Forage and Native Pollinator Considerations: Understanding the Basics

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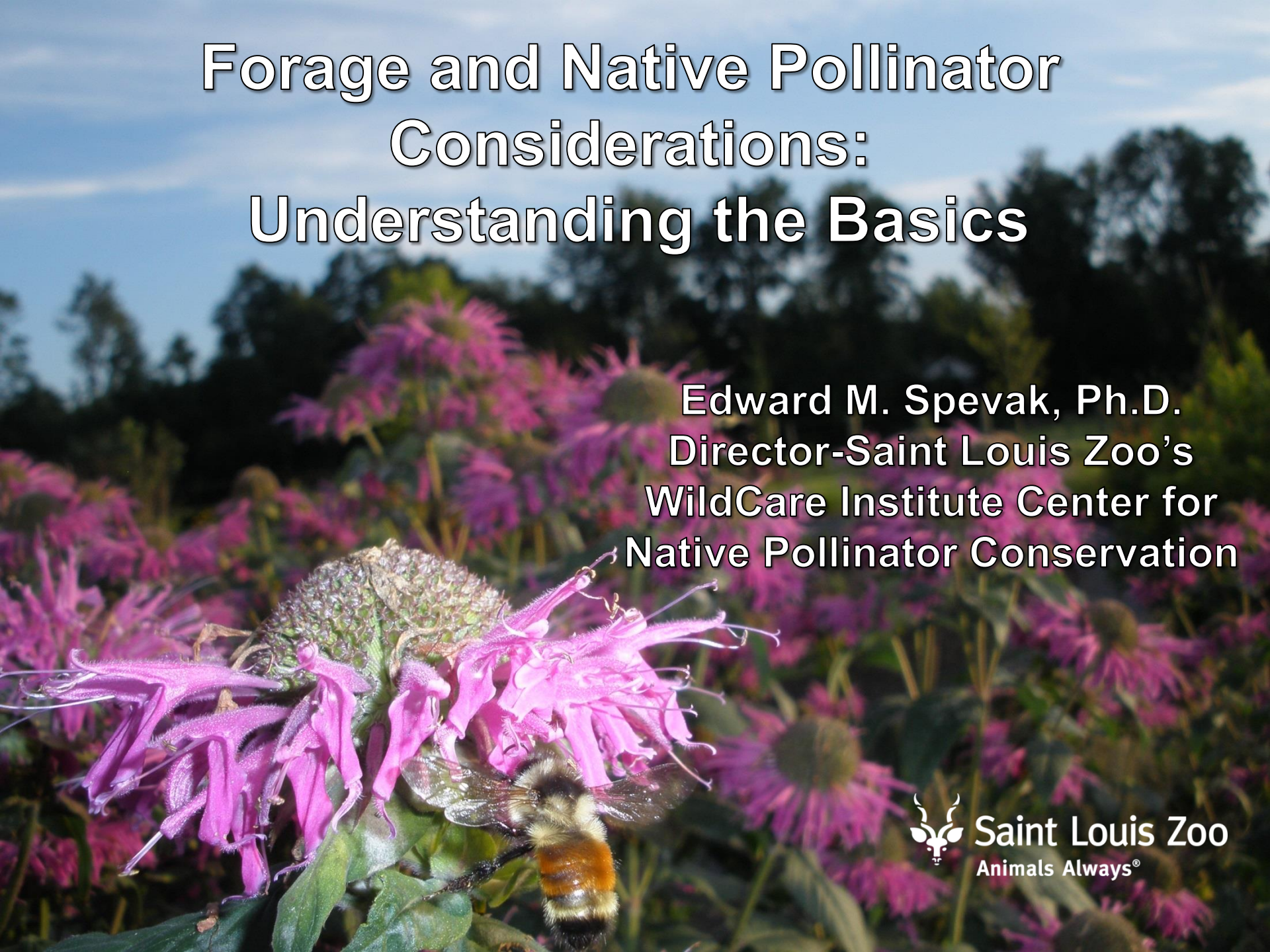

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Pollinators: Ecological Keystone Species

Around 90 percent of flowering plants (~400,000 sp.) depend to some extent on animal pollination.


North American Bear Center www.bear.org

Bees: The Most Important Pollinators

- Bees provide for their young
- Bees actively collect and transport pollen
- Bees exhibit flower constancy
- Bees regularly forage in area around nest

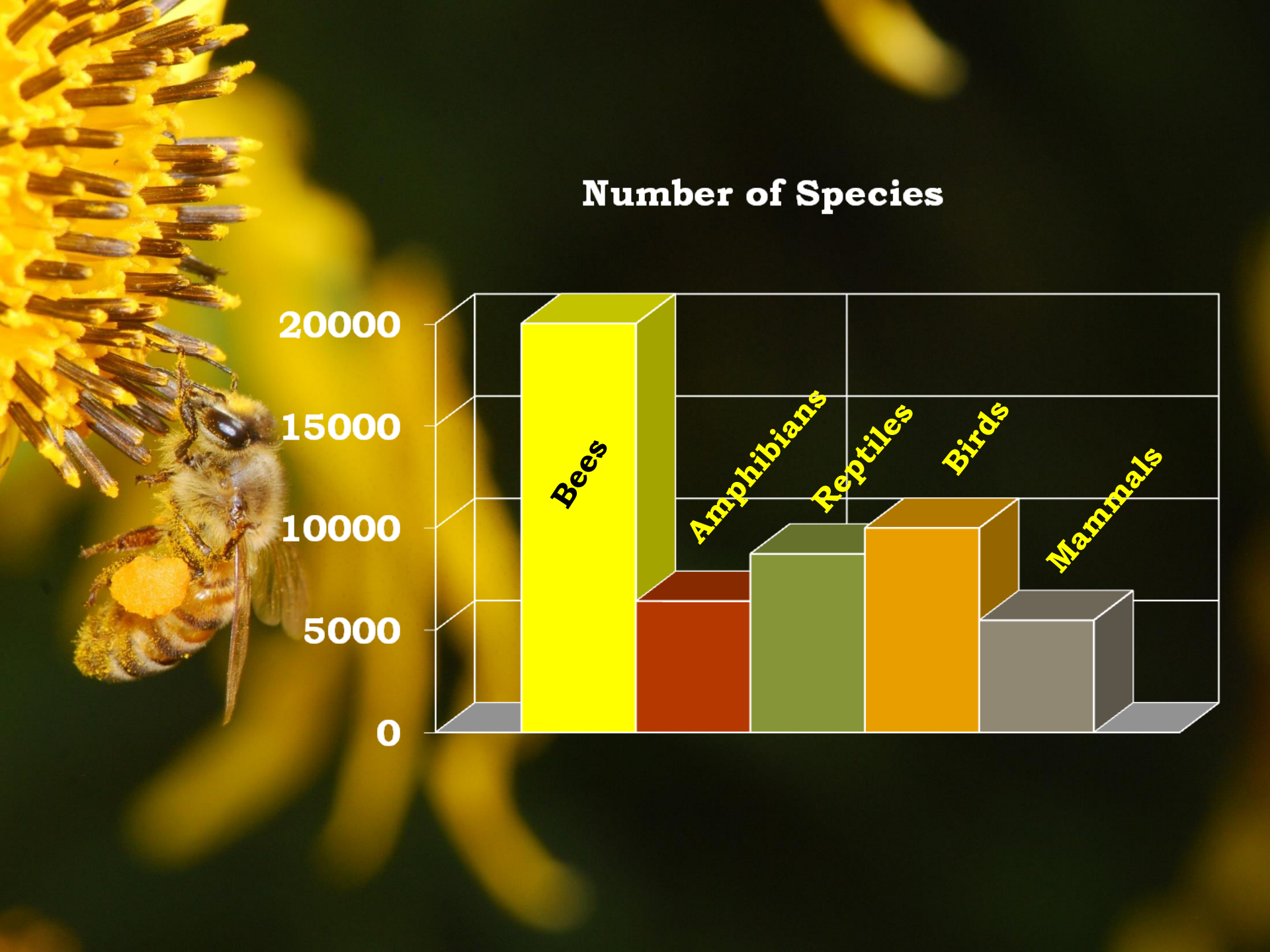

Number of Species
20000
15000
10000
5000
0
Bees
Amphibians
Reptiles
Birds
Mammals

Photo: Steve Buchmann

Pollination and Human Nutrition

- 75% of crop species, worldwide require pollinators
- >$29* billion value of crops in U.S. depend on Honey Bees and Native Bees.
- $235-$577 billion ** value of crops worldwide depend on Honey Bees, Native Bees and other Pollinators
- One out of every three mouthfuls of food and drink we consume depends upon pollinators

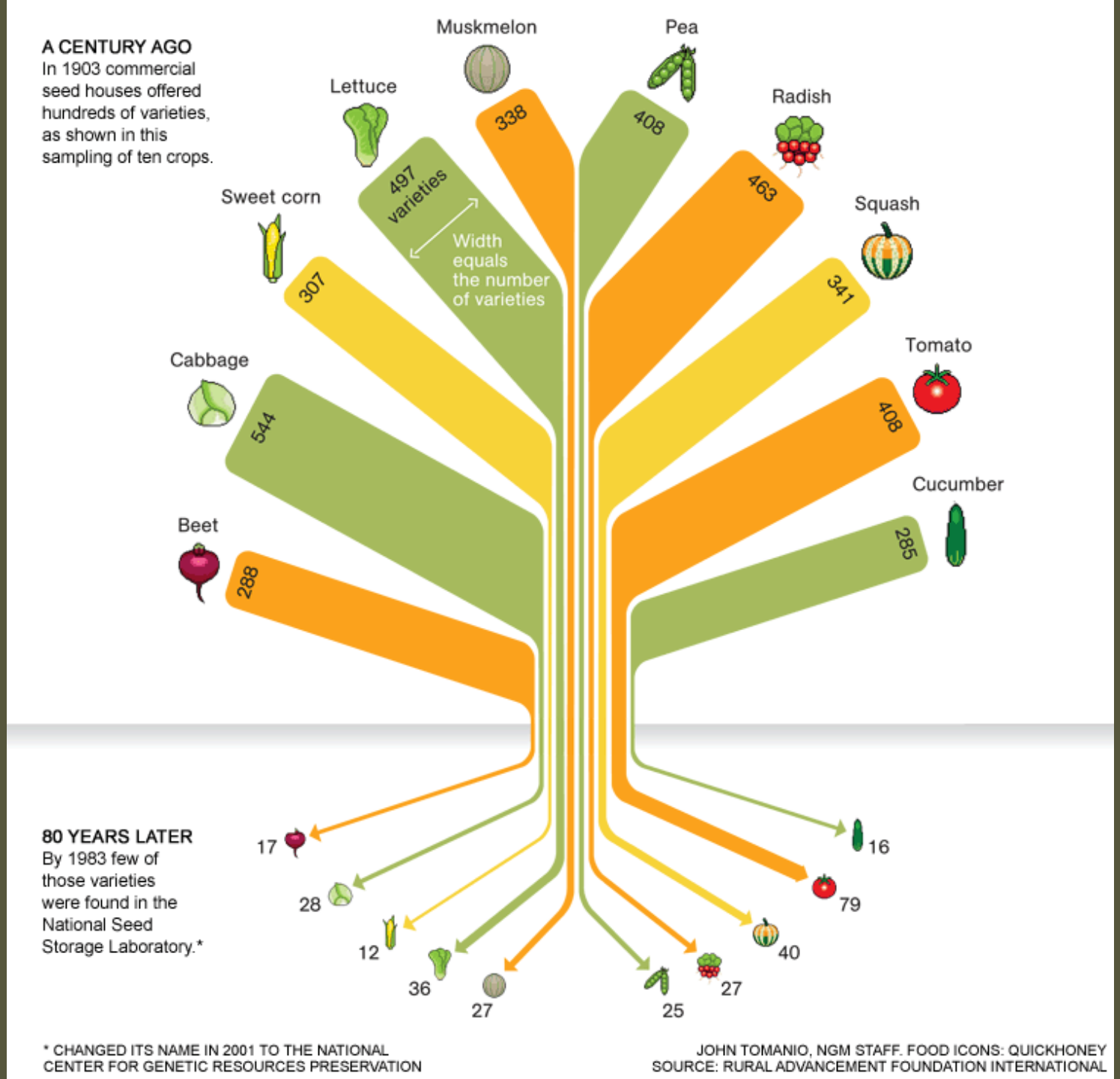
Photo: USDA-ARS/Peggy Greb

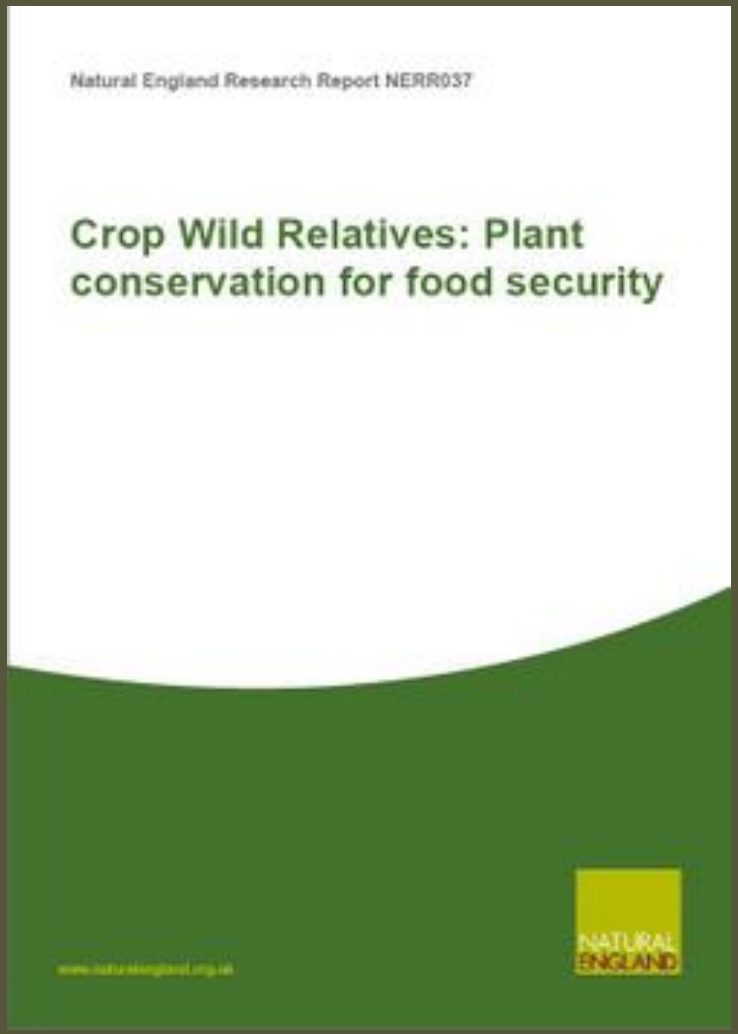
*Calderone, Nicholas W. 2012. Insect Pollinated Crops, Insect Pollinators and US Agriculture: Trend Analysis of Aggregate Data for the Period 1992-2009. PLoS ONE 7(5):e37235. doi:10.1371/journal.pone.0037235

**Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)

Some crops pollinated by Bees

Alfalfa, Allspice, Almonds, Apples, Apricots, Artichokes, Asparagus, Avocados, Broad Beans, Blackberries, Blueberries, Broccoli, Buckwheat, Cabbage, Canola (Rapeseed), Cantaloupe, Carrots, Cashews, Cauliflower, Celery, Cherries, Chile Peppers, Clover, Coriander, Cranberries, Coffee, Cotton, Cucumbers, Currants, Dill, Eggplant, Fennel, Garlic, Guava, Kale, Leeks, Lemons, Lettuce, Lima Beans, Limes, Macadamia Nuts, Mangoes, Mustard, Nutmeg, Onions, Oranges, Passion Fruit, Peaches, Peanuts, Pears, Peppers, Plums, Pumpkins, Raspberries, Sesame, Soybeans, Squash, Strawberries, Sunflowers, Tea, Tomatoes, Turnips, Watermelon, Zucchini……


A CENTURY AGO
In 1903 commercial seed houses offered hundreds of varieties, as shown in this sampling of ten crops.
Muskmelon
Pea
Lettuce
Radish
Sweet corn
Squash
Cabbage
Tomato
Beet
Cucumber
338
408
497 varieties
Width equals the number of varieties
463
307
341
544
408
288
285
80 YEARS LATER
By 1983 few of those varieties were found in the National Seed Storage Laboratory.*
17
16
28
79
12
40
36
27
27
25
* CHANGED ITS NAME IN 2001 TO THE NATIONAL CENTER FOR GENETIC RESOURCES PRESERVATION
JOHN TOMANIO, NGM STAFF. FOOD ICONS: QUICKHONEY
SOURCE: RURAL ADVANCEMENT FOUNDATION INTERNATIONAL



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U. S. Has Surprisingly Large Reservoir of Crop Plant Diversity

Apr. 29, 2013 — North America isn't known as a hotspot for crop plant diversity, yet a new inventory has uncovered nearly 4,600 wild relatives of crop plants in the United States, including close relatives of globally important food crops such as sunflower, bean, sweet potato, and strawberry.

The findings, which were published today (Apr. 29) in the journal *Crop Science*, are good news for plant breeders, who've relied increasingly in recent years on the wild kin of domesticated crops as new sources of disease resistance, drought tolerance, and other traits.

The not-so-good news is that many of these "crop wild relatives" are currently threatened by habitat loss, pollution, and climate change, says lead author Colin Khoury of the International Center for Tropical Agriculture (CIAT) in Cali, Colombia. For instance, a wild sunflower species that breeders have used to restore fertility and create salt tolerance in cultivated sunflower is also globally imperiled. Another 62 taxa in the inventory are listed under the U.S. Endangered Species Act.

In fact, an estimated 30 percent of U.S. plant species are now of "conservation concern," says Khoury, who is also a doctoral student at Wageningen University in the Netherlands. And crop wild relatives are possibly even more vulnerable because they've tended to be overlooked both by agricultural scientists and the conservation community.

Related Topics

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Time Is Ticking for Some Crop's Wild

Native Bees and Pollinators are in trouble

- **Loss of habitat**
- **Changes in Agricultural Practices**
- **Misuse of pesticides**
- **Disease and Parasites**
- **Pollution**
- **Competition with Introduced Species**

Traditional Farming

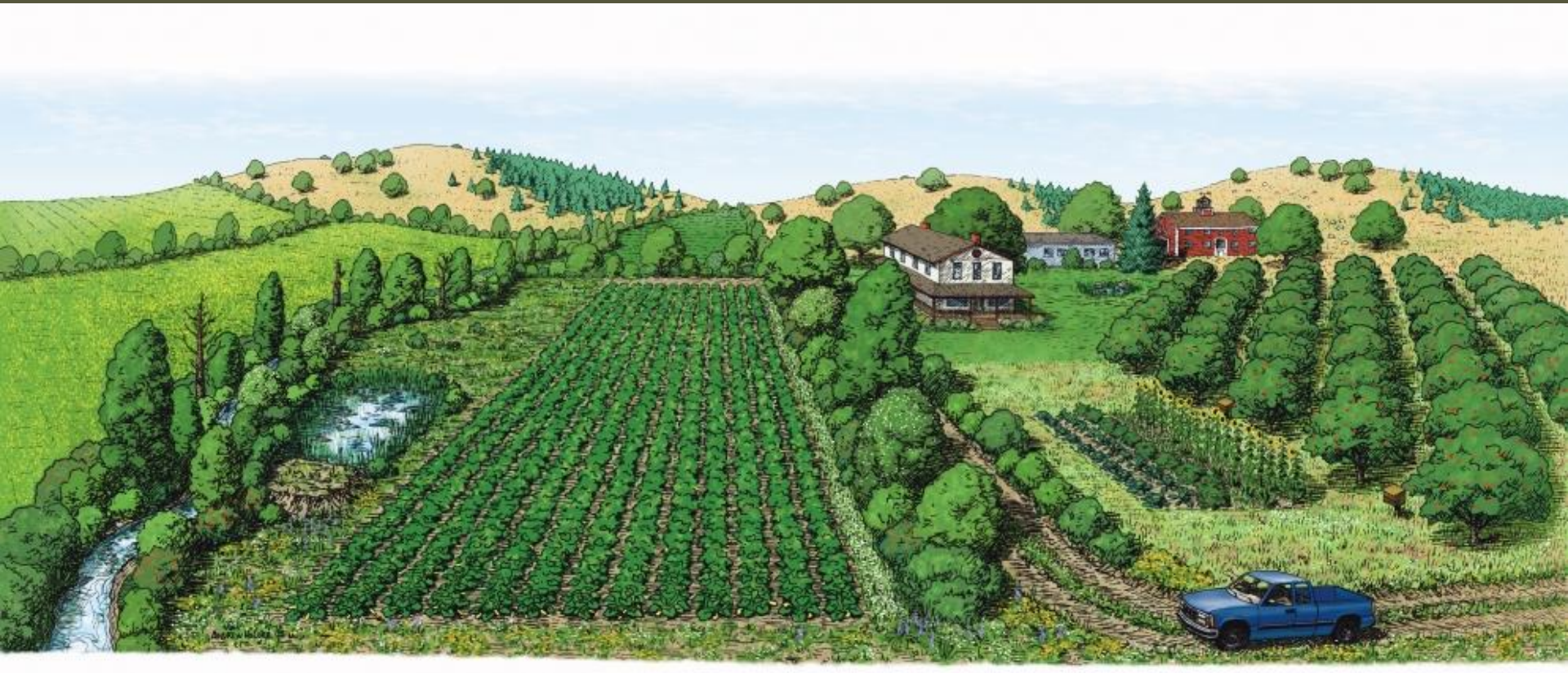
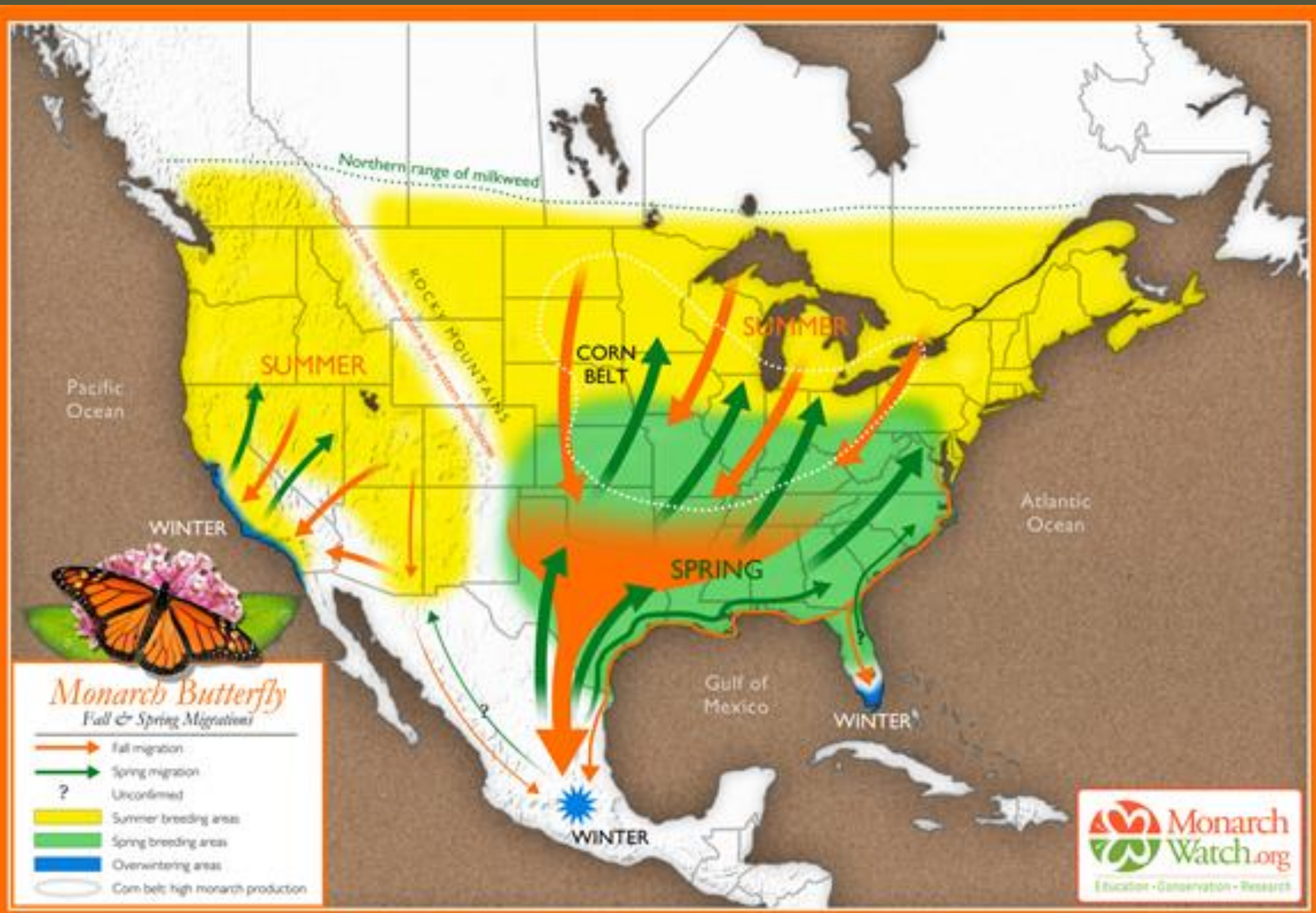


Illustration by Andrew Holder, Xerces Society

Changes in Agricultural Practices

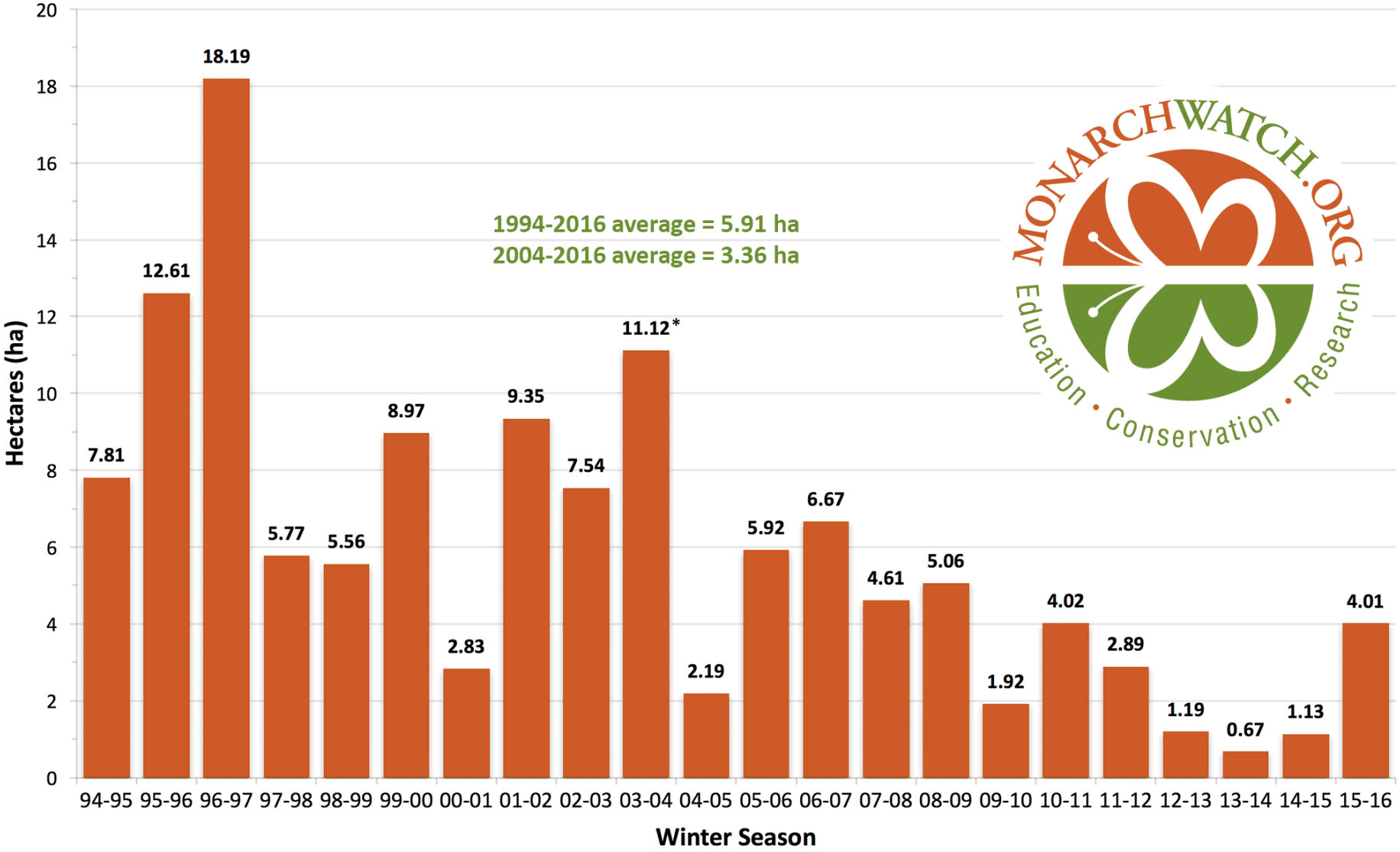
Photo: National Geographic, Nicholas Devore III

Changes in Agricultural Practices


Northern range of milkweed
ROCKY MOUNTAINS
SUMMER
SUMMER
CORN BELT
Pacific Ocean
Atlantic Ocean
WINTER
SPRING
Gulf of Mexico
WINTER
WINTER
Monarch Butterfly
Fall & Spring Migrations
Fall migration
Spring migration
? Unconfirmed
Summer breeding areas
Spring breeding areas
Overwintering areas
Corn belt: high monarch production
Monarch Watch.org
Education · Conservation · Research

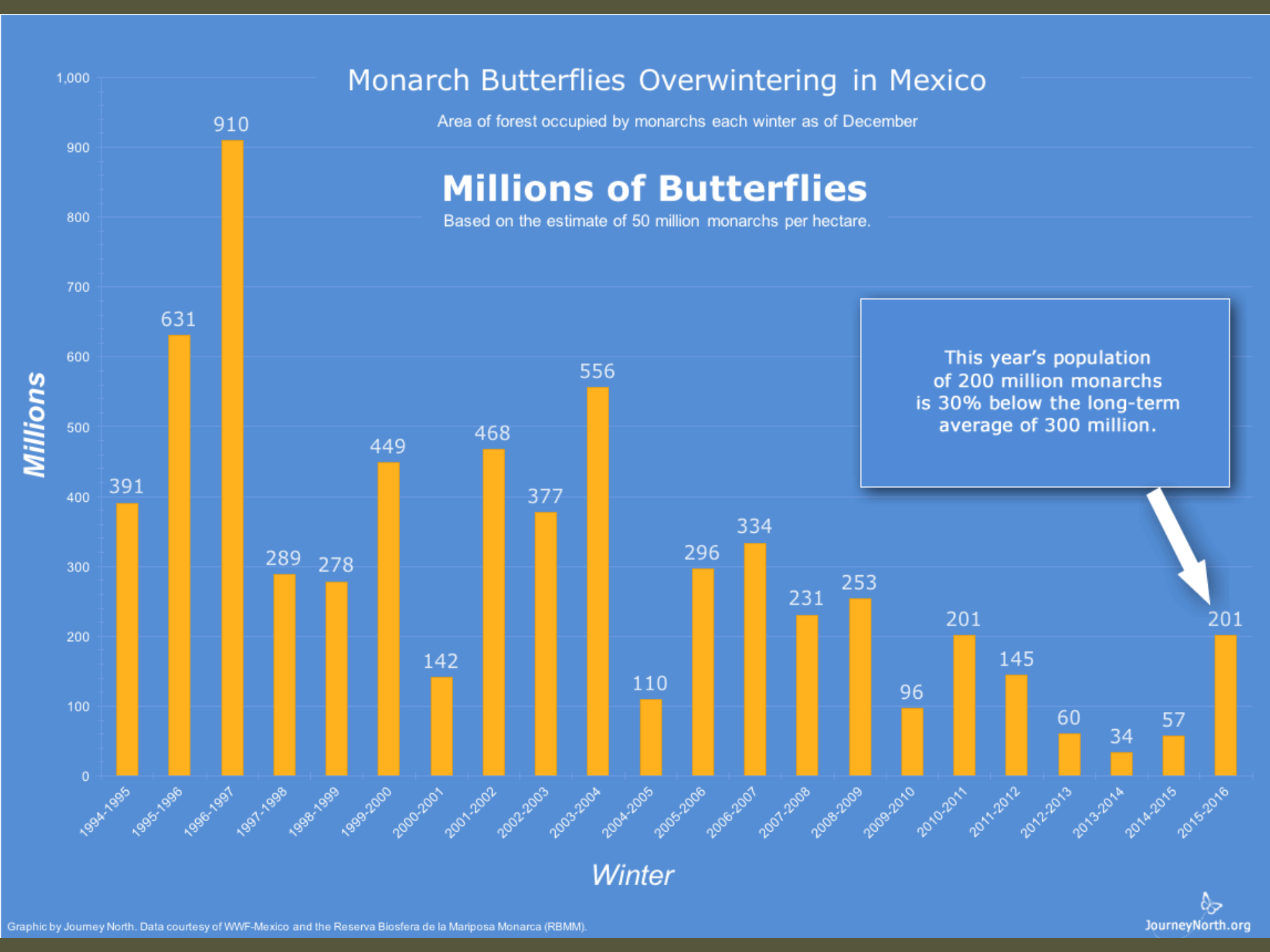

Pleasants and Oberhauser (2012) estimated a 58% decline of milkweed density in the American Midwest between 1999 and 2010.

Total Area Occupied by Monarch Colonies at Overwintering Sites in Mexico



Data for 1994-2003 collected by personnel of the Monarch Butterfly Biosphere Reserve (MBBR) of the National Commission of Natural Protected Areas (CONANP) in Mexico. Data for 2003-2014 collected by World Wildlife Fund Mexico in coordination with the Directorate of the MBBR.

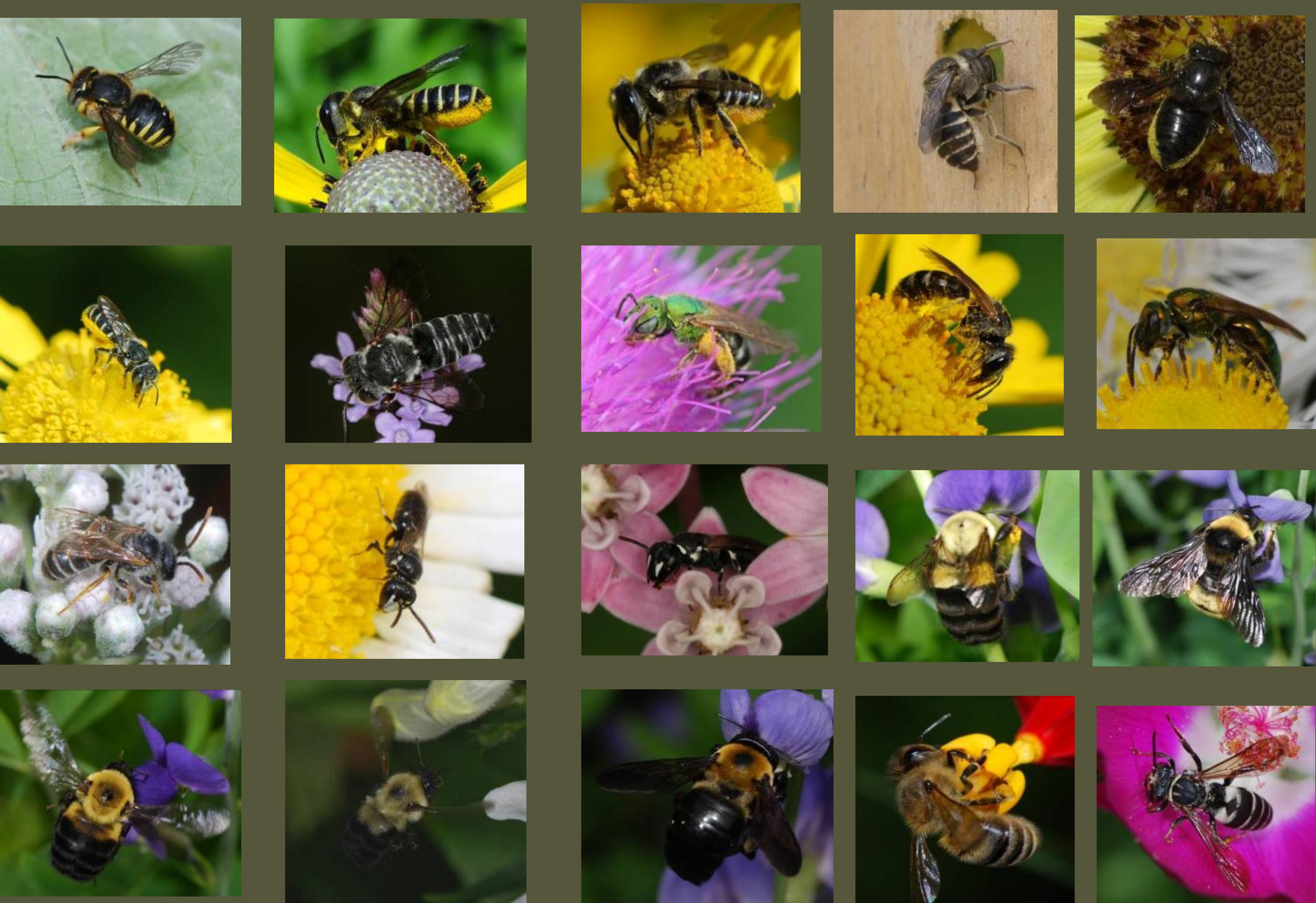
* Represents colony sizes measured in November of 2003 before the colonies consolidated. Measures obtained in January 2004 indicated the population was much smaller, possibly 8-9 hectares. CT


Monarch Butterflies Overwintering in Mexico
Area of forest occupied by monarchs each winter as of December
Millions of Butterflies
Based on the estimate of 50 million monarchs per hectare.
Millions
1,000
900
800
700
600
500
400
300
200
100
0
391
631
910
289
278
449
142
468
377
556
110
296
334
231
253
96
201
145
60
34
57
201
1994-1995
1995-1996
1996-1997
1997-1998
1998-1999
1999-2000
2000-2001
2001-2002
2002-2003
2003-2004
2004-2005
2005-2006
2006-2007
2007-2008
2008-2009
2009-2010
2010-2011
2011-2012
2012-2013
2013-2014
2014-2015
2015-2016
Winter
This year's population of 200 million monarchs is 30% below the long-term average of 300 million.
Graphic by Journey North. Data courtesy of WWF-Mexico and the Reserva Biosfera de la Mariposa Monarca (RBMM).
JourneyNorth.org

Designing Pollinator Habitat

- Clumps of single species within larger diverse plantings are most effective
- Pollinator diversity maximized when 15 to 25 flower species are present
- Minimum of 3 blooming species throughout the year (spring, summer, fall)

Bee Diversity versus Bee Abundance



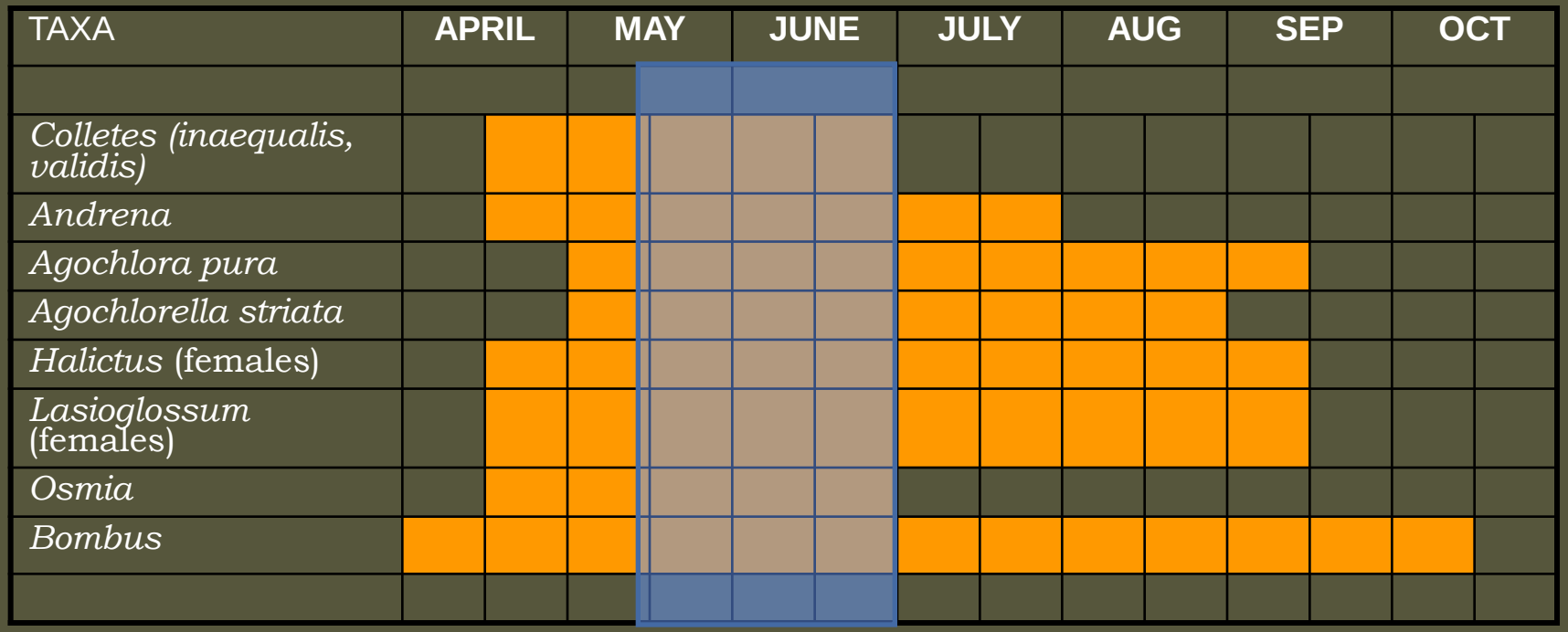
Pronounced seasonality among bees:

- Number of species in flight THROUGHOUT the growing season (April-October): approximately 40 (some *Hylaeus, Augochlora, Augochlorella, Halictus, Agapostemon, Lasioglossum, Ceratina, Bombus*)
- Number of seasonally-limited species = the vast majority
- Number of species in flight ONLY in April/May = 82 (e.g., Osmia)
- Number of species in flight ONLY August/September = 49 (e.g.,Melissodes)

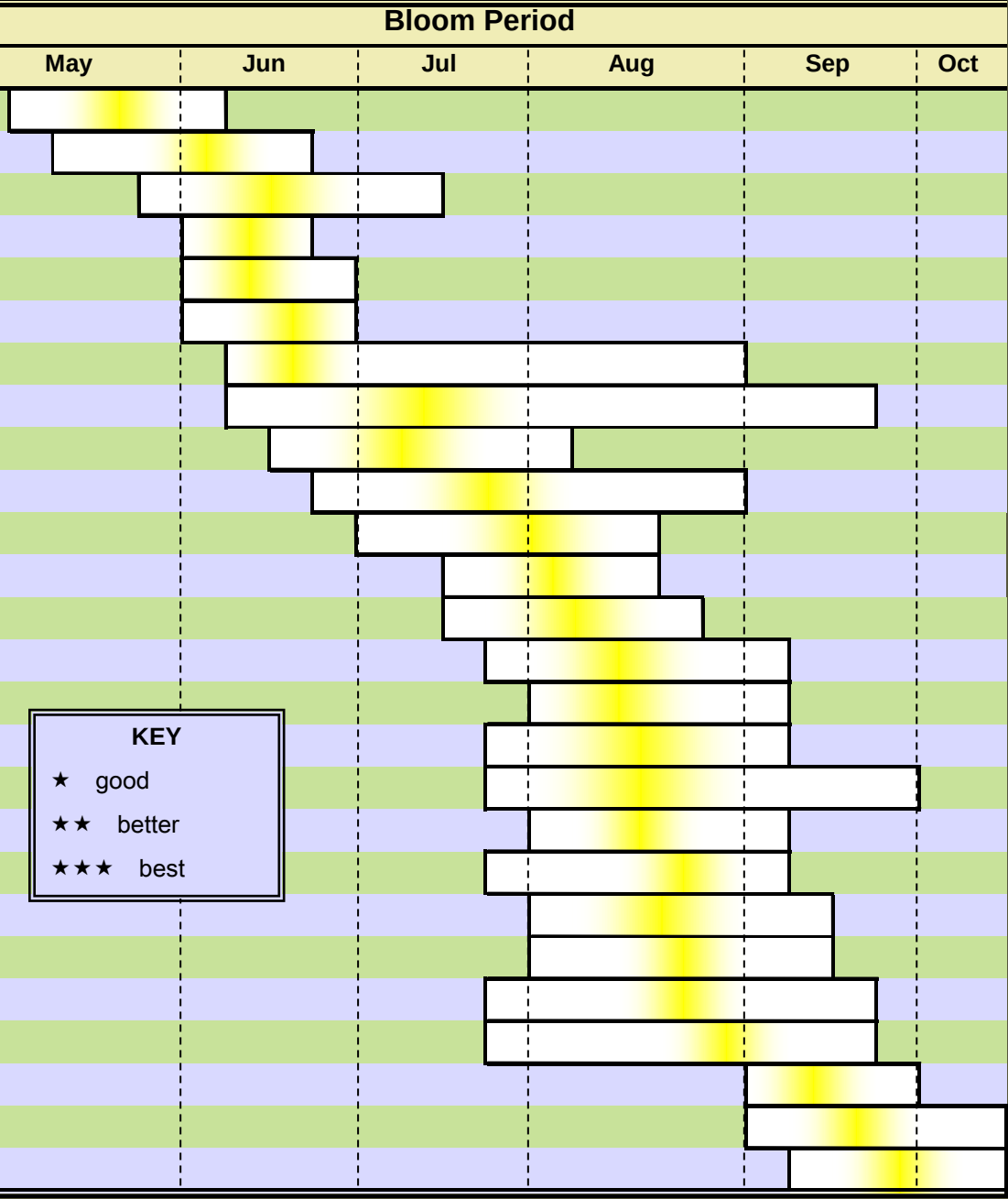
Data: Mike Arduser

Bees need food sources before and after crop bloom

Example: flight periods of native bees in relation to blueberry bloom.



Native plant	Natural enemies	Bees
wild strawberry	★★	★
golden Alexanders	★★★	★★
Canada anemone	★★★	★
penstemon	★★	★★
angelica	★★★	★
cow parsnip	★★★	★
sand coreopsis	★★★	★
shrubby cinquefoil	★★★	★
Indian hemp	★★★	★
late figwort	★★	★★
swamp milkweed	★★	★★
Culver's root	★★	★★★
yellow coneflower	★★★	★★
nodding wild onion	★	★★
meadowsweet	★★★	★★
yellow giant hyssop	★★	★★★
horsemint	★★★	★★
Missouri ironweed	★★	★★
cup plant	★★★	★★★
pale Indian plantain	★★	★★
boneset	★★★	★★
blue lobelia	★★★	★★★
pale-leaved sunflower	★★★	★★
Riddell's goldenrod	★★★	★★★
New England aster	★★★	★★
smooth aster	★★	★★



Rufus Isaacs and Julianna Tuell, 2007. Enhancing Farm Landscapes for Native Bees and Improved Crop Pollination. Michigan State University

Bee/flower relationships in MO

…30 families of plants host oligolectic bees in Missouri

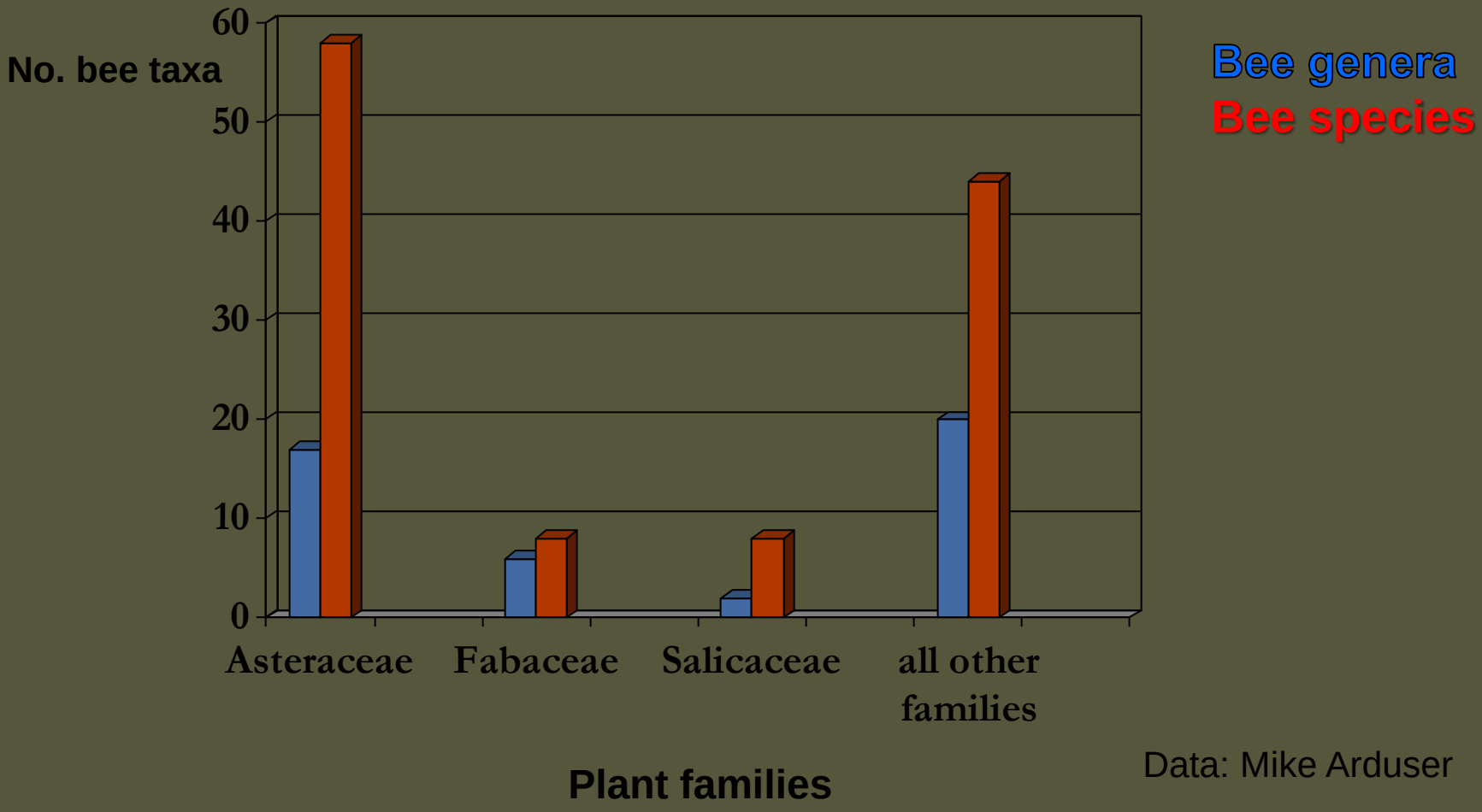
…152 species of Missouri bees (34% of the 452 bee species) are oligolectic at some level

...21 species of bees are oligolectic on conservative plant taxa

...112 species of bees are Natural Community Dependent (NCD)

Data and Slide :
Mike Arduser

Oligolectic MO bee taxa and host plant families



Data: Mike Arduser

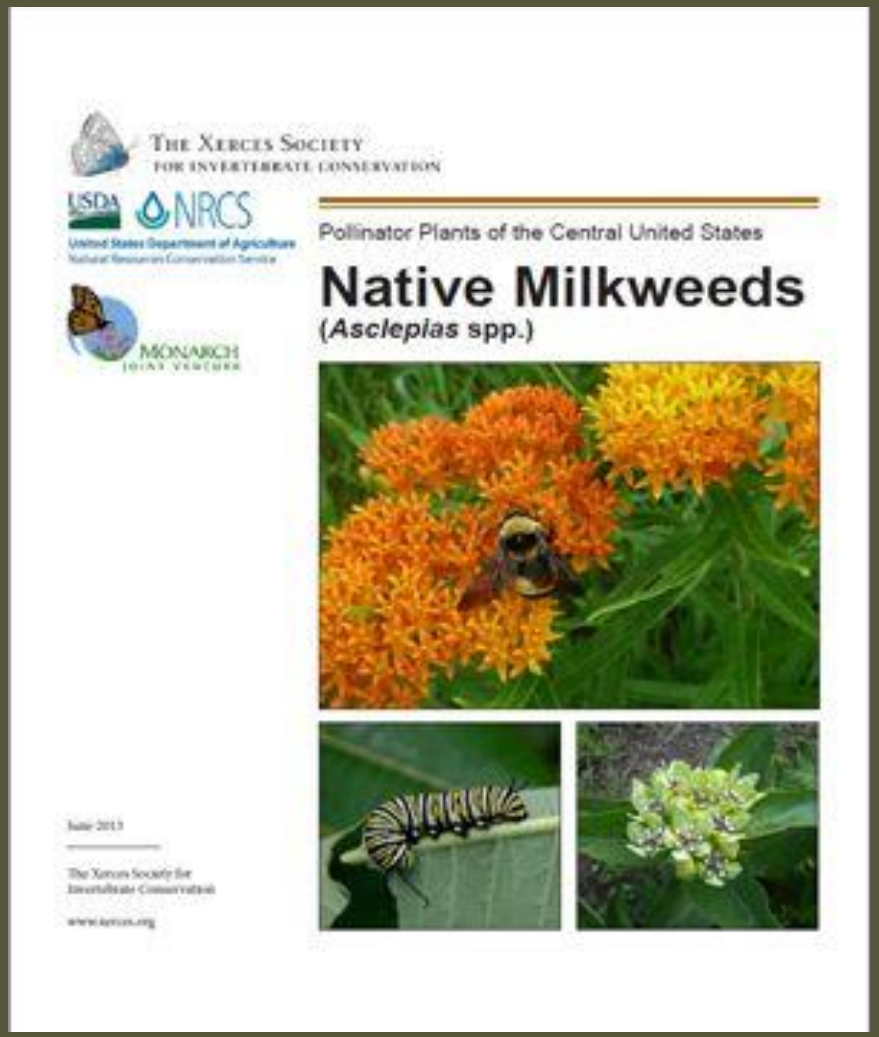

Swamp, Marsh, Red Milkweed
Asclepias incarnata

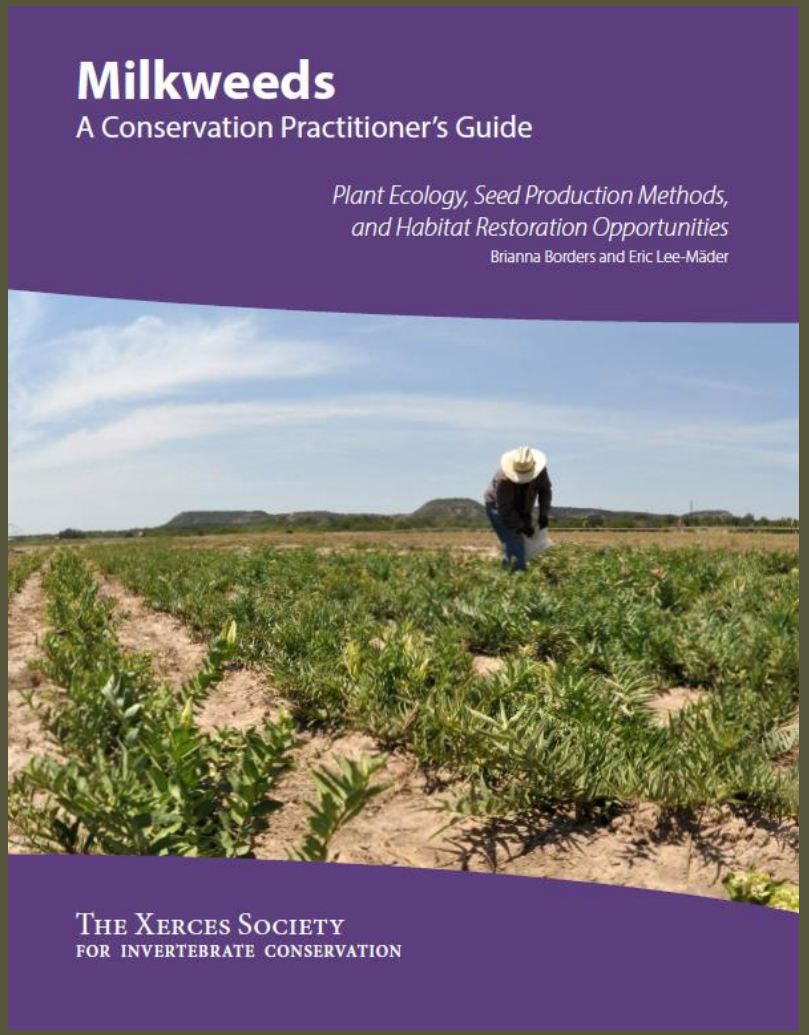

Whorled Milkweed
Asclepias verticillata


Butterflyweed
Asclepias tuberosa

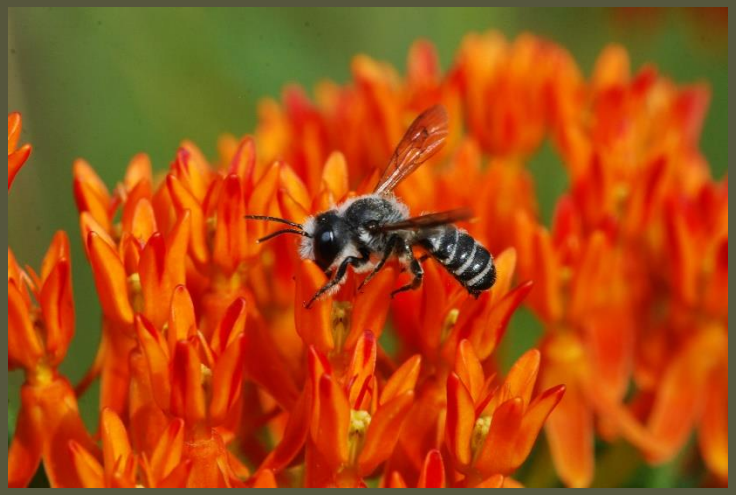

Common Milkweed
Asclepias syriaca

http://monarchjointventure.org/resources/publications/

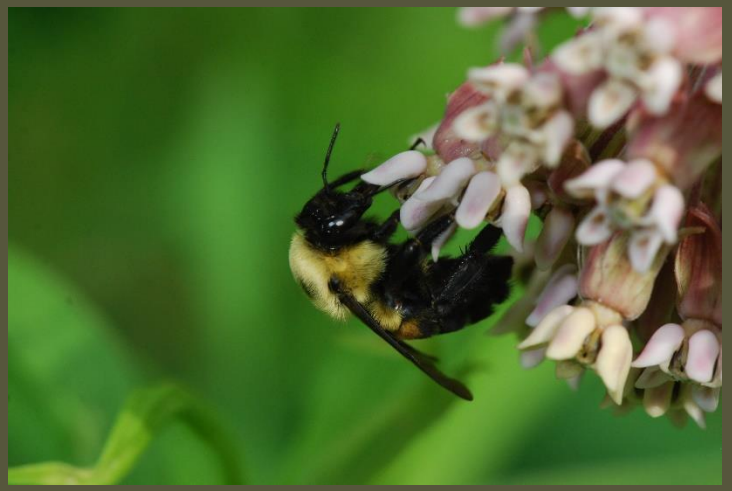




http://www.xerces.org/milkweeds-a-conservation-practitioners-g



Butterfly Milkweed - *Asclepias tuberosa*



Common Milkweed – *Asclepias syriaca*

Swamp or Marsh Milkweed - *Asclepias incarnata*

Access to Clean Water

Nesting Resources

nest entrance in soil

nest made in sloping soil

nest made in burrow

holes in a tree that could be used by bees

nesting box constructed for cavity nesting bees

Ground Nesting Bees

- Approximately ~70% (or 3,000 species in North America)

Ground Nesting Bees

- From above ground bee nests resemble ant hills
- May be found in turf, more often on bare, exposed ground
- Nests may be a deep as three feet

Ground Nesting Bees

Twig/Tunnel Nesting Bees

Twig/Tunnel-nesting bees:

- Approximately ~30% (or almost 1,000 species in North America)
- Hollow stems and beetle-borer holes

Retain or create tunnels:

- Protect snags wherever possible
- Provide artificial nests

IUCN SSC
BUMBLEBEE
SPECIALIST GROUP

Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services (IPBES)

- 16.5% -- Percentage of vertebrate pollinators threatened with extinction globally.
- +40% – Percentage of invertebrate pollinator species – particularly bees and butterflies – facing extinction.

Franklin's Bumble Bee (*Bombus franklini*)

Extinct (2006)?

IUCN RED LIST©

THE IUCN RED LIST
OF THREATENED SPECIES™

Photos: Pete Schroeder, Southern Oregon University

NOT EVALUATED	DATA DEFICIENT	LEAST CONCERN	NEAR THREATENED	VULNERABLE	ENDANGERED	CRITICALLY ENDANGERED	EXTINCT IN THE WILD	EXTINCT
NE	DD	LC	NT	VU	EN	CR	EW	EX

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Pollinators Always®