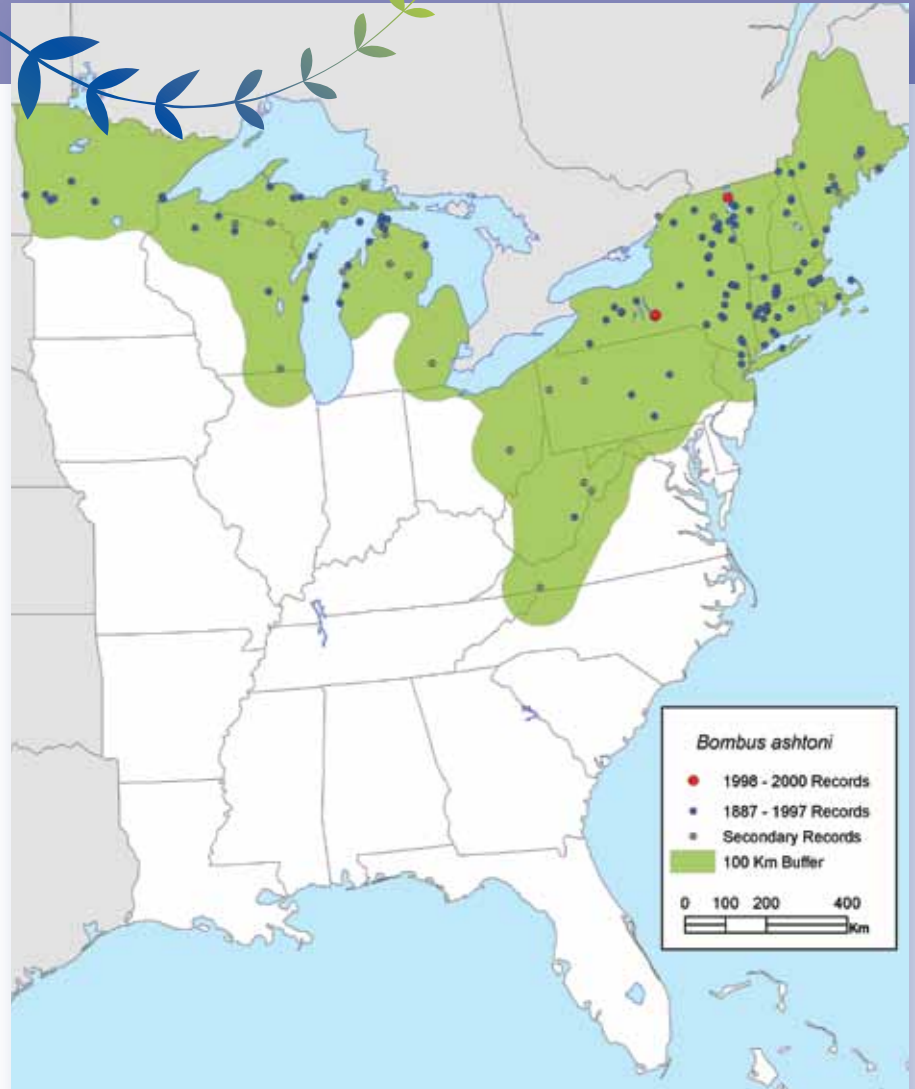
Lateral image of a *Bombus ashtoni* female.
Photo Sheila Colla



Female *Bombus ashtoni* face.
Photo Sheila Colla



Bombus ashtoni continued





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.

female



male



Bombus fernaldae



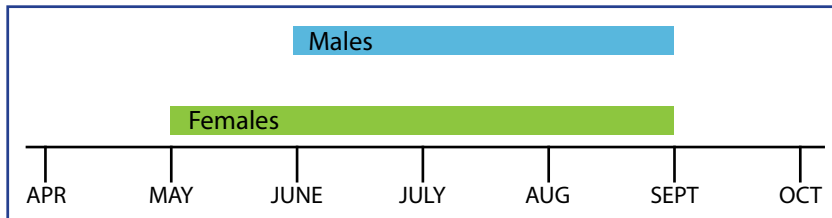
Fernald cuckoo bumble bee

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



Male *Bombus fernaldae* foraging.
Photo Beatriz Moisset

Phenology Chart



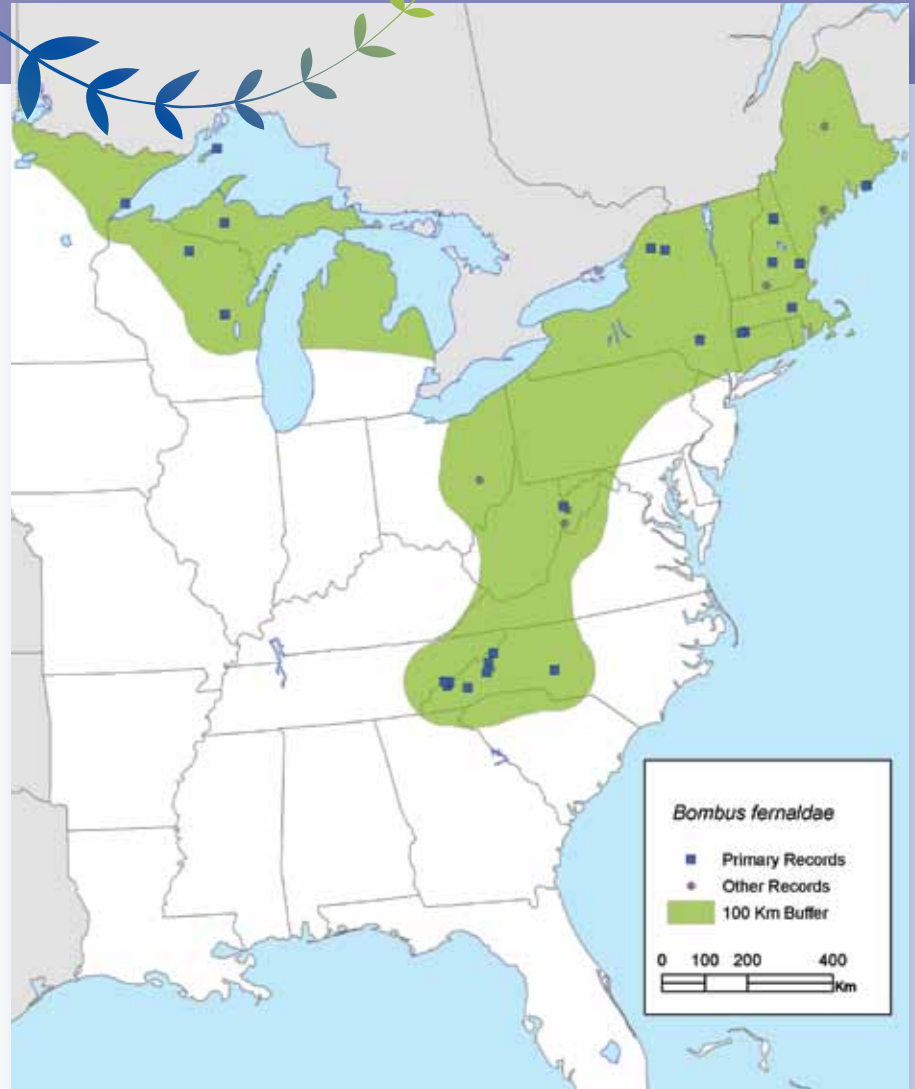
Lateral image of a female *Bombus fernaldae*.
Photo Sheila Colla



Female *Bombus fernaldae* face.
Photo Sheila Colla



Bombus fernaldae continued





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.

female



male



Identification Key

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).

- 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 ... **fervidus**
 - 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 as or shorter than broad ($L \leq B$), 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 predominately black, yellow, or pale orange ... 10
- 9 (8) Cheeks as long as broad (L=B); T2 pile predominately orange-red, often with some black in the middle ... ***ternarius***
- 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, orange, or red ... 24
- 11 (10) T2 pile completely black ... ***impatiens***
- 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 ($L \ll B$), about half as long as broad; T2–T4 pile very short, even, and decumbent ... **fraternus**
- 20 (19) Hind basitarsus with the posterior edge nearly straight in the distal three quarters; top of the head between the ocelli with the pile usually predominantly yellow; body size small to medium (length ≤ 19 mm) ... 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 ≥ 20 mm) but includes occasional smaller individuals ... **affinis**
- 21 (20) Cheeks shorter than or equal to broad ($L \leq B$), 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 (21) 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 front of 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 or 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 ... **variabilis**
- 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 the bases the pile without a black band, but sometimes with a black spot ... **citrinus**
- 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**

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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

Bumble bee Economics by B. Heinrich, Harvard University Press, 2004.

Bumble bees by D.V. Alford, Davis-Poynter, London, 1974.

Bumble bees: their behaviour and ecology by D. Goulson, Oxford University Press, 2003.

Bumble bee vulnerability and conservation world-wide. *Apidologie* 40: 367-387. Williams, P.H. & J.L. Osborne. 2009. [Online]

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/](http://www.xerces.org/bumble%20bees/)

Discover Life Bumblebee Key [Online]

[http://www.discoverlife.org/mp/20q?guide=v bees](http://www.discoverlife.org/mp/20q?guide=v%20bees)



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