A close-up photograph of a bumblebee's head, showing its large compound eyes, antennae, and the dense, golden-brown hairs covering its face. The background is a solid, vibrant blue. The image is partially overlaid with a semi-transparent green banner at the top and bottom.

the nat

SAN DIEGO  
NATURAL HISTORY  
MUSEUM

# Bumble bee diversity and conservation

with some focus on San Diego County

- Background on bees
- Natural history of bumblebees
- Bumblebee declines and threats
- San Diego bumblebees
- Future monitoring and research

# Background on bees

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SAN DIEGO  
NATURAL HISTORY  
MUSEUM





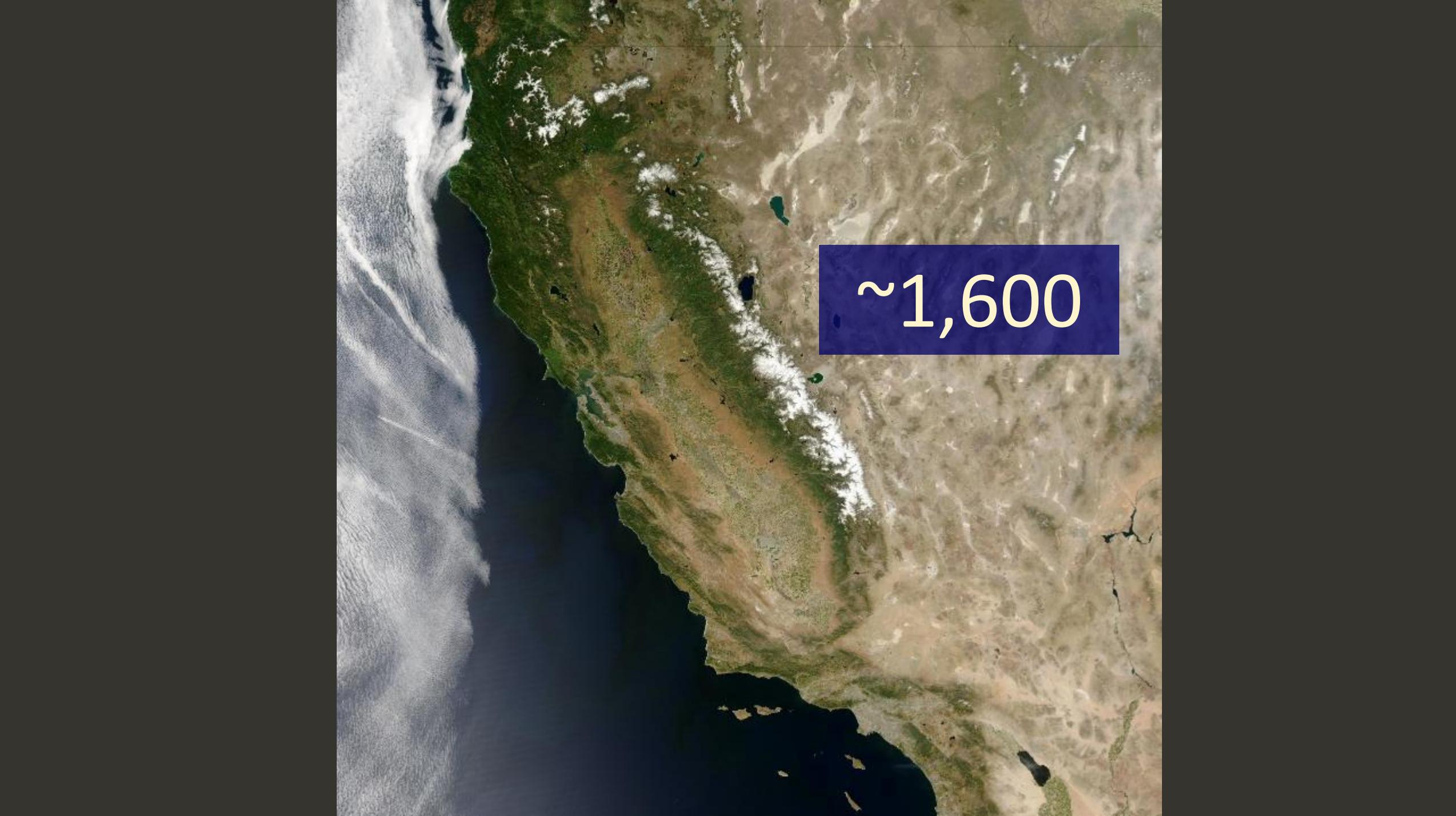
Source: USGS Bee Inventory and Monitoring Lab



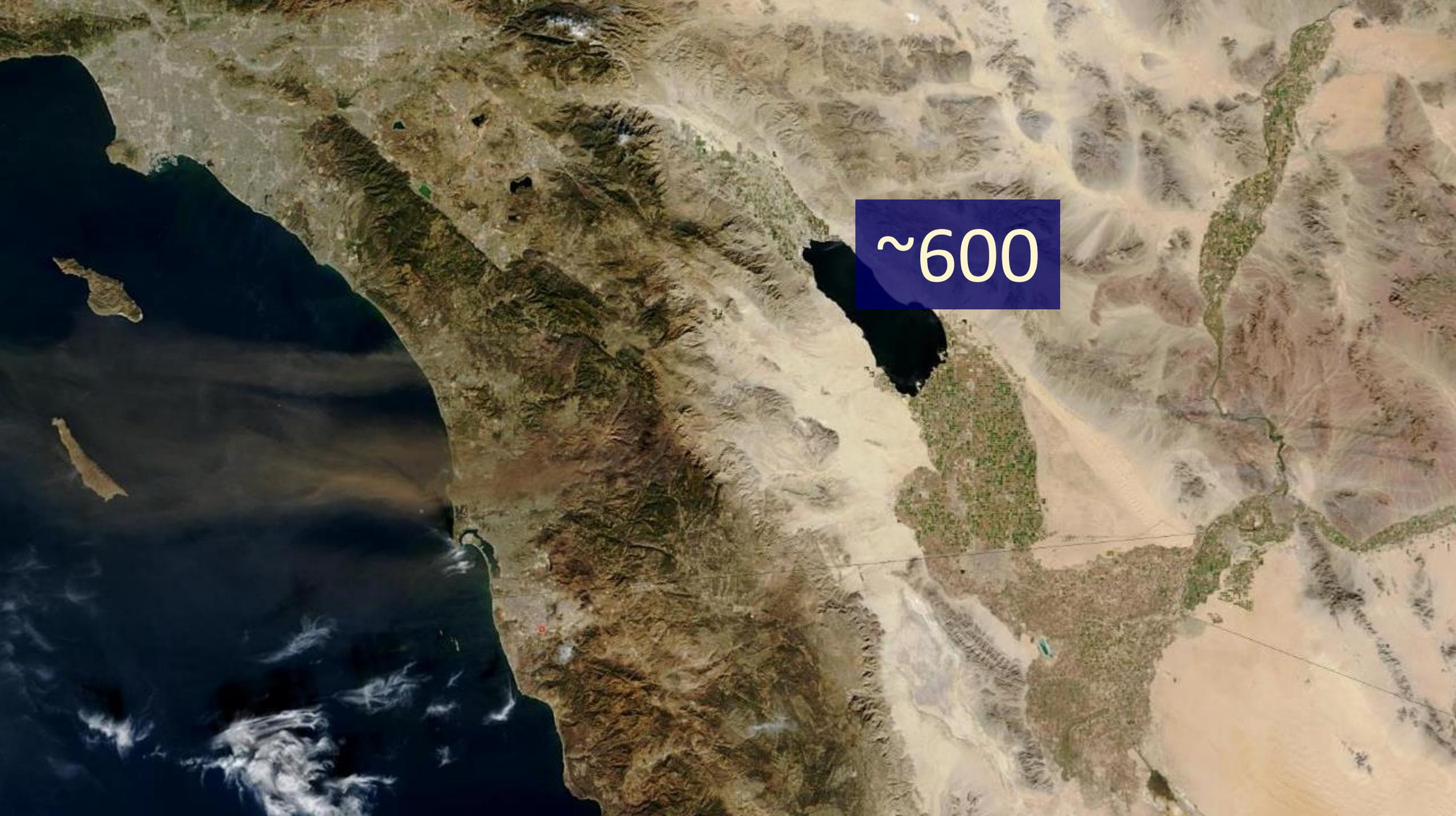
~16,000



~4,000

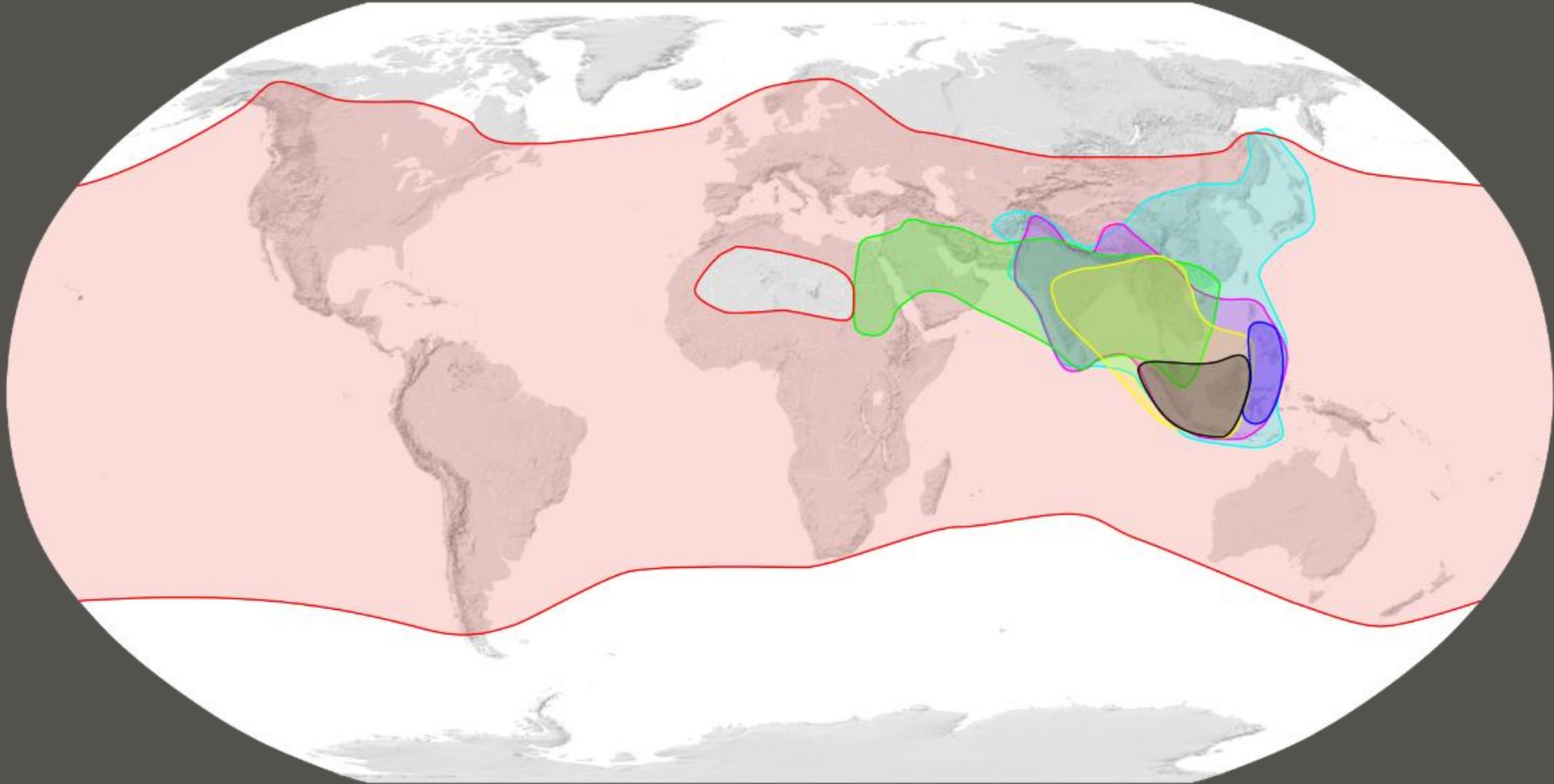
A satellite-style map of the western United States, showing the coastline, mountain ranges, and various terrain features. A blue rectangular box is overlaid on the map, containing the text '~1,600'.

~1,600



~600







Source: USGS Bee Inventory and Monitoring Lab





# Natural history of bumblebees

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SAN DIEGO  
NATURAL HISTORY  
MUSEUM



Source: USGS Bee Inventory and Monitoring Lab



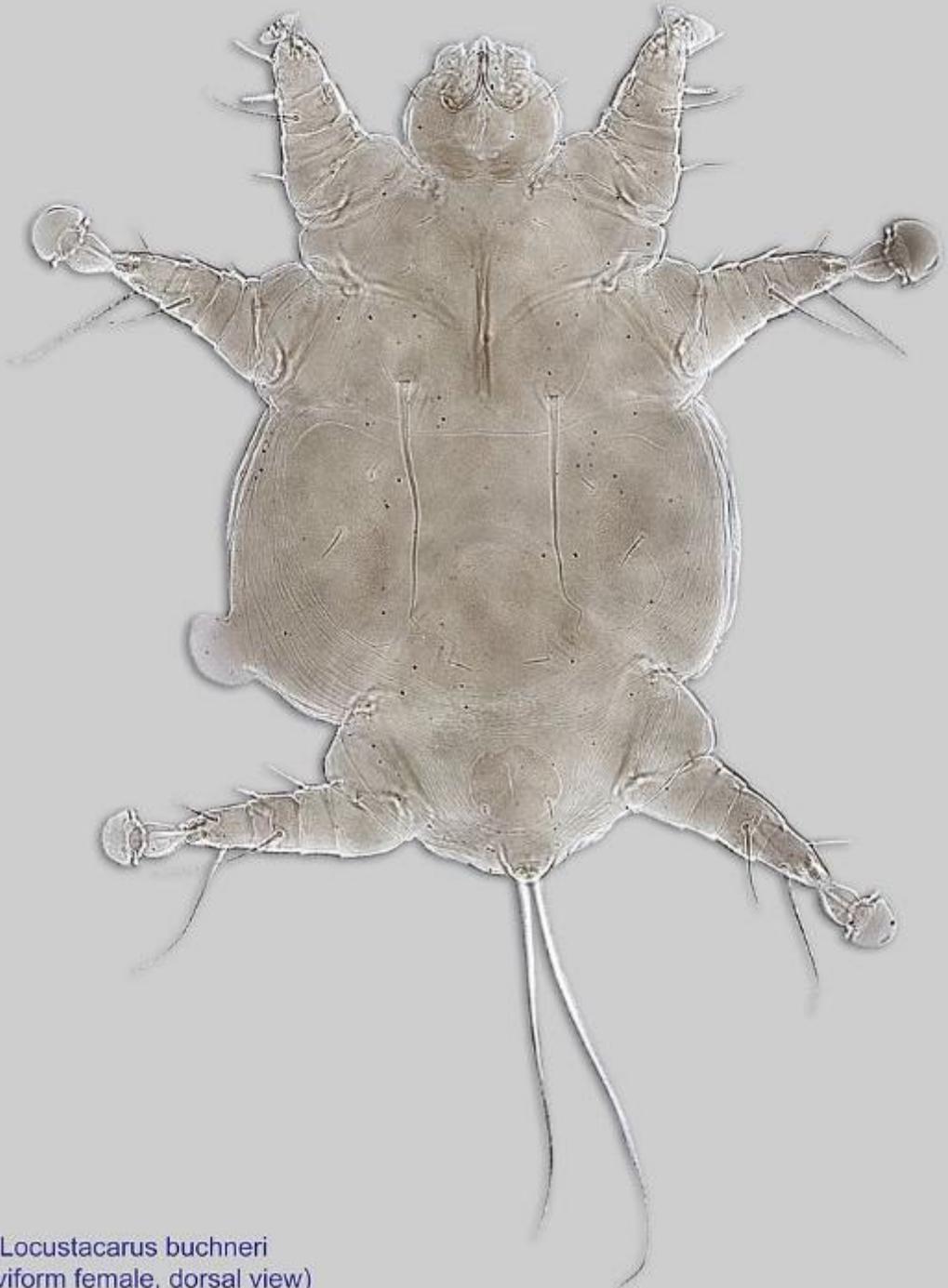




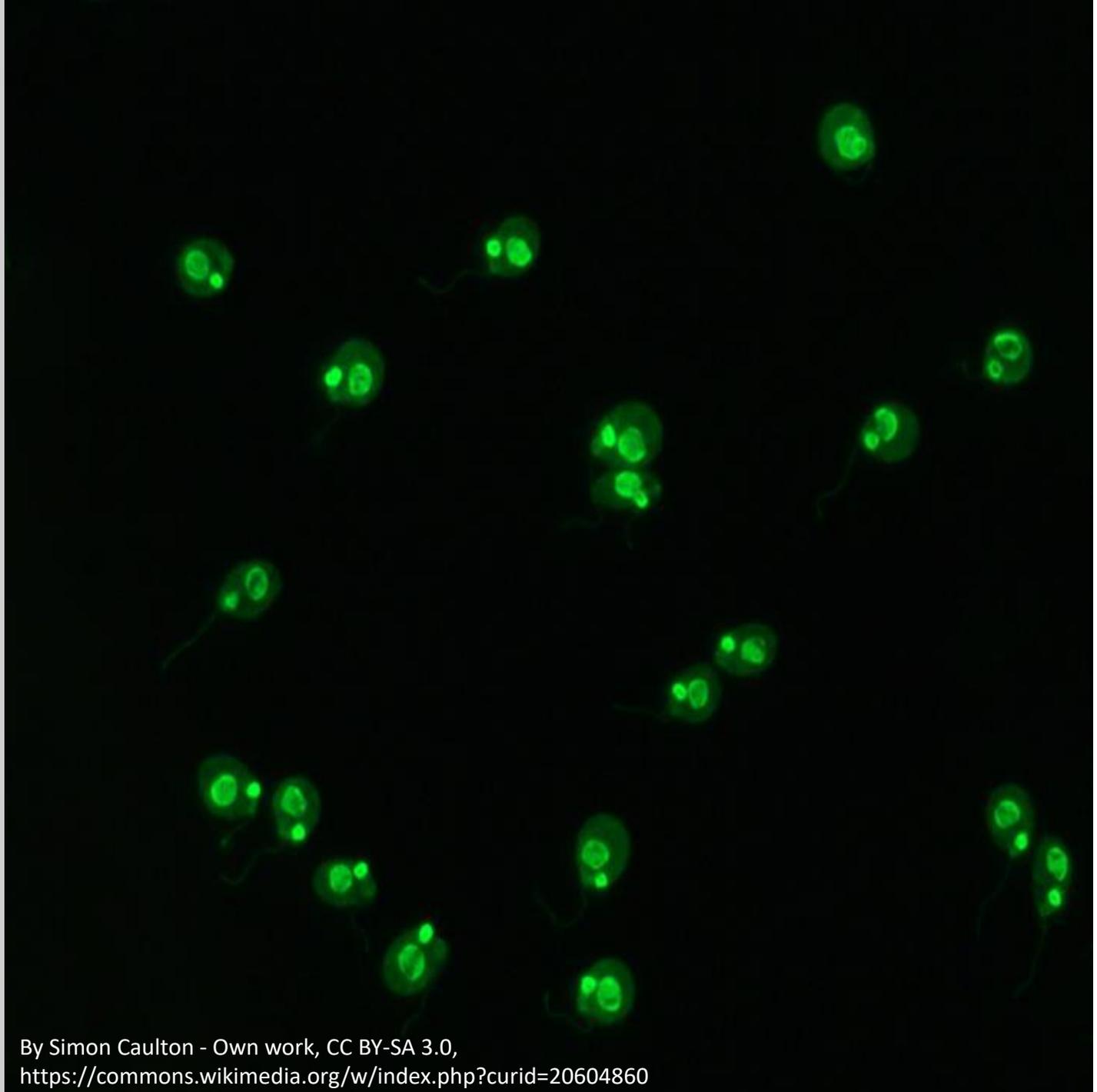




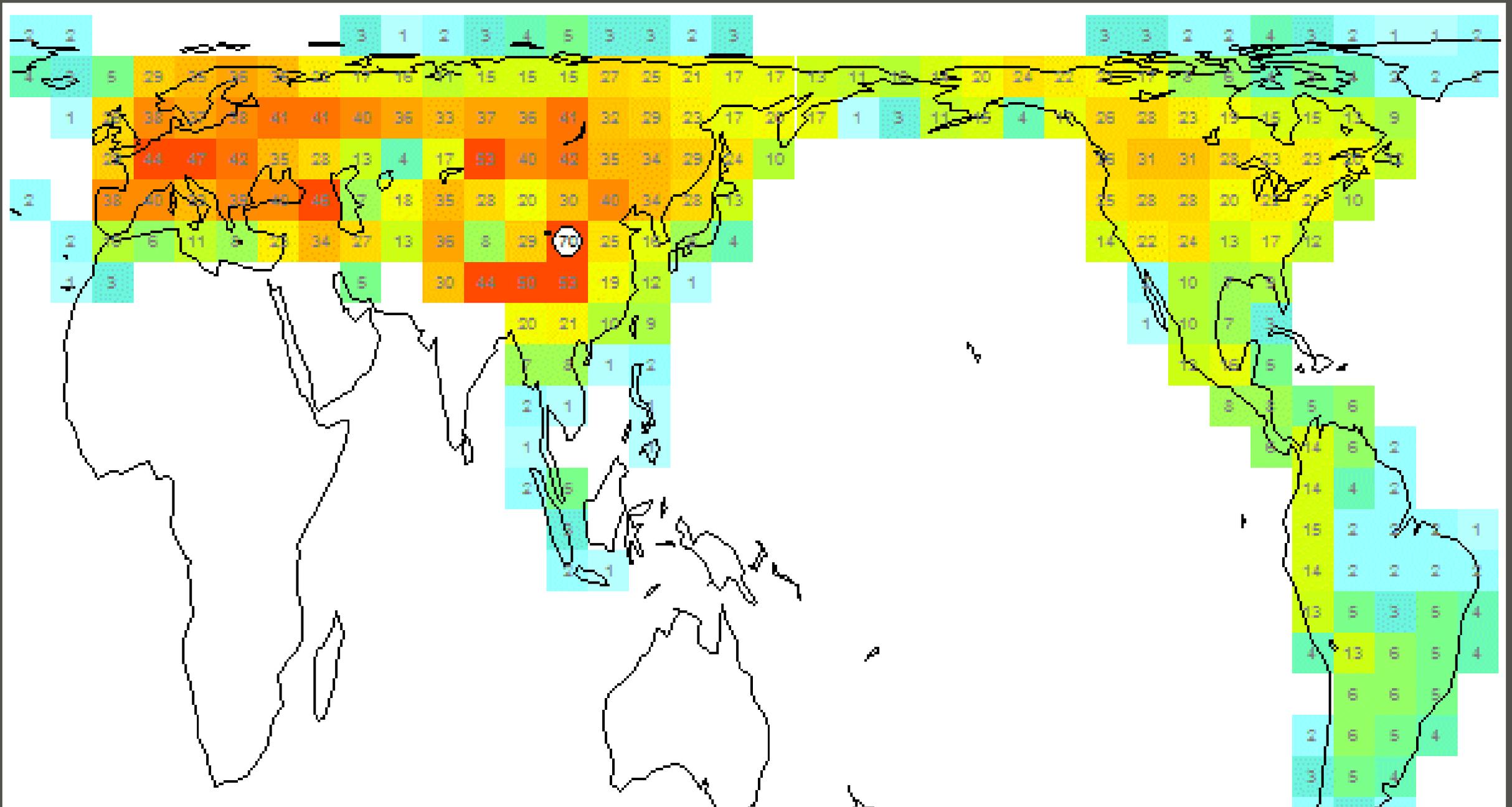
Source: USGS Bee Inventory and Monitoring Lab

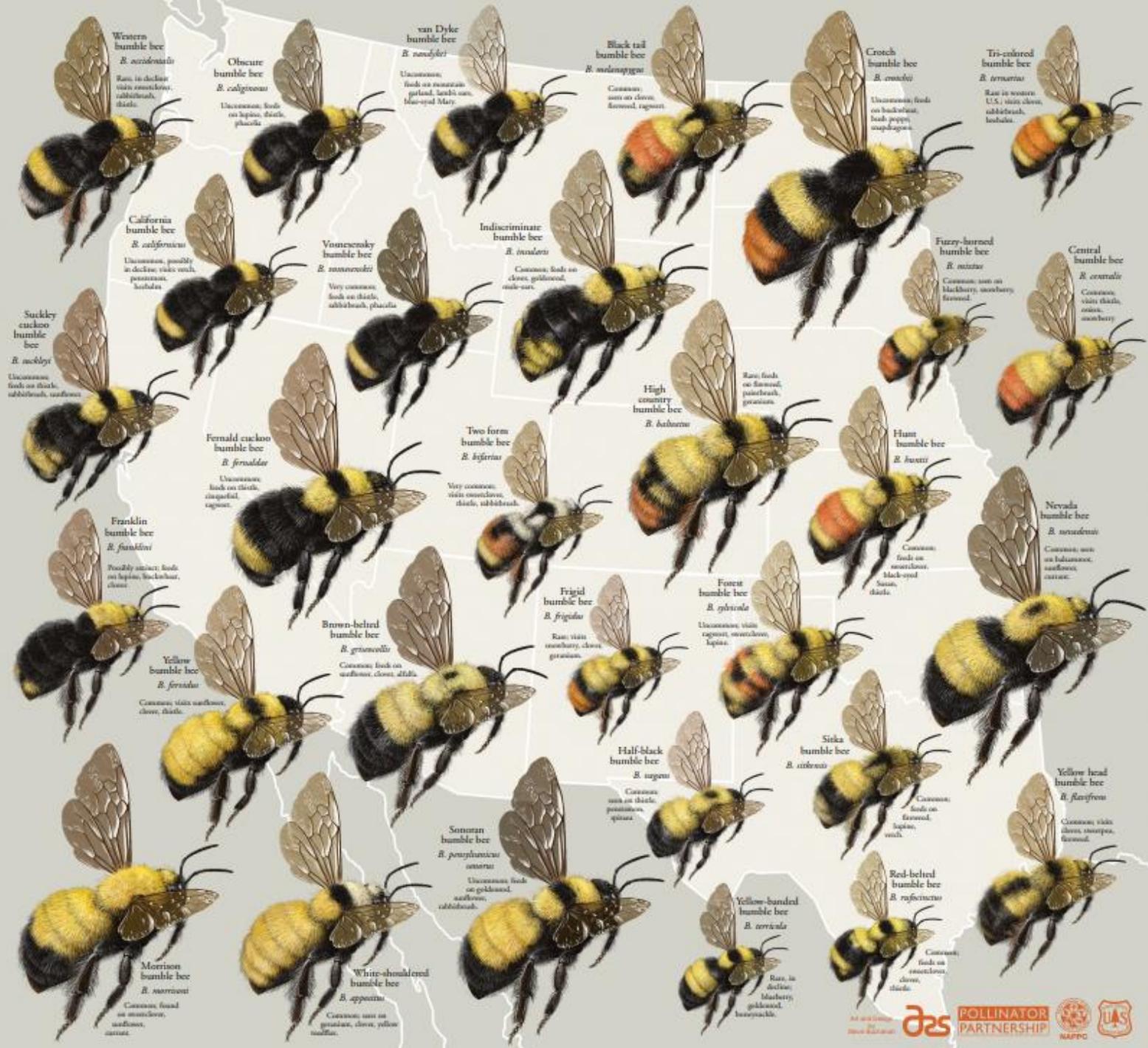


*Locustacarus buchneri*  
(larviform female, dorsal view)



By Simon Caulton - Own work, CC BY-SA 3.0,  
<https://commons.wikimedia.org/w/index.php?curid=20604860>





**Western bumble bee**  
*R. occidentalis*  
Rare, in decline  
via montane,  
subalpine,  
alpine.

**Obscure bumble bee**  
*R. caliginosus*  
Uncommon, feeds  
on lupine, thistle,  
phacelia.

**van Dyke bumble bee**  
*R. nevadensis*  
Uncommon, feeds  
on mountain  
gorilla, heath, and  
blue-eyed Mary.

**Black tail bumble bee**  
*R. melanopygus*  
Common, seen on clover,  
fennel, ragwort.

**Crotch bumble bee**  
*R. crotchii*  
Uncommon, feeds  
on buckwheat,  
leaf poppy,  
snapdragon.

**Tri-colored bumble bee**  
*R. armitator*  
Rare in western  
U.S., visits clover,  
abbotsrue,  
lobelia.

**California bumble bee**  
*R. californicus*  
Uncommon, possibly  
in decline, visits vetch,  
penstemon,  
lobelia.

**Vosnesensky bumble bee**  
*R. vosnesenskii*  
Very common, feeds on thistle,  
abbotsrue, phacelia.

**Indiscriminate bumble bee**  
*R. insularis*  
Common, feeds on clover,  
goldenrod,  
milk-vetch.

**Fuzzy-banded bumble bee**  
*R. mixtus*  
Common, seen on  
blackberry, manberry,  
fennel.

**Central bumble bee**  
*R. centralis*  
Common, visits thistle,  
onion,  
manberry.

**Suckley cuckoo bumble bee**  
*R. suckleyi*  
Uncommon, feeds on thistle,  
abbotsrue, wallflower.

**Fernald cuckoo bumble bee**  
*R. fernaldii*  
Uncommon, feeds on thistle,  
cinquifol,  
ragwort.

**Two form bumble bee**  
*R. bifarius*  
Very common, visits cornflower,  
thistle, abbotsrue.

**High country bumble bee**  
*R. bathorum*  
Rare, feeds on fennel,  
paterson,  
granium.

**Hunt bumble bee**  
*R. huntii*  
Common, feeds on  
marigold,  
black-eyed  
Susan,  
thistle.

**Nevada bumble bee**  
*R. nevadensis*  
Common, seen  
on balsamorhiza,  
wallflower,  
cattail.

**Franklin bumble bee**  
*R. franklinii*  
Possibly similar, feeds  
on lupine, black-chair,  
clover.

**Brown-belted bumble bee**  
*R. griseocollis*  
Common, feeds on  
wallflower, clover, dill.

**Frigid bumble bee**  
*R. frigidus*  
Rare, visits  
manberry, clover,  
granium.

**Forest bumble bee**  
*R. sylvicola*  
Uncommon, visits  
ragwort, manflower,  
lupine.

**Half-black bumble bee**  
*R. vagans*  
Common, seen on thistle,  
penstemon,  
quince.

**Sika bumble bee**  
*R. sikoi*  
Common, feeds on  
fennel,  
lupine,  
vetch.

**Yellow head bumble bee**  
*R. flavifrons*  
Common, visits  
thorn, manberry,  
fennel.

**Yellow bumble bee**  
*R. fervidus*  
Common, visits wallflower,  
clover, thistle.

**Sonoran bumble bee**  
*R. peninsularis*  
Uncommon, feeds  
on goldenrod,  
wallflower,  
abbotsrue.

**Morrison bumble bee**  
*R. morrisoni*  
Common, feeds on  
manflower,  
wallflower,  
cattail.

**White-shouldered bumble bee**  
*R. appositus*  
Common, seen on  
granium, clover, yellow  
wallflower.

**Yellow-banded bumble bee**  
*R. arcticus*  
Rare, in  
Alaska;  
blackberry,  
goldenrod,  
manberry.

**Red-belted bumble bee**  
*R. rufocinctus*  
Common, feeds on  
manflower,  
clover,  
thistle.

Crotch  
bumble bee

*B. crotchii*

Uncommon; feeds  
on buckwheat,  
bush poppy,  
snapdragons.



Vosnesensky  
bumble bee

*B. vosnesenskii*

Very common;  
feeds on thistle,  
rabbitbrush, phacelia



Sonoran  
bumble bee

*B. pensylvanicus  
sonorus*

Uncommon; feeds  
on goldenrod,  
sunflower,  
rabbitbrush.



Black tail  
bumble bee

*B. melanopygus*

Common;  
seen on clover,  
fireweed, ragwort.



Two form  
bumble bee

*B. bifarius*

Very common;  
visits sweetclover,  
thistle, rabbitbrush.



Yellow  
bumble bee

*B. fervidus*

Common; visits sunflower,  
clover, thistle.



# Bumblebee declines and threats

# Bumblebees' decline points to mass extinction - study

Populations disappearing in areas where temperatures are getting hotter, scientists say

**The  
Guardian**



*Journal of Apicultural Research* 21(4) : 236-245 (1982)

**THE DISTRIBUTION AND DECLINE OF BRITISH BUMBLE BEES  
(*BOMBUS LATR.*)**

PAUL H. WILLIAMS

*Department of Applied Biology, University of Cambridge, Pembroke Street, Cambridge CB2 3DX,  
UK*

*Revised manuscript received 18 August 1982*

It has been 'commonly supposed that the bumblebee population has declined in recent years' in Britain (Free & Butler, 1959; see also Manning, 1974), as was previously suggested for Manitoba in Canada (Stephen, 1955). The British authors did not specify whether the change

# Decline of bumble bees (*Bombus*) in the North American Midwest

Jennifer C. Grixti<sup>a,\*</sup>, Lisa T. Wong<sup>a</sup>, Sydney A. Cameron<sup>b</sup>, Colin Favret<sup>a</sup>

<sup>a</sup>Center for Biodiversity, Illinois Natural History Survey, 1816 S. Oak Street, Champaign, IL 61820, USA

<sup>b</sup>Department of Entomology, 320 Morrill Hall, 505 S. Goodwin Avenue, University of Illinois at Urbana-Champaign, Urbana, IL 61801, USA

Biodivers Conserv (2012) 21:3585–3595  
DOI 10.1007/s10531-012-0383-2

ORIGINAL PAPER

## Assessing declines of North American bumble bees (*Bombus* spp.) using museum specimens

Sheila R. Colla · Fawziah Gadallah · Leif Richardson ·  
David Wagner · Lawrence Gall

# Patterns of widespread decline in North American bumble bees

Sydney A. Cameron<sup>a,1</sup>, Jeffrey D. Lozier<sup>a</sup>, James P. Strange<sup>b</sup>, Jonathan B. Koch<sup>b,c</sup>, Nils Cordes<sup>a,2</sup>, Leellen F. Solter<sup>d</sup>,  
and Terry L. Griswold<sup>b</sup>

PNAS | January 11, 2011 | vol. 108

# Decline and Conservation of Bumble Bees

D. Goulson, G.C. Lye, and B. Darvill

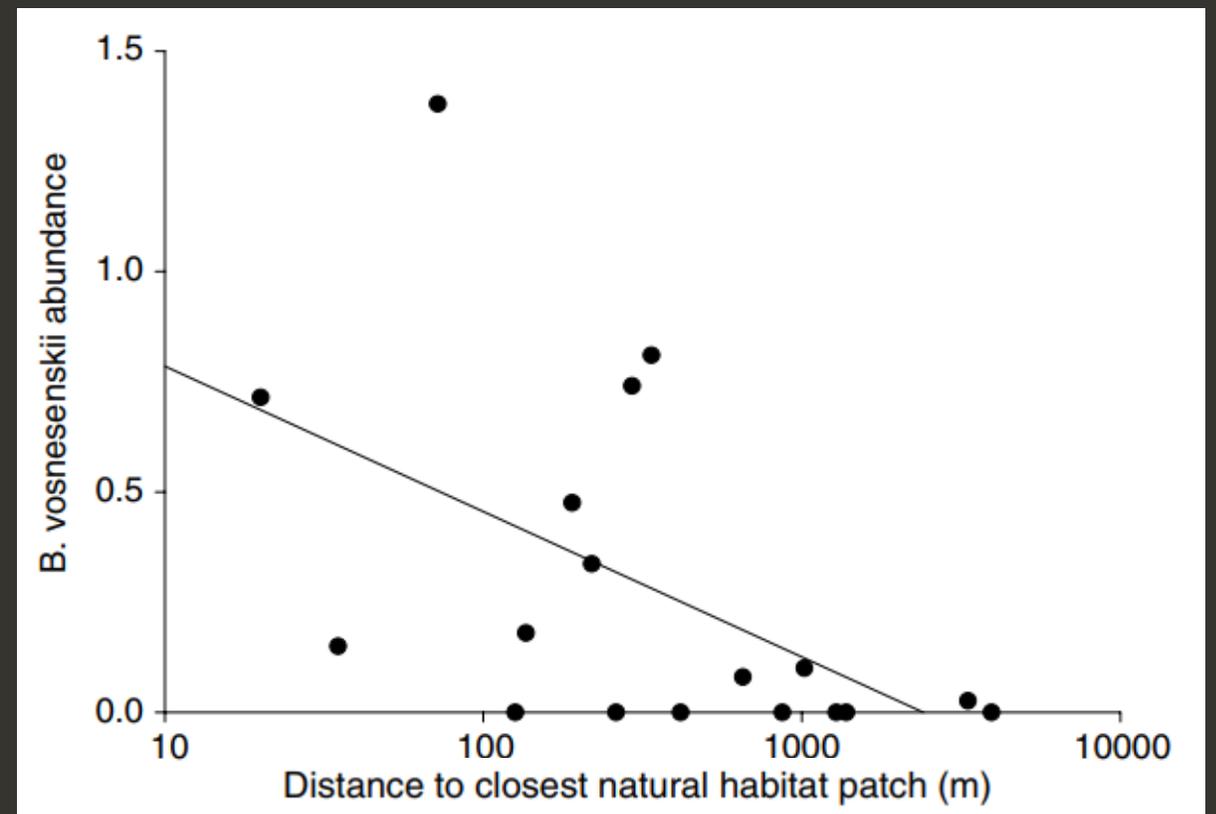
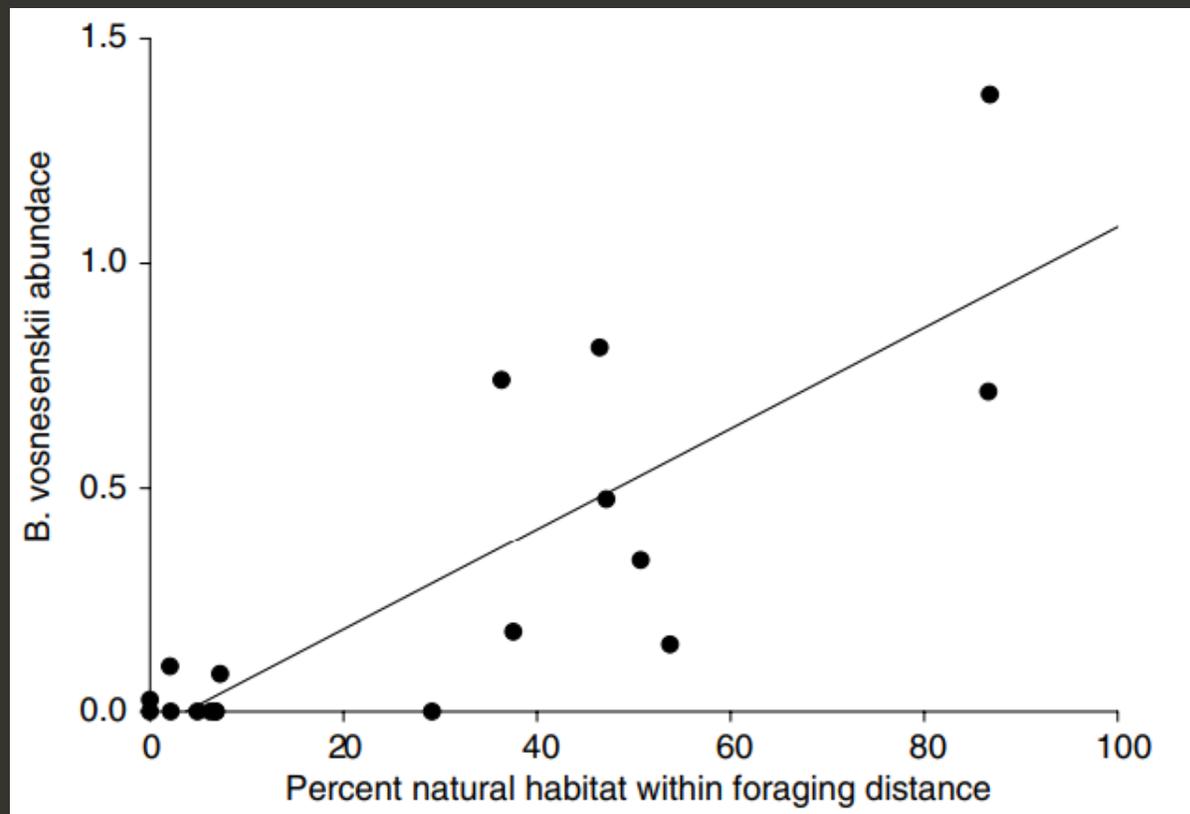
School of Biological & Environmental Sciences, University of Stirling, Stirling,  
FK9 4LA, United Kingdom; email: [Dave.Goulson@stir.ac.uk](mailto:Dave.Goulson@stir.ac.uk)

- Agricultural intensification (declines in floral resources, pesticides, loss of nest sites)
- Impacts of nonnative Bees (particularly pathogen spillover)
- Habitat Fragmentation and Population Structure
- Climate change

# Wild bee species increase tomato production and respond differently to surrounding land use in Northern California

Sarah S. Greenleaf\*, Claire Kremen<sup>1</sup>

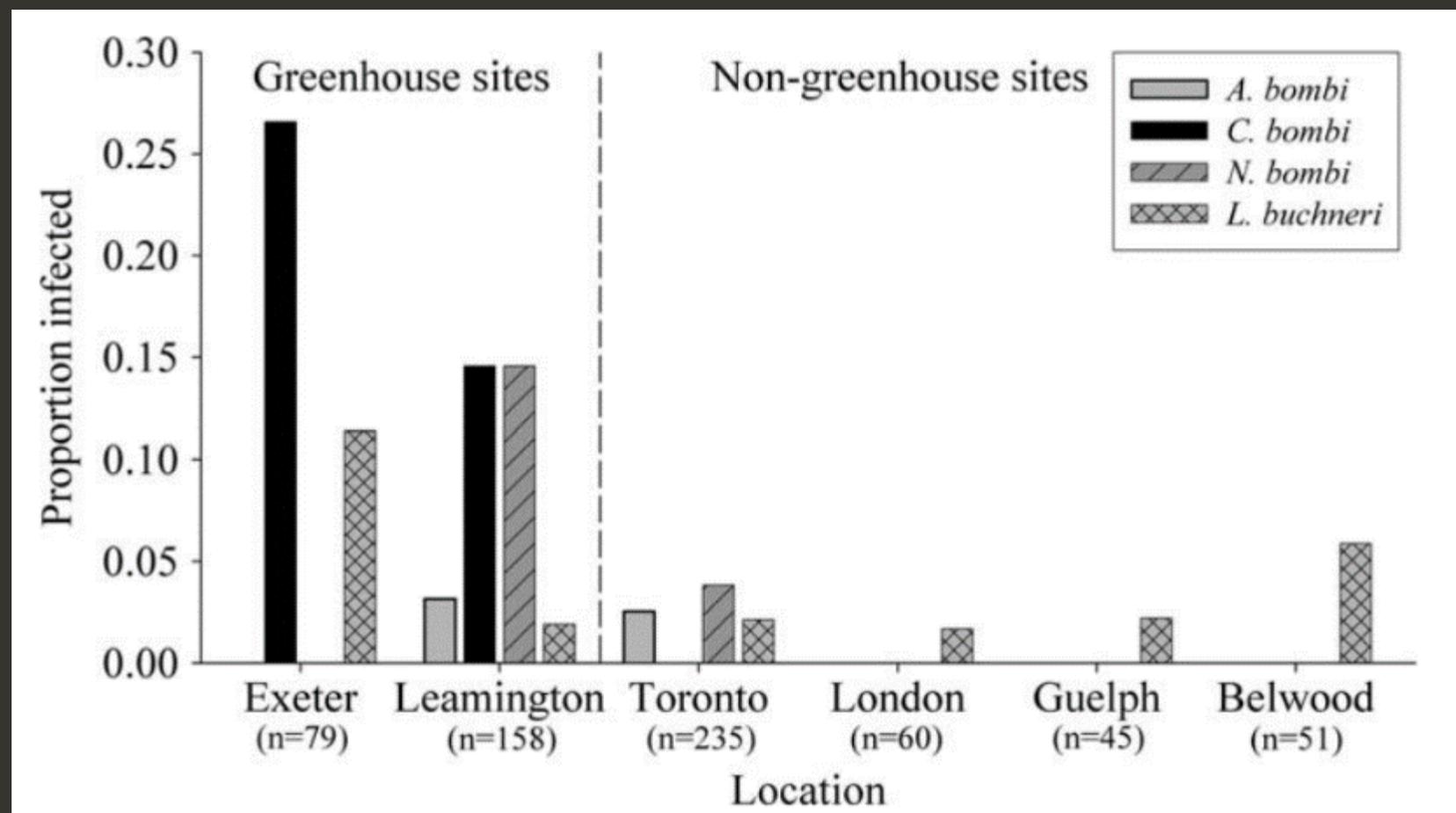
Department of Ecology and Evolutionary Biology, Princeton University, Princeton, NJ, United States



# Plight of the bumble bee: Pathogen spillover from commercial to wild populations

Sheila R. Colla, Michael C. Otterstatter\*, Robert J. Gegear, James D. Thomson

Department of Zoology, University of Toronto, 25 Harbord Street, Toronto, Ont., Canada M5S 3G5



CLIMATE CHANGE

# Climate change impacts on bumblebees converge across continents





# Patterns of widespread decline in North American bumble bees

Sydney A. Cameron<sup>a,1</sup>, Jeffrey D. Lozier<sup>a</sup>, James P. Strange<sup>b</sup>, Jonathan B. Koch<sup>b,c</sup>, Nils Cordes<sup>a,2</sup>, Leellen F. Solter<sup>d</sup>, and Terry L. Griswold<sup>b</sup>

PNAS | January 11, 2011 | vol. 108

- relative abundances of four species have declined by up to 96%
- geographic ranges have contracted by 23–87%
- declining populations have significantly higher infection levels of the microsporidian pathogen *Nosema bombi* and lower genetic diversity
- Higher pathogen prevalence and reduced genetic diversity are, thus, realistic predictors of these alarming patterns of decline in North America, although cause and effect remain uncertain.



# Entomologia Experimentalis et Applicata



## Diploid males in the bumble bee *Bombus terrestris*

Sex determination, sex alleles and viability

M. J. Duchateau, H. Hoshiba, H. H. W. Velthuis

First published: June 1994 | <https://doi.org/10.1111/j.1570-7458.1994.tb01793.x> | Citations: 52

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## **Tolerance of pollination networks to species extinctions**

**Jane Memmott<sup>1\*</sup>, Nickolas M. Waser<sup>2</sup> and Mary V. Price<sup>2</sup>**

“Plant species diversity declined most rapidly with preferential removal of the most-linked pollinators...the most-linked pollinators were bumble-bees and some solitary bees. These animals should receive special attention in efforts to conserve temperate pollination systems.”

**Commissioners**

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**Jacque Hostler-Carmesin**, Vice President  
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**Peter S. Silva**, Member  
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**Samantha Murray**, Member  
Del Mar

STATE OF CALIFORNIA  
Gavin Newsom, Governor

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fgc@fgc.ca.gov  
www.fgc.ca.gov

## Fish and Game Commission



*Wildlife Heritage and Conservation*  
*Since 1870*

### **CALIFORNIA FISH AND GAME COMMISSION NOTICE OF FINDINGS**

Crotch Bumble Bee (*Bombus crotchii*), Franklin's Bumble Bee (*Bombus franklini*),  
Suckley Cuckoo Bumble Bee (*Bombus suckleyi*), and  
Western Bumble Bee (*Bombus occidentalis occidentalis*)

June 18, 2019

Petition for Writ of Mandate filed. 09/09/2019

**SUPERIOR COURT OF THE STATE OF CALIFORNIA**

**COUNTY OF SACRAMENTO**

Case No. 34-2019-80003216-CU-WM-GDS

ALMOND ALLIANCE OF CALIFORNIA;  
CALIFORNIA ASSOCIATION OF PEST  
CONTROL ADVISERS;  
CALIFORNIA CITRUS MUTUAL;  
CALIFORNIA COTTON GINNERS AND  
GROWERS ASSOCIATION;  
CALIFORNIA FARM BUREAU  
FEDERATION; WESTERN  
AGRICULTURAL PROCESSORS  
ASSOCIATION; and WESTERN GROWERS  
ASSOCIATION,

Petitioners,

v.

CALIFORNIA FISH AND GAME  
COMMISSION, a California Public Agency;  
CALIFORNIA DEPARTMENT OF FISH  
AND WILDLIFE, a California Public Agency,

Respondents.

Petition for Writ of Mandate  
Writ of Mandate scheduled for  
11/13/2020 at 10:00:00 AM in  
Department 17 at Gordon D  
Schaber Courthouse.

# San Diego bumblebees

Crotch  
bumble bee

*B. crotchii*

Uncommon; feeds  
on buckwheat,  
bush poppy,  
snapdragons.



Vosnesensky  
bumble bee

*B. vosnesenskii*

Very common;  
feeds on thistle,  
rabbitbrush, phacelia



Sonoran  
bumble bee

*B. pensylvanicus  
sonorus*

Uncommon; feeds  
on goldenrod,  
sunflower,  
rabbitbrush.



Black tail  
bumble bee

*B. melanopygus*

Common;  
seen on clover,  
fireweed, ragwort.



Two form  
bumble bee

*B. bifarius*

Very common;  
visits sweetclover,  
thistle, rabbitbrush.



Yellow  
bumble bee

*B. fervidus*

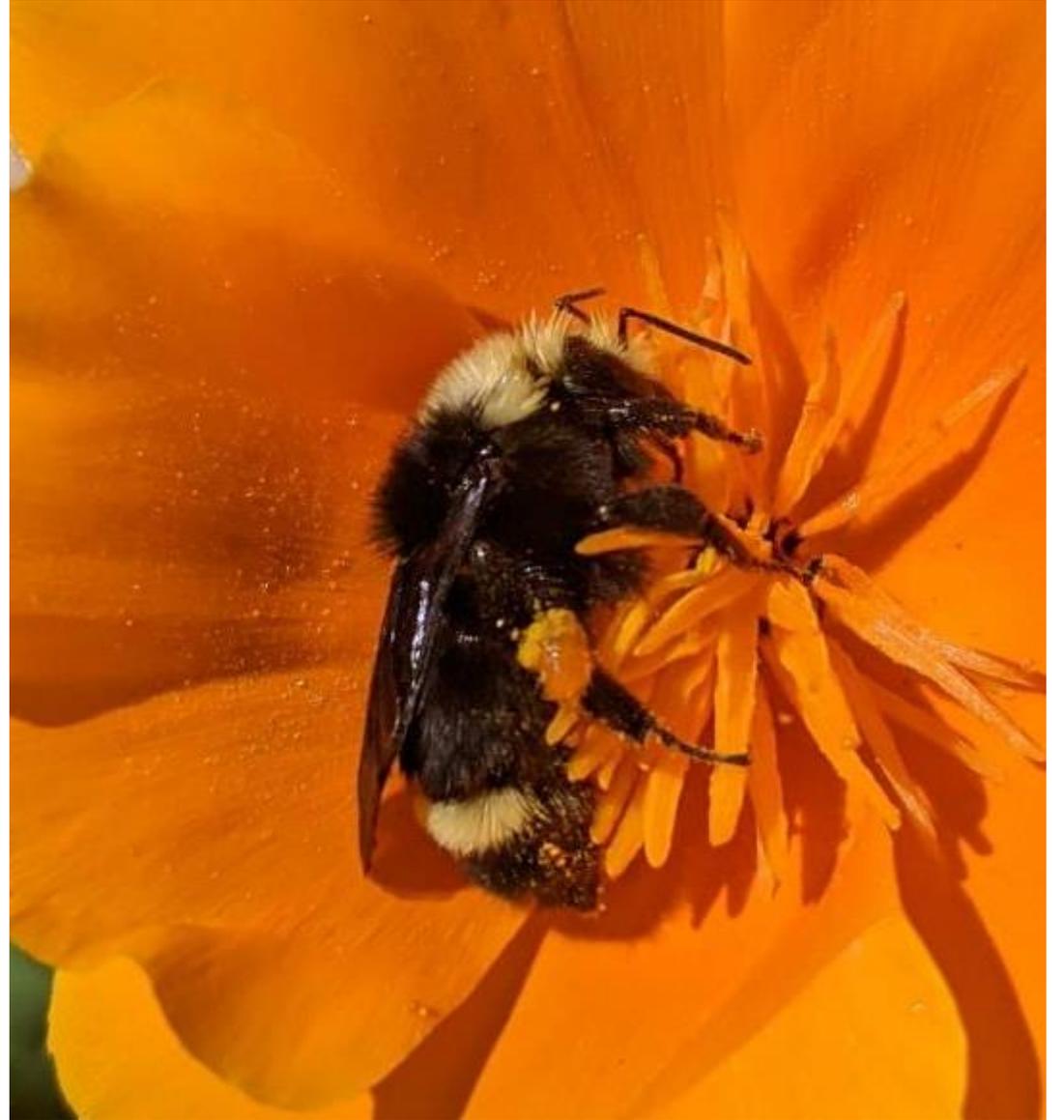
Common; visits sunflower,  
clover, thistle.





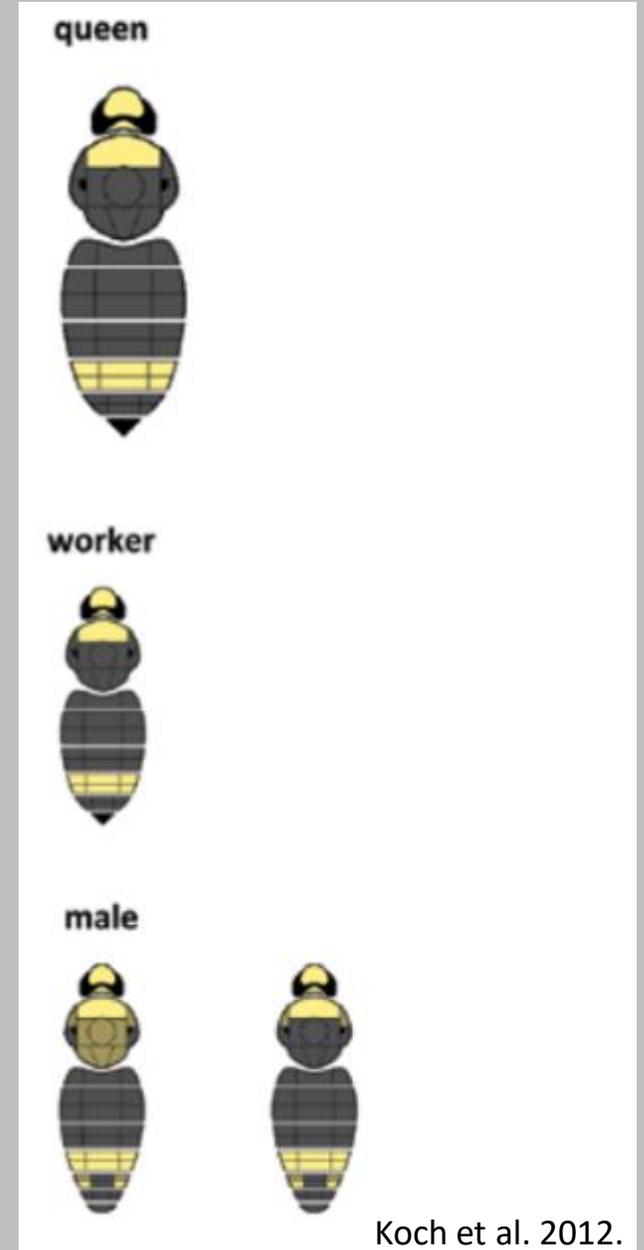
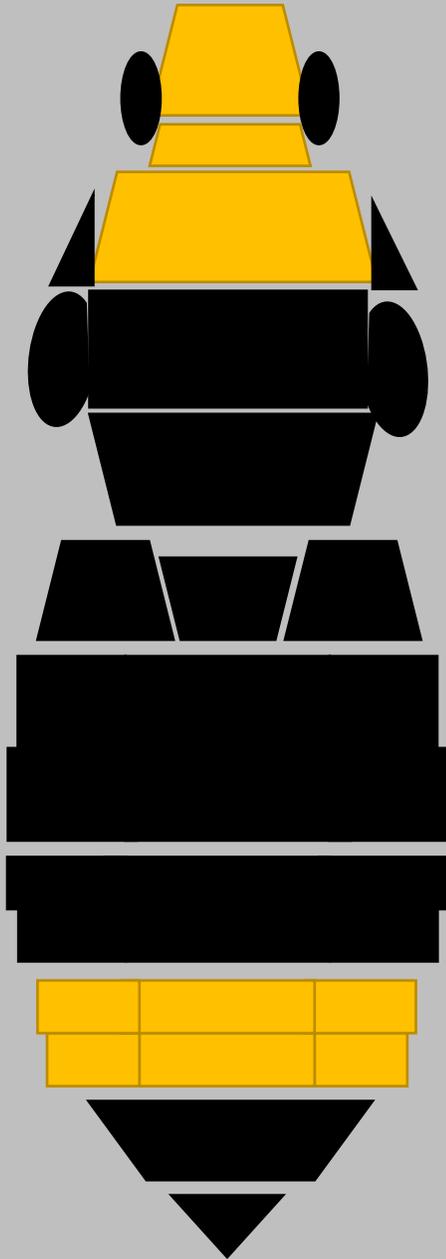
cc - @naturesarchive on inaturalist

*Bombus vosnesenskii*



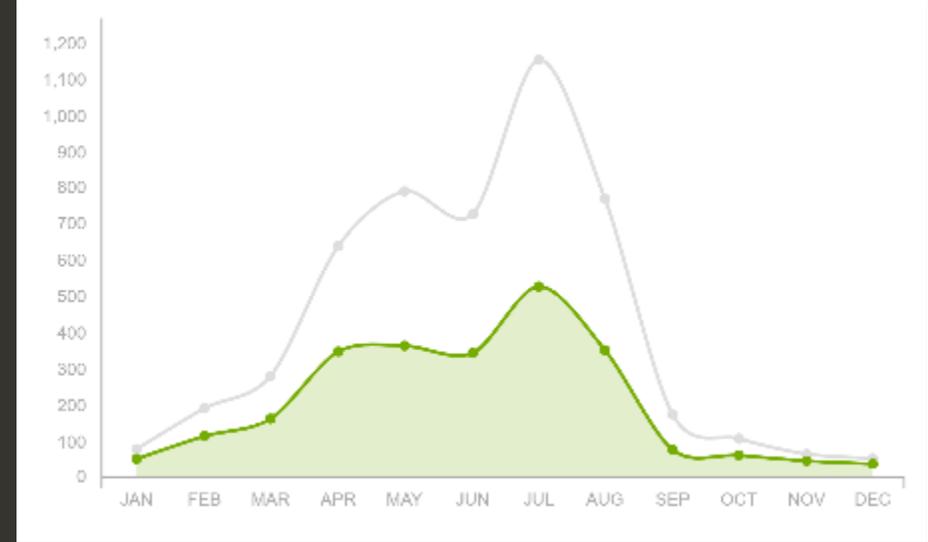
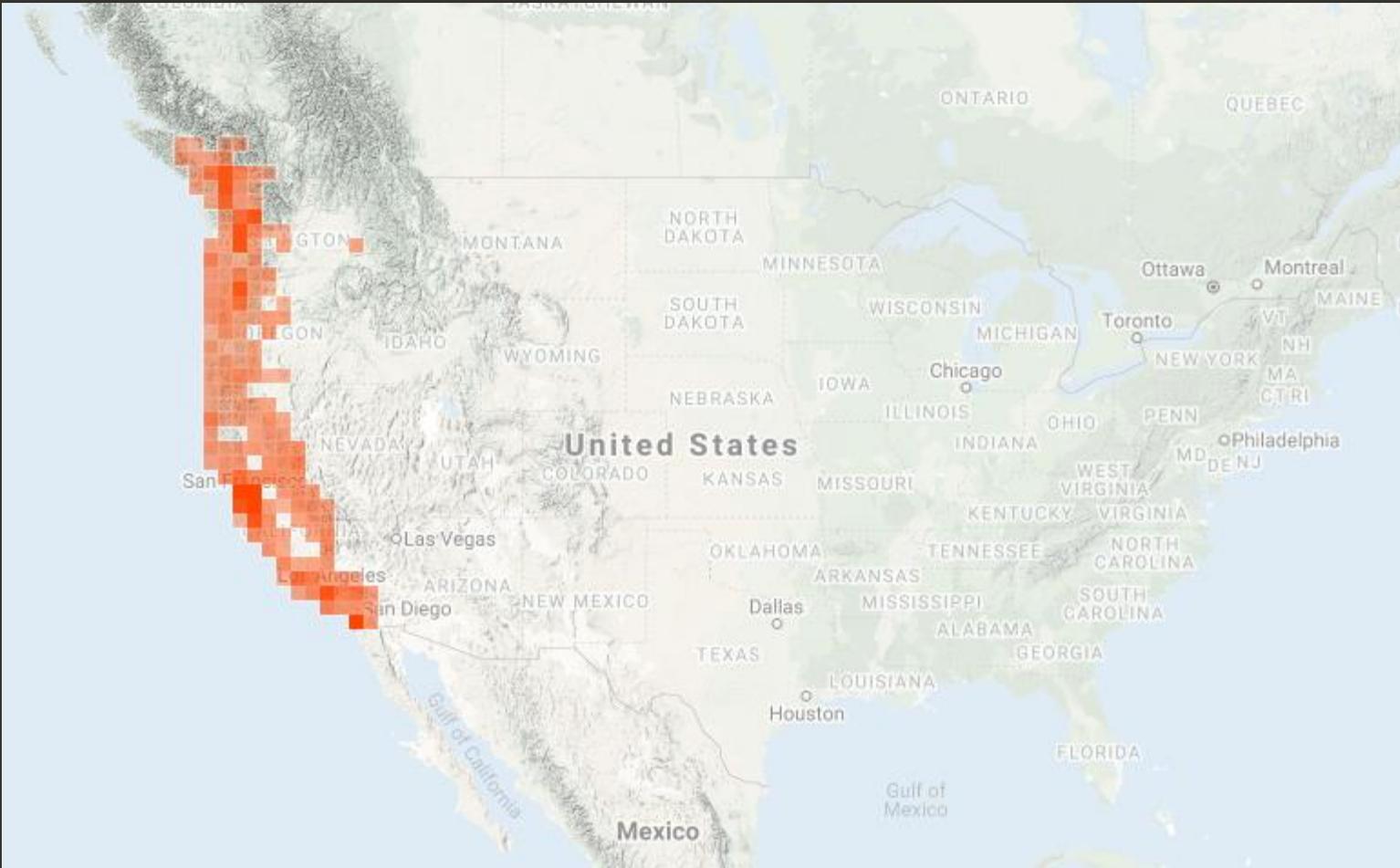
cc - @micro\_ecologist on inaturalist

# *Bombus vosnesenskii*



# Yellow-faced Bumble Bee (*Bombus vosnesenskii*)

## Entire Range



## Southern California



# Host plants

34 families  
90+ genera

Commonly on:

*Cirsium*

*Phacelia*

*Monardella*

*Eriogonum*

*Bombus vosnesenskii*



Aprilly on Flickr CC



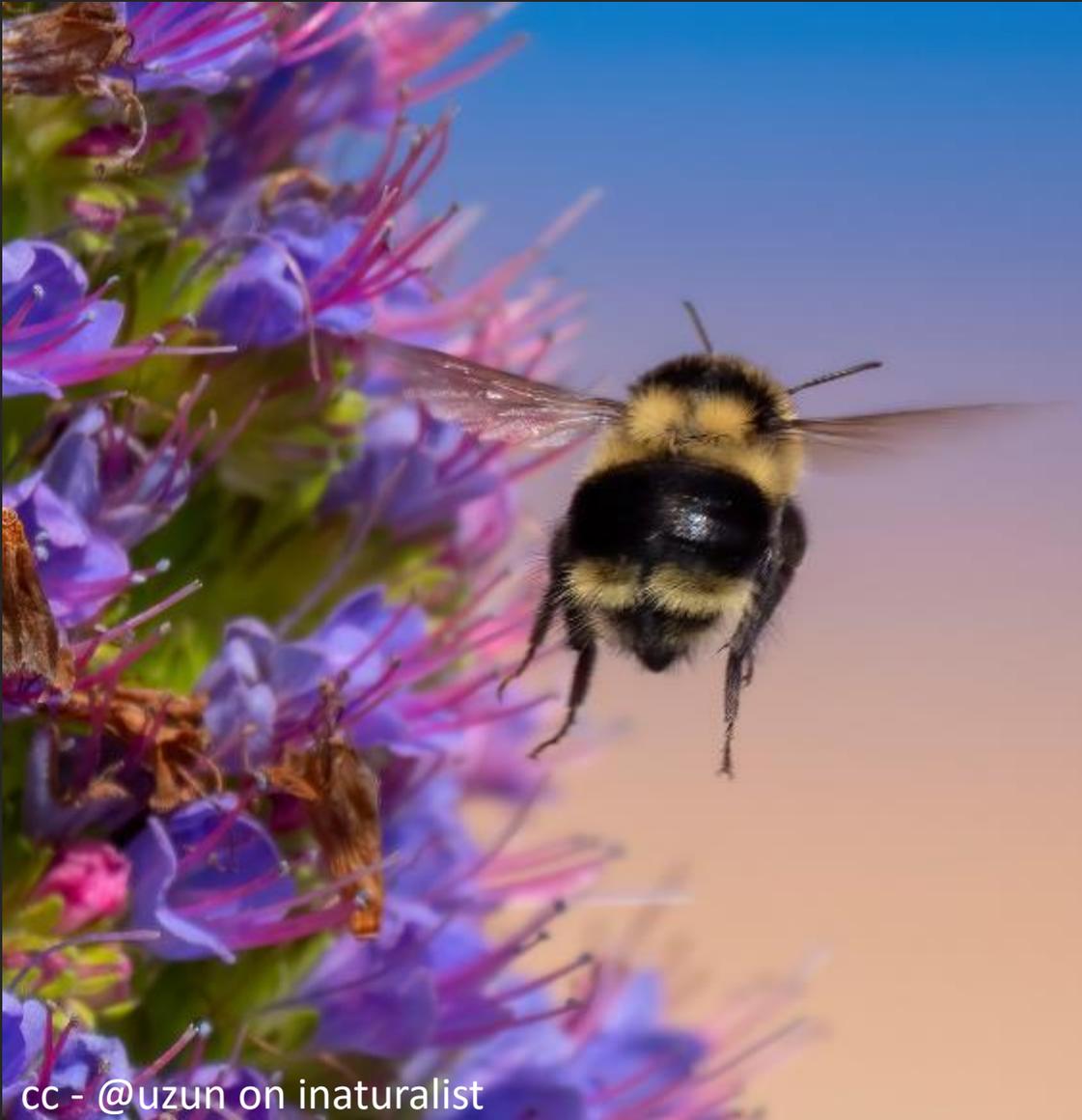
David Seibold on Flickr CC



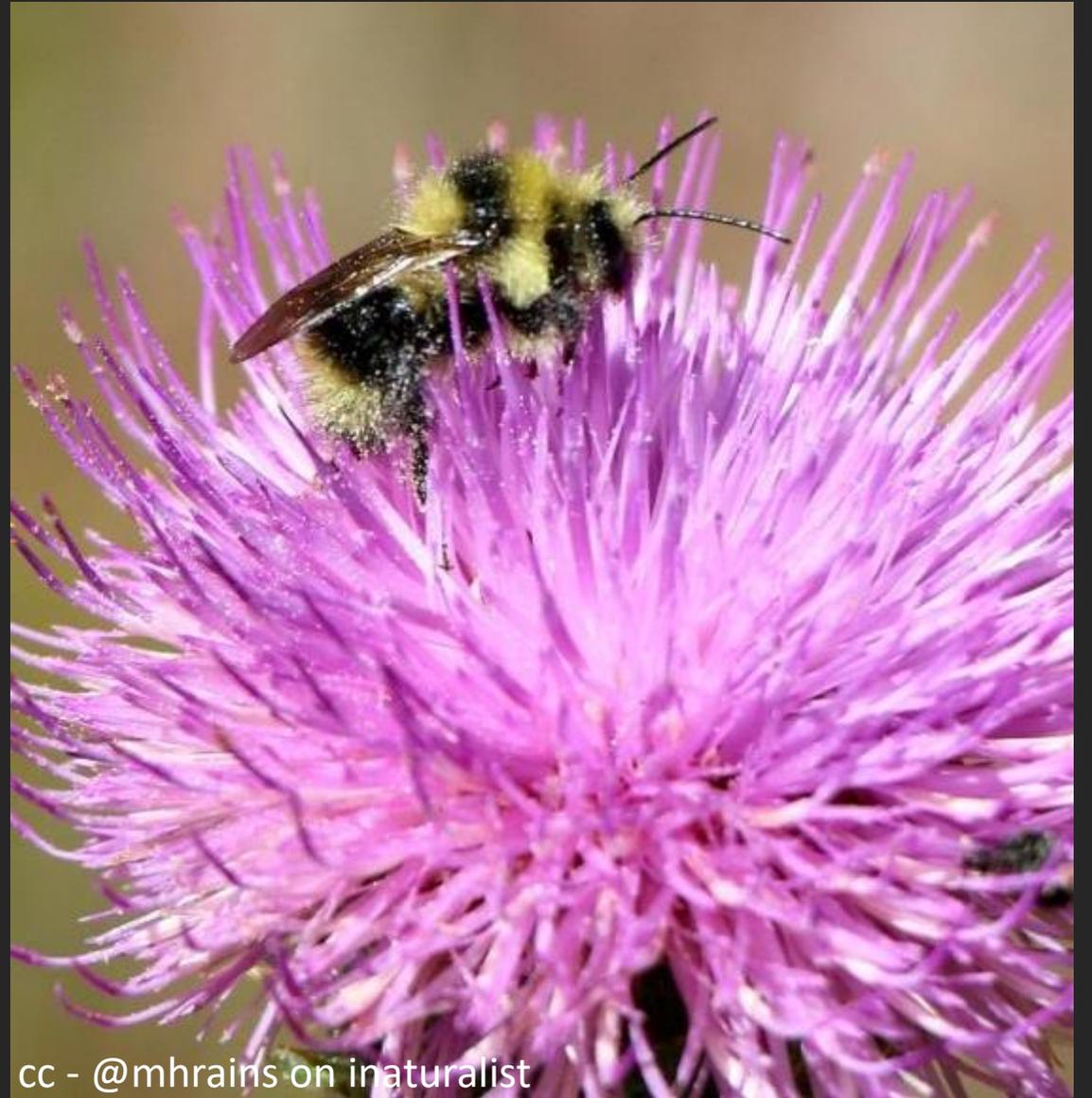
Dustin Blakey on Flickr CC



J. Maughn on Flickr CC



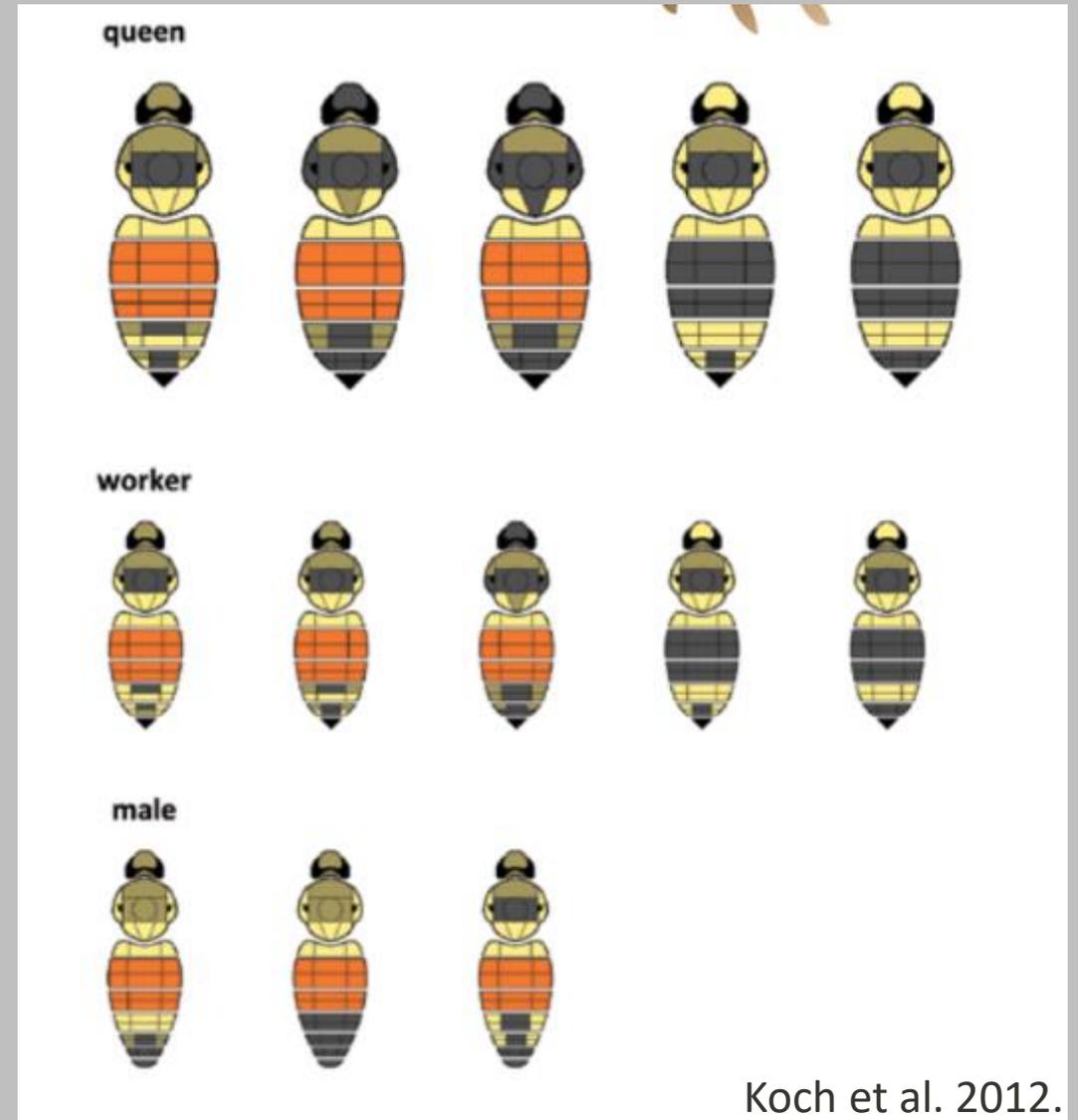
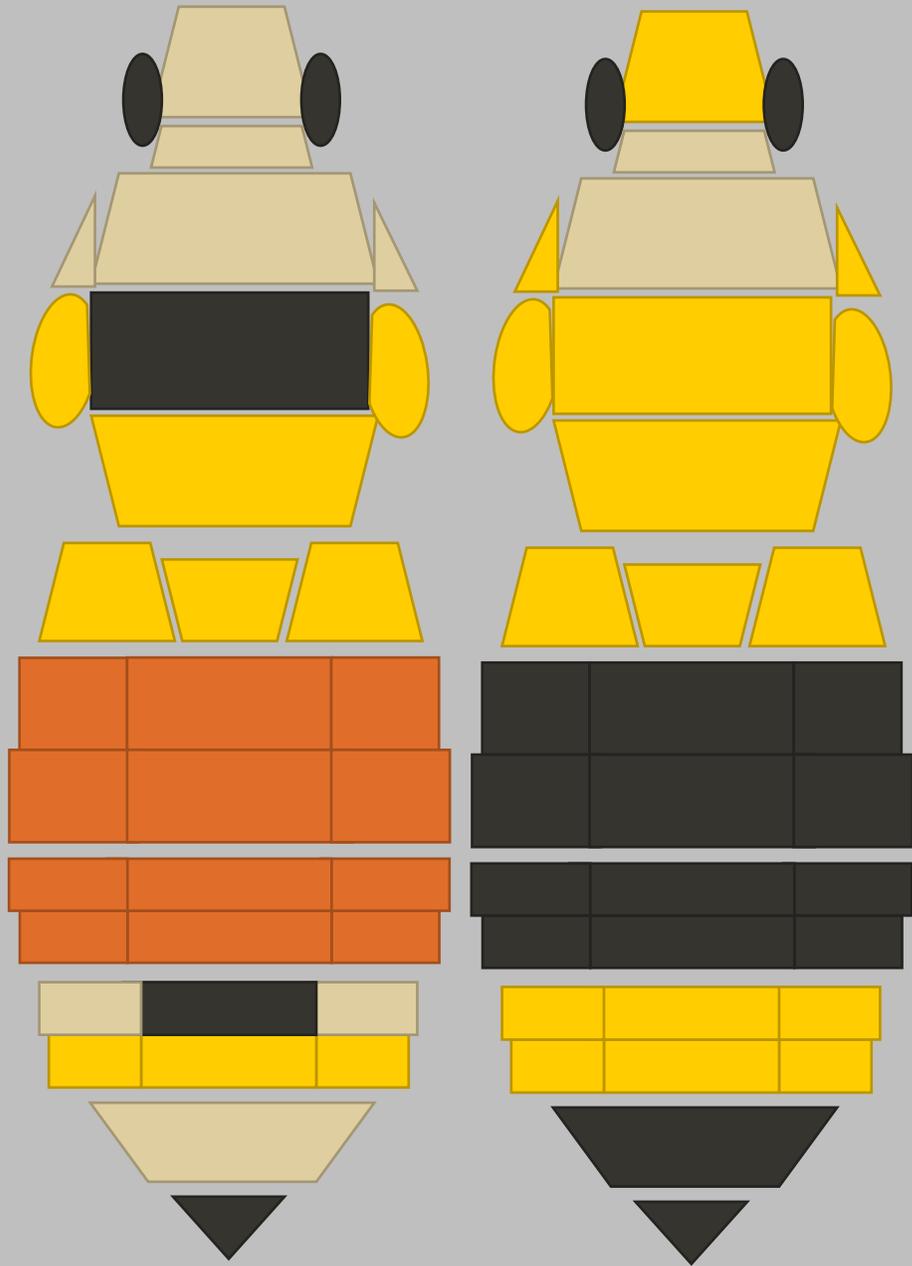
cc - @uzun on inaturalist



cc - @mhrains on inaturalist

*Bombus melanopygus*

# *Bombus melanopygus*



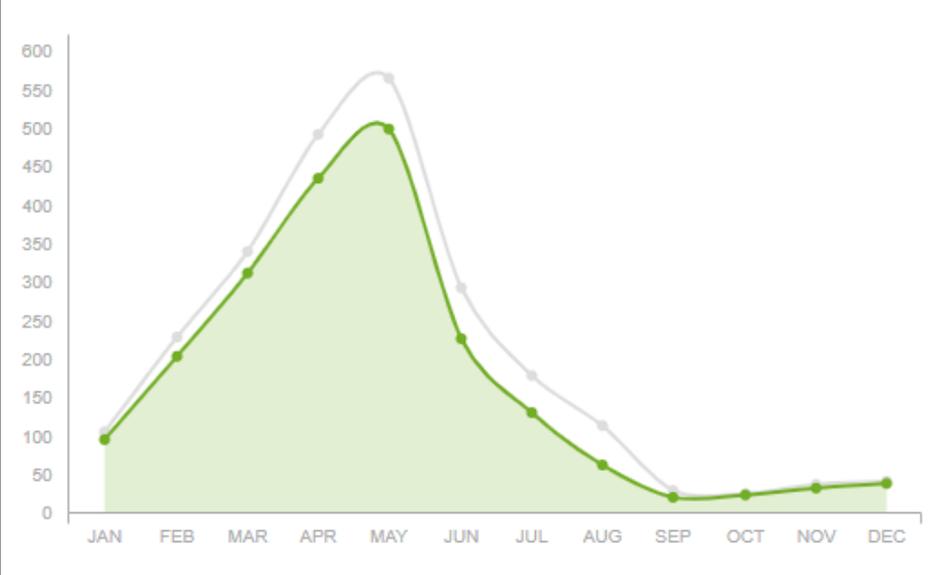
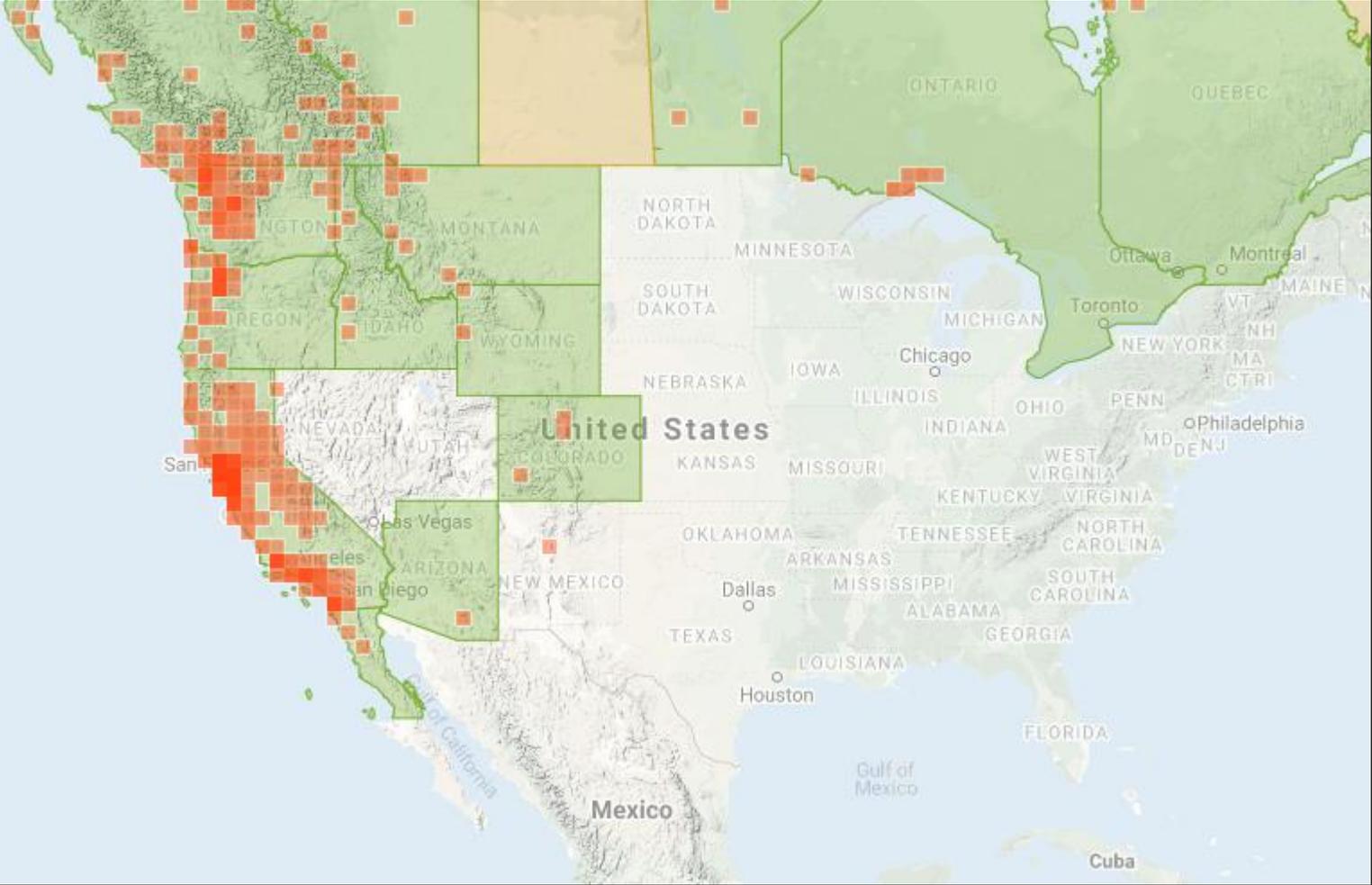
Koch et al. 2012.



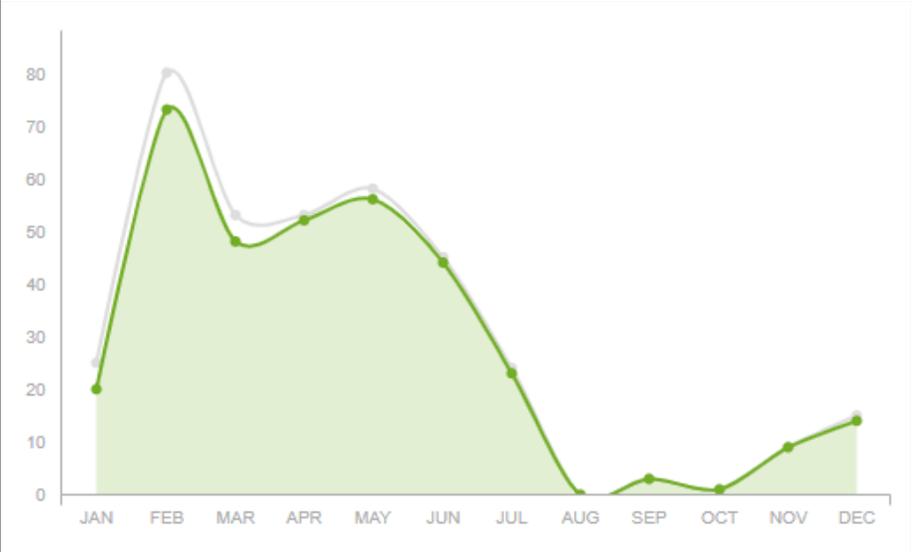
*Bombus melanopygus*

# Black-tailed Bumble Bee (*Bombus melanopygus*)

## Entire Range



## Southern California



# Host plants

13 families

18 genera

Commonly on:

*Salix*

*Viola*

*Lonicera*

*Lupinus*

*Bombus melanopygus*



Claire Willatt on Flickr CC



Themadbirdlady on Flickr CC



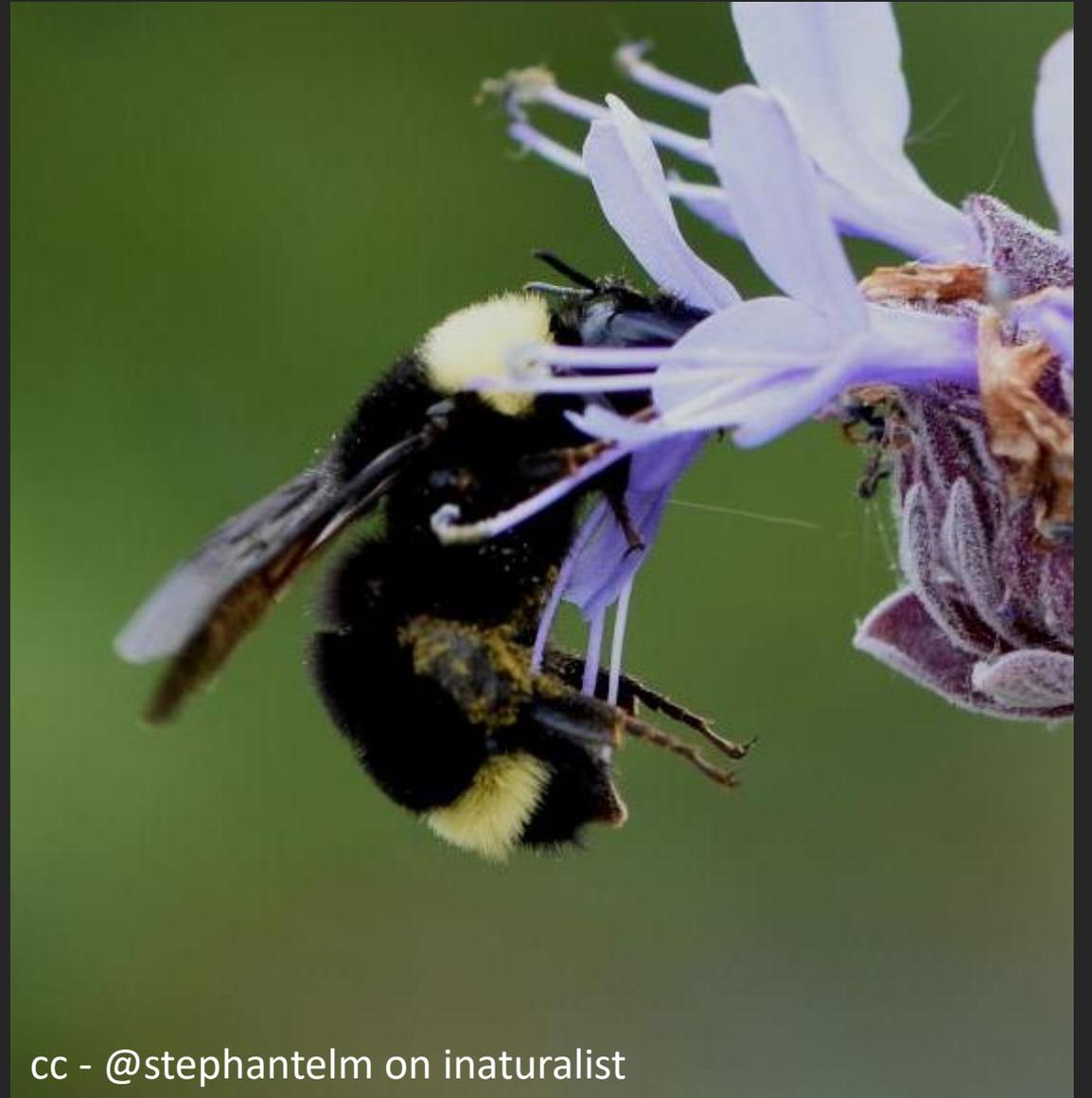
René Van Wallendael on Flickr CC



Elisabeth Aurora V. on Flickr CC

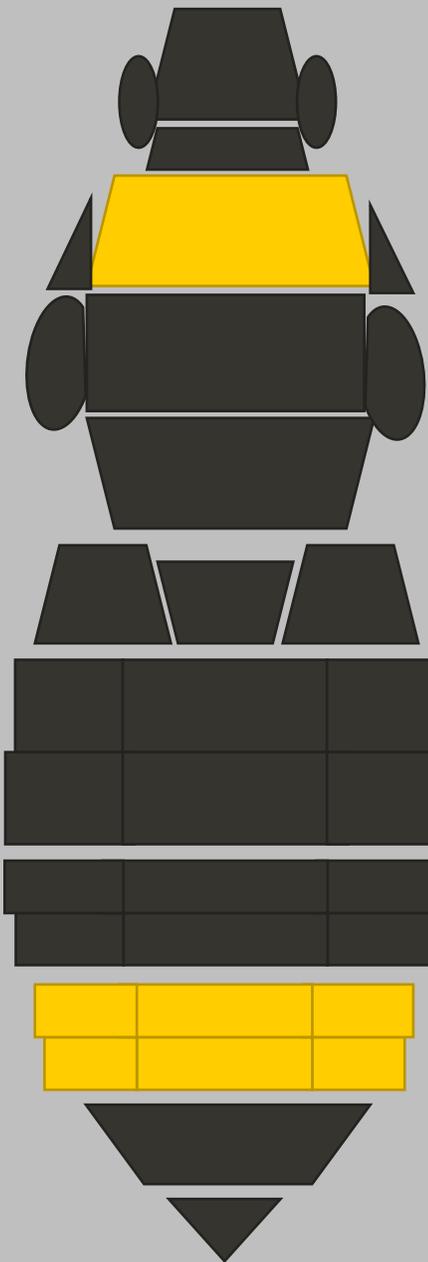
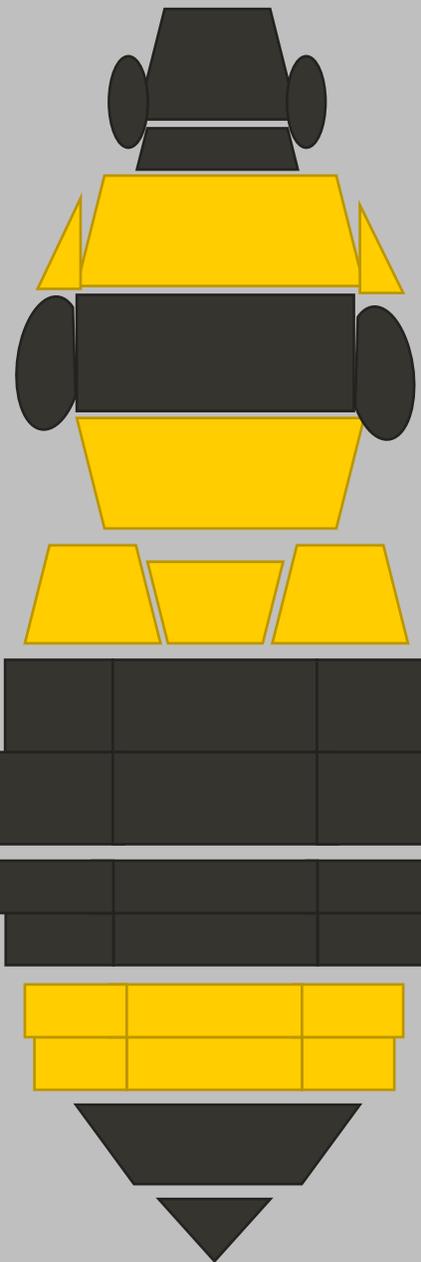
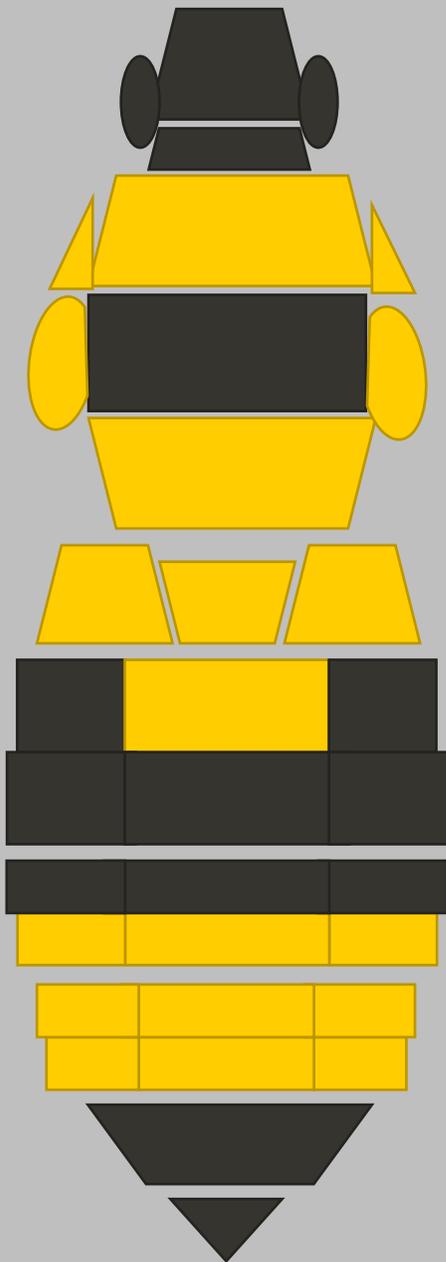


cc - @sfelton on inaturalist

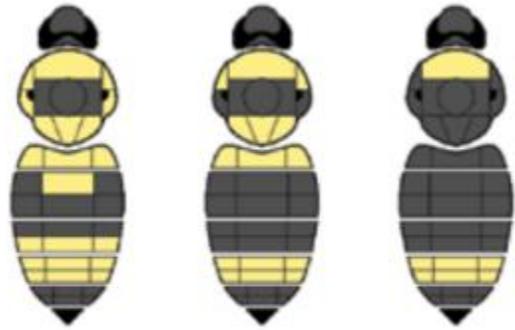


cc - @stephantelm on inaturalist

*Bombus fervidus californicus*



queen *Bombus fervidus californicus*



worker

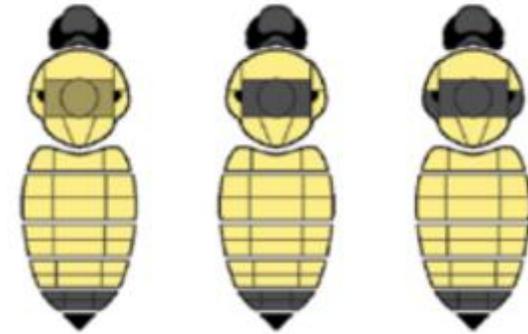


male



Koch et al. 2012.

queen *Bombus fervidus fervidus*



worker

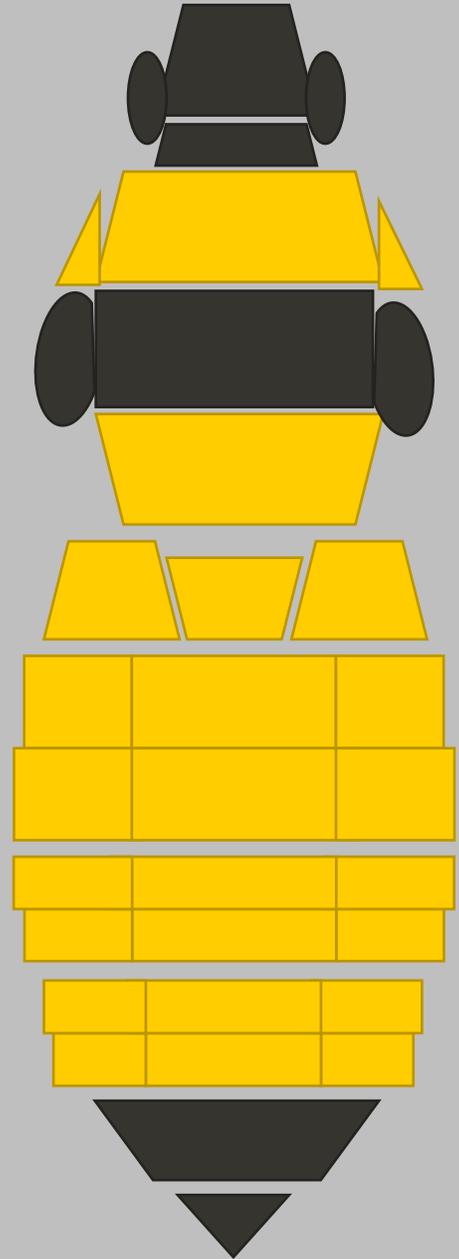
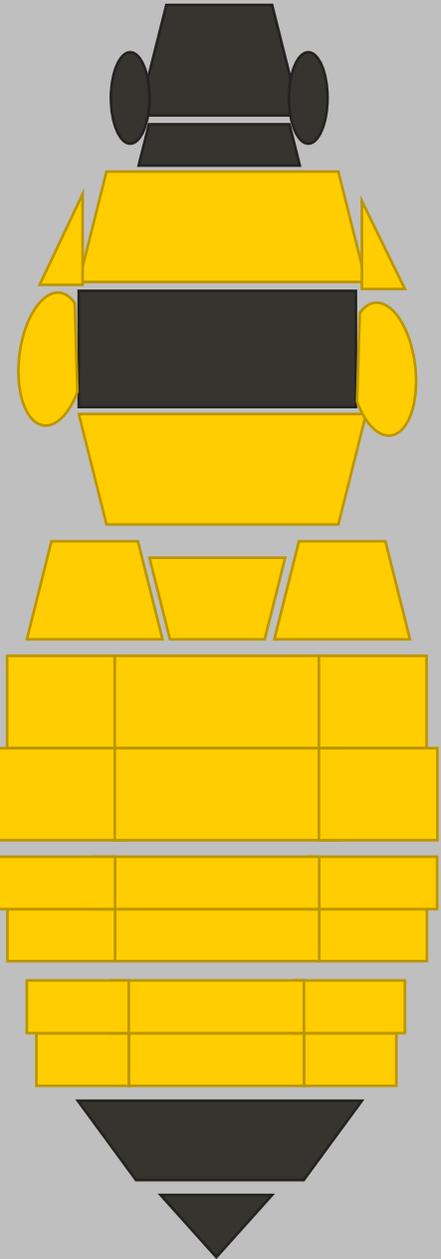
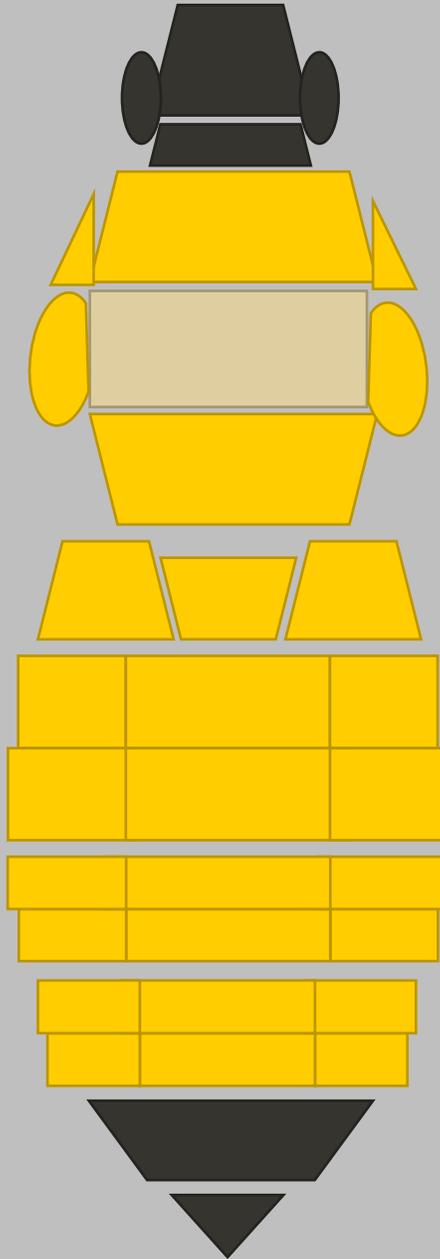


male

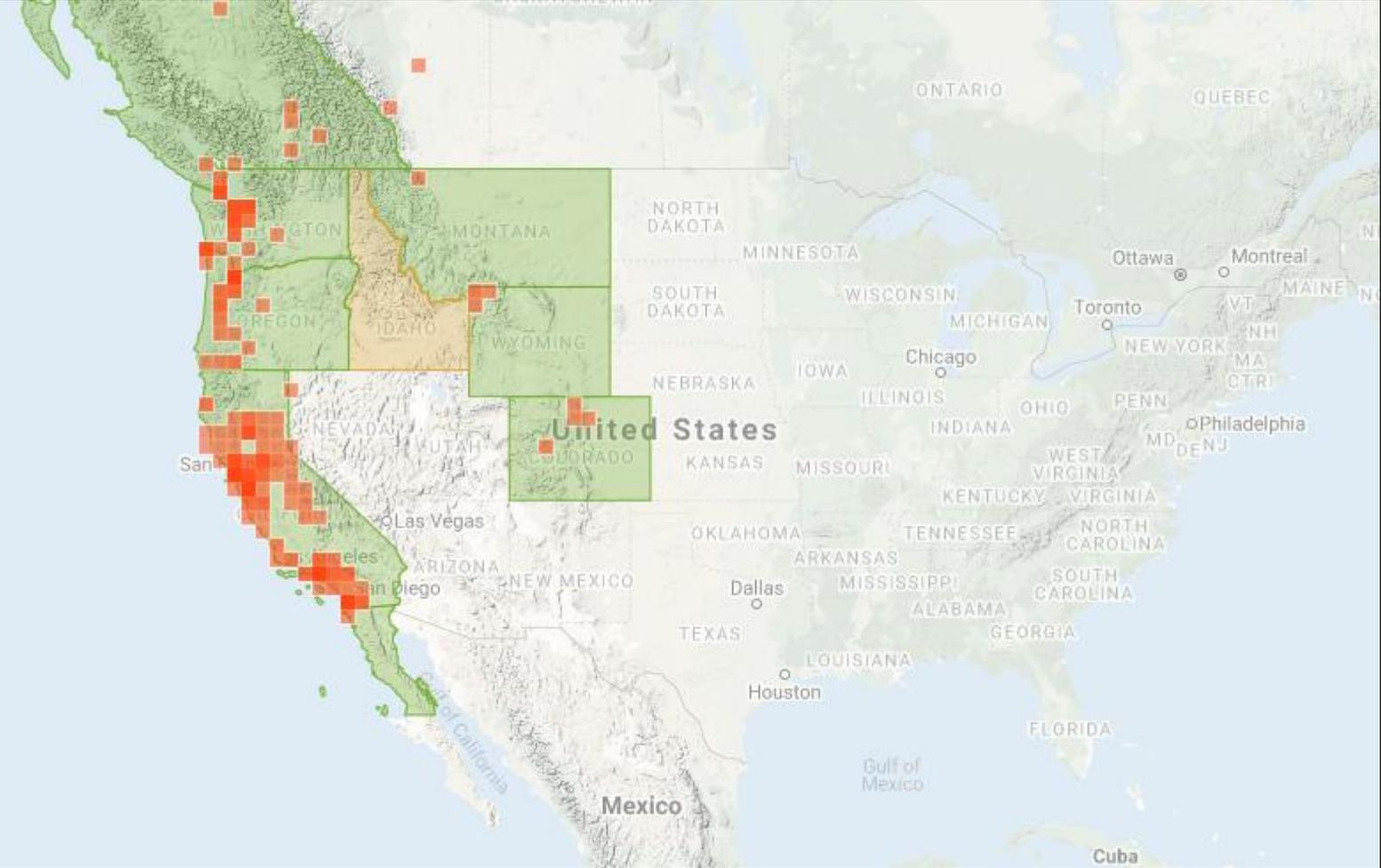


Koch et al. 2012.

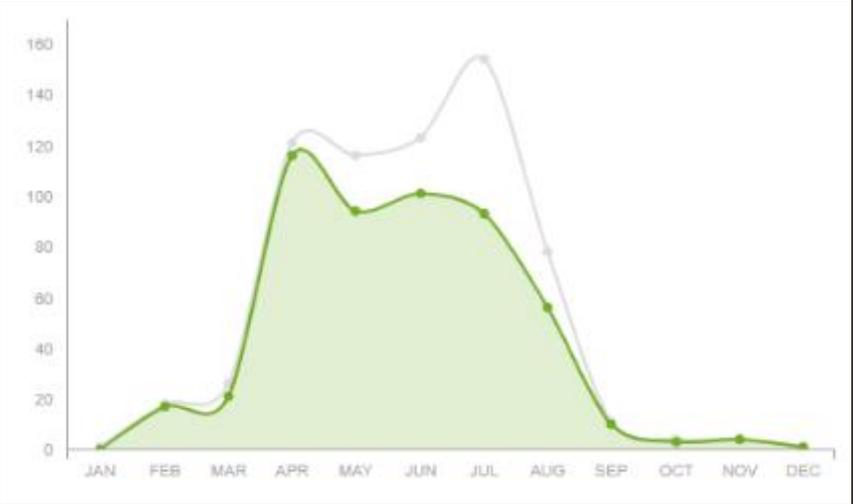
*Bombus fervidus fervidus*



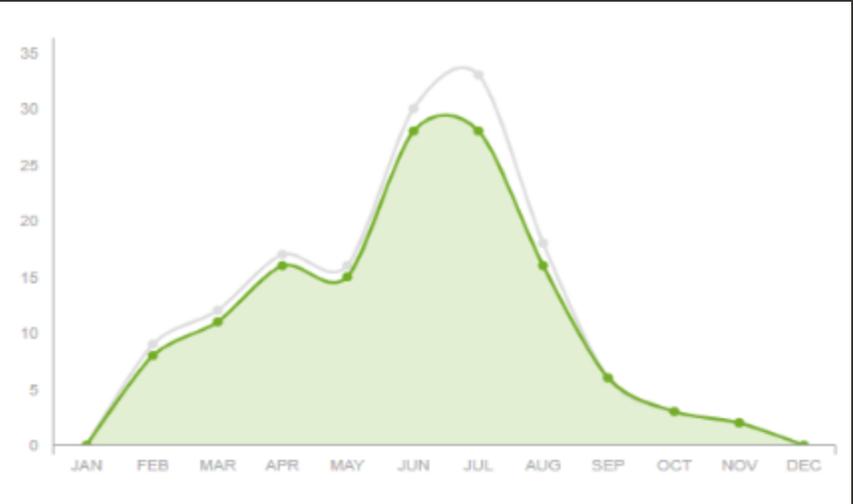
# California Bumble Bee (*Bombus fervidus californicus*)



Entire Range

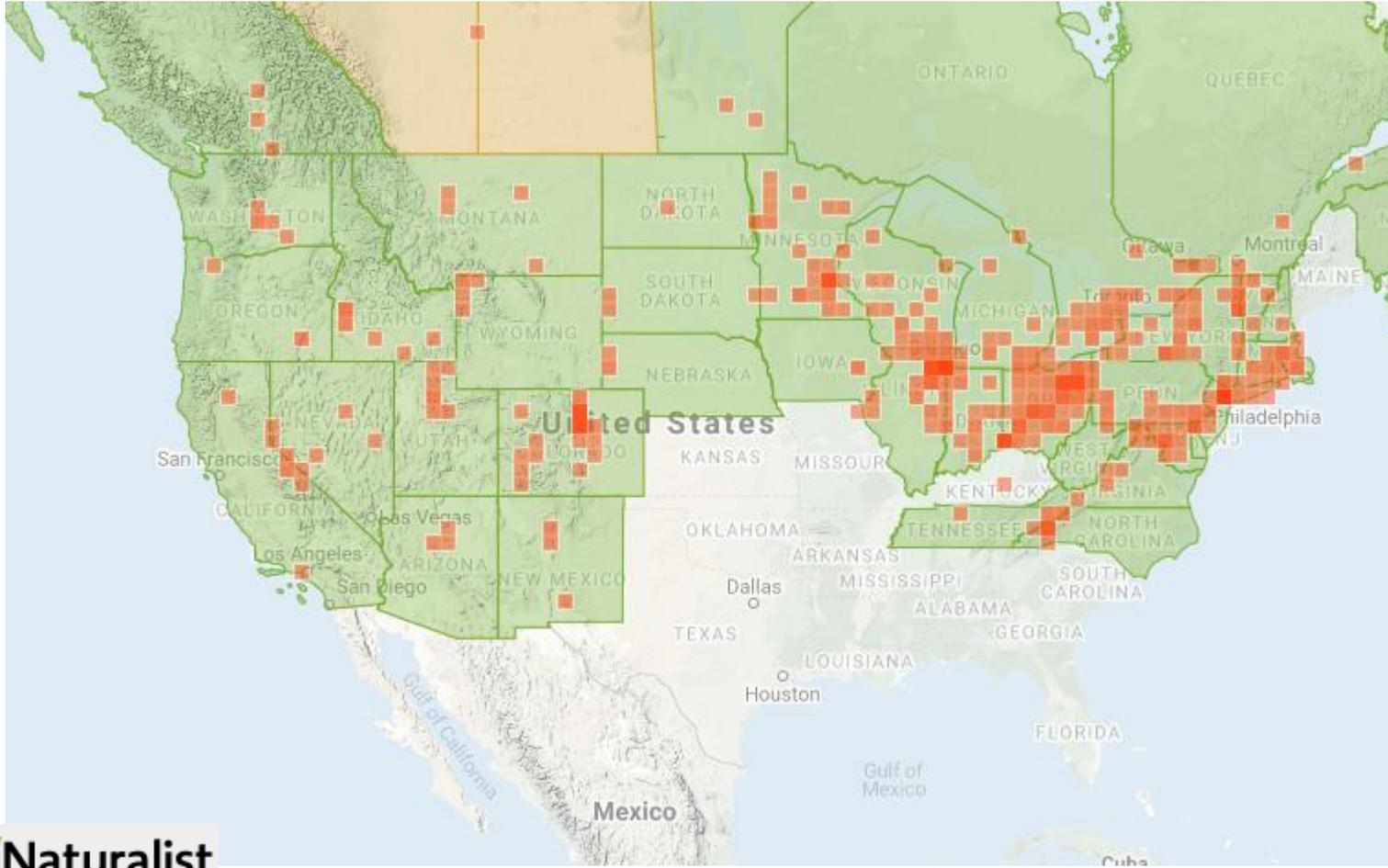


Southern California

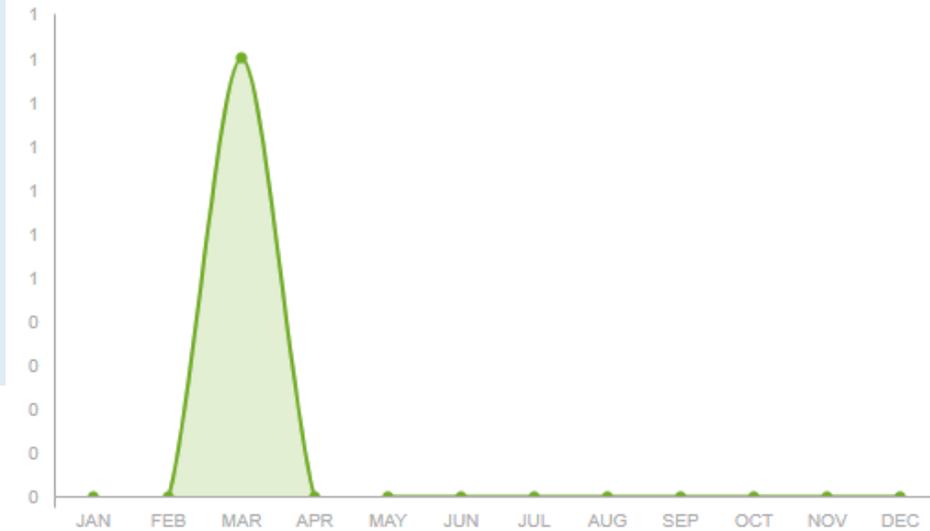


# Golden Northern Bumble Bee (*Bombus fervidus* (*fervidus*))

## Entire Range



## Southern California



# Host plants

15 families

34 genera

Commonly on:

*Astragalus*

*Caragana*

*Cirsium*

*Helianthus*

*Bombus fervidus*



Fiona Paton on Flickr CC



Sasho Popov on Flickr CC



Aprilly on Flickr CC



Ivo Novák on Flickr CC



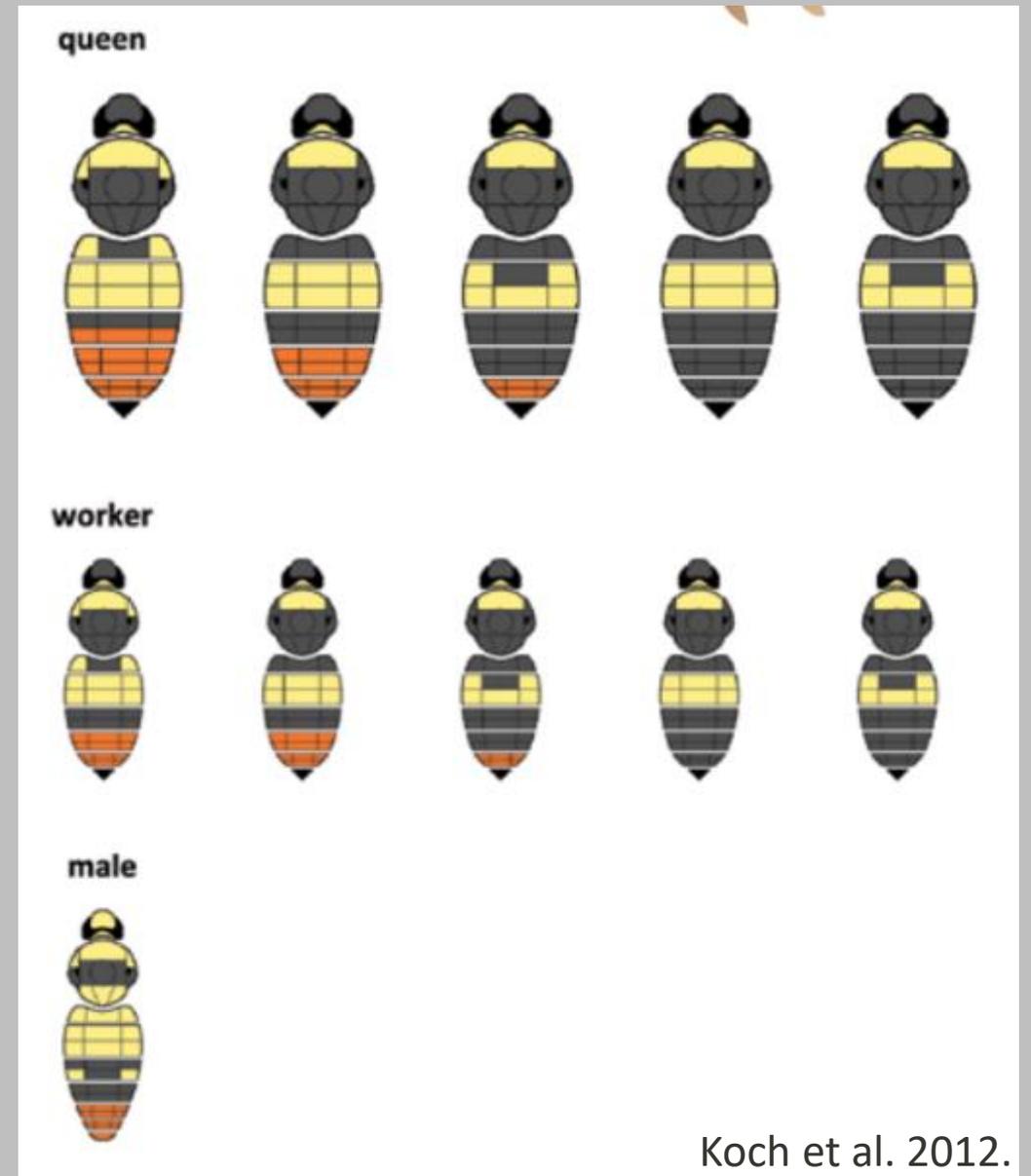
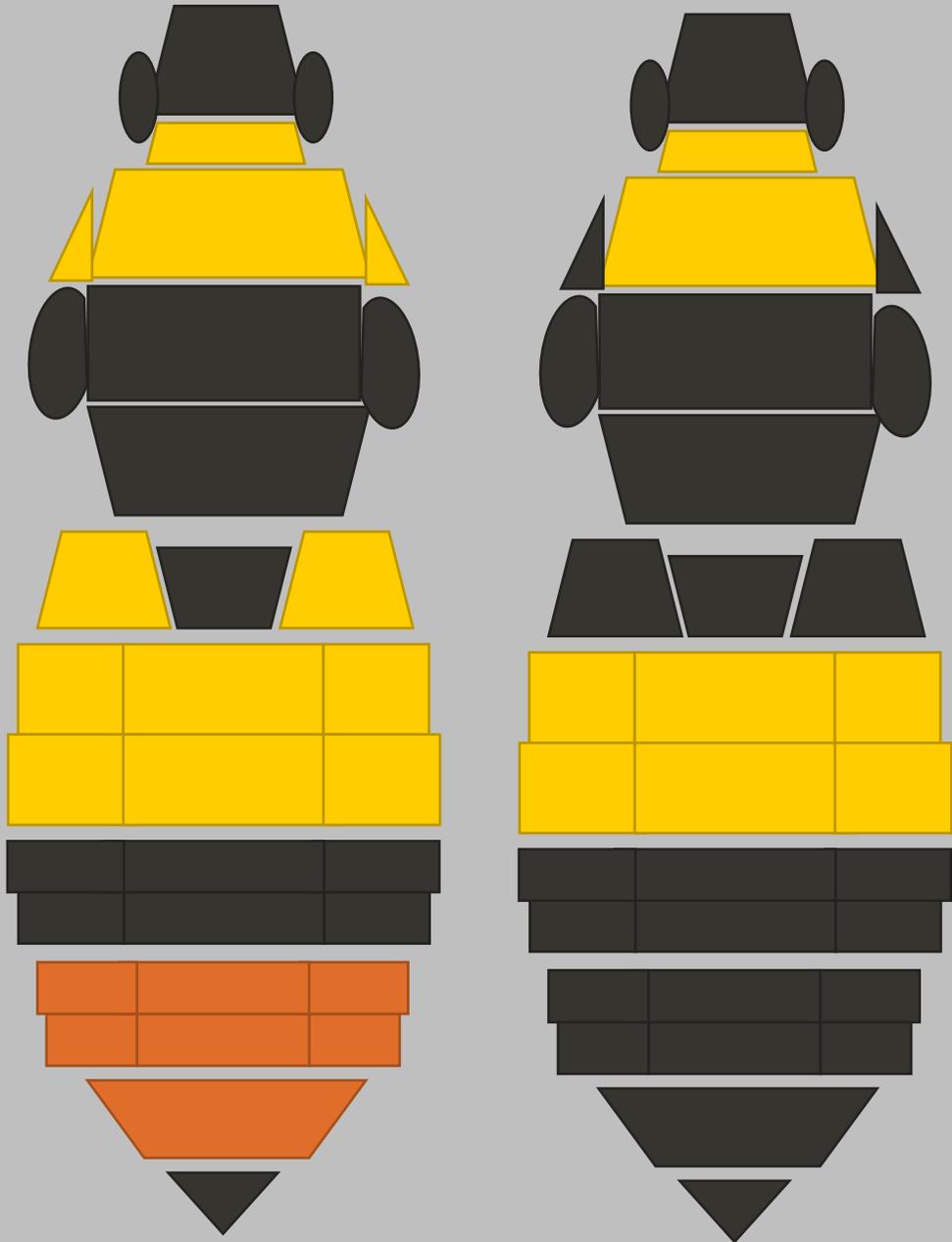
cc - @andrecala on inaturalist

*Bombus crotchii*



cc - @alex\_bairstow on inaturalist

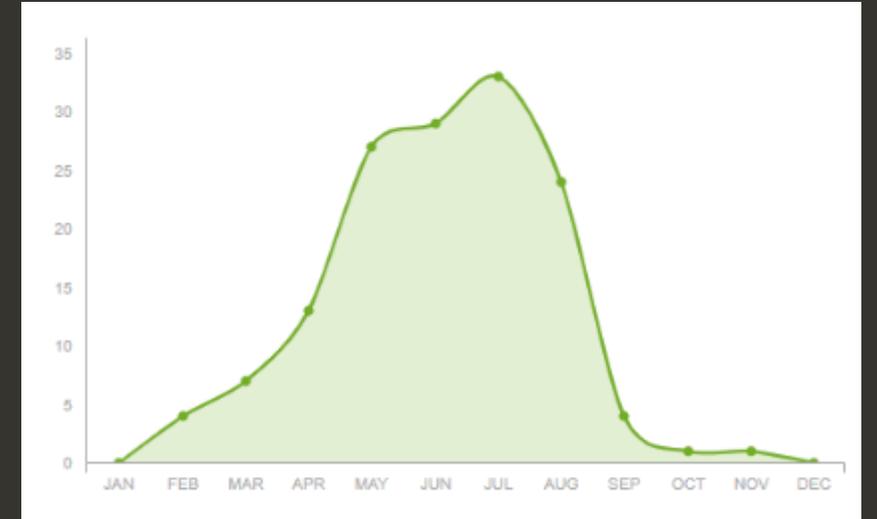
# *Bombus crotchii*



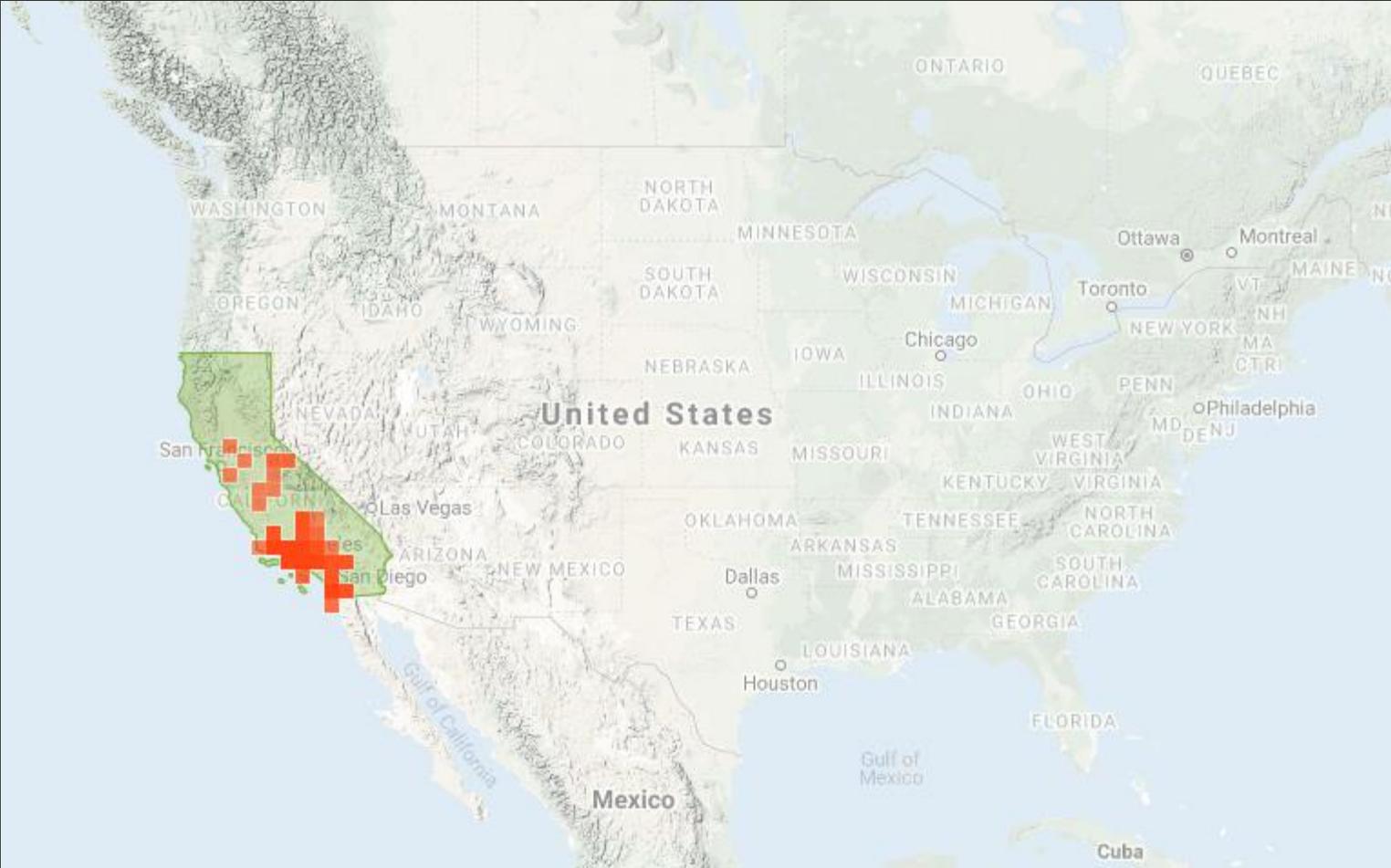
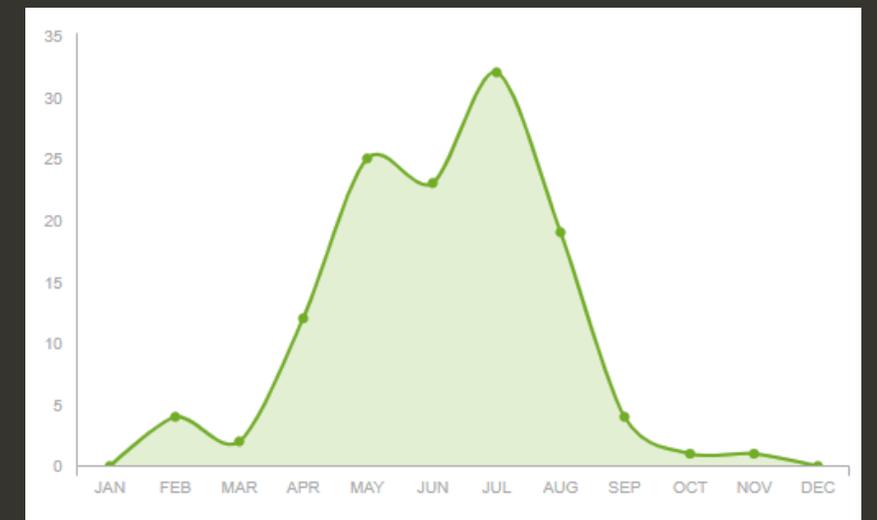
Koch et al. 2012.

# Crotch's Bumble Bee (*Bombus crotchii*)

## Entire Range



## Southern California



# Host plants

15 families

33 genera

Commonly on:

*Asclepias*

*Chaenactis*

*Medicago*

*Salvia*

*Bombus crotchii*



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R. Russell Beaston on Flickr CC



René Van Wallendael on Flickr CC



Woodelfgardener on Flickr CC

# *Bombus sonorus*

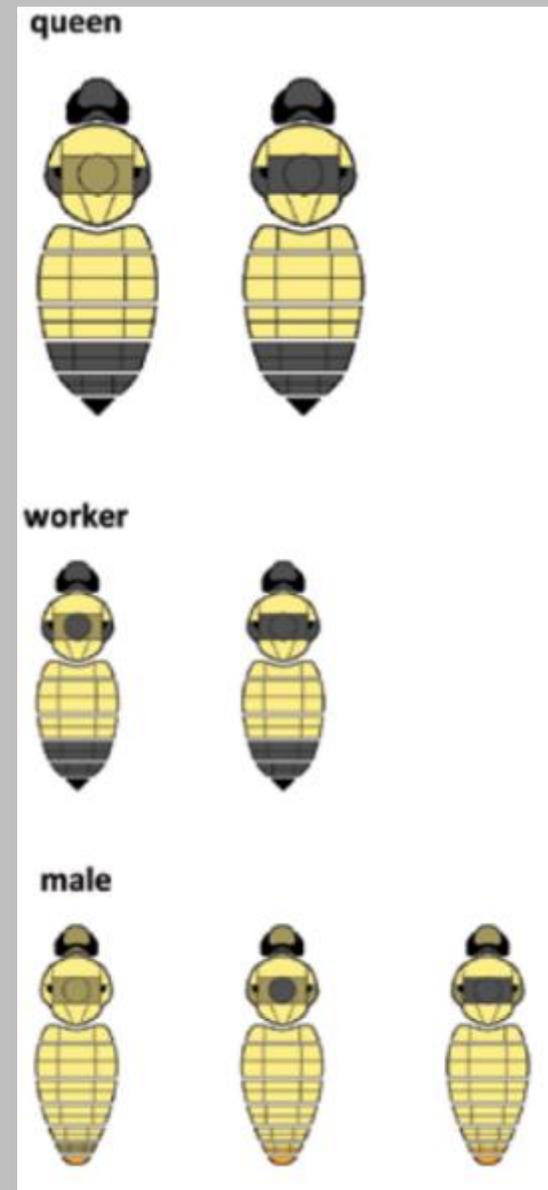
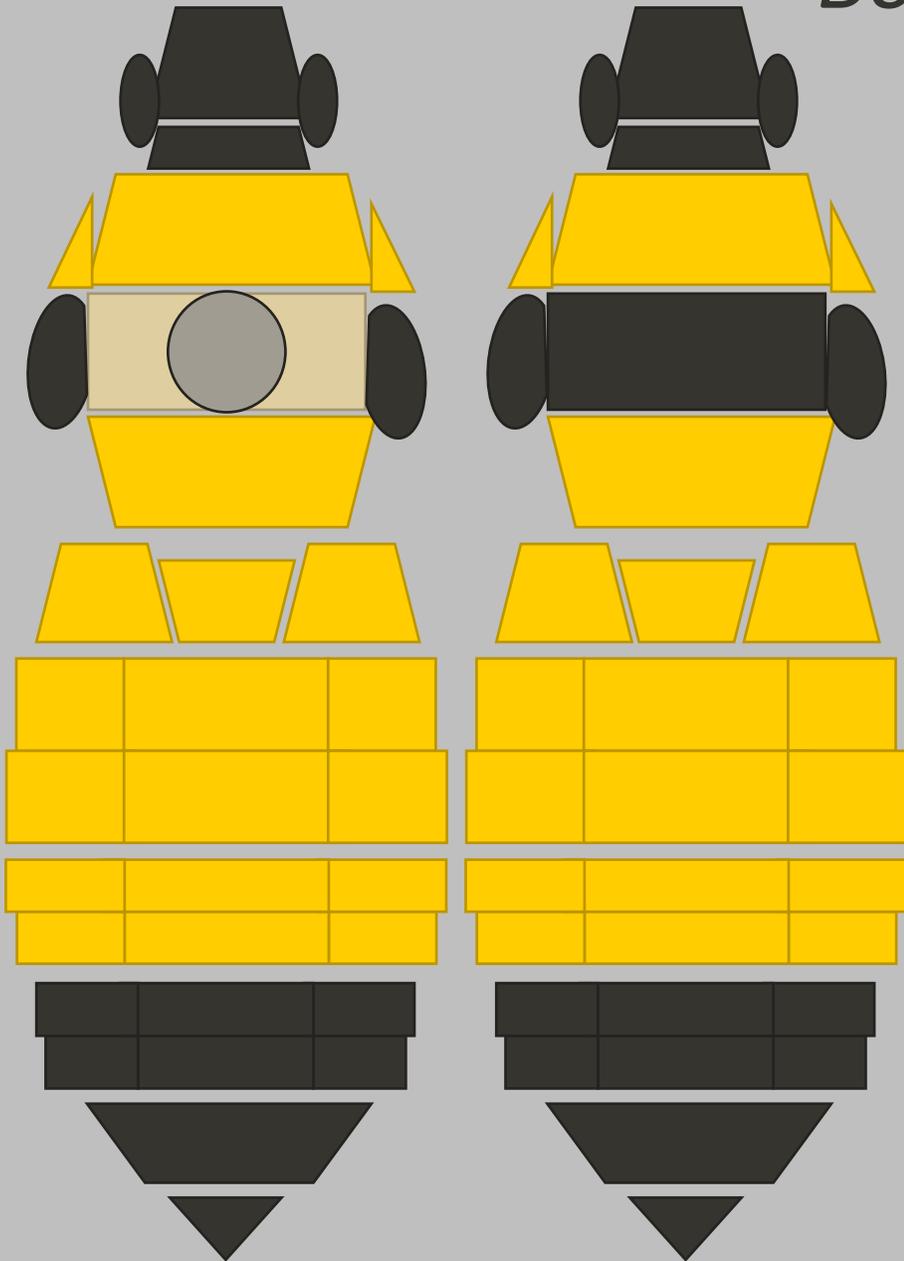


CC - @nmoorhatch on inaturalist



CC - @tom\_barnes\_ on inaturalist

# *Bombus sonorus*

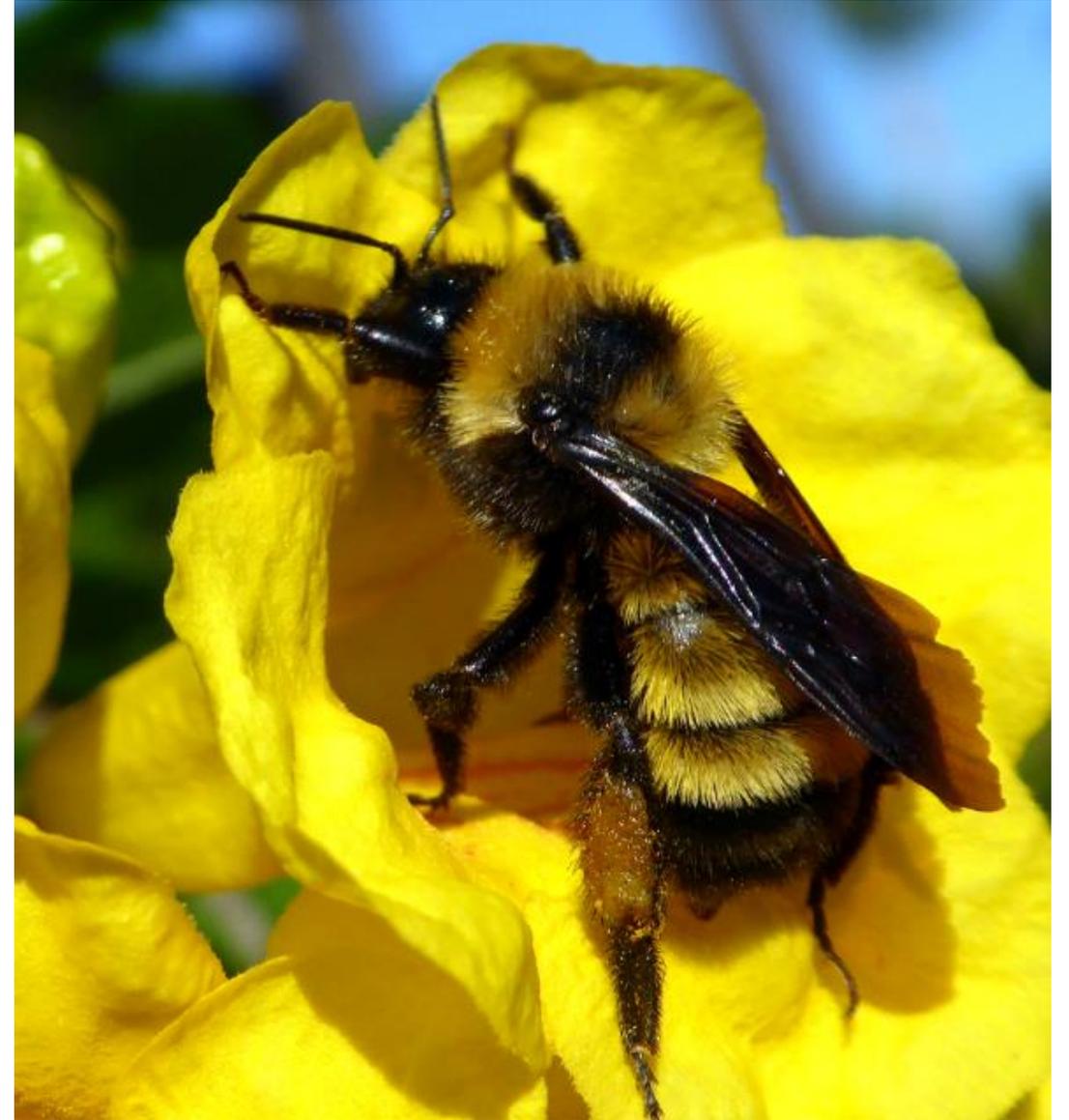


Koch et al. 2012.

# *Bombus sonorus*

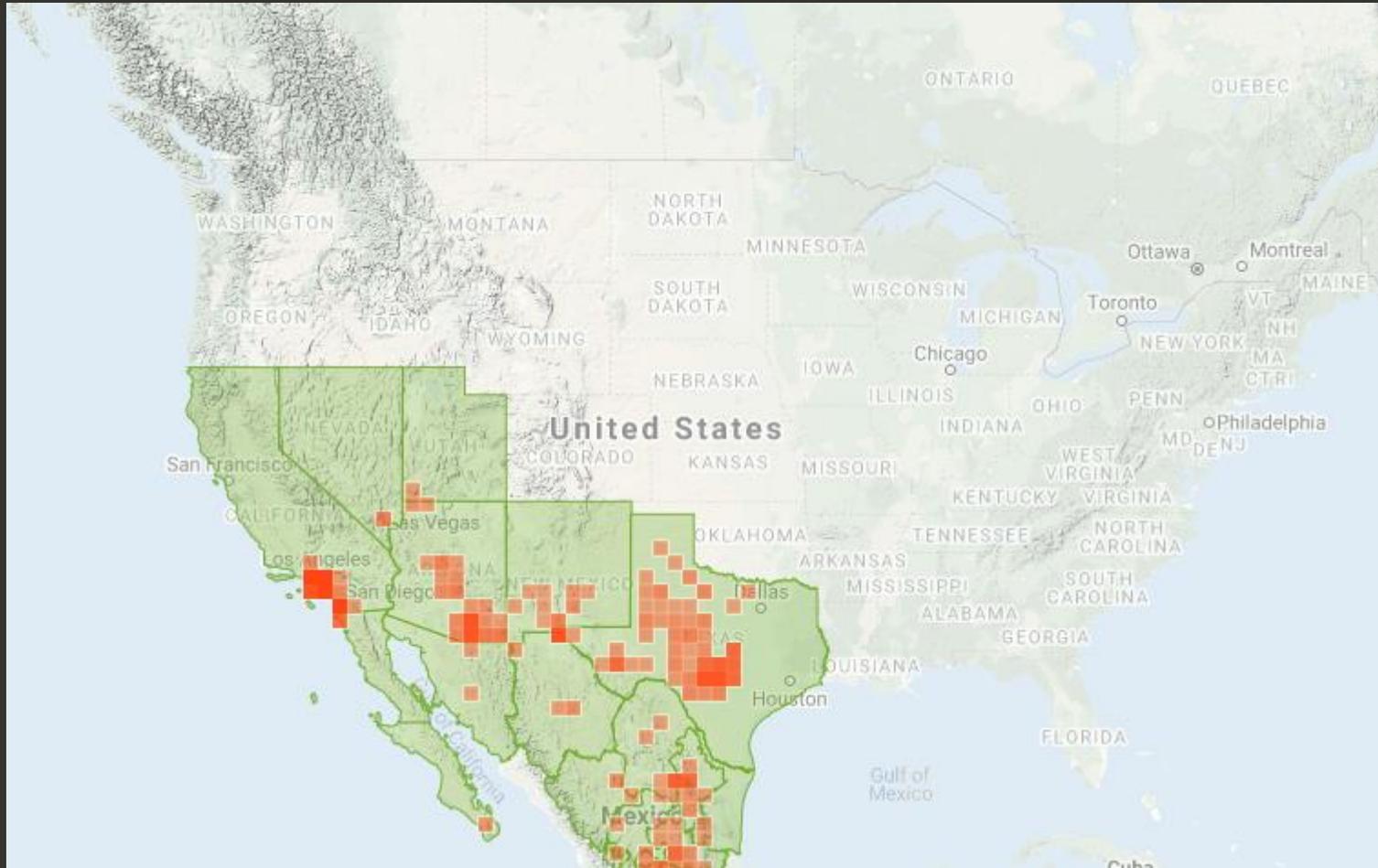


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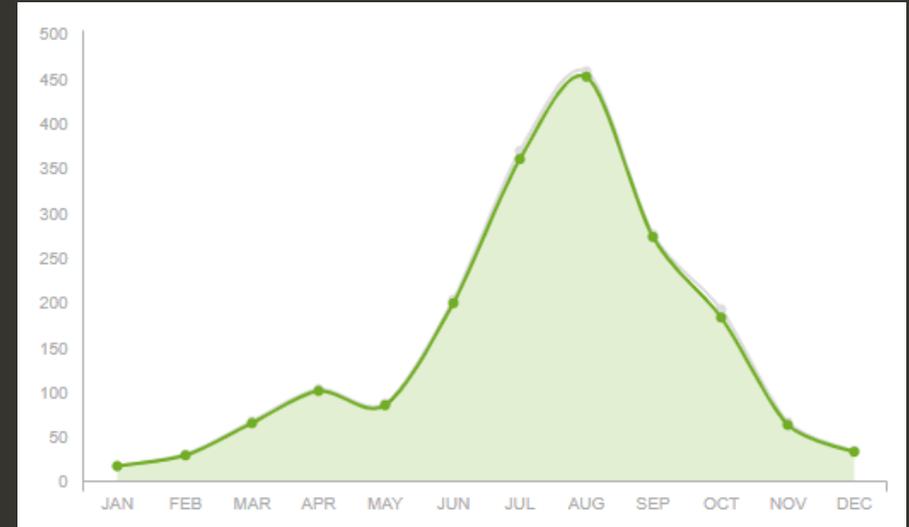
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# Sonoran Bumble Bee (*Bombus sonorus*)



iNaturalist

## Entire Range



## Southern California



# Host plants

30 families

73 genera

Commonly on:

*Cirsium*

*Medicago*

*Solanum*

*Helianthus*

*Bombus sonorus*



Aprilly on Flickr CC



René Van Wallendael on Flickr CC



John King on Flickr CC



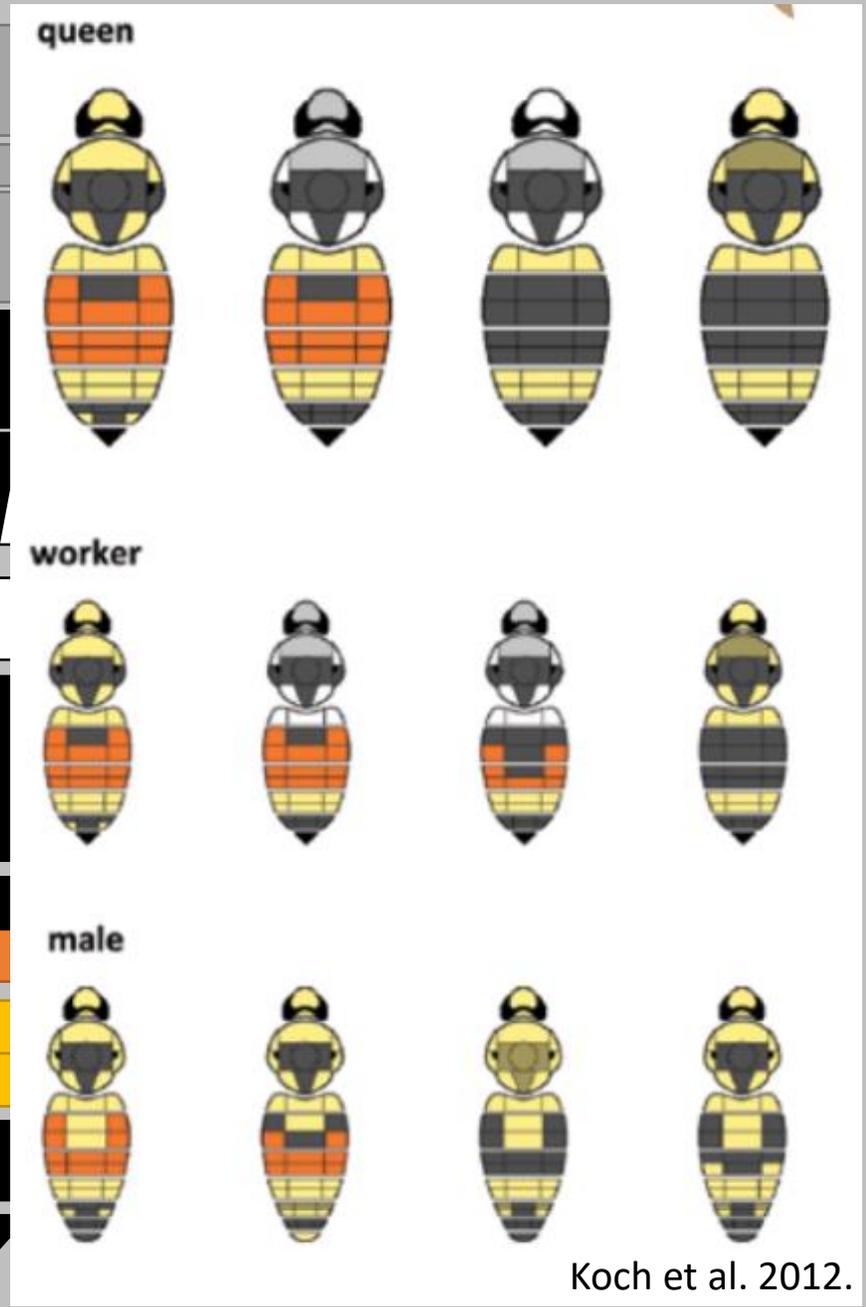
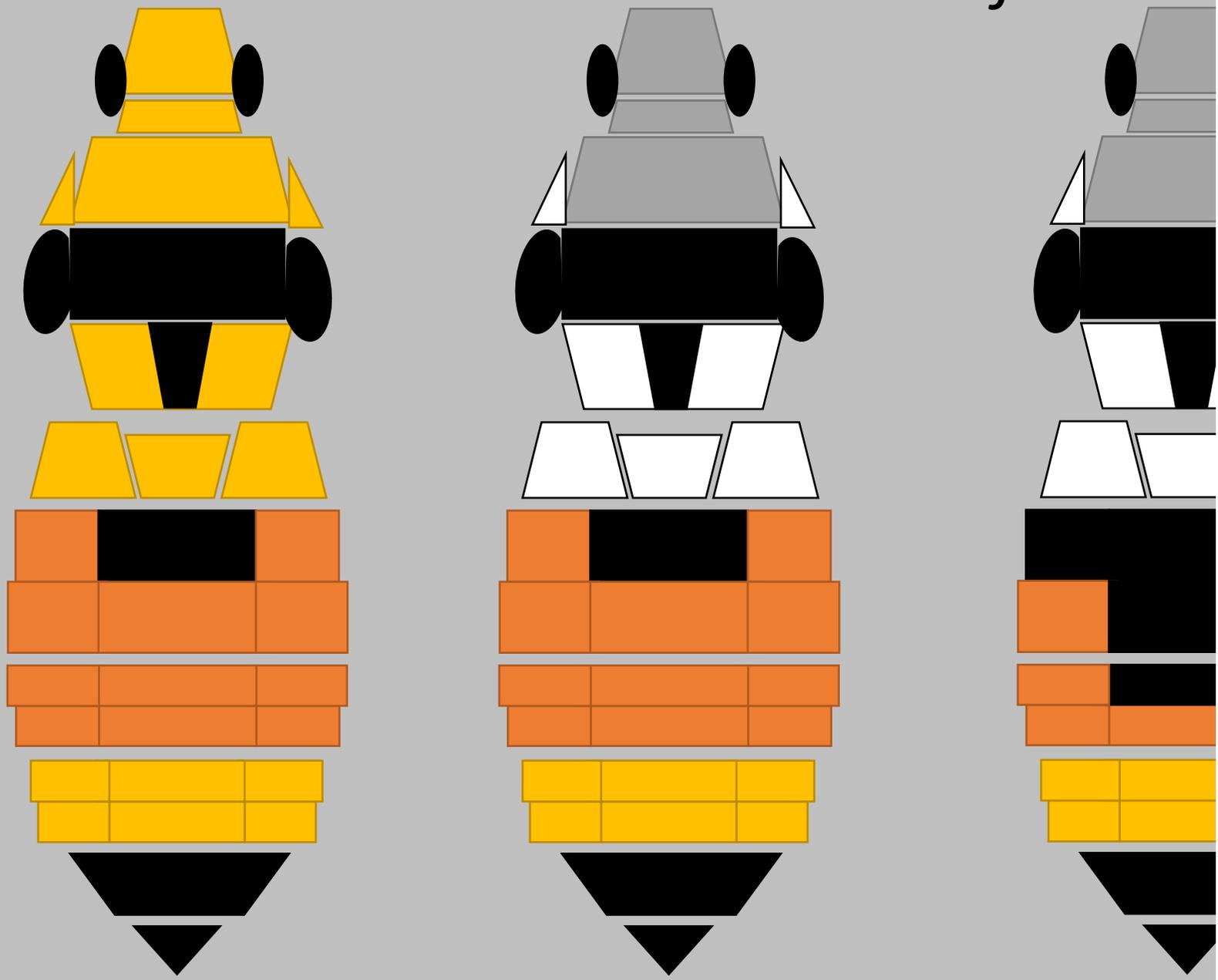
Ivo Novák on Flickr CC



*Bombus bifarius*

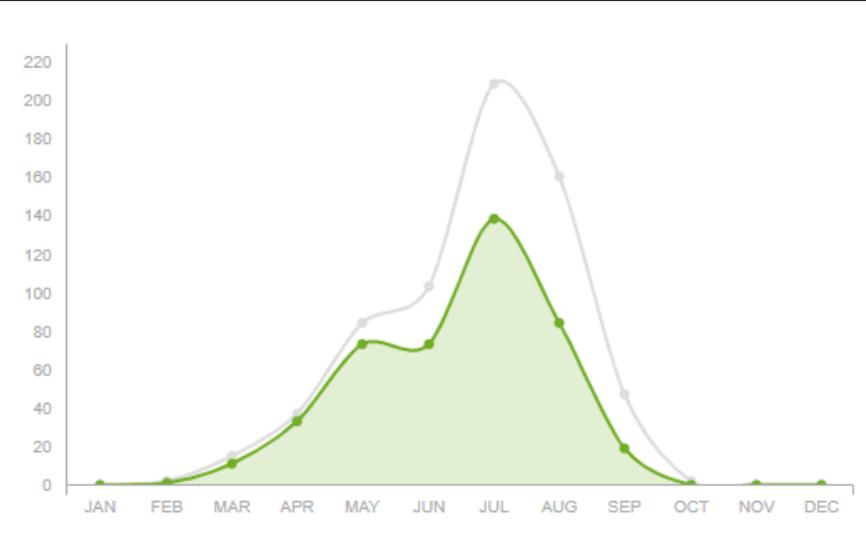
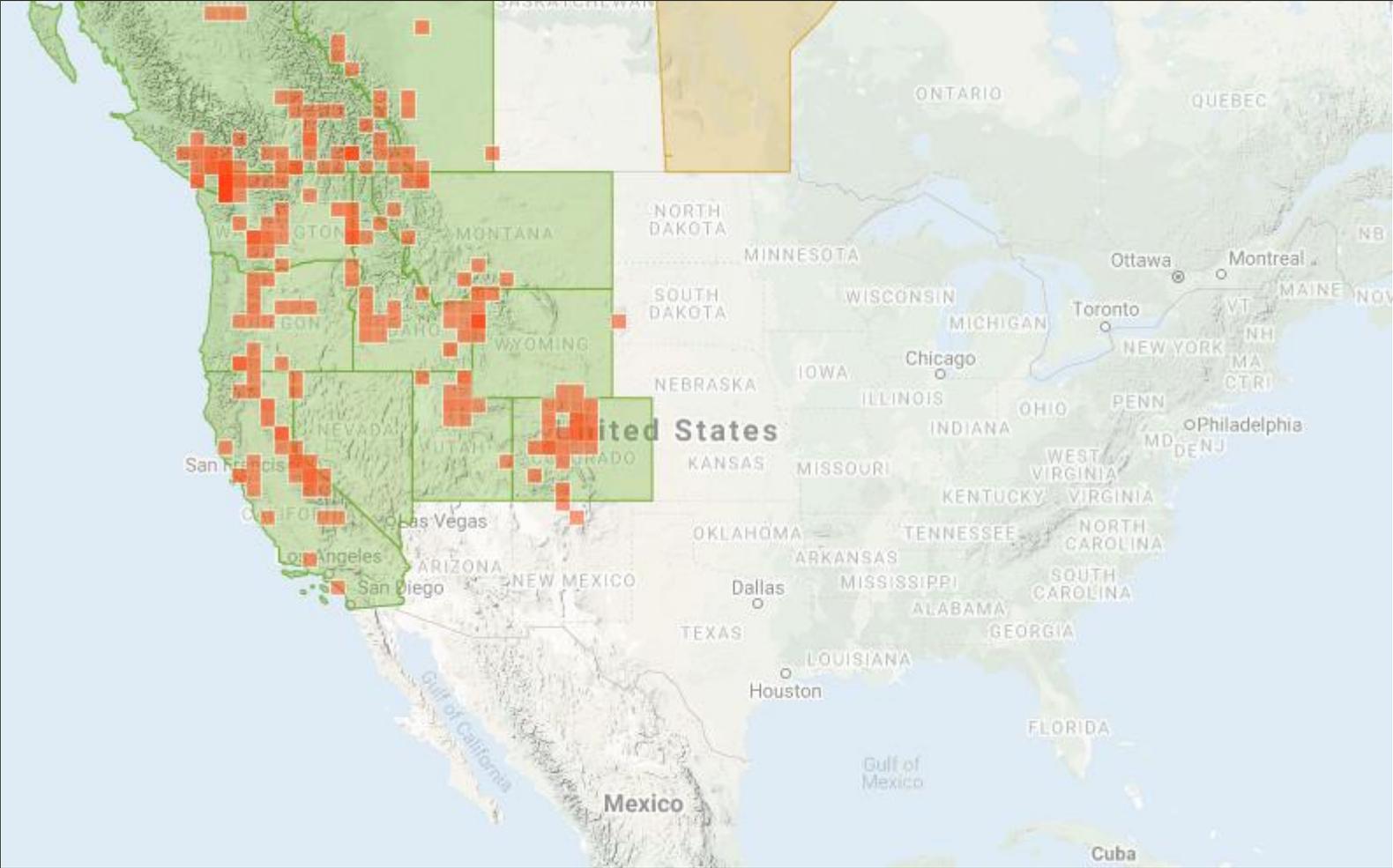


# *Bombus bifarius*



# Black-notched Bumble Bee (*Bombus bifarius*)

## Entire Range



## Southern California



# Host plants

20 families  
45 genera

Commonly on:  
*Chrysothamnus*  
*Monardella*  
*Ribes*  
*Solidago*



Andrey Zharkikh on Flickr CC



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Koos Nuninga on Flickr CC



Angela Cappella on Flickr CC

*Bombus bifarius*

Future monitoring, research, and outreach.

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## Bumblebees of San Diego County

## About

Members 16

The time is now - Bumblebees are out and about!

Bumblebees are cute. Bumblebees are fuzzy. Bumblebees are a good indicator of ecosystem health. Let's keep an eye on them.

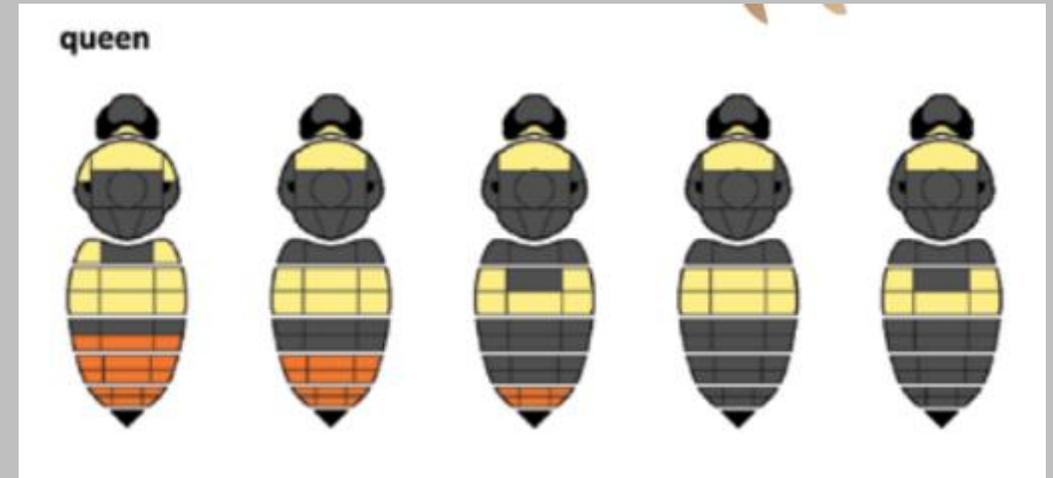
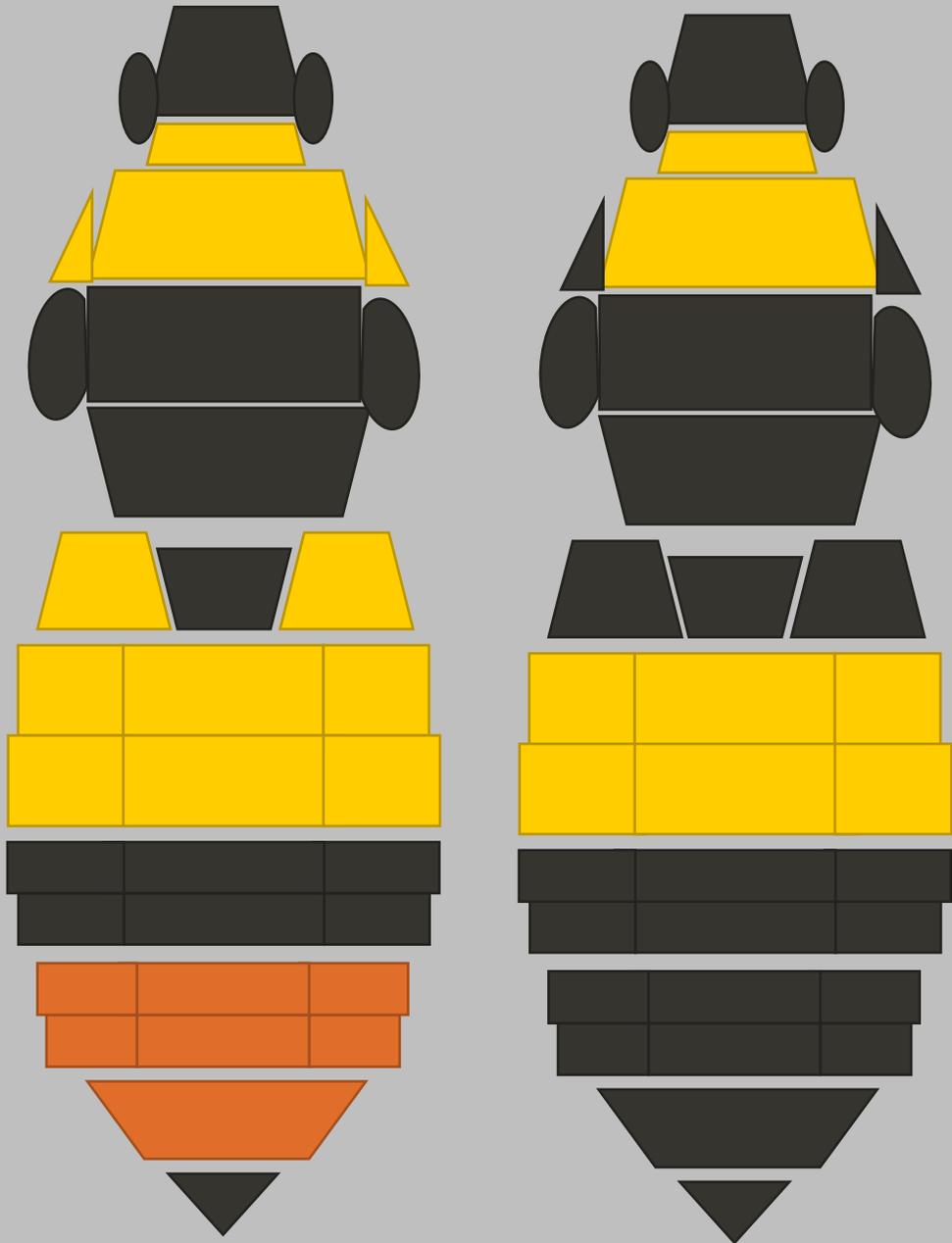
[Read More >](#)[Edit Project](#)[Project Journal](#)

Overview

1,151  
OBSERVATIONS5  
SPECIES124  
IDENTIFIERS437  
OBSERVERS[Stats](#)

- Design a practical and standardized monitoring protocol for regional surveys.
- Institute long-term monitoring program analogous to Christmas Bird Count and Monarch Watch.

# *Bombus crotchii*



**Create regionally-targeted identification aides and guides for photography of specimens in the field.**

## **Non-lethal sampling of DNA from bumble bees for conservation genetics**

**K. A. Holehouse<sup>1</sup>, R. L. Hammond<sup>1,2</sup> and A. F. G. Bourke<sup>1,\*</sup>**

“...we found that, unlike sampling haemolymph, sampling the terminal portion of the tarsus of a mid-leg of a worker reliably yielded amplifiable microsatellite DNA and did not significantly reduce worker survivorship.”

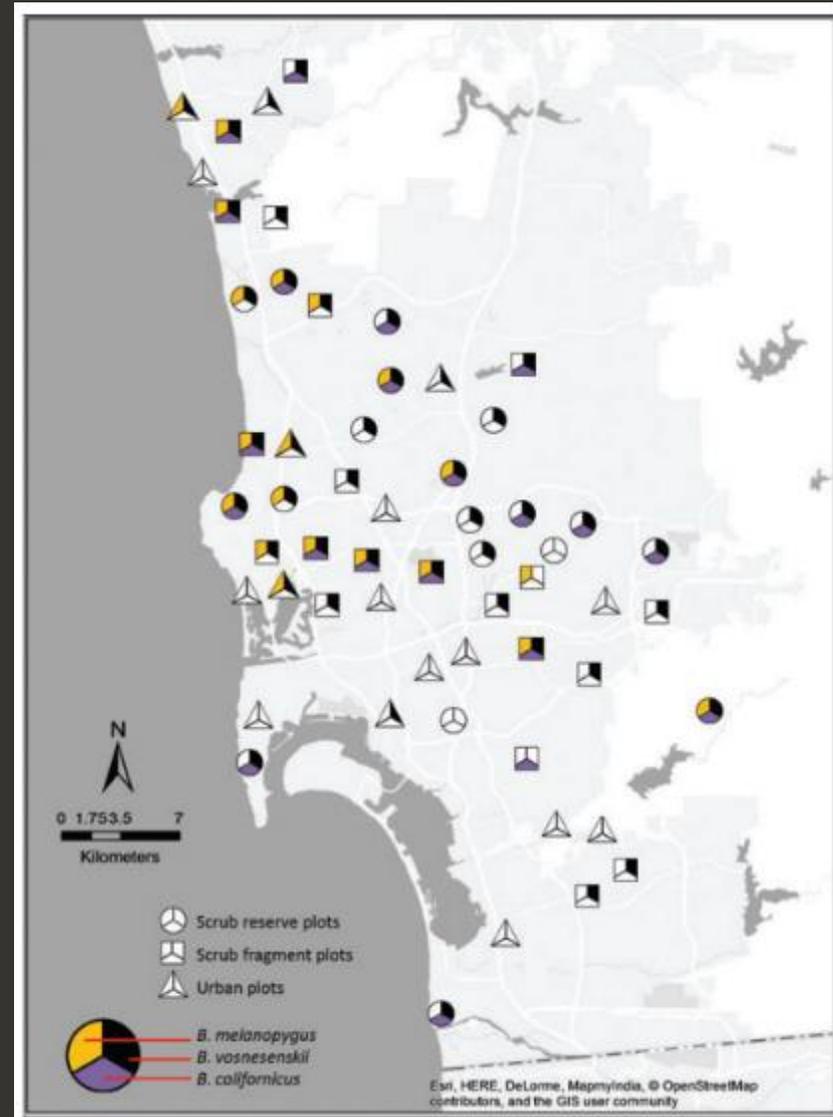


Source: USGS Bee Inventory and Monitoring Lab

# Bumble bee species exhibit divergent responses to urbanisation in a Southern California landscape

AMANDA B. SCHOCHET, KENG-LOU J. HUNG and DAVID A. HOLWAY  
 Division of Biological Sciences, University of California at San Diego, La Jolla, California, U.S.A.

“In contrast, the long-tongued *B. californicus* was never observed in any urban plot and exhibited strong positive associations with native sage cover...The present results suggest that urban areas may harbor adequate floral resources from the perspective of some, but not all, *Bombus* species.”



Maybe a regional *Bombus* working group? Because I certainly don't have all the answers.

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