

Non-*Apis* Bees Important for Crop Pollination in Virginia and Other States

(presented to the Virginia State Beekeepers Association, April 18, 2009)

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VirginiaTech
Invent the Future

Program objectives

- ① Increase awareness of the role of native bees in crop pollination



bumble bee on
blackberry

Program objectives

- ④ Highlight ways to support both native and honey bees
 - Reduced use of pesticides
 - Protection of nesting sites
 - Habitat enhancement



sweat bee on
verbena

Why should a beekeeper care about other bees?

@ You are the bee experts

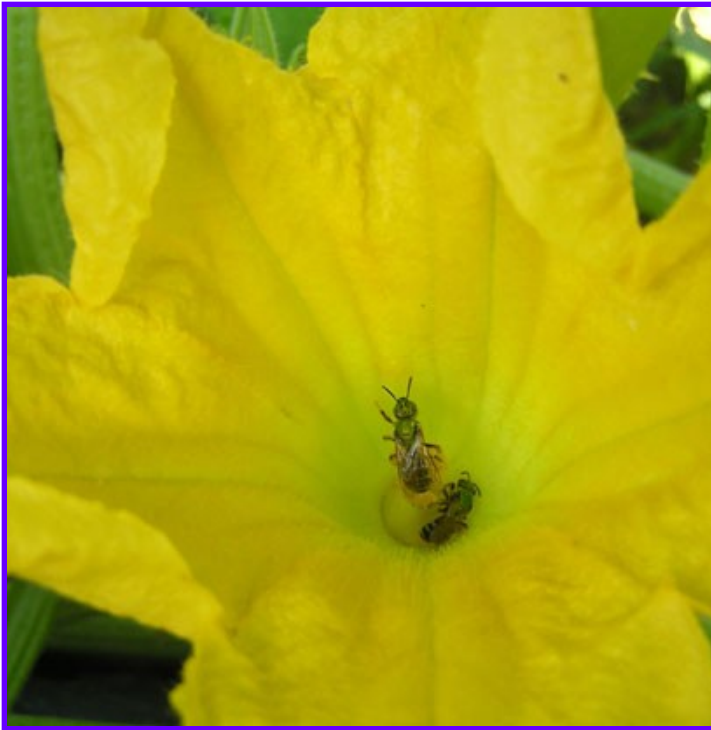
- The more you know about basic bee biology, the better resource you are for your clients



bumble bee on sage ↑
entomologist, Aidan, studying pollinators →

The same things that affect native bees affect honey bees

- ① Native bees may be good indicators of environmental issues that also affect honey bees
- ① Bee complexes provide a fuller picture than 1 species



sweat bees on squash



bumble bees on squash

Practices that support native bee populations like protecting natural areas also benefit honey bees

Ⓢ Some of the best pollen & nectar sources are found in natural areas

- willow, tulip tree, locust, sourwood, sumac...

sweat bee
on service berry



Protecting natural areas to support native bee populations also benefits honey bees

- 🌿 Late season wildflowers provide vital winter resources for honey bees (wingstem 🌿, goldenrod, asters...)



In Virginia, we have 18 species of bumble bees, and more than 450 other bee species (mostly solitary)



Agapostemon sp.
sweat bee



Andrena sp.
mining bee



Halictid family
sweat bee



Bombus griseocollis
bumble bee queen



Xylocopa virginica
carpenter bee



Peponapis pruinosa
squash bee

Bee genera in Virginia (55) & species per genus

<i>Agapostemon</i>	4	<i>Epeoloides pilosula</i>	1	<i>Melitta</i>	3
<i>Andrena</i>	97	<i>Epeolus</i> ✨	19	<i>Nomada</i> ✨	37
<i>Anthidiellum</i>	1	<i>Eucera</i>	5	<i>Nomia</i>	1
<i>Anthidium</i>	4	<i>Euglossa viridissima</i>	1	<i>Osmia</i>	20
<i>Anthophora</i>	6	<i>Florilegus condignus</i>	1	<i>Panurginus</i>	2
<i>Apis mellifera</i>	1	<i>Habropoda laboriosa</i>	1	<i>Paranthidium jugatorium</i>	1
<i>Ashmeadiella</i>	2	<i>Halictus</i>	6	<i>Peponapis pruinosa</i>	1
<i>Augochlora pura</i>	1	<i>Heriades</i>	3	<i>Perdita</i>	17
<i>Augochlorella</i>	3	<i>Holcopasites</i>	2	<i>Protandrena</i>	1
<i>Augochloropsis</i>	3	<i>Hoplitis</i>	7	<i>Pseudopanurgus</i>	14
<i>Bombus</i>	18	<i>Hylaeus</i>	17	<i>Ptilothrix bombiformis</i>	1
<i>Calliopsis</i>	2	<i>Lasioglossum</i>	6	<i>Sphecodes</i>	15
<i>Cemolobus ipomoeae</i>	1	<i>Lithurgus</i>	1	<i>Stelis</i>	8
<i>Ceratina</i>	3	<i>Macropis</i>	3	<i>Svastra</i>	4
<i>Chelostoma</i>	3	<i>Megachile</i>	36	<i>Trachusa</i>	5
<i>Coelioxys</i>	16	<i>Melecta pacifica</i>	1	<i>Triepeolus</i> ✨	19
<i>Colletes</i>	24	<i>Melissodes</i>	27	<i>Xenoglossa strenua</i>	1
<i>Dieunomia</i>	3	<i>Melitoma taurea</i>	1	<i>Xylocopa</i>	2
<i>Dufourea</i>	3				

✨ some or all species parasitic

How are other bees different from honey bees?

- ⓐ None have perennial colonies
- ⓐ Management—only a few species are “managed”
 - bumble bees (mostly for greenhouse production of tomatoes), *Bombus* spp.
 - alfalfa leaf cutting bees, *Megachile rotundata*
 - alkali bee (alfalfa), *Nomia melanderi*
 - blue orchard bees (fruit trees), *Osmia* spp.
- ⓐ Sociality—except bumble bees, most are solitary
 - May aggregate nests
- ⓐ Life cycles—annual colonies or solitary, short adulthood
- ⓐ Foraging ability/habits
 - Tongue length can determine best forage
 - No recruitment to the best resources

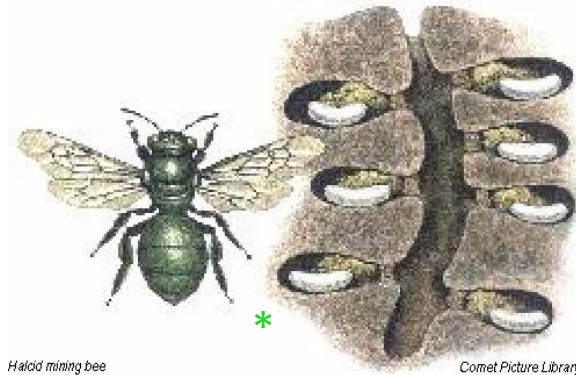
Honey bees are eusocial, bumble bees are primitively eusocial, and most other bees are solitary

Ⓢ **Bumble bee** queens start a new colony in spring

Ⓢ Female solitary bees make and provision their nests alone



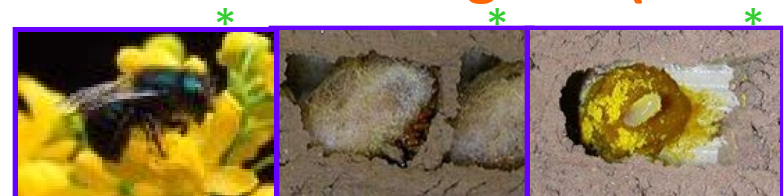
www.bayceer.uni-bayreuth.de/bayc



http://4.bp.blogspot.com/_uZ17CDPpLgU/SGL



mining bee (solitary)

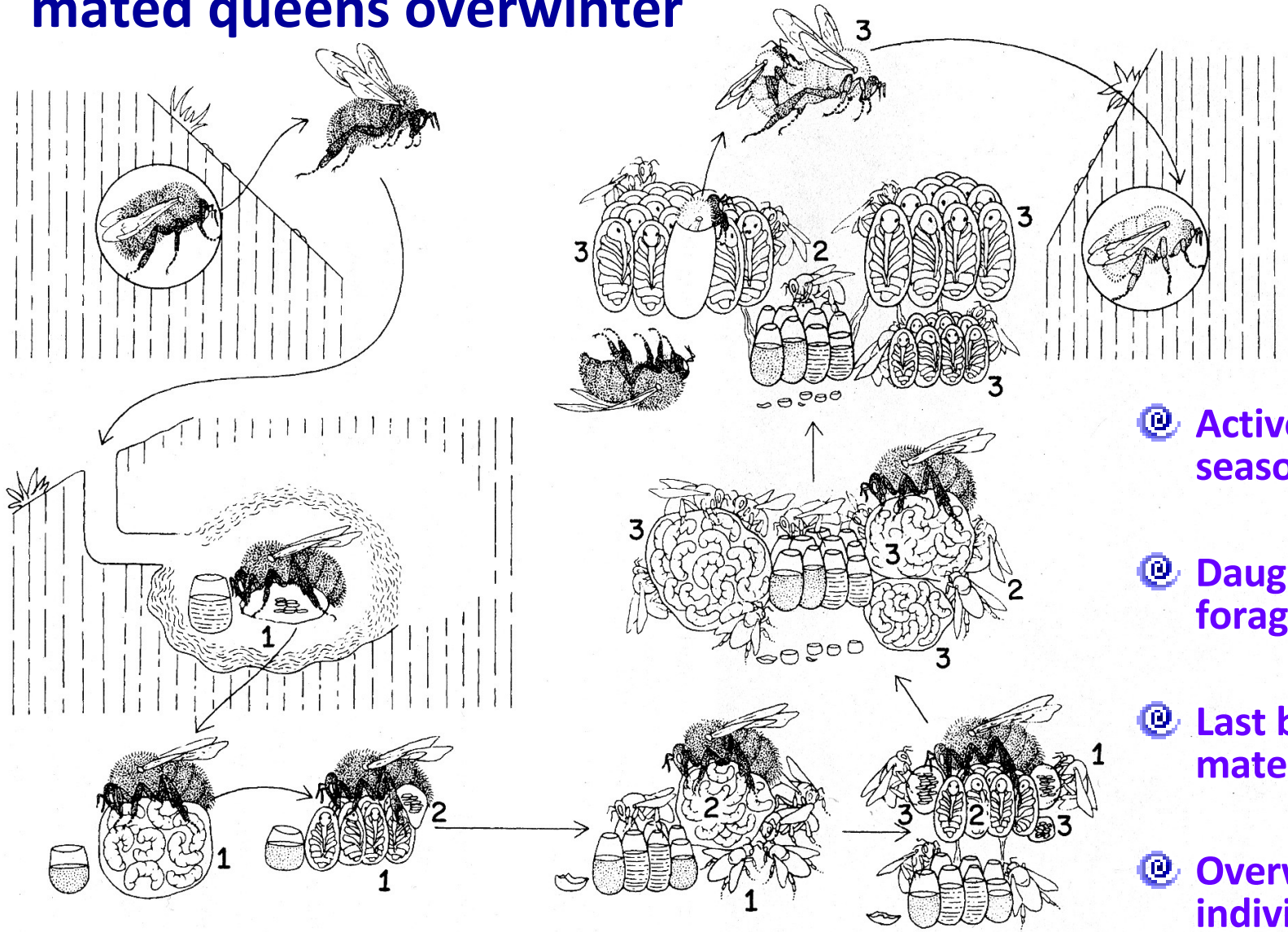


www.ars.usda.gov/Research/docs.htm?docid=18333

blue orchard bee (solitary)



Bumble bee life cycle—in late summer or fall, newly mated queens overwinter



- Ⓢ Active all season
- Ⓢ Daughters forage
- Ⓢ Last brood mates
- Ⓢ Overwinter individually

From Bernd Heinrich's *Bumblebee Economics*

Typical solitary bee life cycle—most overwinter as larvae or pupae, but some overwinter as adults

Ⓢ Active adult only a few weeks—most of life as pupae or larva

Ⓢ Females build & provision nests alone

Ⓢ May aggregate nests for protection from predators & parasites, & to ease finding a mate



pupa



adult



egg

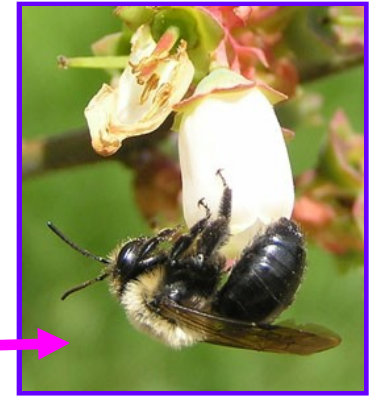


larva

Some bees are active in cooler temperatures in spring or earlier in the morning than honey bees

Ⓢ early spring bees

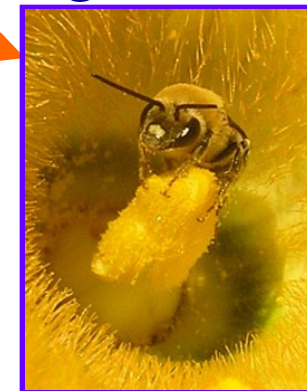
- bumble bees, *Bombus* spp.
- mining bees, *Andrena* spp.
- blue orchard bees, *Osmia* spp.
- large carpenter bees, *Xylocopa* spp.



<http://en.wikipedia.org/wiki/C>

Ⓢ summertime early risers

- bumble bees, *Bombus* spp.
- squash bees, *Peponapis pruinosa* & *Xenoglossa strenua*
- large carpenter bees, *Xylocopa* spp.

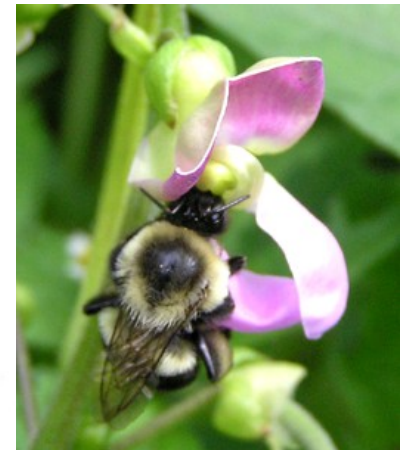
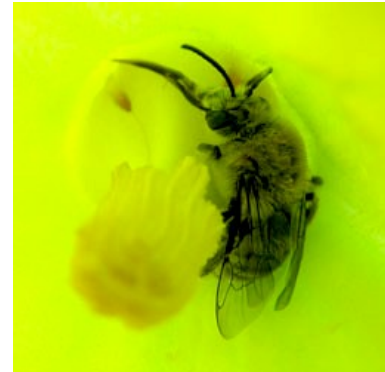


Ⓢ some work later into the evening

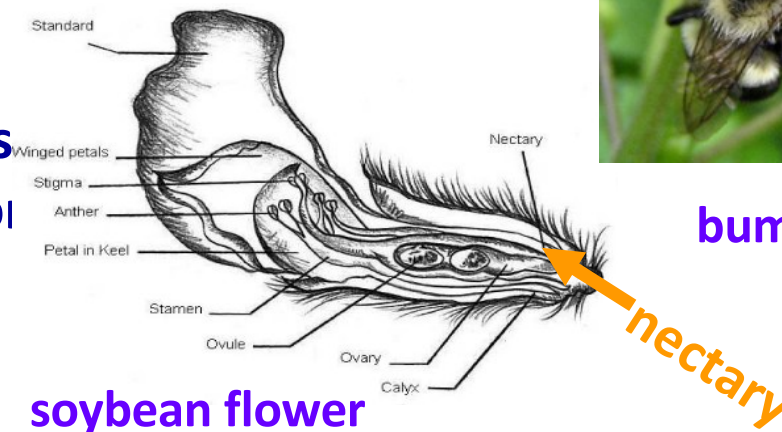
Foraging ability may be affected by tongue length or ability to open flowers

- Honey bees, squash bees, and many bumble bees have long tongues
- Bumble bees are generally better at working pea family flowers
 - Though agricultural peas and beans often are self-pollinating, most wild types still depend on insect pollinators

squash bee



bumble bees



soybean flower

Some bees are better pollinators of flowers like alfalfa, blueberry, and tomato than honey bees

- Ⓢ because of flower structure--in alfalfa, honey bees avoid being whacked on the head

alfalfa



untripped vs. tripped

alkali bee
Nomia melanderi



pollinators.nbii.gov

alfalfa leaf cutter bee (European)
Megachile rotundata



www.tierundnatur.de/wildbienen/eb-mrotu.htm

www.delange.org/Alfalfa/Dsc00010b.jpg

[/alfalfa.okstate.edu/images/flowers/flower-06.htm](http://alfalfa.okstate.edu/images/flowers/flower-06.htm)

Many native bees “buzz” pollinate—sonicating flowers improves pollination of crops like blueberry & tomato

@ Nightshade family & blueberry flowers



Foraging habits may make some bees more effective in transferring pollen

① Squash bees are specialists--they only forage on squash and a few other cucurbits

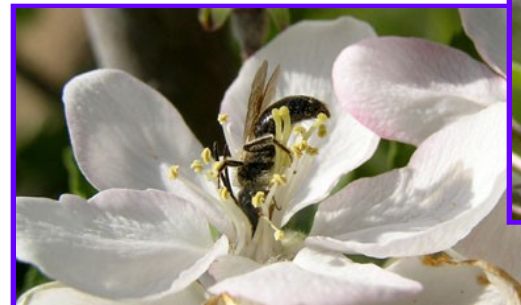


① Carpenter bees tend to “rob” nectar from blueberry flowers later in the season, cutting holes through tissue



- This allows honey bees & other bees to follow suit-- may still pollinate

① Apple flowers can force Andrenid bees to really get into the pollen!



Foraging habits--orchard mason bees (*Osmia* species) are very efficient fruit tree pollinators

Ⓢ Bees needed to pollinate 1 acre of apples

- 250 female *Osmia*
- 1.5 – 2 honey bee hives (15,000 to 20,000 foragers)

Ⓢ Pollination rate

- *Osmia cornuta**: 15 flowers/minute (about 2,500/day)
- Honey bee: 50 flowers/day

**Osmia cornuta* is a Japanese species



Osmia taurus female carrying nest material ↑

↓ *Osmia collinsiae* on *Oxalis*



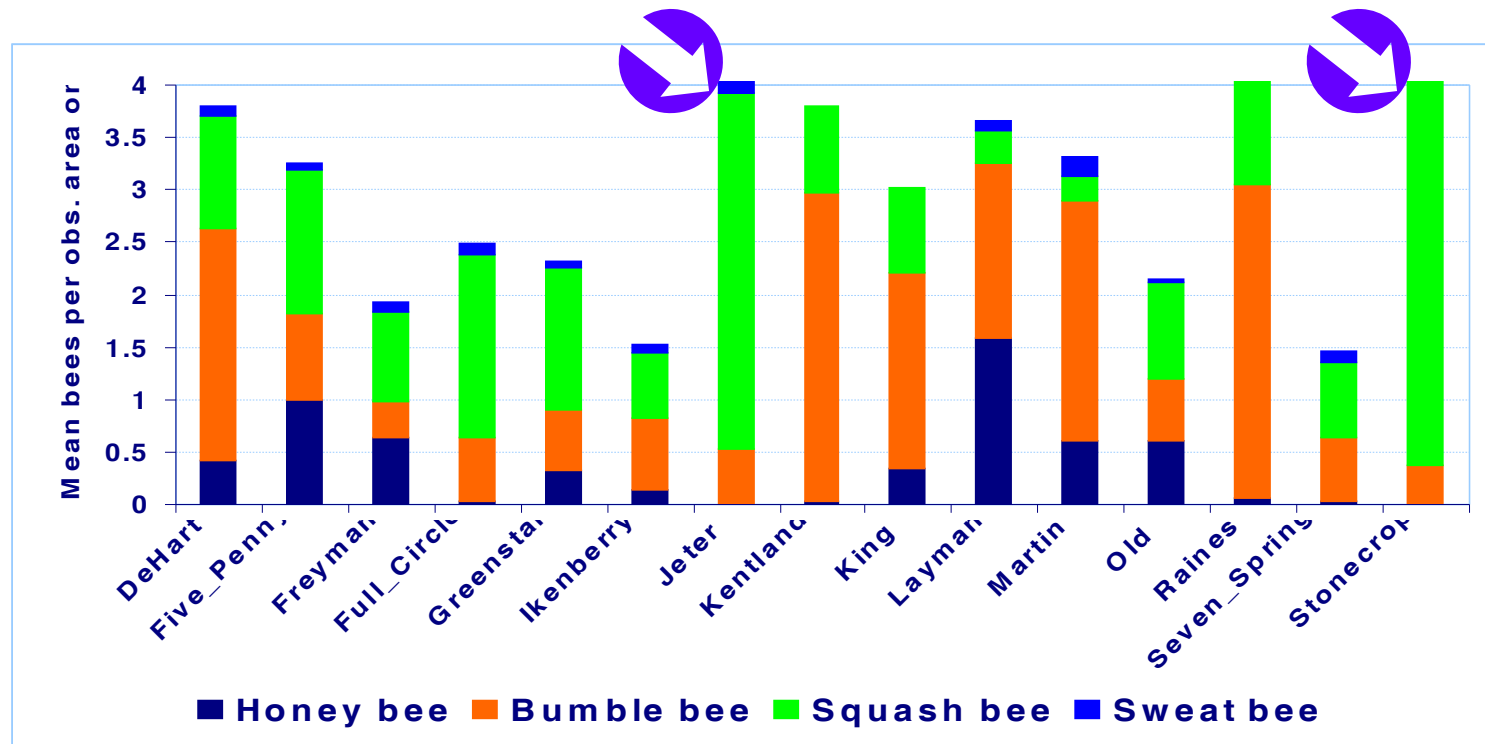
Photos by Dr. T'ai Roulston,

http://people.virginia.edu/~thr8z/Bee_Diversity/Blandy_

Foraging habits: honey bees recruit their sisters to the best nectar and pollen sites, so may abandon crops

- ⓐ Other bees do not recruit one another
- ⓐ Although sites with arrows (↻) had honey bee colonies, the honey bees were busy elsewhere

Relative abundance of honey, bumble, squash, and sweat bees on squash flowers



Besides honey bees, what other bees are important crop pollinators in Virginia?

mason bees, *Osmia* spp.



**mining bees
Andrena spp.**



**bumble bees
Bombus spp.**

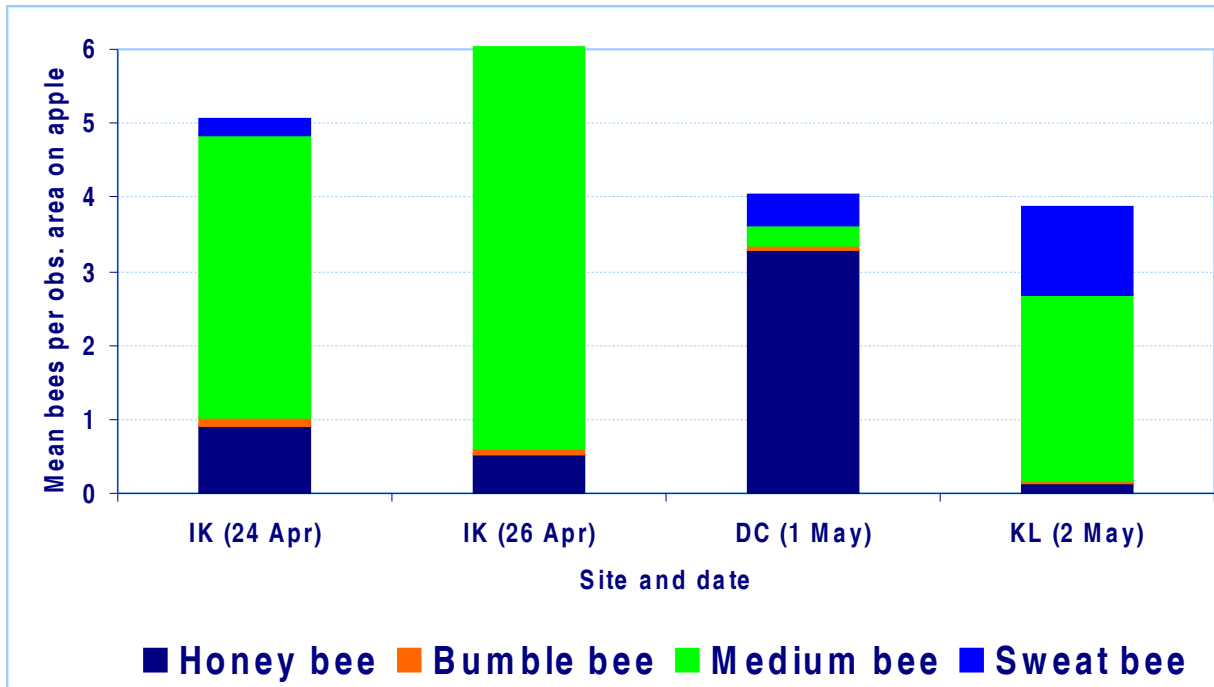


**squash bees
Peponapis pruinosa
*Xenoglossa strenua***



sweat bees (many genera)

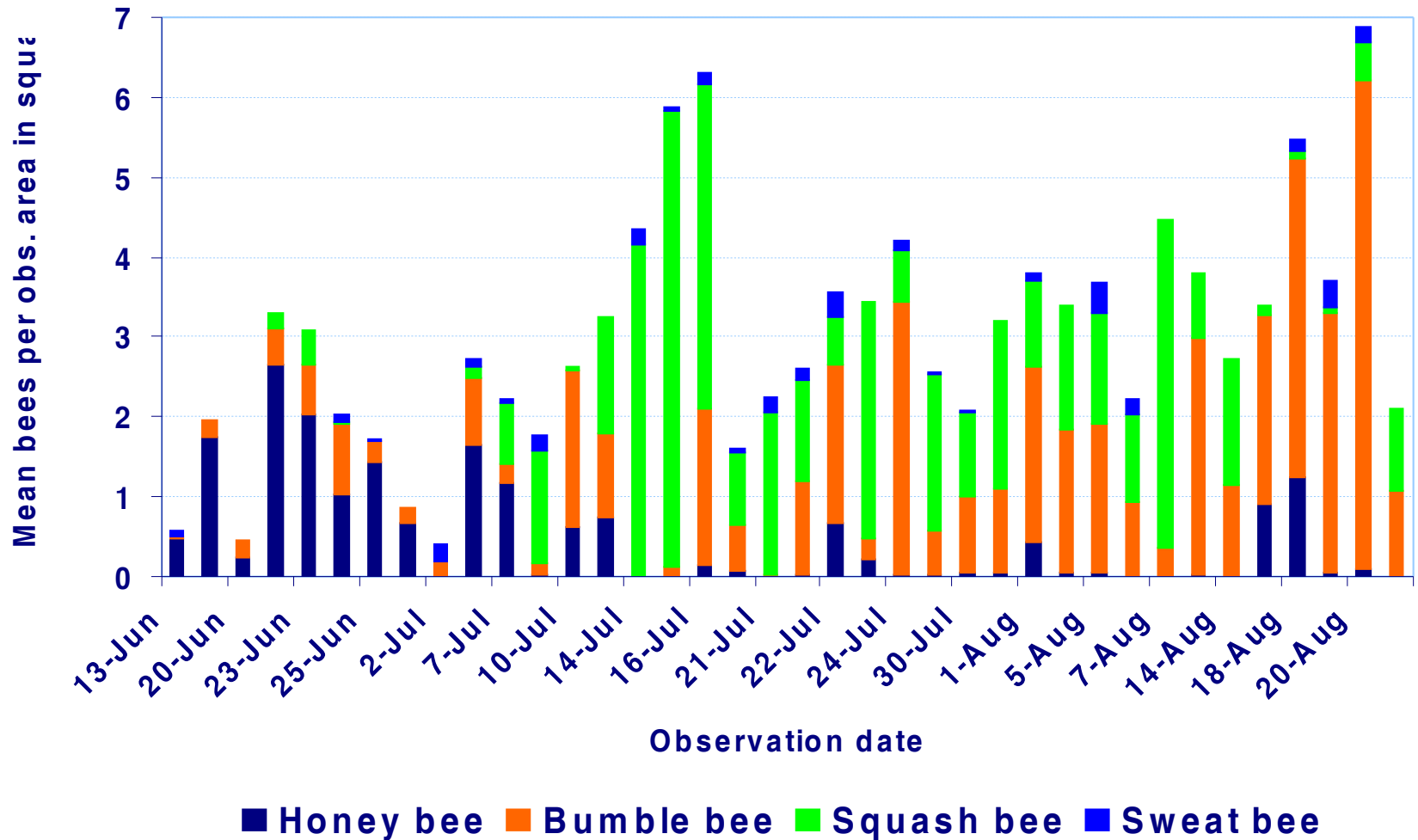
Relative abundance of honey bee and native bee visitors to apple flowers, spring 2008



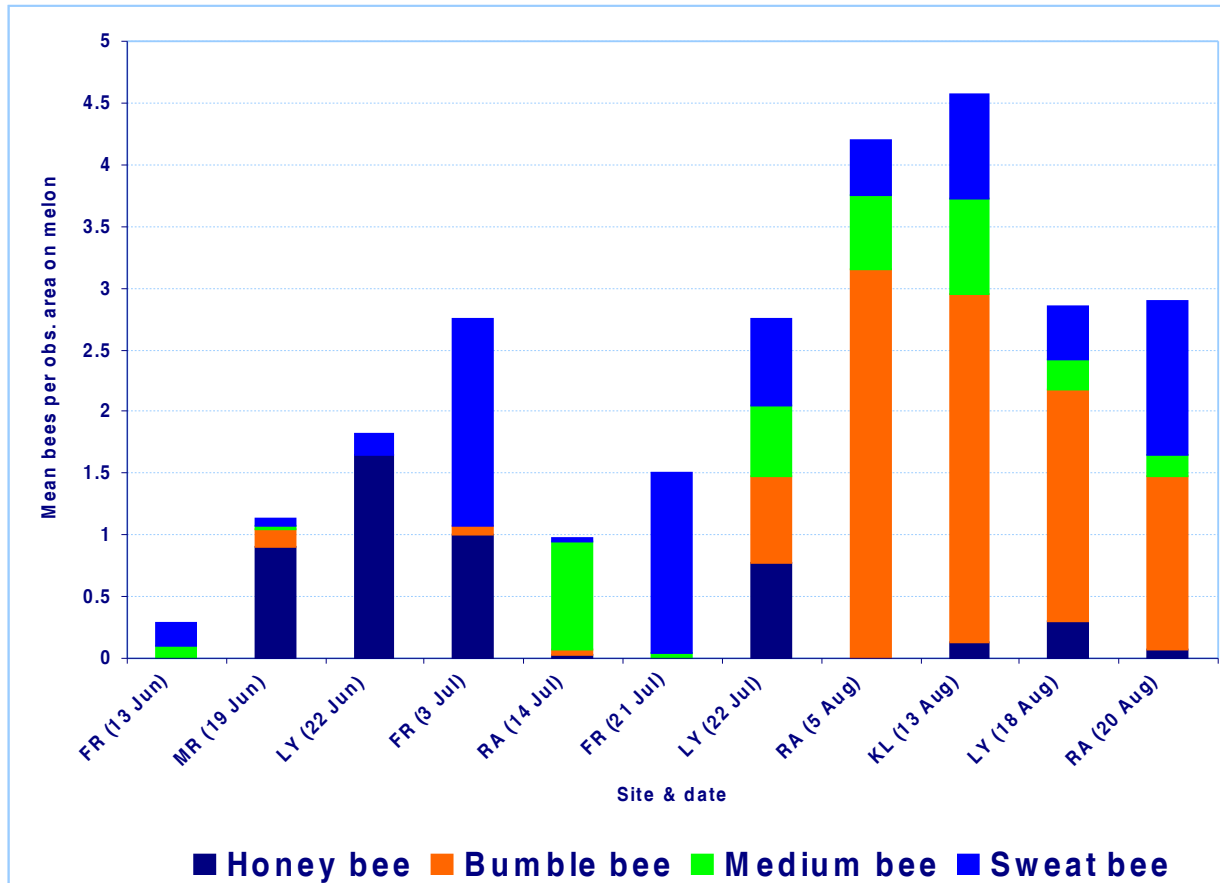
Mining bees (*Andrena* species) were the most abundant medium bees on apple and blueberry flowers

mining bees
Andrena spp.

Relative abundance of honey bees and native bees on squash flowers, summer 2008



Relative abundance of honey bees, bumble bees, medium bees, and sweat bees on melon flowers by site



sweat bee, probably *Halictus* sp. or *Lasioglossum* sp.



long horned bee, *Melissodes bimaculata*

Long horned bees (*Melissodes bimaculata*) were active from mid-July through August.

Do honey bees and native bees compete for resources?

- ⓐ **Results of research are conflicting**
 - a recent review found inadequate methodologies
- ⓐ **When results indicate displacement, it is honey bees that are the winners**
- ⓐ **Some research indicates complementary roles**
 - in sunflowers, the presence of native bees increased cross-pollination by honey bees
 - in strawberries, honey bees pollinate the lower flowers that have more nectar, while smaller native bees pollinate the upper flowers

Land and crop management practices can support both honey bee and native bee populations

② The main difference between honey bees and native bees is sociality and nesting sites

- Measure supporting native bee populations also benefit honey bees

② Ways to support bee populations

- Minimize pesticide use
 - Maintain bee-friendly lawns
- Maintain nesting and forage areas around crops by
 - Protecting or creating uncultivated areas
 - Ensuring forage availability throughout the growing season
 - Plant or protect a variety of nectar and pollen-producing plants so that something is blooming all season
 - Provide nesting areas



Analyses of honey bee pollen found 55 different kinds of pesticides (insecticides, herbicides, fungicides)

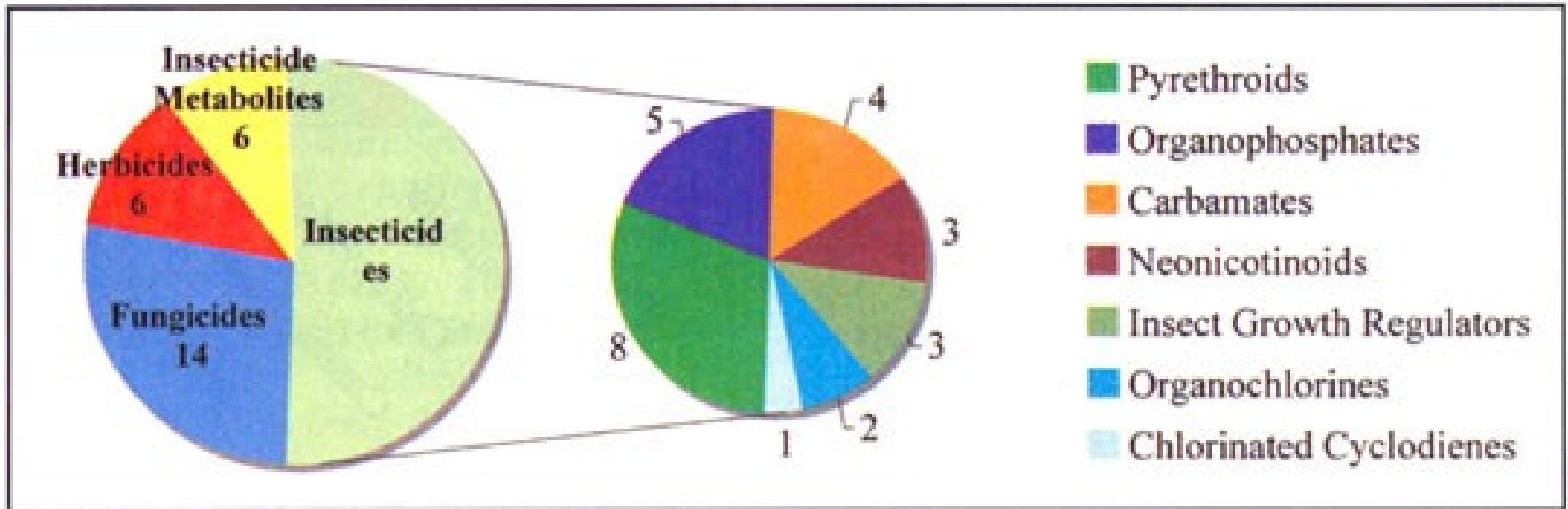


Figure 1. Pesticide class and types of compounds detected in 108 pollen samples in 2007.

Frazier, M., C. Mullin, J. Frazier, and S. Ashcraft. 2008. *What have pesticides got to do with it?* American Bee Journal (June): 521-523.

The miticides fluvalinate & coumaphos were most abundant, followed by chlorpyrifos & endosulfan

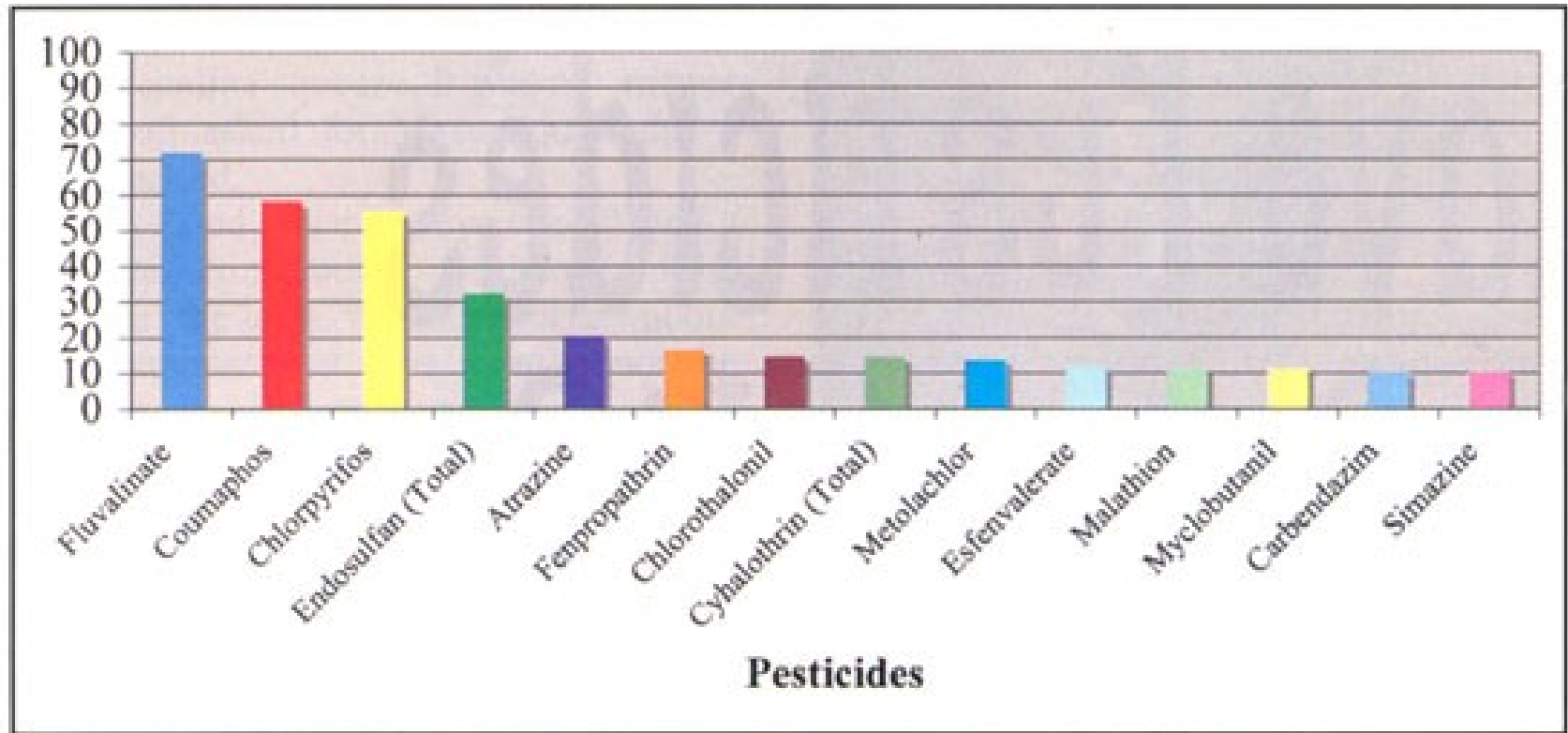


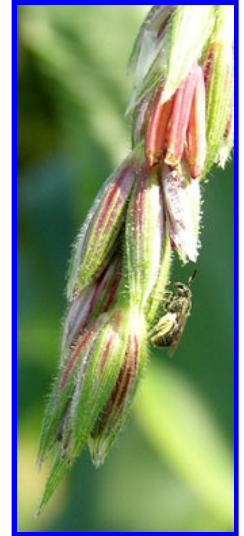
Figure 2. Most frequently detected pesticides in honey bee pollen (bee bread and trapped at entrances).

Frazier, M., C. Mullin, J. Frazier, and S. Ashcraft. 2008. *What have pesticides got to do with it?* American Bee Journal (June): 521-523.

Talk with farmers & your community--bees carry pesticides back to their nests with pollen and nectar

Ⓢ Crops like corn do not need insects for pollination, but bees collect corn pollen in the morning when it's released

- If farmers spray after 4 p.m., there's no pollen & no harm to bees



Ⓢ Weed and feed lawn products destroy good forage

- Many people advocate using old-fashioned clover as a great fertilizer & bee food



Native bees nest in the ground and in vegetation

- ① **Protect natural areas or create buffer zones to support bees**
 - **leave brushy debris unless it may harbor a pest species**
- ② **Many trees are fantastic sources of nectar and pollen**
 - **stream buffers provide some of the best habitat**
 - **willow, maple, black locust, tulip tree, wingstem, goldenrod**
- ③ **Hedgerows also support other beneficial creatures**
 - **spiders & predatory wasps**



You can provide nesting sites



Osmia larvae

① Make your own by

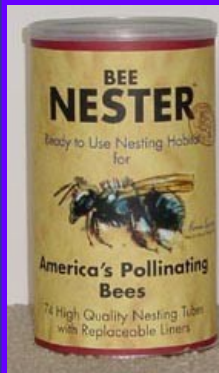
- drilling holes in large pieces of wood
- bundling reed or cane, or leaving canes standing or piled

② Let bare areas remain in your yard

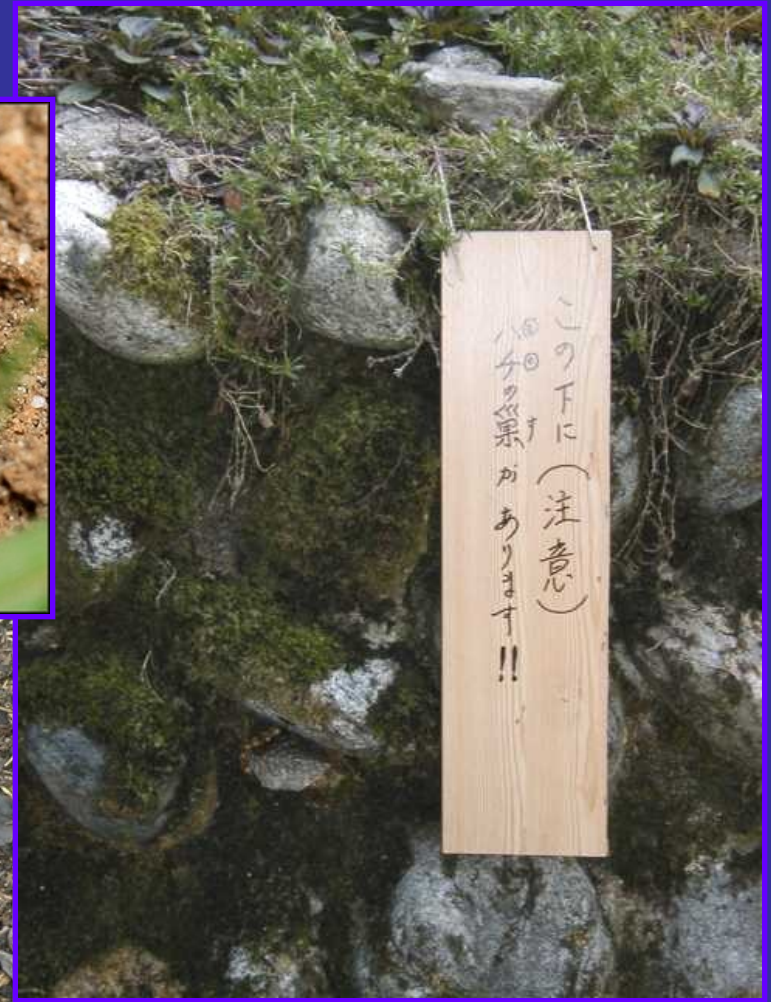
③ Buy nesting materials or larvae/pupae ready to emerge



More nest ideas *



Here are some nest entrances of ground-nesting bees



Promote diverse lawns with natural fertilizers like clover—label your yard as “pollinator friendly”

- ⓐ In Ontario, cosmetic lawn chemicals are banned
- ⓐ Avoid pollenless cultivars
 - plant pollenful sunflowers



Get to know the “other” bees



The following links are in a small hand-out-- they include info on pollinator habitat & identification

FRONT SIDE

Xerces Society: www.xerces.org

Farming for Bees: Guidelines for Providing Native Bee Habitat on Farms Using Farm Bill Programs for Pollinator Conservation

Pollinator Partnership: www.pollinator.org

Selecting Plants for Pollinators: A Regional Guide for Farmers, Land Managers, and Gardeners in the Southeastern Mixed Forest Province

North American Pollinator Protection Campaign: www.nappc.org

Reducing Risk to Pollinators from Pesticides

Bee Identification

Discover Life: www.discoverlife.org/mp/20q?search=Apoidea

USGS, Sam Droege: www.slideshare.net/sdroege/slideshows

VA, T'ai Roulston: people.virginia.edu/~thr8z/Bee_Diversity/Blandy_Bee_Diversity.php

Florida (good intro): chiron.valdosta.edu/jbpascars/Intro.htm

Bug Guide: bugguide.net

**The following links are in a small hand-out--
they include info on pollinator habitat & identification**

BACK SIDE

National Biological Information Infrastructure:

http://pollinators.nbi.gov/portal/community/Communities/Ecological_Topics/Pollinators/Pollinator_Species/Invertebrates/Bees_and_Wasps/

USDA *Sustaining Native Bee Habitat For Crop Pollination*

http://plants.usda.gov/pollinators/Agroforestry_Sustaining_Native_Bee_Habitat_for_Crop_Pollination.pdf

Virginia

VA Fruit Page: <http://www.virginiafruit.ento.vt.edu/VAFS-bees.html>

Apiculture & Social Insects at Virginia Tech:

<http://www.apiculture.ento.vt.edu/> (has a nice plant list--check back because site will include more native bee information in the future)

Virginia Native Bees: <http://virginianativebees.com/>

(Also see VA site under identification above)

Thank you!

- @ Thanks to all of you for your interest!
- @ Thanks to my advisors
 - Dr. Fell and Dr. Mullins
- @ Thanks to my committee members
 - Dr. Pfeiffer, Dr. Kennedy,
& Dr. Roulston
- @ Thanks to Virginia for supporting this project via a grant to Virginia Cooperative Extension
- @ Thanks to all the farmers who so generously give access to their farms for this research
- @ Thanks to the VT Entomology Department
- @ Thanks to Sam Droege, US Geological Survey, for teaching me to identify bees





Questions?

Thanks to those folks whose terrific photos were used (no room to squeeze in all the websites with each photo)

* by photo or web link by photo indicates photo from web--other photos by Nancy

Nest sites

[http://www.ars.usda.gov/sp2userfiles/Place/36251200/graphics/Pollinator_Osmia\(2\)SmOsmiaDomiciles.jpg](http://www.ars.usda.gov/sp2userfiles/Place/36251200/graphics/Pollinator_Osmia(2)SmOsmiaDomiciles.jpg)

<http://www.ofb.net/~frederik/japan-pictures/01-09-05-mozumi/009.bees-nest.jpg>

http://3.bp.blogspot.com/_TYDSwyPn0eY/SHD7X1GJzI/AAAAAAAAAH4/8tGL4MBMyL8/s1600-h/beenest.jpg

<http://ucanr.org/blogs/bugsqquad/blogfiles/1474.jpg>

<http://www.ars.usda.gov/Research/docs.htm?docid=18333>

http://en.wikipedia.org/wiki/Orchard_mason_bee

<http://www.meticulum.com/beehouse.jpg>

<http://lamb-abbey.livejournal.com/>

<http://gage.unl.edu/ag/BeeBoxes.htm#plans>

<http://www.knoxcellars.com>

<http://www.homesteadingwithozarkguy.com/cooking/beehouse.htm>

<http://www.maes.msu.edu/nwmihort/nestingmaterials.pdf>

<http://www.beetberry.com/BeetberryBees.html>

<http://www.cometpc.btinternet.co.uk/btpage11.htm>

Apologies to any I have
inadvertently missed.
Please write to me at
adamson@vt.edu to let
me know.

Bumble bee observation colony

<http://resonatingbodies.wordpress.com/art/bumble-domicile/bumble-domicile/>

Schoolyard habitat

<http://www.fws.gov/chesapeakebay/schoolyd.html>