PROTECTING MICHIGAN POLLINATORS

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OCTOBER, 2016
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IN THE BEGINNING…..

500 million years ago

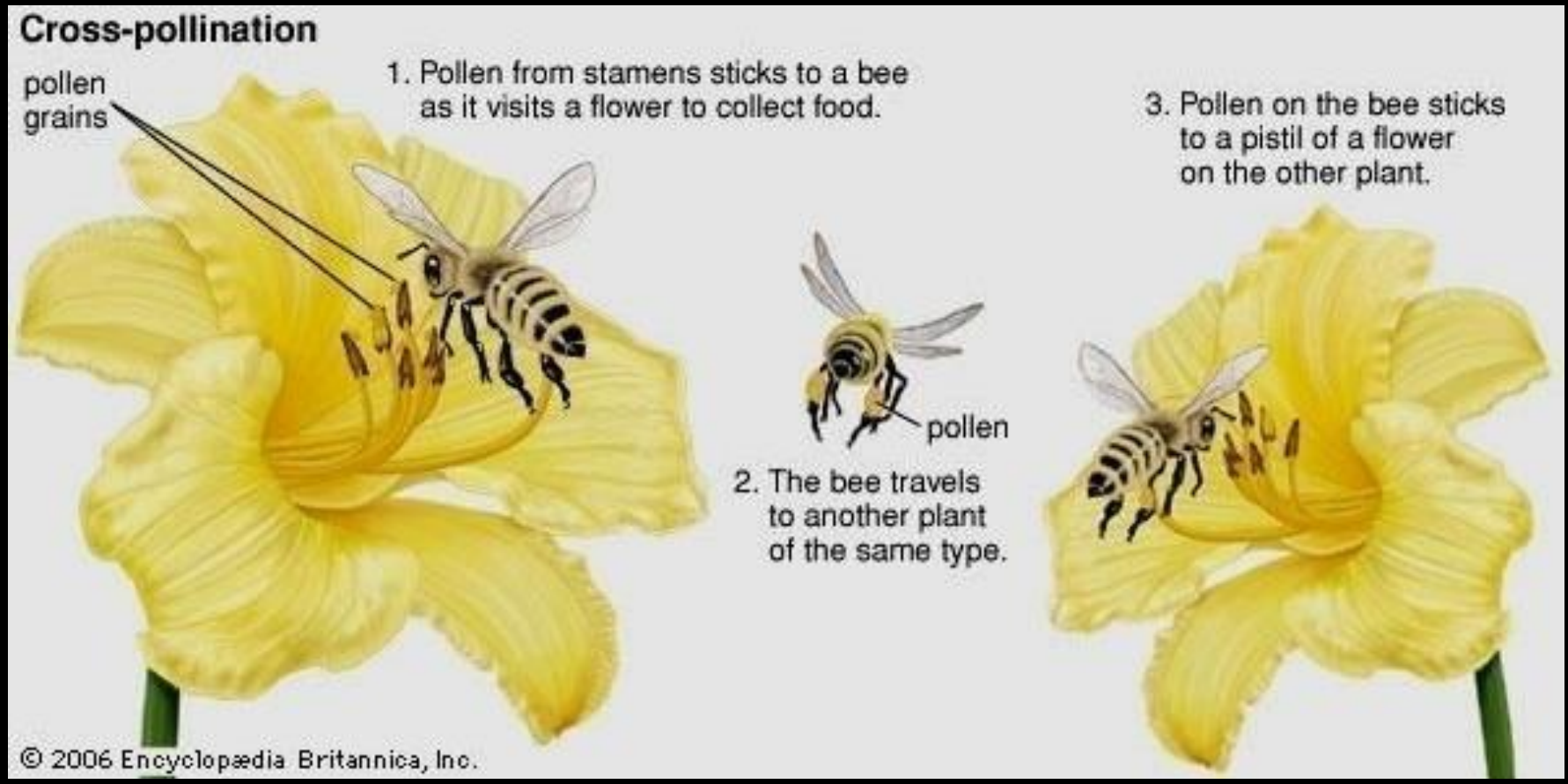
First Insects

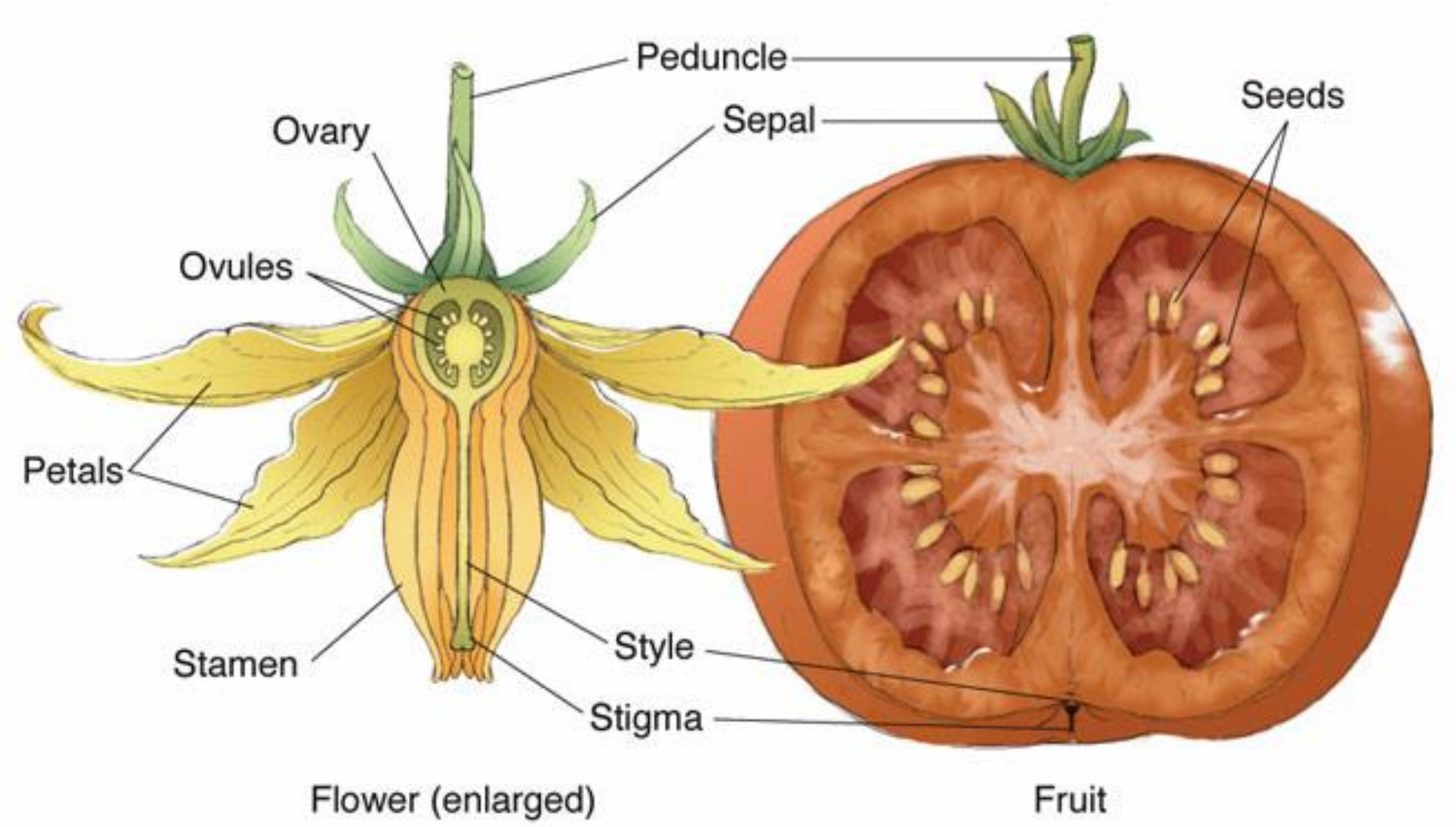
Also first Plants

400 million years ago

First *Flying* Insects

Also first *Flowering* plants


Cross-pollination
pollen grains
1. Pollen from stamens sticks to a bee as it visits a flower to collect food.
pollen
2. The bee travels to another plant of the same type.
3. Pollen on the bee sticks to a pistil of a flower on the other plant.
© 2006 Encyclopædia Britannica, Inc.


Peduncle
Sepal
Ovary
Ovules
Petals
Stamen
Style
Stigma
Seeds
Flower (enlarged)
Fruit

Apples
Onions
Avocados
Carrots
Mangos
Lemons
Limes

OVER 80% OF FLOWERING PLANTS REQUIRE POLLINATORS TO PRODUCE SEEDS AND FRUIT.

Cauliflower
Leeks
Bok choy
Kale
Broccoli
Broccoli rabe
Mustard greens

http://media.wholefoodsmarket.com/news/bees#sthash.kNAxM2wg.dpuf

1. Good horticultural practices
2. Preventing diseases
3. Managing pests

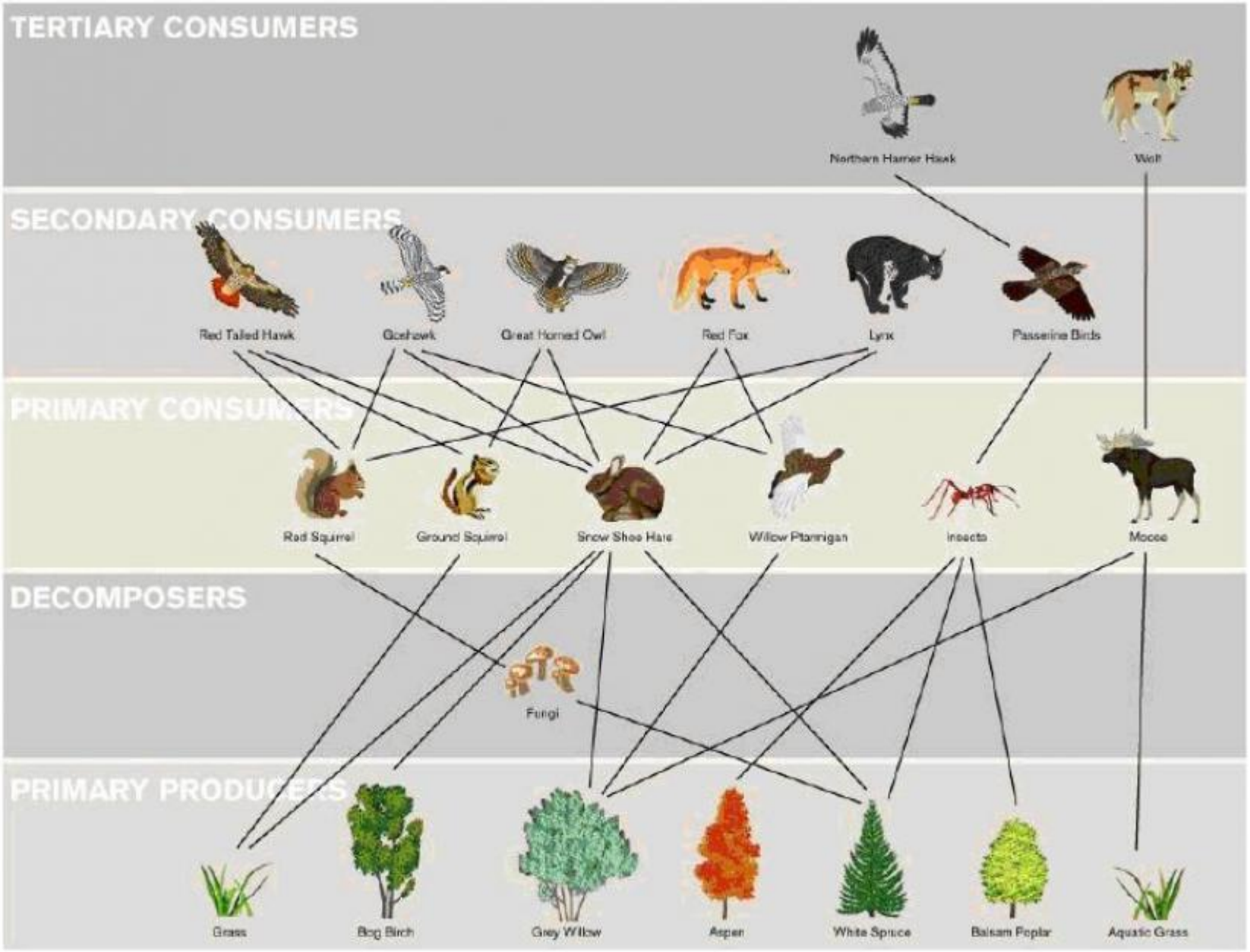
4. Adequate pollination

WELL POLLINATED

POORLY POLLINATED

It's not just food.

We need pollinators for plant diversity and ecosystem function.


TERTIARY CONSUMERS
Northern Harrier Hawk
Wolf
SECONDARY CONSUMERS
Red Tailed Hawk
Goshawk
Great Horned Owl
Red Fox
Lynx
Passerine Birds
PRIMARY CONSUMERS
Red Squirrel
Ground Squirrel
Snow Shoe Hare
Willow Ptarmigan
Insects
Moose
DECOMPOSERS
Fungi
PRIMARY PRODUCERS
Grass
Bog Birch
Grey Willow
Aspen
White Spruce
Balsam Poplar
Aquatic Grass

Who are our pollinators?

Apis mellifera = Western Honey Bee

Over 20,000 species of bees in the world

Around 450 species recorded in Michigan

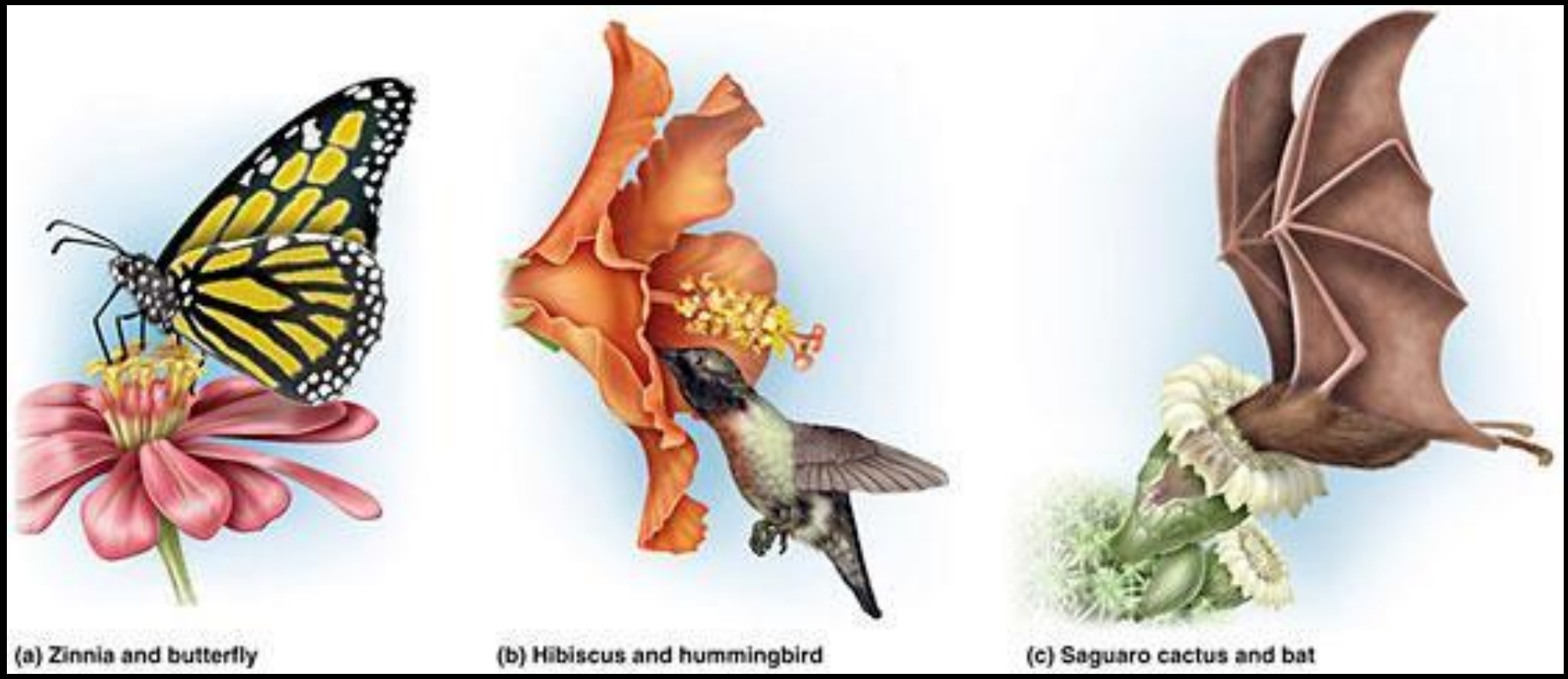

♀ Ceriana vespiformis
♀ Chrysotoxum intermedium
♀ Sessyrphus albostriatus
♀ Episyrphus balteatus
♂ Eristalinus taeniops
♀ Eristalis arbustorum
♂ Eristalis tenax
♂ Eupeodes corolla
♀ Eupeodes luniger
♀ Meliscaeva auricollis
♀ Scaeva pyrastri
♂ Sphaerophoria scripta
♀ Syritta pipiens
♀ Syrphus ribesii
♀ Volucella zonaria
♂ Xanthogramma pedissequum











Moths, beetles, wasps, flies, ants….

Some pollinators have specific relationships

SCIENTIFIC REPORTS

Altmetric: 18 Views: 9,314 Citations: 2 More detail »

Article | OPEN

Fine-tuned Bee-Flower Coevolutionary State Hidden within Multiple Pollination Interactions

Akira Shimizu, Ikumi Dohzono, Masayoshi Nakaji, Derek A. Roff, Donald G. Miller III, Sara Osato, Takuya Yajima, Shûhei Niitsu, Nozomu Utsugi, Takashi Sugawara & Jin Yoshimura

Scientific Reports **4**, Article number: 3988

Received: 23 July 2013

Other plants do better when pollinated by multiple species

December, 1942

"Wherever a proper balance exists between plants and pollinating insects, both flourish. Agricultural development, however, has seriously interfered with this balance. It has demanded the growing of certain plants in enormous acreages and has unwittingly destroyed native pollinating insects as well as their nesting places. As a result the burden of pollination has been increased to such an extent that wild bees are no longer adequate or dependable, particularly where agriculture is highly developed. In many places the depletion of wild pollinators is so acute that honeybees have to be brought in especially for pollination, and so in practically all agricultural areas honeybees are now the most numerous of the flower-visiting insects.“

United States Department of Agriculture Agricultural Research Administration Bureau of Entomology and Plant Quarantine THE DEPENDENCE OF AGRICULTURE ON THE BEEKEEPING INDUSTRY—A REVIEW

California's Central Valley has 1,000,000 acres of almond trees

Pollination requires 1.6 - 2 million hives

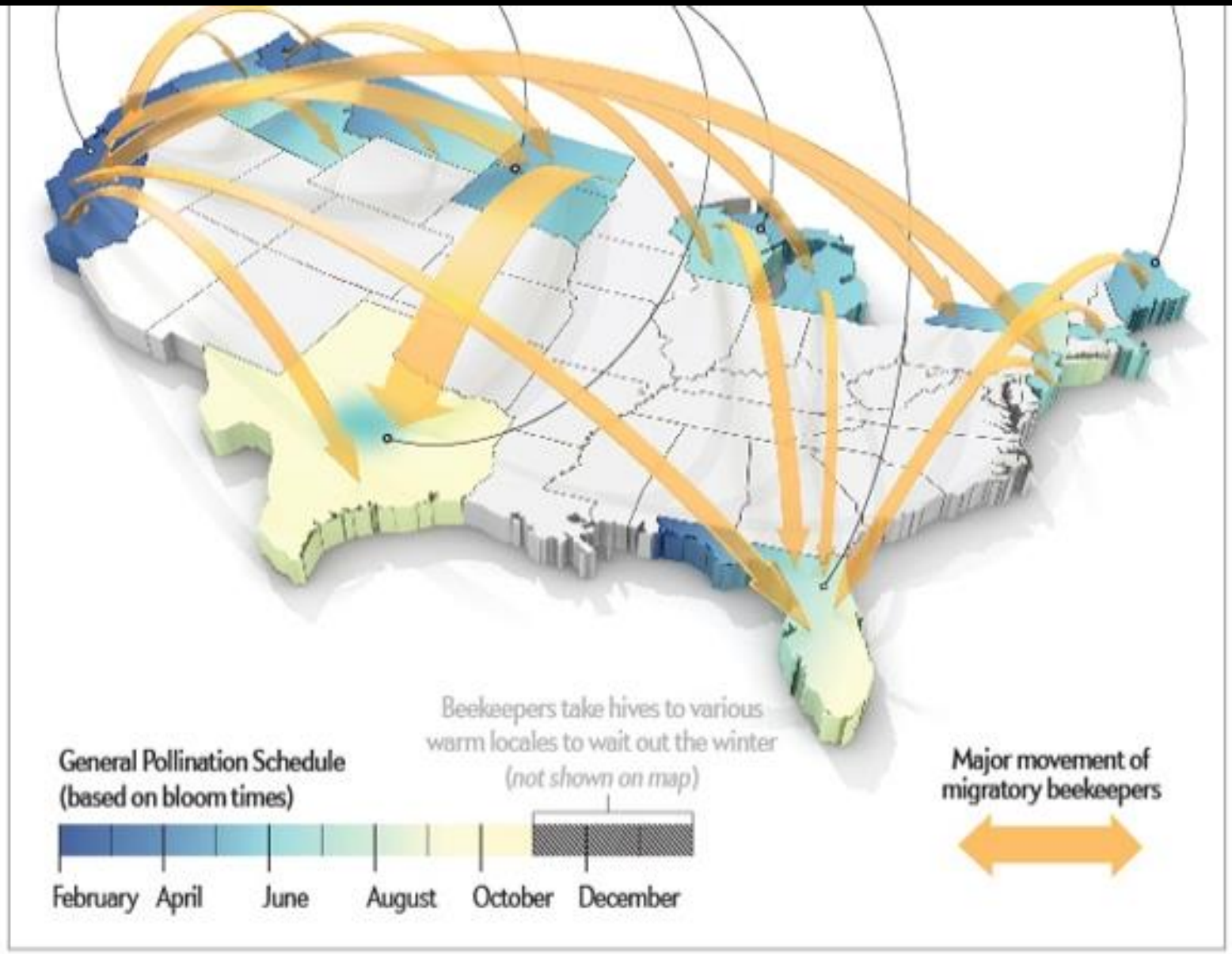
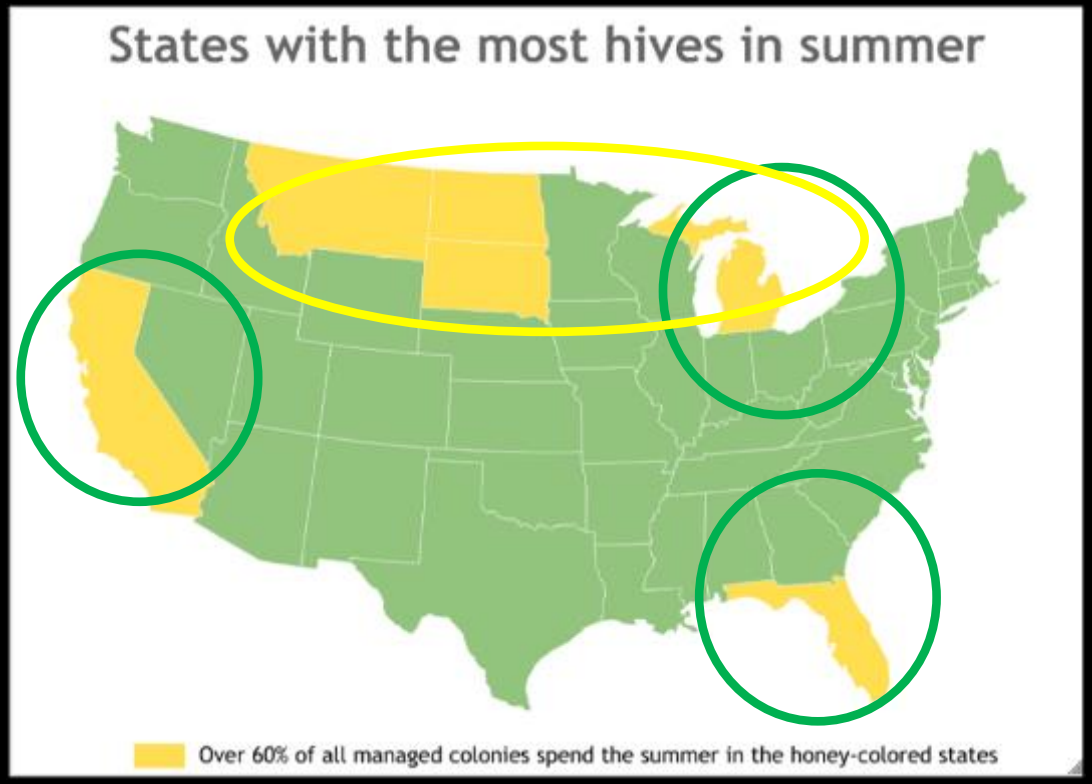


Illustration by Bryan Christie, for SCIENTIFIC AMERICAN

Michigan's Unique situation



NO POLLINATORS = NO FLOWERING PLANTS

NO FLOWERING PLANTS = LOSS OF FOOD AND ECOSYSTEMS

WHAT IS HAPPENING TO THE BEES?

HONEY BEE COLONY LOSS ESTIMATES

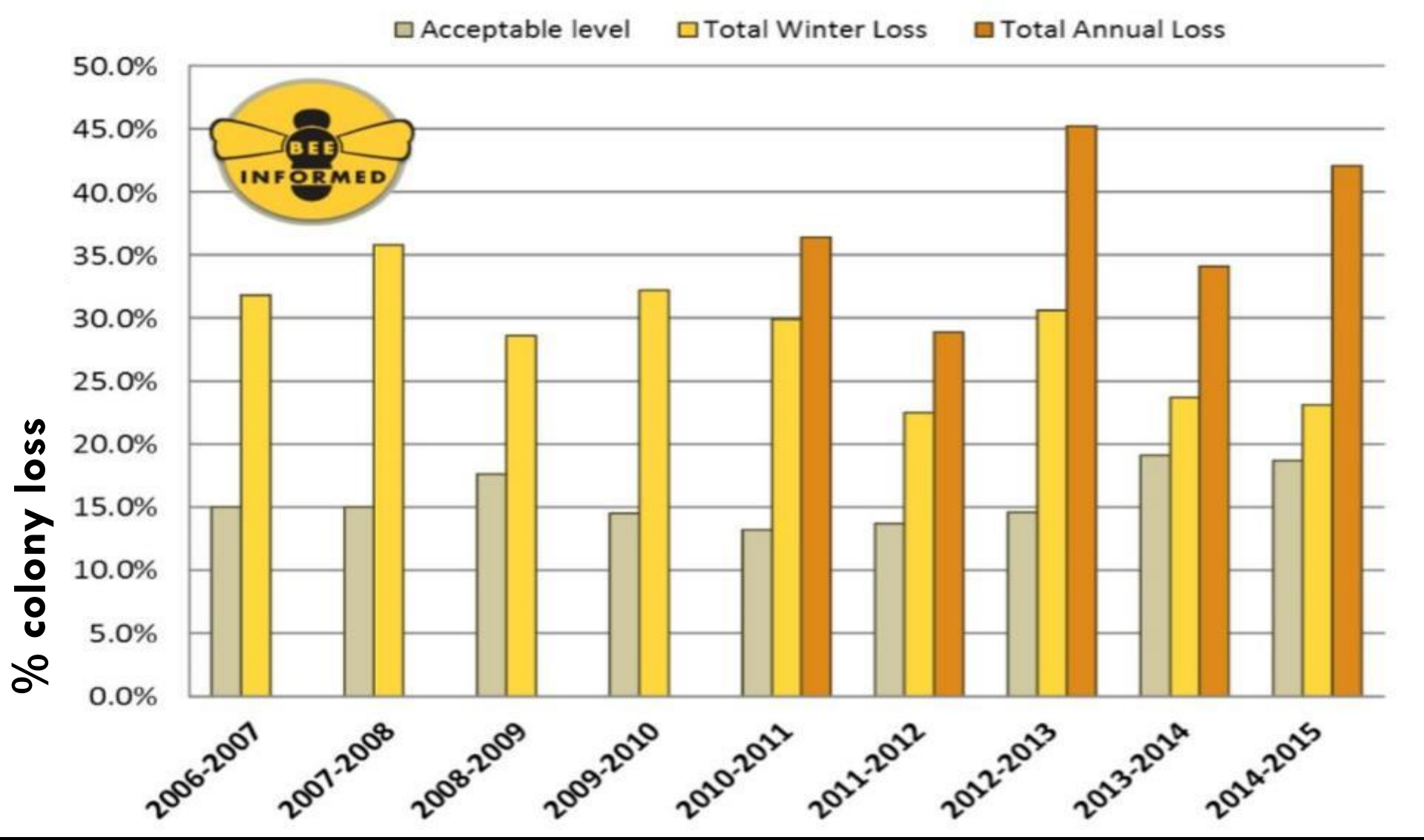
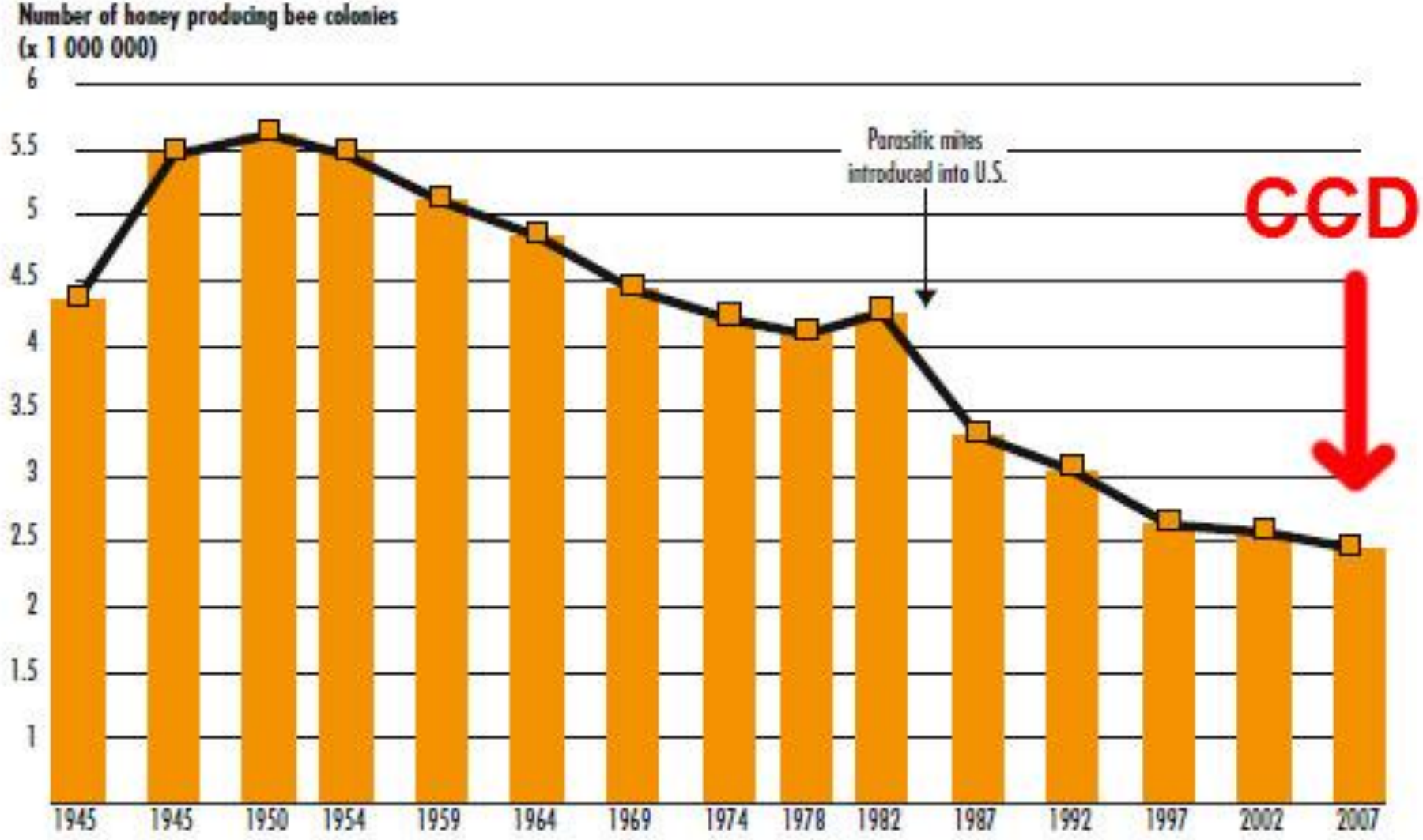
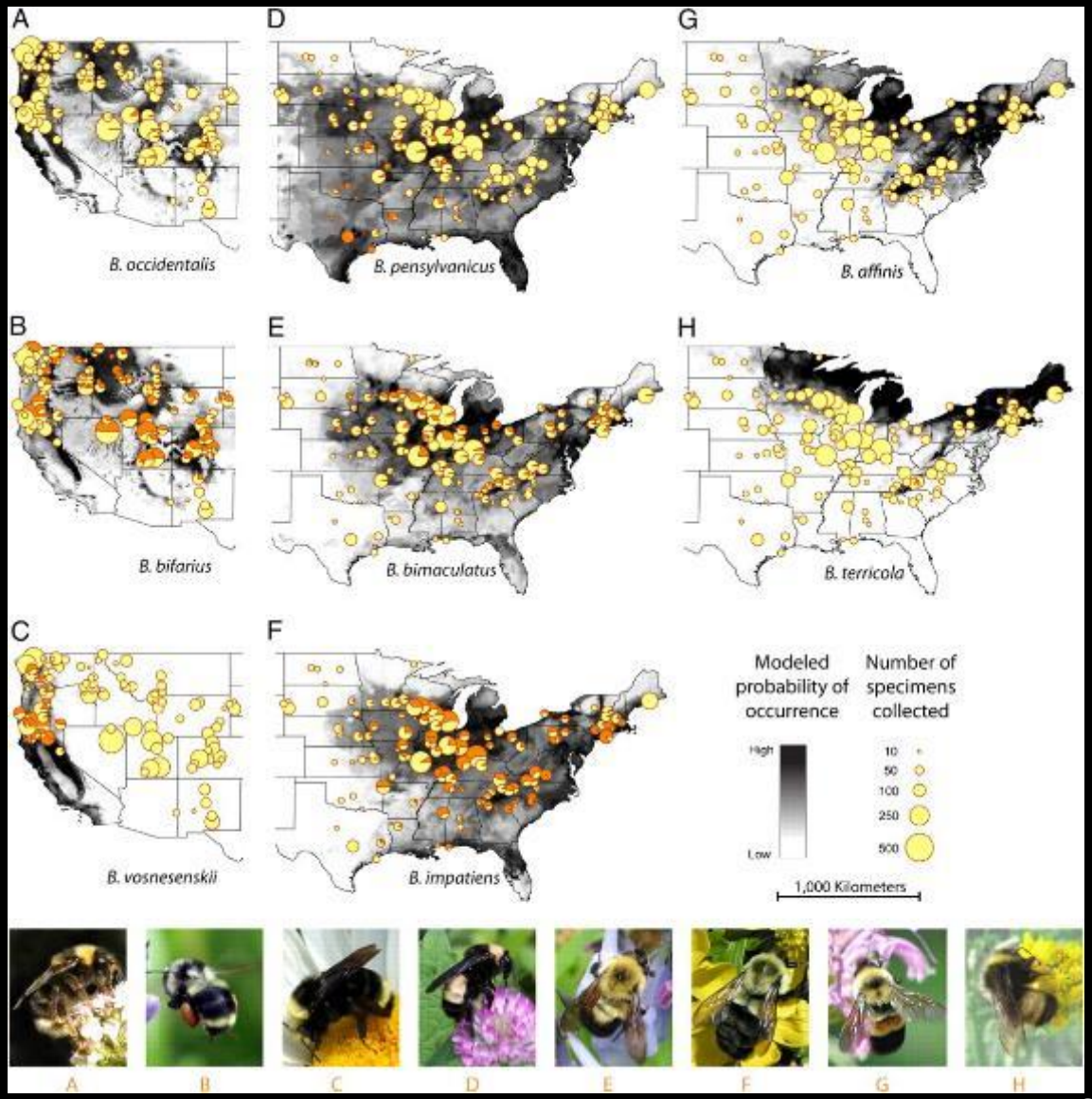


Figure 4: US honey-producing colonies



Data source: U.S. Department of Agriculture's (USDA) National Agricultural Statistics Service (NASS) NB: Data collected for producers with 5 or more colonies. Honey producing colonies are the maximum number of colonies from which honey was taken during the year. It is possible to take honey from colonies which did not survive the entire year.

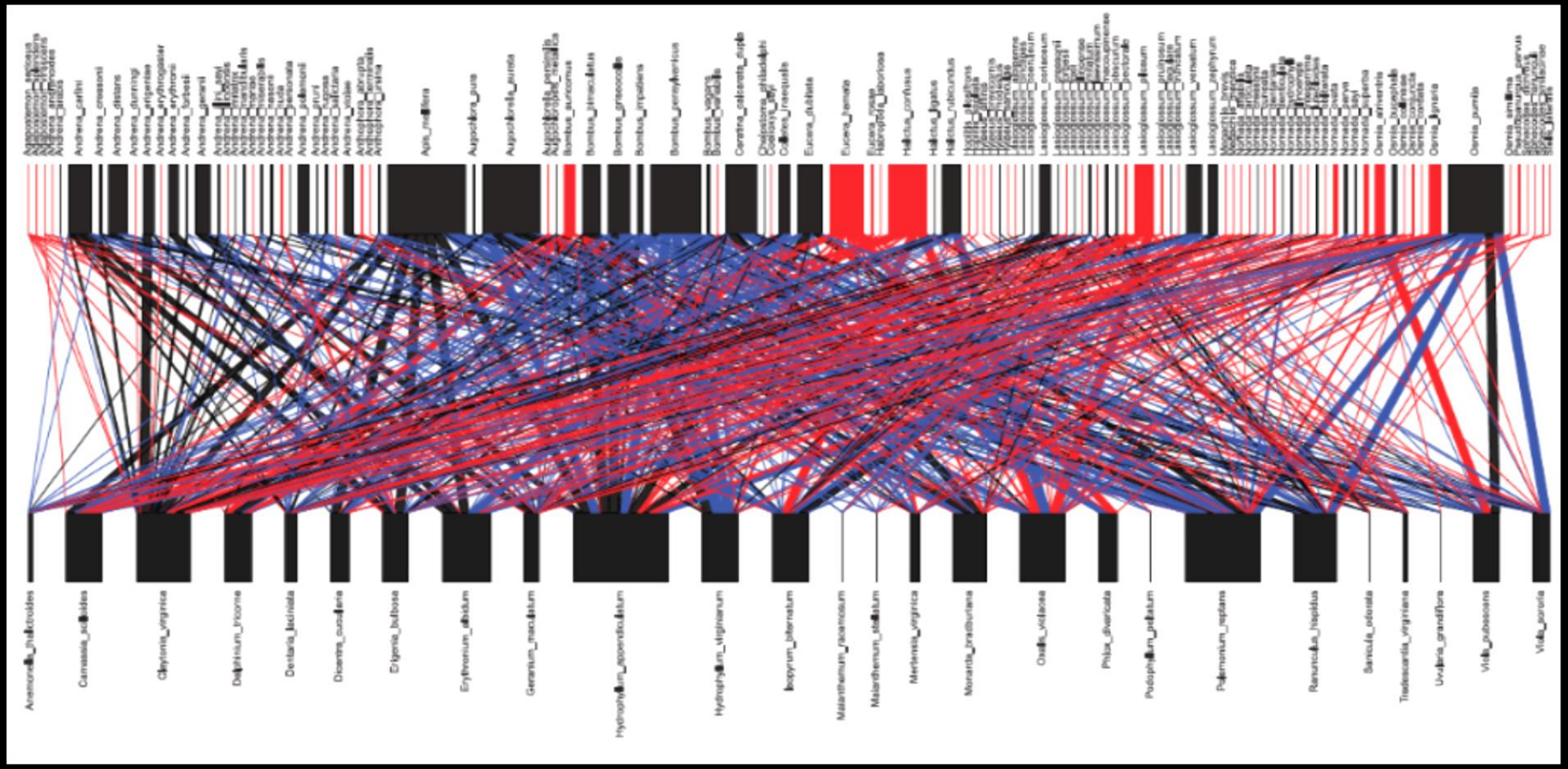
DECLINES IN RELATIVE ABUNDANCE – 4 species by 96 percent.



Cameron et al (2011) *PNAS*

LOSS OF PLANT-POLLINATOR INTERACTIONS

Bee species (n = 109)



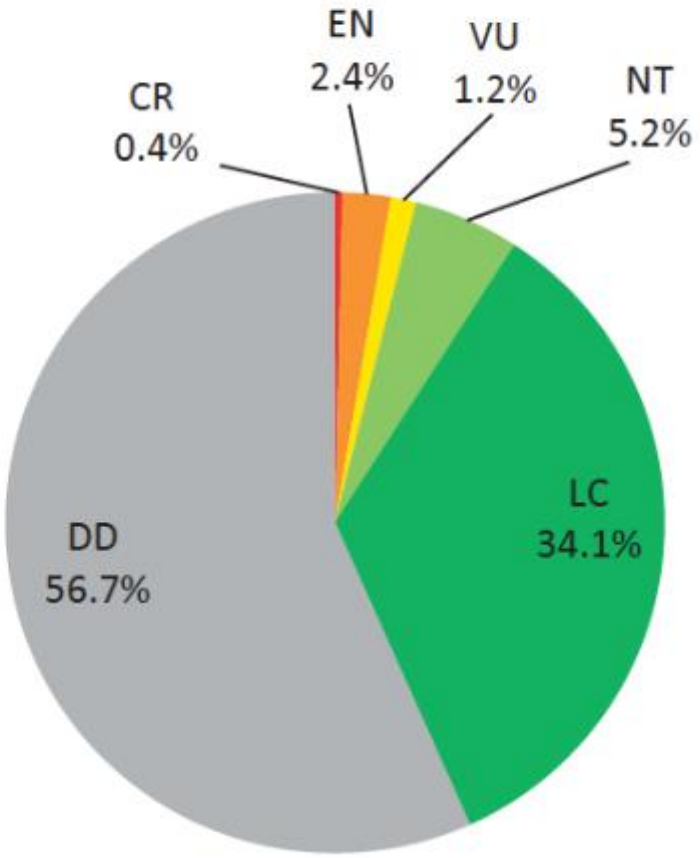
Plant (forb) species (n = 26)

Only 24% (125/532) of the interactions recorded by Robertson in late 1800s were still found in 2009-2010 (black lines) in Carlinville, Illinois

Burkle et al (2013) Science 339: 1611-1615

Conservation status of most species unknown

Figure 3. IUCN Red List status of bees in Europe.



4% at risk of extinction

Critically endangered (CR),

Endangered (EN),

Vulnerable (VU)

Not Threatened (NT)

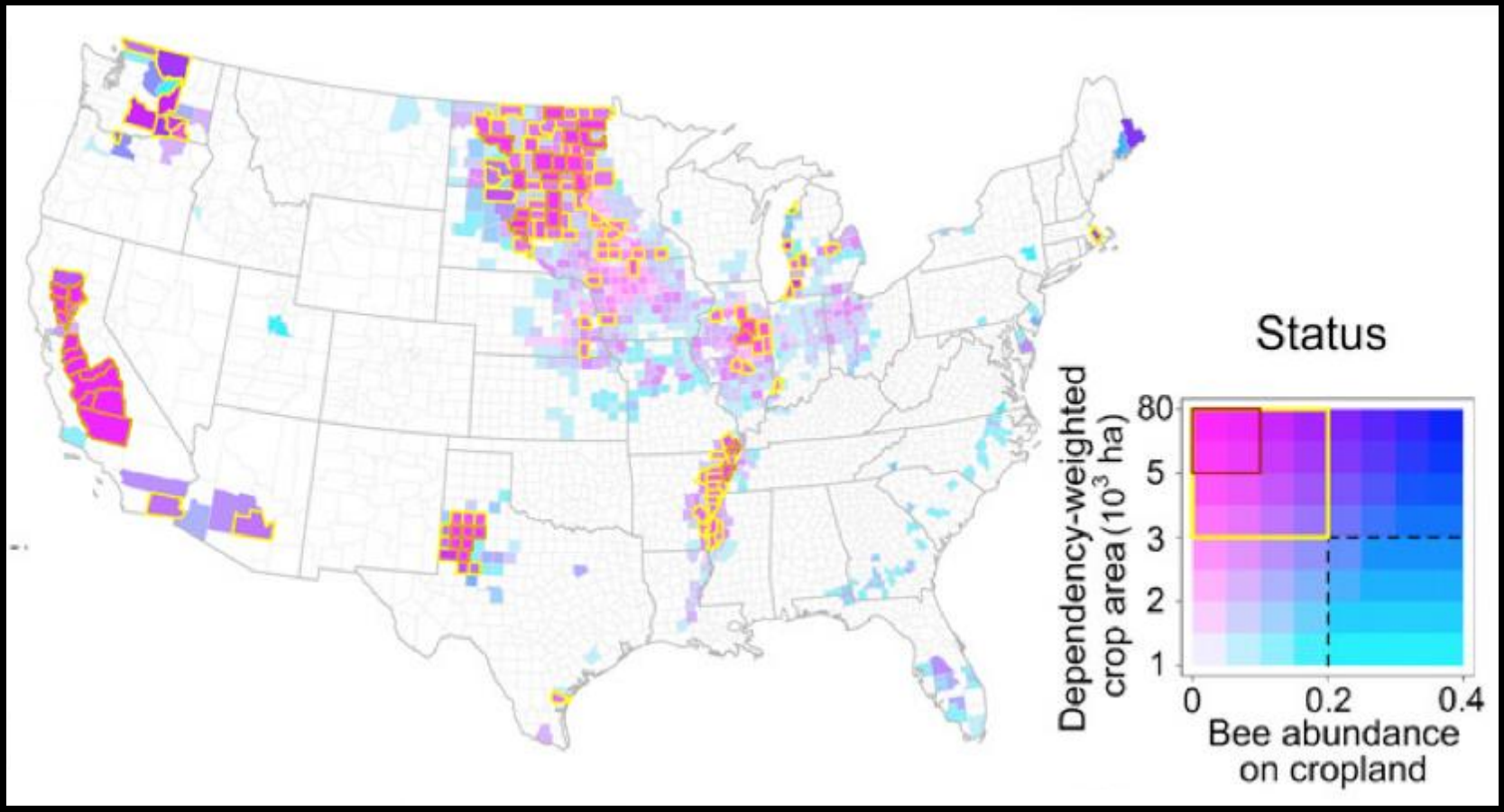
Least concern (LC)

Data deficient (DD)

More than half (1101/1942) of European bee species could not be assessed – issue likely to be more severe in N. America

Nieto et al (2014) European Red List of Bees. Publication Office of the European Union

DECLINES LEAD TO POLLINATION DEFICITS

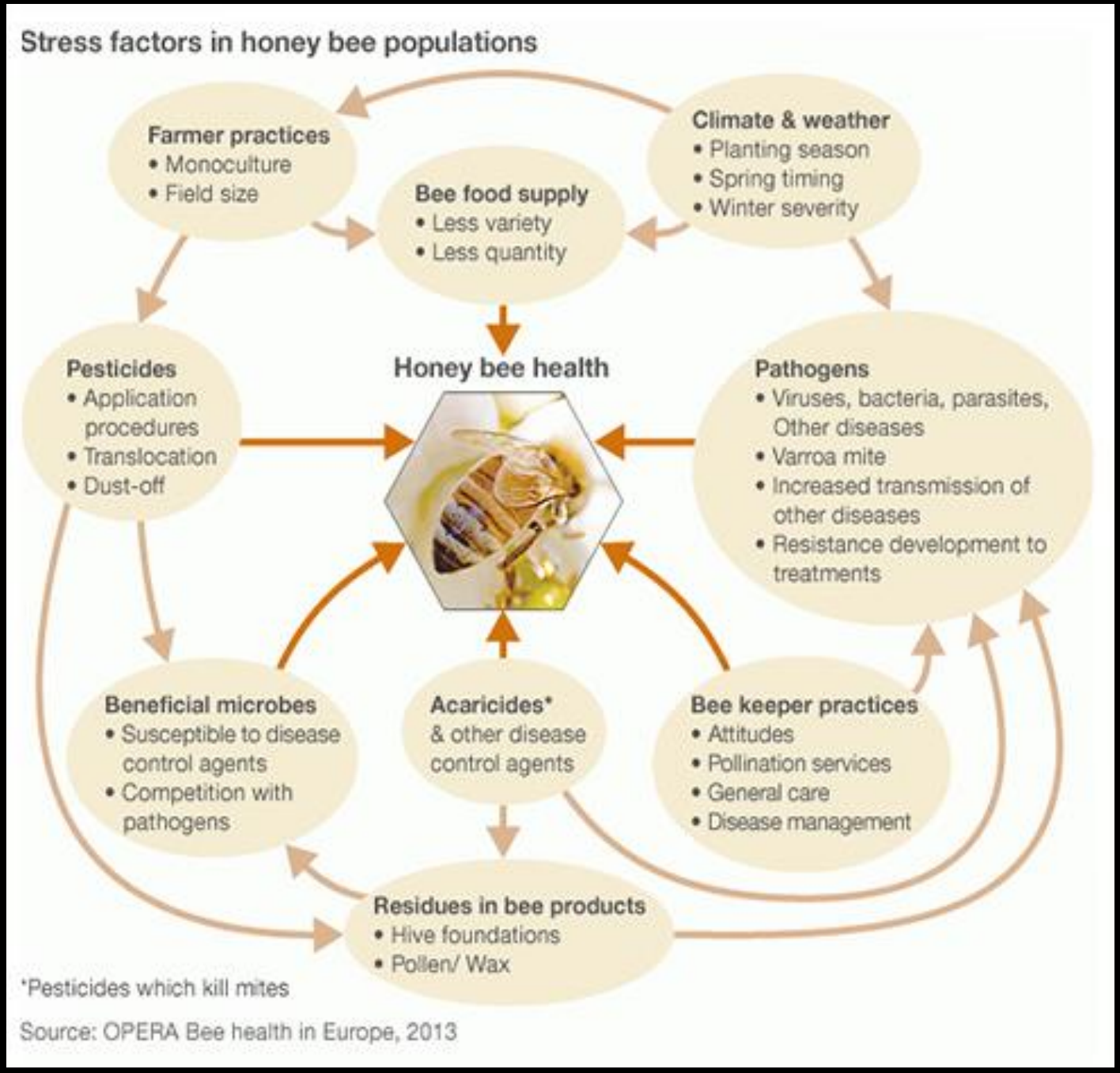


Bee abundance estimates declined across 23% of US land area from 2008-2013

Significant mismatch between wild bee abundance and need for crop pollinators

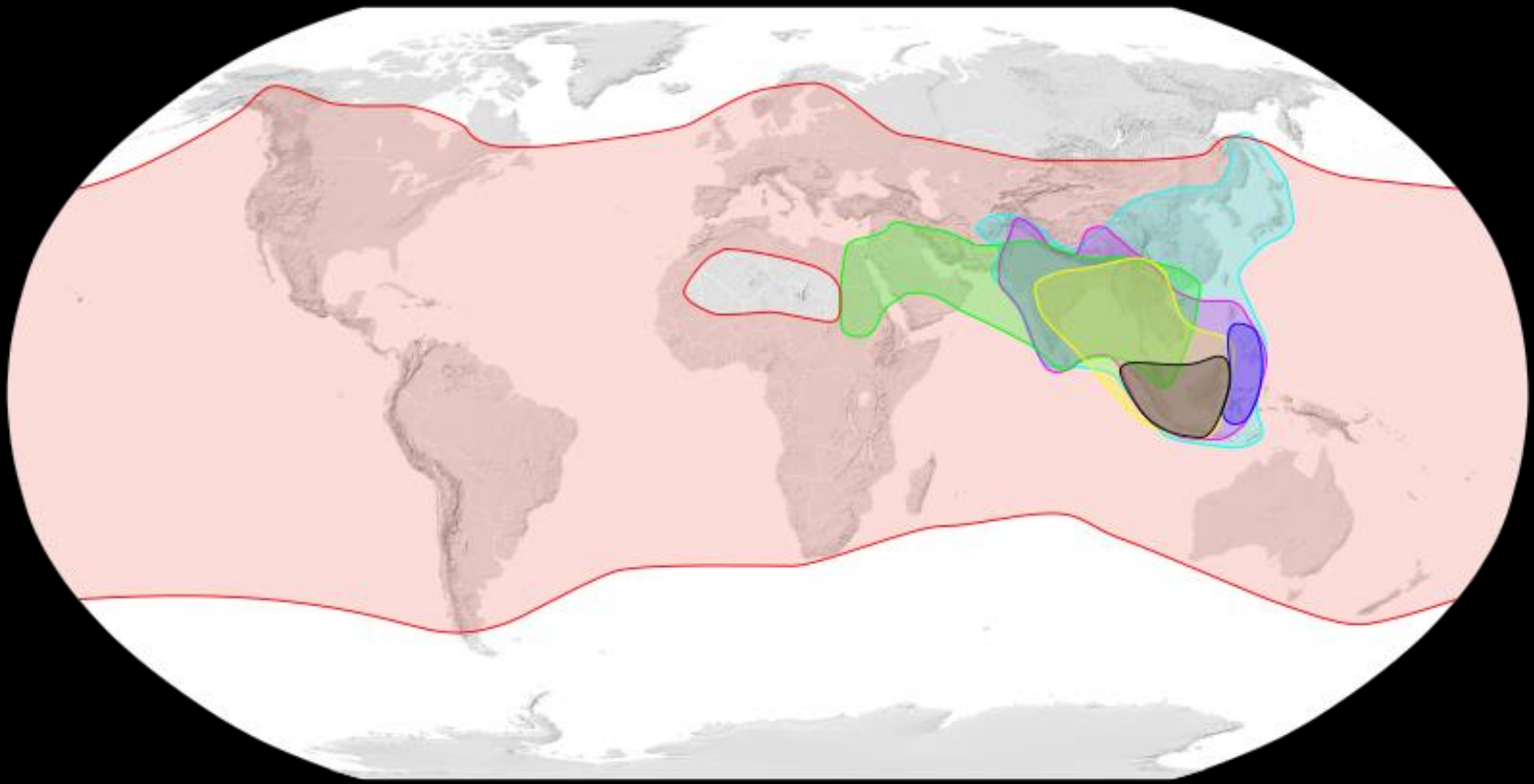
Koh et al (2016) PNAS 113: 140–145

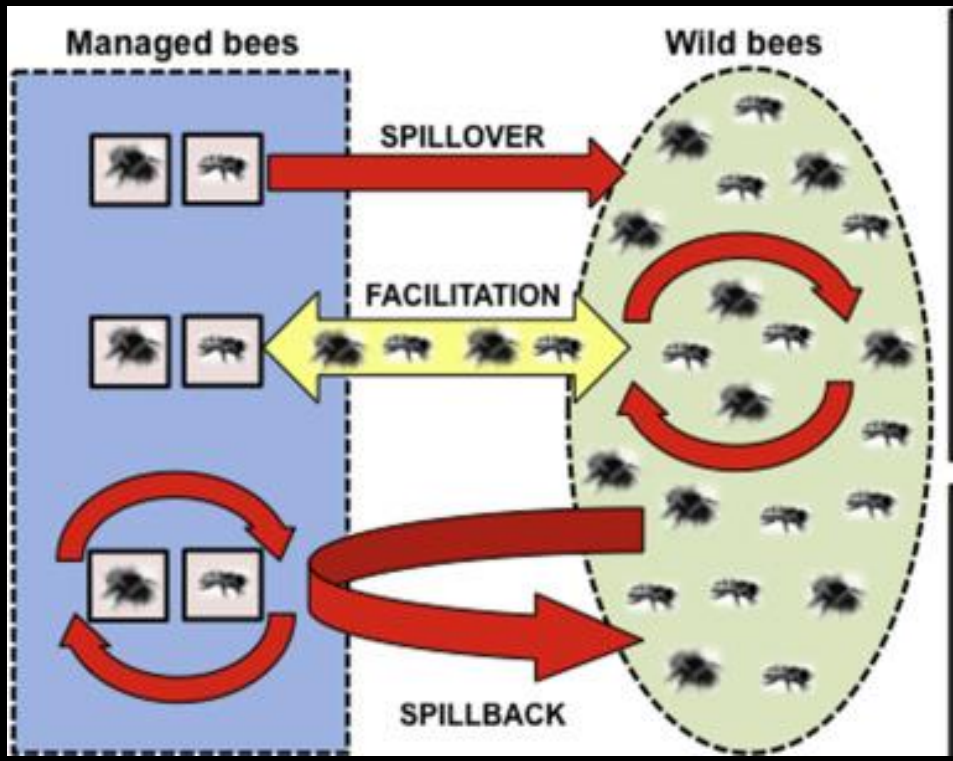
Stress factors in honey bee populations



Source: OPERA Bee health in Europe, 2013

EMERGING INFECTIOUS DISEASES





Do managed bees drive parasite spread and emergence in wild bees?

Peter Graystock, Edward J. Blane, Quinn S. McFrederick, Dave Goulson, William OH. Hughes
International Journal for Parasitology: Parasites and Wildlife, 2015, Available online 28 October 2015

http://dx.doi.org/10.1016/j.ijppaw.2015.10.001

Varroa have been reported on bumble bees and other insects, and feeding on their larvae.

Allan Jones (Davis)

PESTICIDES

ACUTE ‘BEE KILLS’

Less toxic pesticides can be more damaging to a colony –if it doesn't kill a worker, they bring it home.

most of the products have not been tested to determine what effects occur with ***prolonged exposure*** ***to subacute dosages*** *of contaminated pollen being consumed in the hive…*

Eric Mussen, UC Entomologist/Apiculturist

When a solitary bee is killed, so Are all of the future offspring

SUBLETHAL IMPACTS ON BEHAVIOR AND POLLINATION

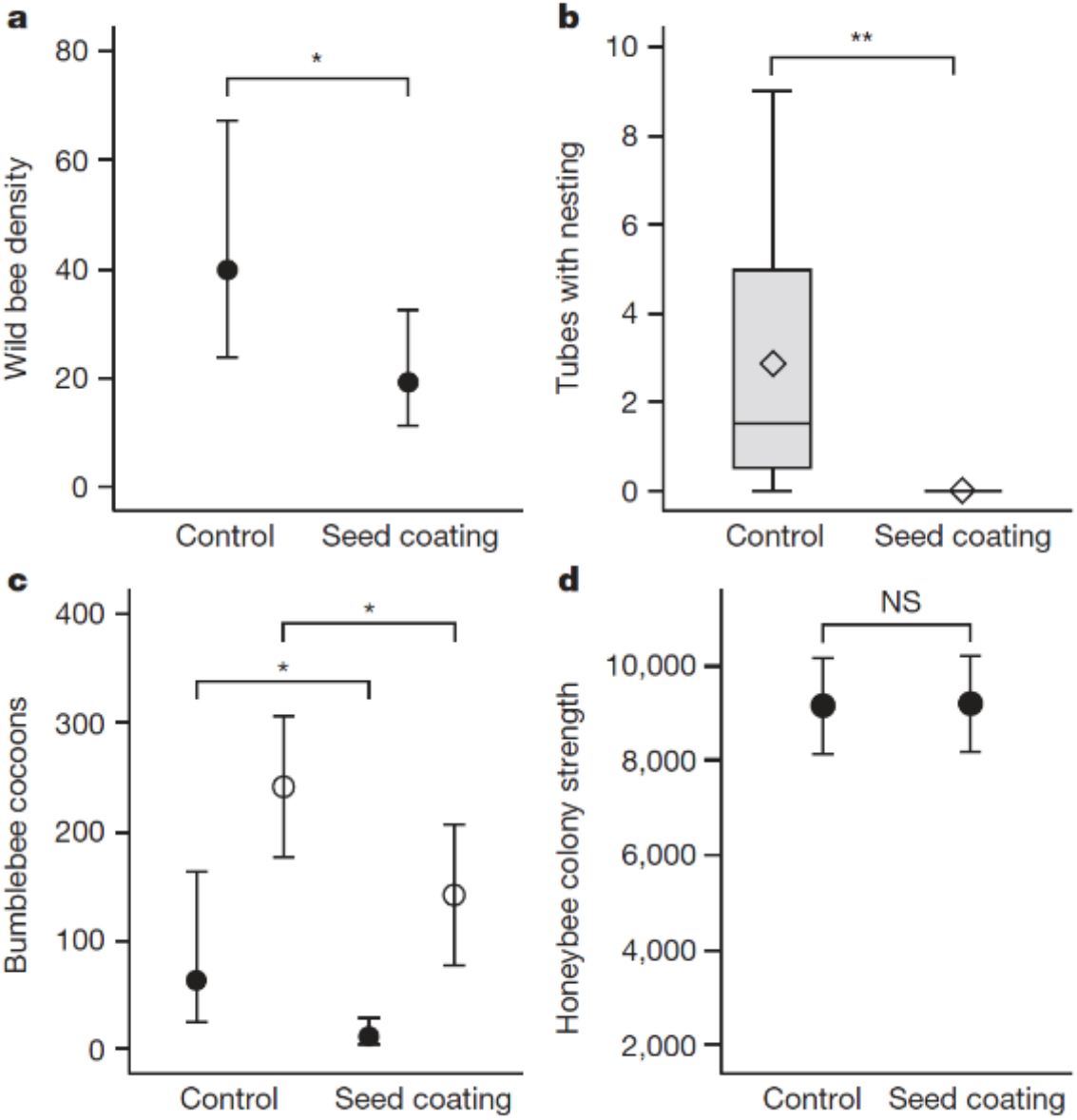
PESTICIDE IMPACTS IN THE FIELD

Wild bees

Bombus terrestris

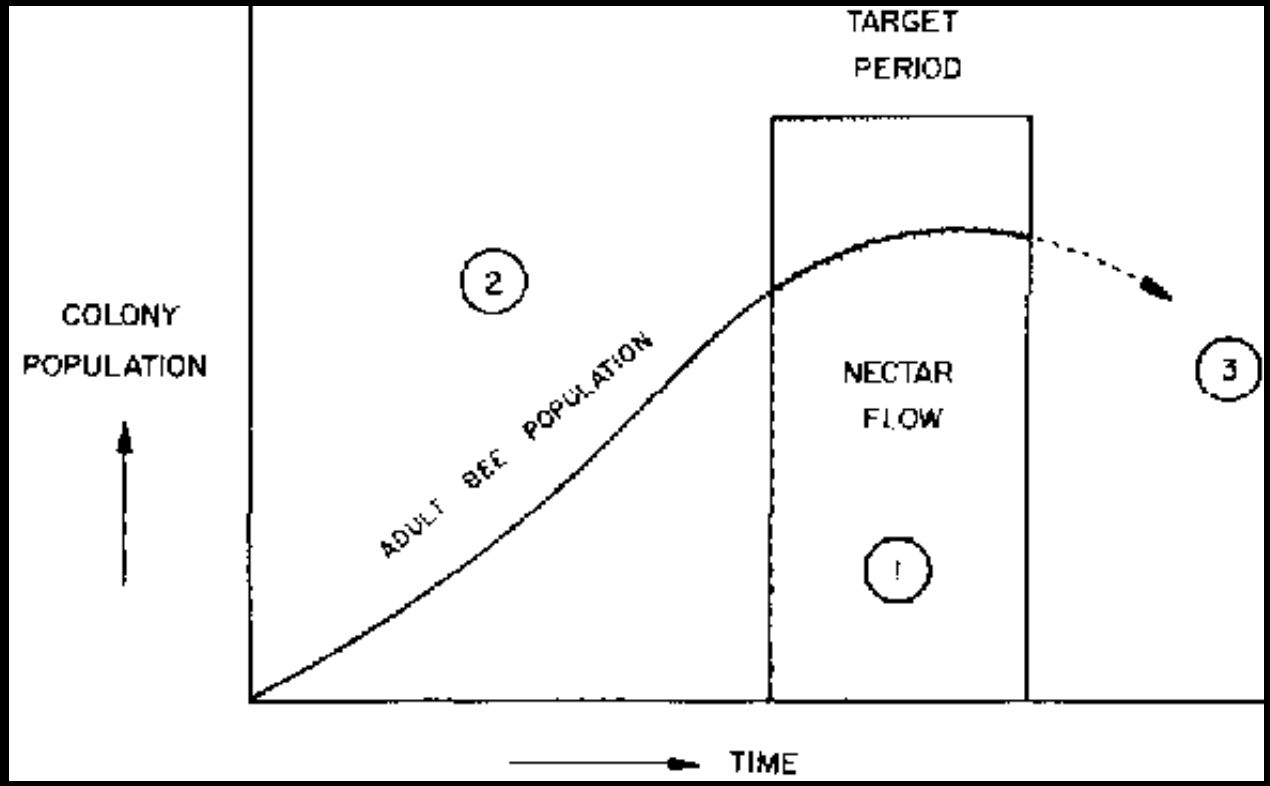
Osmia bicornis

Apis mellifera



Rundlöf et al (2015) *Nature* 521: 77–

Colony Build up



Bee Labeling

PROTECTION OF POLLINATORS

APPLICATION RESTRICTIONS EXIST FOR THIS PRODUCT BECAUSE OF RISK TO BEES AND OTHER INSECT POLLINATORS. FOLLOW APPLICATION RESTRICTIONS FOUND IN THE DIRECTIONS FOR USE TO PROTECT POLLINATORS.

Look for the bee hazard icon in the Directions for Use for each application site for specific use restrictions and instructions to protect bees and other insect pollinators.

This product can kill bees and other insect pollinators.

Bees and other insect pollinators will forage on plants when they flower, shed pollen, or produce nectar.

Bees and other insect pollinators can be exposed to this pesticide from:

- Direct contact during foliar applications, or contact with residues on plant surfaces after foliar applications
- Ingestion of residues in nectar and pollen when the pesticide is applied as a seed treatment, soil, tree injection, as well as foliar applications.

When Using This Product Take Steps To:

- Minimize exposure of this product to bees and other insect pollinators when they are foraging on pollinator attractive plants around the application site.
- Minimize drift of this product on to beehives or to off-site pollinator attractive habitat. Drift of this product onto beehives can result in bee kills.

Information on protecting bees and other insect pollinators may be found at the Pesticide Environmental Stewardship website at:
http://pesticidestewardship.org/pollinatorprotection/Pages/default.aspx

Pesticide incidents (for example, bee kills) should immediately be reported to the state/tribal lead agency. For contact information for your state/tribe, go to: www.aapco.org. Pesticide incidents can also be reported to the National Pesticide Information Center at: www.npic.orst.edu or directly to EPA at: beekill@epa.gov

Alerts users to separate restrictions on the label. These prohibit certain pesticide use when bees are present.

The new bee icon helps signal the pesticide's potential hazard to bees.

Makes clear that pesticide products can kill bees and pollinators.

Bees are often present and foraging when plants and trees flower. EPA's new label makes it clear that pesticides cannot be applied until all petals have fallen.

Warns users that direct contact and ingestion could harm pollinators. EPA is working with beekeepers, growers, pesticide companies, and others to advance pesticide management practices.

Highlights the importance of avoiding drift. Sometimes, wind can cause pesticides to drift to new areas and can cause bee kills.

The science says that there are many causes for a decline in pollinator health, including pesticide exposure. EPA's new label will help protect pollinators.

EPA

What does it mean to be 'Bee Safe'?

Most chemicals are tested for **acute toxicity** of direct contact in adults

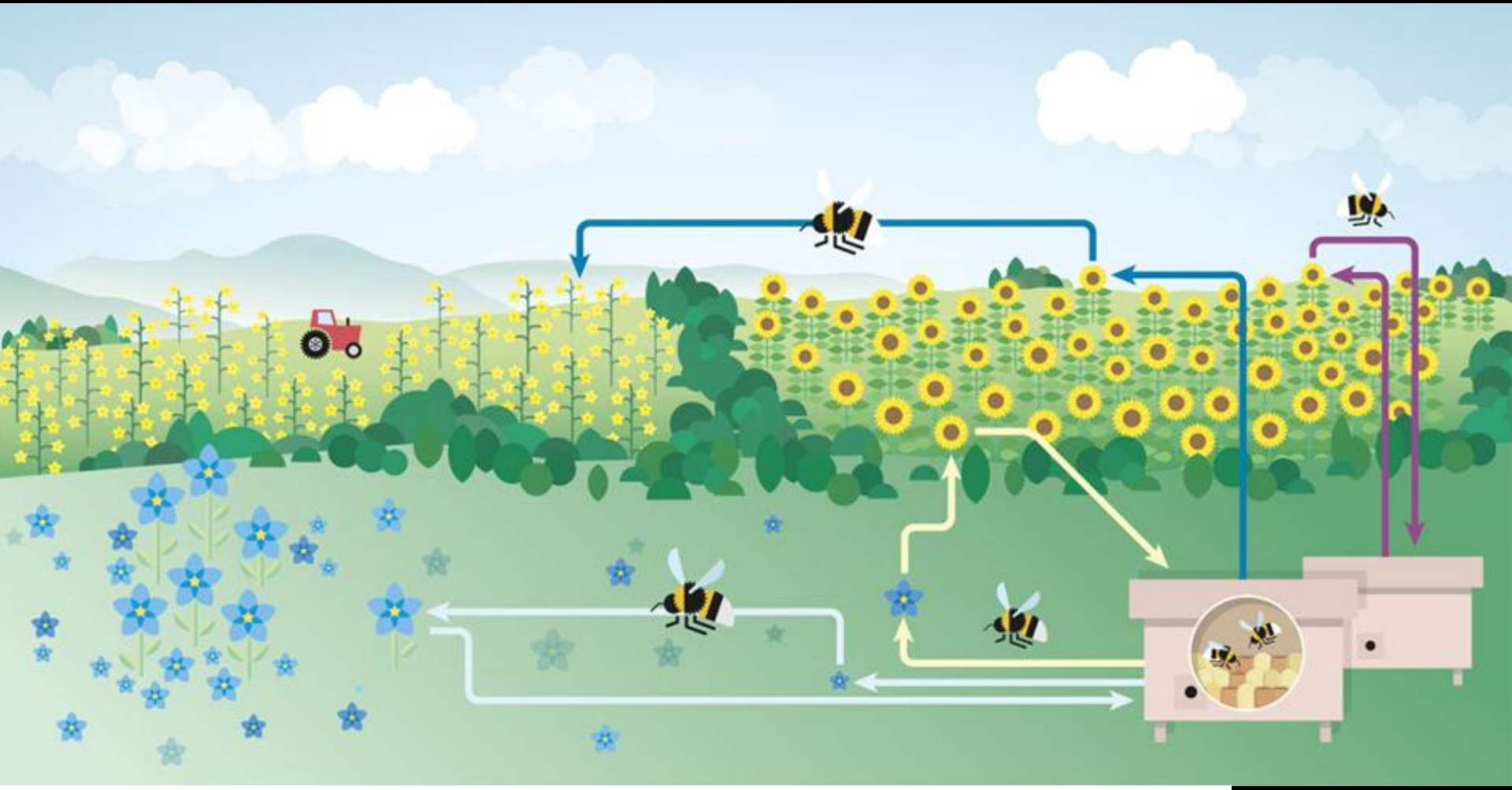
Things that aren't tested:

- Effects on larvae and pupae
- Effects on hormones
- Changes to rates of growth
- Changes to eating patterns
- Changes to navigation
- Decreased sperm counts
- Decreased egg laying
- Behavioral changes
- …

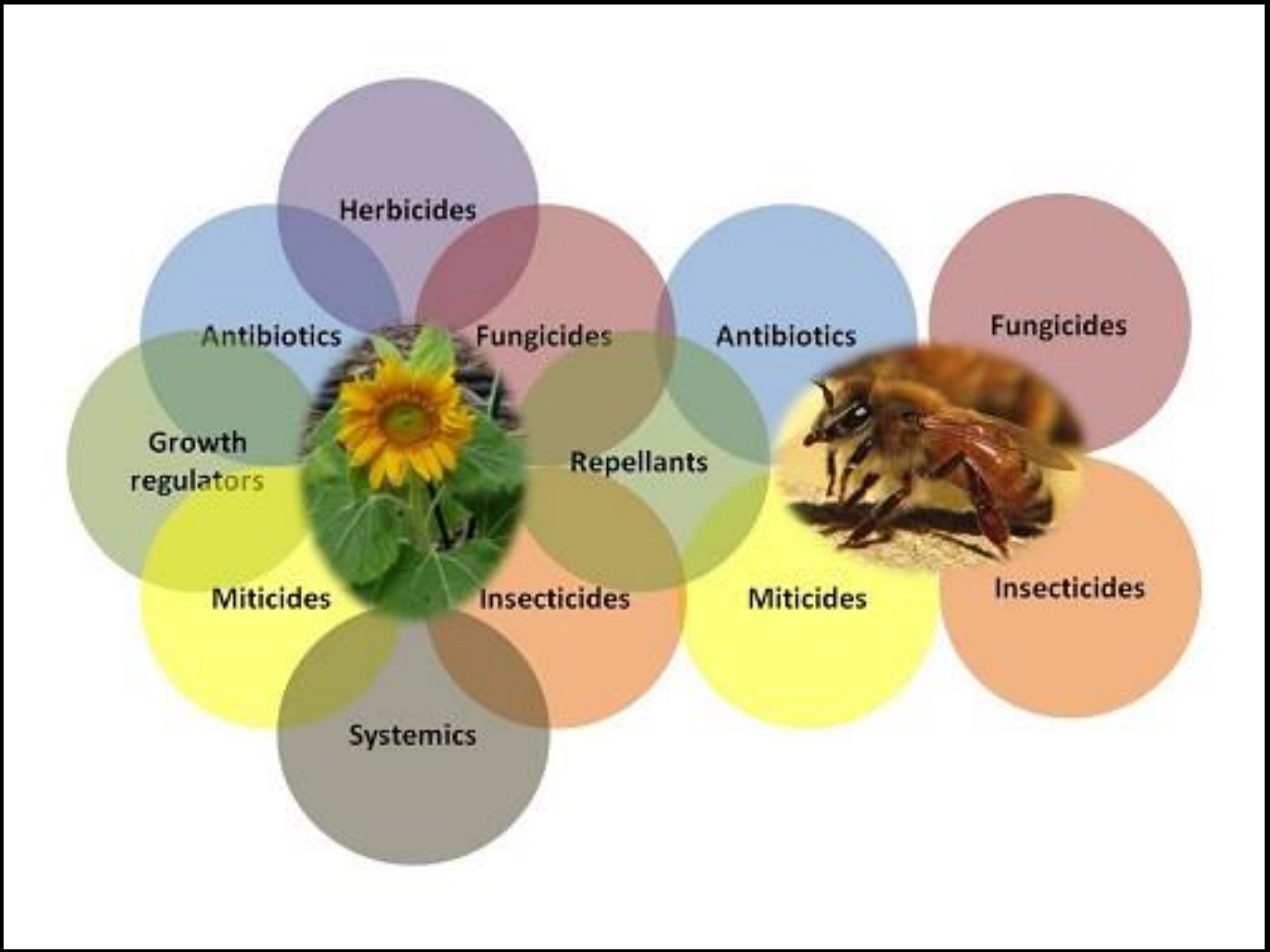
The EPA has *just started* performing risk assessments for pollinators.

You cannot go by labeling to determine if a pesticide will have an effect on pollinators.

Pesticide exposure is complex

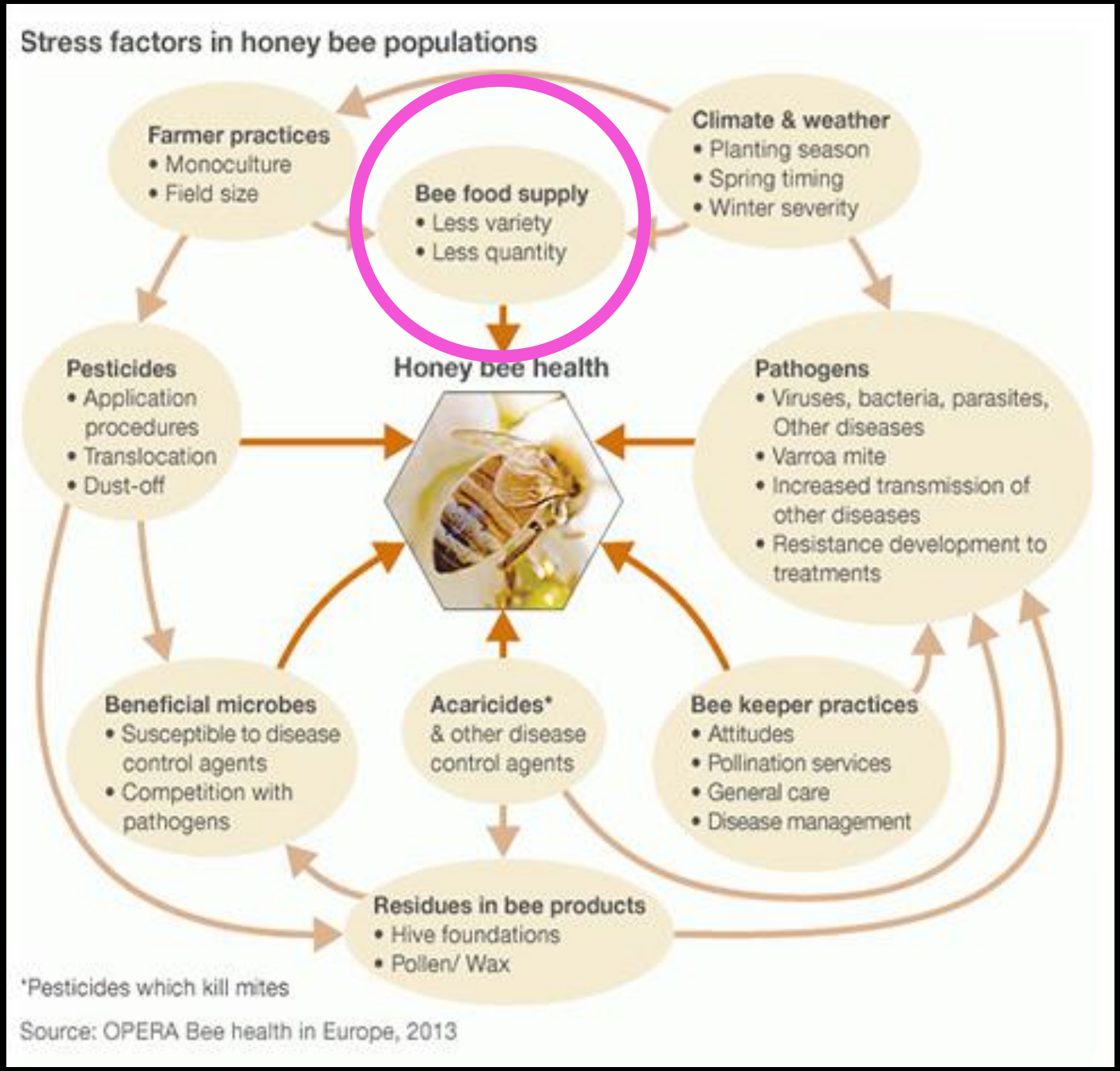


Nature **491**,43–45 (01 November 2012) doi:10.1038/nature11637



IN MOST CASES, WE DON'T KNOW THE EXTENT OF THE HARM OR RISK OF THE MIX OF EXPOSURES.

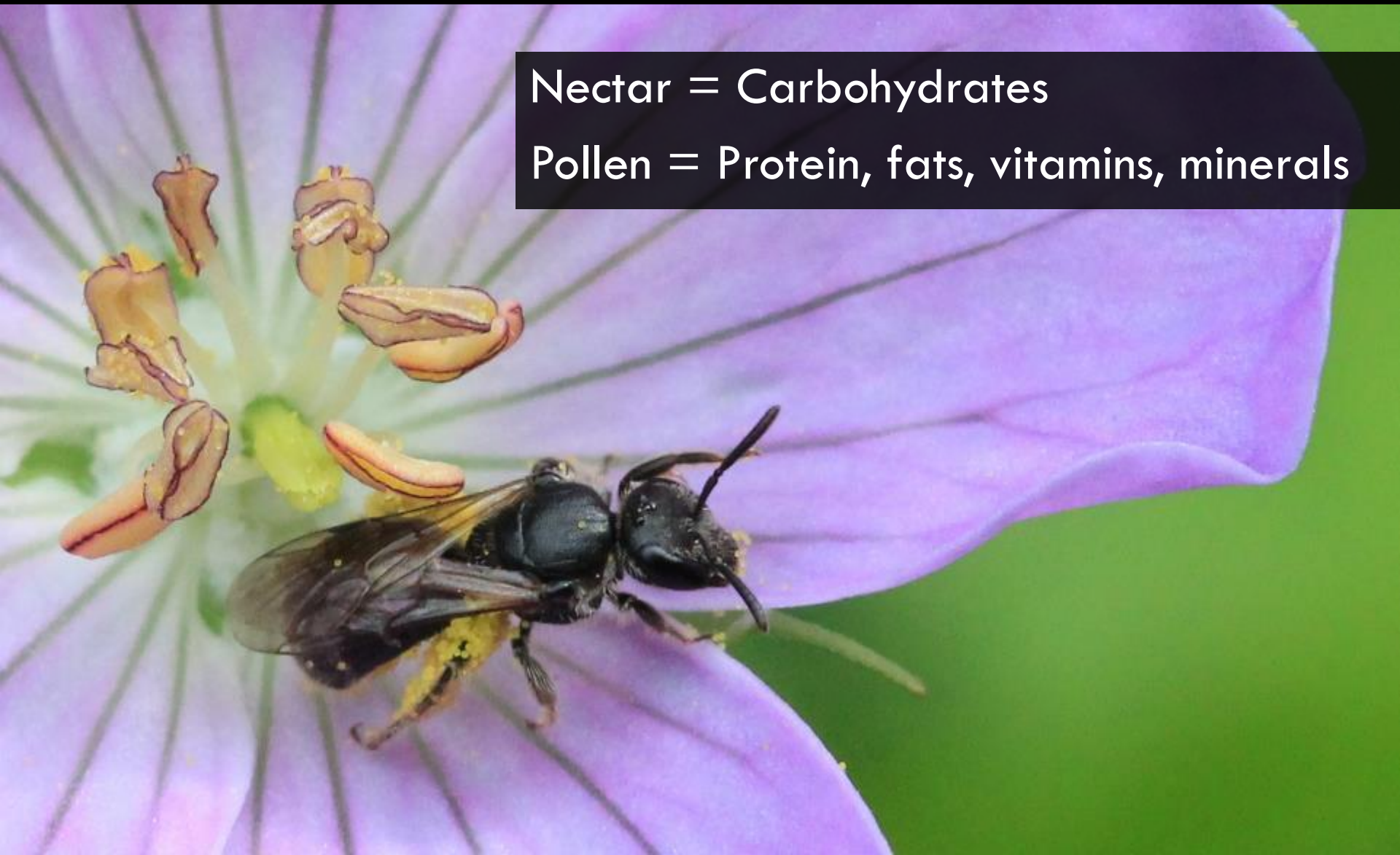
Don’t spray unless you have to. If you have to - Spray at night, and don’t spray flowers, and pick the most specific chemicals possible


Stress factors in honey bee populations
Farmer practices
• Monoculture
• Field size
Bee food supply
• Less variety
• Less quantity
Climate & weather
• Planting season
• Spring timing
• Winter severity
Pesticides
• Application procedures
• Translocation
• Dust-off
Honey bee health
Pathogens
• Viruses, bacteria, parasites, Other diseases
• Varroa mite
• Increased transmission of other diseases
• Resistance development to treatments
Beneficial microbes
• Susceptible to disease control agents
• Competition with pathogens
Acaricides*
& other disease control agents
Bee keeper practices
• Attitudes
• Pollination services
• General care
• Disease management
Residues in bee products
• Hive foundations
• Pollen/ Wax
*Pesticides which kill mites
Source: OPERA Bee health in Europe, 2013

NO POLLINATORS = NO FLOWERING PLANTS

NO FLOWERING PLANTS = NO POLLINATORS

100% OF BEES' DIET IS FROM FLOWERS



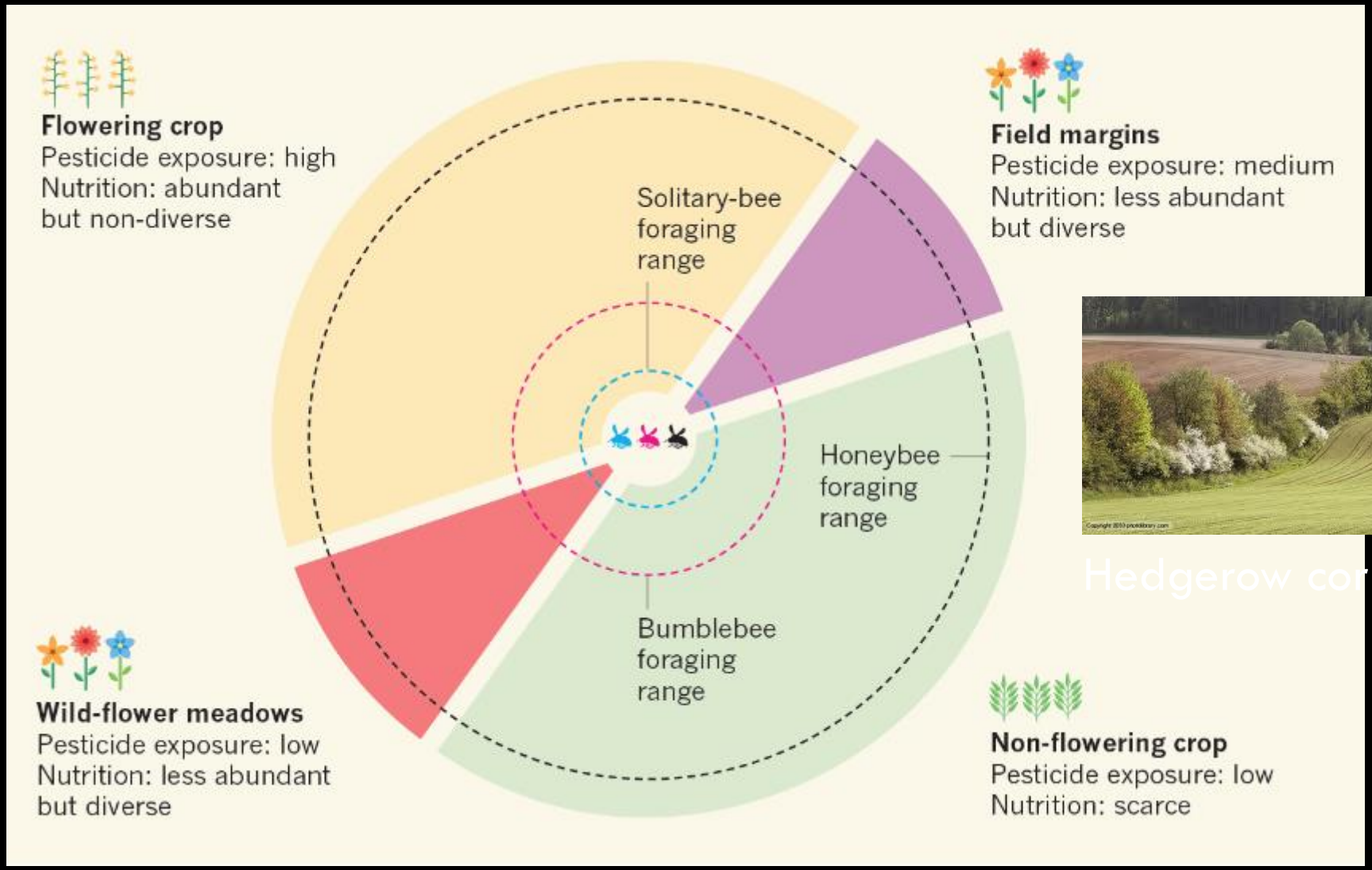
Nectar = Carbohydrates

Pollen = Protein, fats, vitamins, minerals

In the last 30 years, we have seen an Enormous, unprecedented, dramatic loss of flowers in the US Landscape.

1. Loss of CRP Land
2. Changes in farming practices
3. Lawn sprawl

Considering landscape from pollinator perspective



Hedgerow corridors

Connect the landscape: how far do pollinators move?

Consider the timing + duration of flowering when planting

Raine & Gill (2015) *Nature*

Loss of foraging land

CHANGES IN FARMING PRACTICE – Loss of Pasture

Loss of foraging land

CHANGES IN FARMING PRACTICE – Less Use of Cover Crops

Loss of foraging land

CHANGES IN FARMING PRACTICE – Edge to edge farming

Cleaner Fields and Ditches

Conversion of Farms to Lawns


bing
© 2015 Microsoft Corporation

LOSS OF FORAGE DEVELOPMENT

The only source of food for bees is from flowers.

We have lost many floral landscapes, and replaced them with landscapes without food for pollinators.

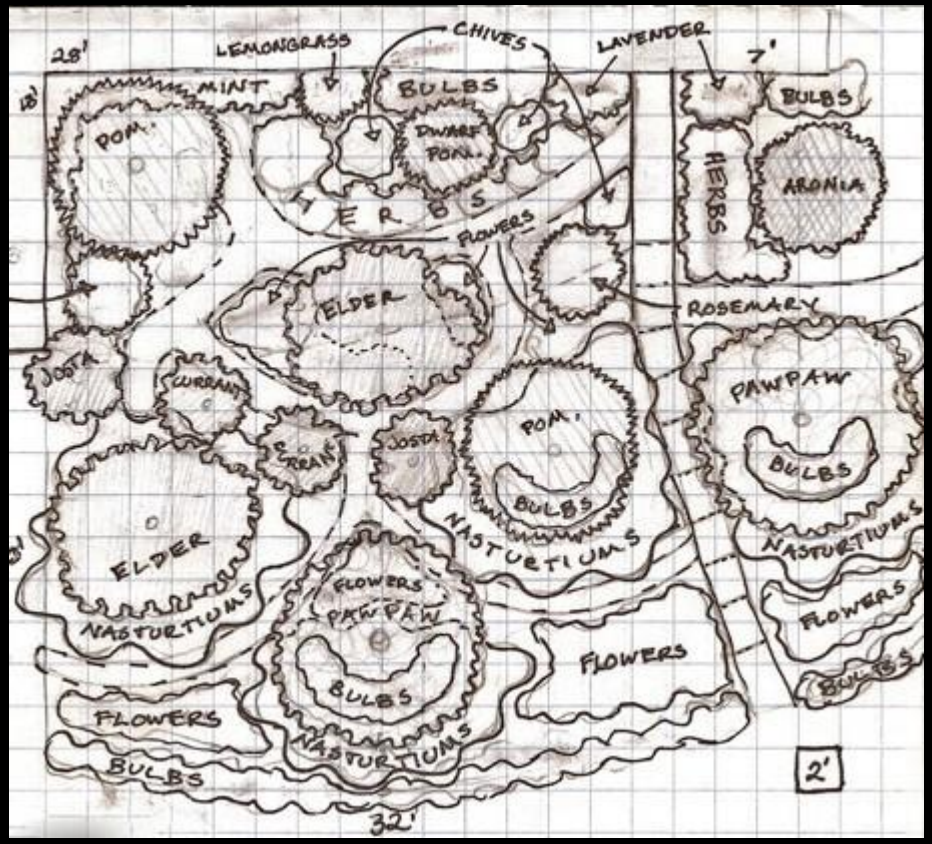
When bees have poor nutrition, they are more susceptible to other threats.

Multiple, Interacting Causes of Death

Marla Spivak Ted Talk

Do what you can, where you can.

Where is there potential for flowers?



Trees are some of the most important food sources for bees

- Timing – dearth / early spring
- Quantity – many blooms at once
- Stability – nectar during drought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TREES FOR BEES

- Willows
- Maples
- Elms
- Basswood
- Locust
- Cherries
- Apples
- Alders
- Catalpa
- Redbud
- Sumac

INVASIVES

Native Plants – best adapted

Conclusions

- Pollinators are incredibly important
  - They provide essential ecosystem services when they pollinate our food
  - They support the plants on our natural lands

Pollinators are facing a lack of clean food.

The problems affecting pollinators arose from a variety of land use decisions, by a lot of people, over a long period of time.

The solution to help pollinators will require many positive land use decisions, by a lot of people, over a long period of time.

Michigan has a unique role

- We have a lot of specialty crops
- We have a large beekeeping industry.

- We have a lot of land, a lot of open space, and a lot of potential.
- We have a lot of programs and groups supporting pollinators.

Simple changes to pesticide use, and planting/ habitat improvements

Do what you can, where you can

Thank you

www.xerces.org

Meghan Milbrath
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Pollinators.msu.edu

MICHIGAN STATE UNIVERSITY

Ditches

Rethink lawns

Unused spaces

Green Roofs

Can be formal

Add Signage/ Bird houses

Accentuate Educational Opportunities

Don’t forget trees

- Apples
- Maples
- Black Locu
- Basswood
- Elms
- Sumac
- Willows
- Cherries

PLANT FLOWERS – Perennials / Herbs

- Lavender
- Mints
- Clematis
- Verbena
- Coneflowers
- Bee balm

PLANT FLOWERS!

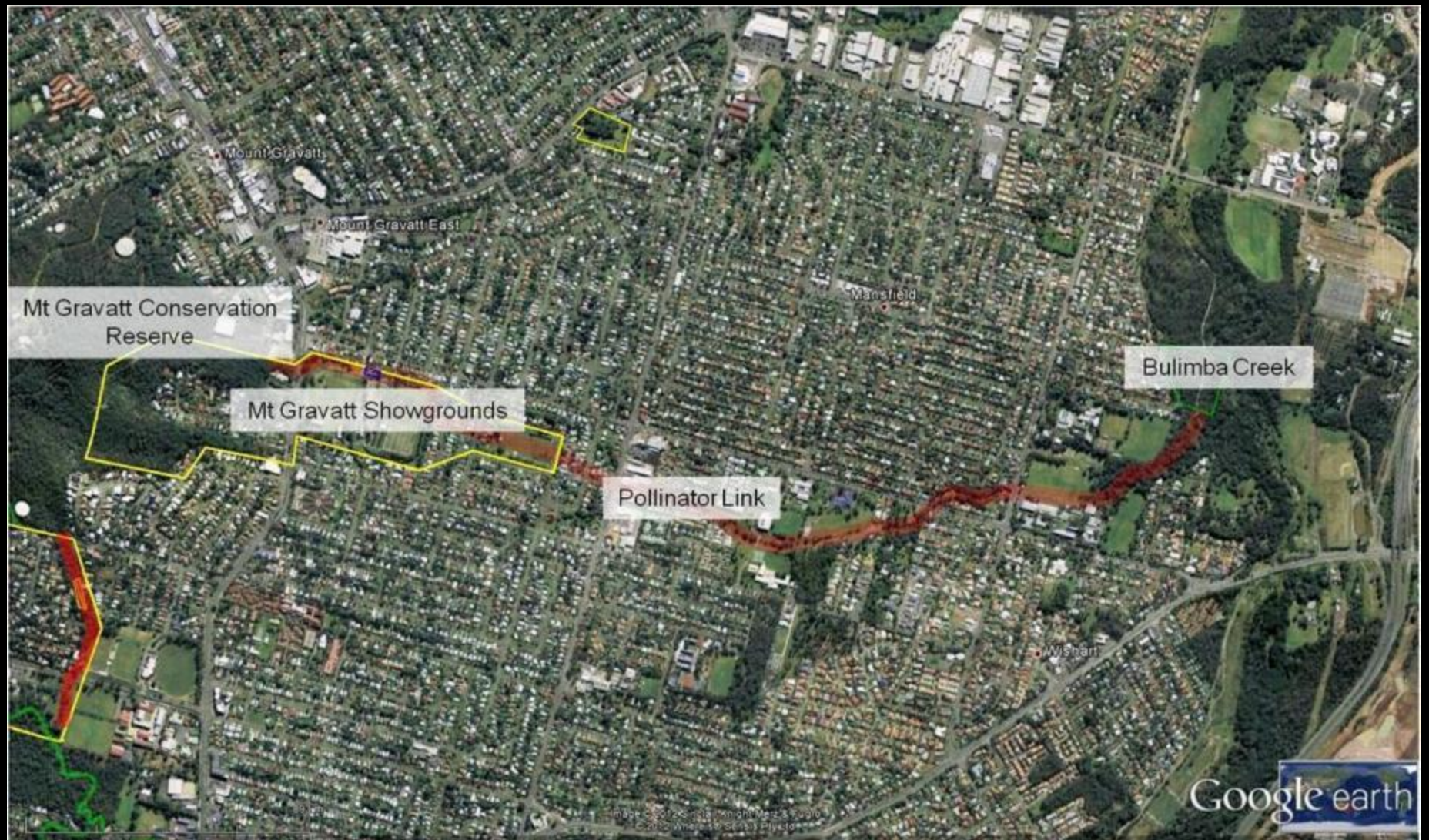
- Long blooms – through dear

Plant for Constant Blooms

Diversity is important

Even small plantings are important

Pollinator Corridors



Housing for bees

Beneficial Insects

Drainage / Rain Gardens

Wild life habitat

Mowing/ Maintenance costs

Grants, federal Funding, Technical Support

Discussion

- 1. List some changes that you could do (propose your organization can do) to the land you manage (yard, school, business).

- 2. What would be some obstacles to making these changes?

- 3. What would help over come those obstacles?

Michigan Pollinator Protection Plan

- A managed pollinator plan consistent with National EPA Managed Pollinator Protection plans, that provides a roadmap for protecting the health and future growth of honey bees and other managed pollinators while also maintaining the ability of agricultural producers to produce their crops.
- Beekeepers make presence known
- Pesticide applicators make known to beekeepers
- Contact beekeepers
- BMPS/Integrated pest management practices
- Communicate to the public
- Measurement metric - sample /survey hives

A STATE-WIDE STRATEGY FOR INCREASING HABITAT FOR ALL POLLINATORS

1. Reduce honey bee losses to < 15% by 2025.
2. Increase Eastern monarch butterfly populations to 225 million by 2020.
3. Restore or enhance 7 million acres for pollinators by 2020.

NATIONAL STRATEGY TO PROMOTE THE HEALTH OF HONEY BEES AND OTHER POLLINATORS

Pollinator Health Task Force