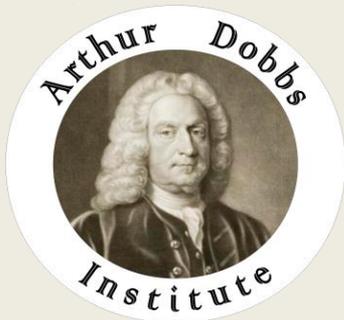


A Presentation to 3rd-Age (Life-Long) Learning,
Guelph,
24 March, 2016

Pollination: What it is and Why it matters?

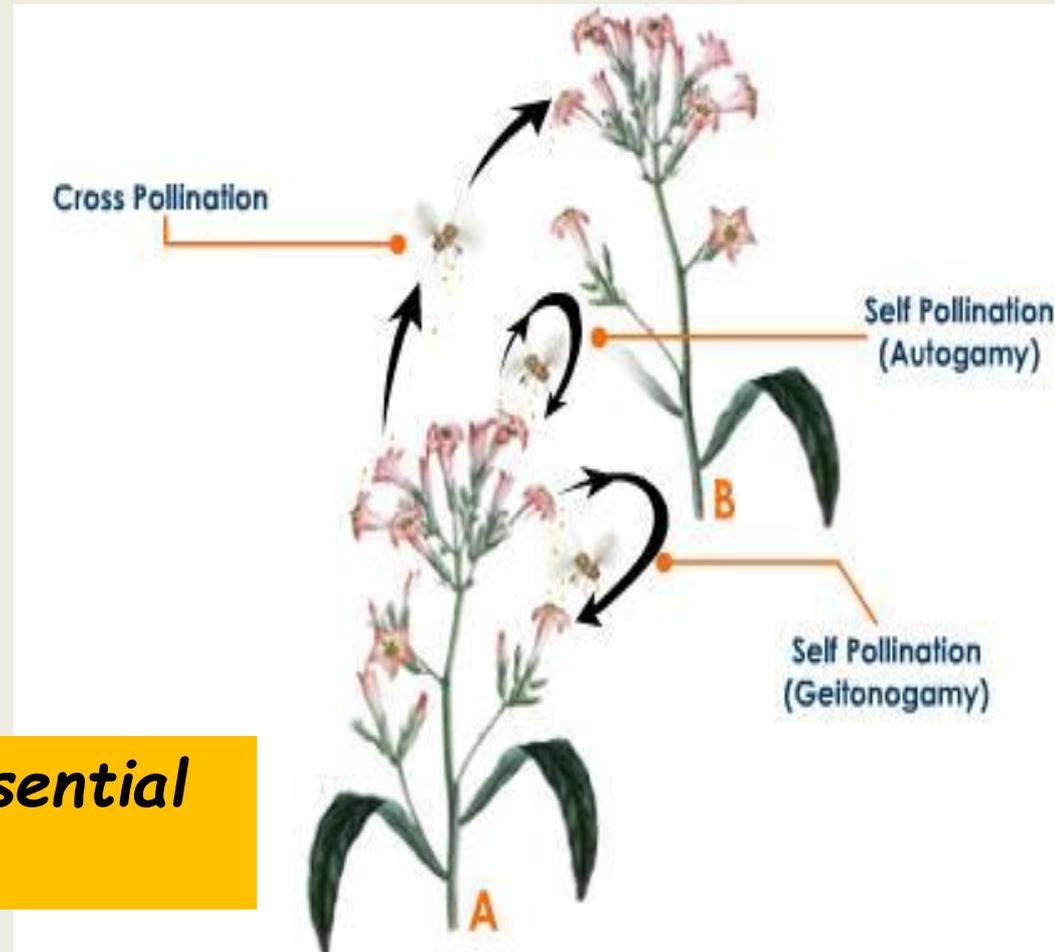
Peter G. Kevan & Vernon G. Thomas



What is Pollination?

It is the transfer of pollen grains from male to female parts of flowers.

It is one of nature's Essential Ecosystem Services!

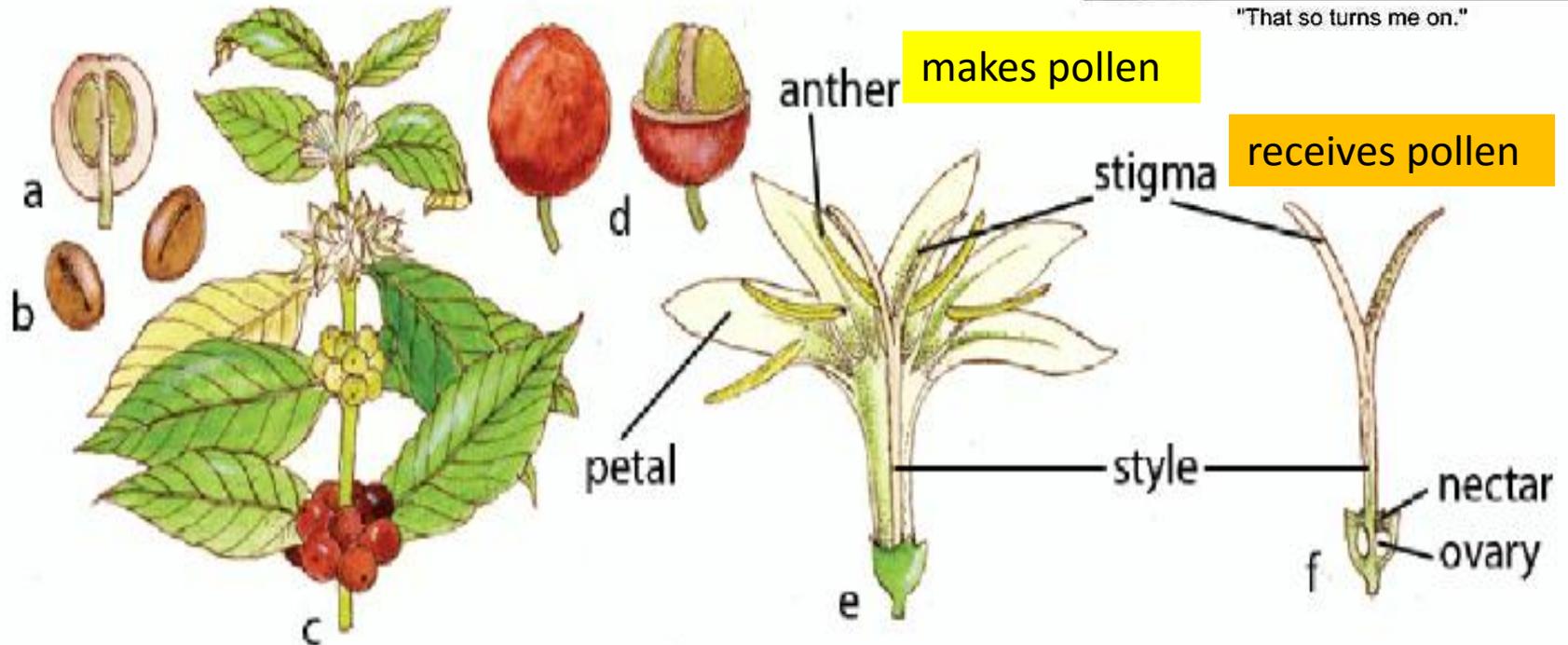


Pollination

- *The flower: How it works*



"That so turns me on."



Managed Pollinators

- Honey bees (*Apis* spp.; *A. mellifera*)
- Alfalfa Leafcutting Bees (*Megachile rotundata*)
- Bumble Bees (*Bombus* spp.; *B. impatiens*)
- Orchard Bees (*Osmia* spp.; *O. lignaria*)
- Flies for vegetable seed production



Pollinator Diversity: Wild Pollinators

Huge Diversity!



< 850 Canadian species of bees



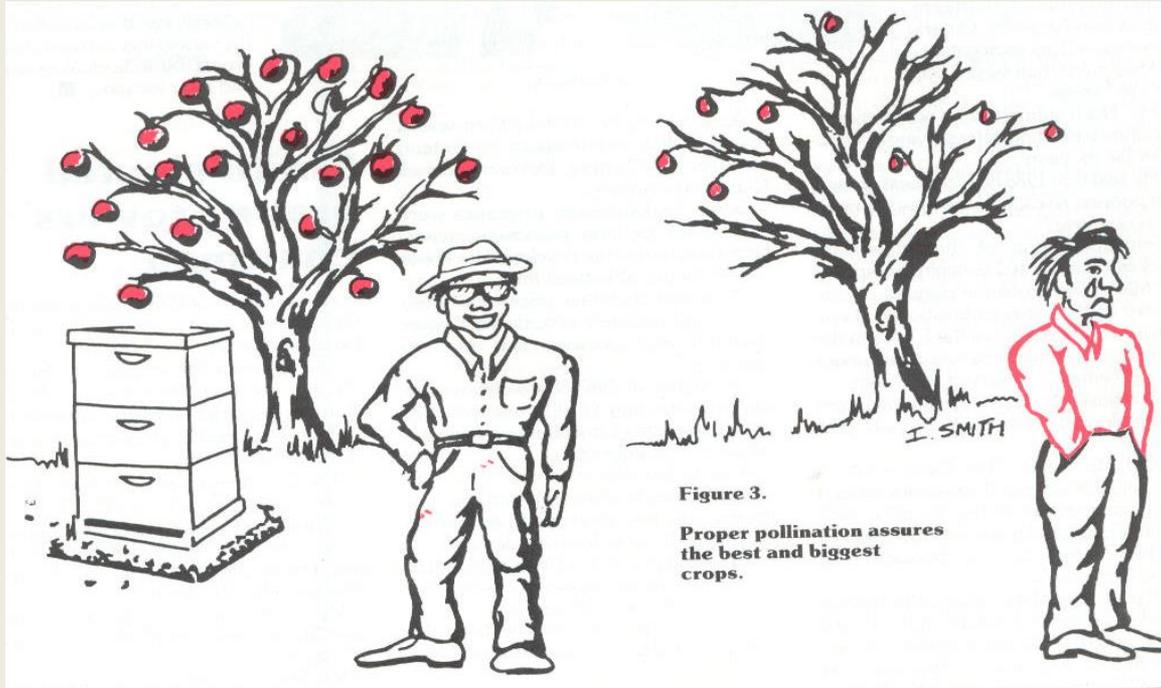
Pollinators & Pollination for Food & Fibre:

The Plant & Animal Actors

| Crops | Managed Pollinators (especially Honeybees) |
|---|---|
| Apples, Pears, Sweet cherries | ESSENTIAL: Honeybees , Orchard bees, Wild bees not really studied |
| Blueberries, Cranberries, Raspberries | ESSENTIAL: Honeybees, Bumblebees, Wild bees |
| Vegetables (Squash, pumpkin, field cucumbers) | ESSENTIAL: Honeybees, Squash bees , Bumblebees |
| Other orchard fruit | Improve yields, but details not understood |
| Other small & tender fruit | Managed pollinators essential for some, for others improve yields, but details and wild pollinators not understood |
| Oilseed crops, canola, mustards, sunflower | Managed pollinators essential for some, for others improve yields, but details not understood |
| Greenhouse crops | Bumblebees (tomato & pepper, not for cucumbers) |
| Forage legumes | Leafcutting bees (alfalfa), other bees essential for some |

Missing details mostly botanical/agronomic for plant breeding and mating systems

Pollinator & Pollination Deficits in Canada



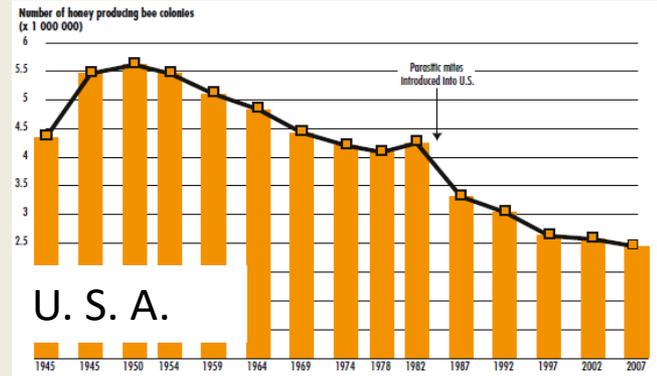
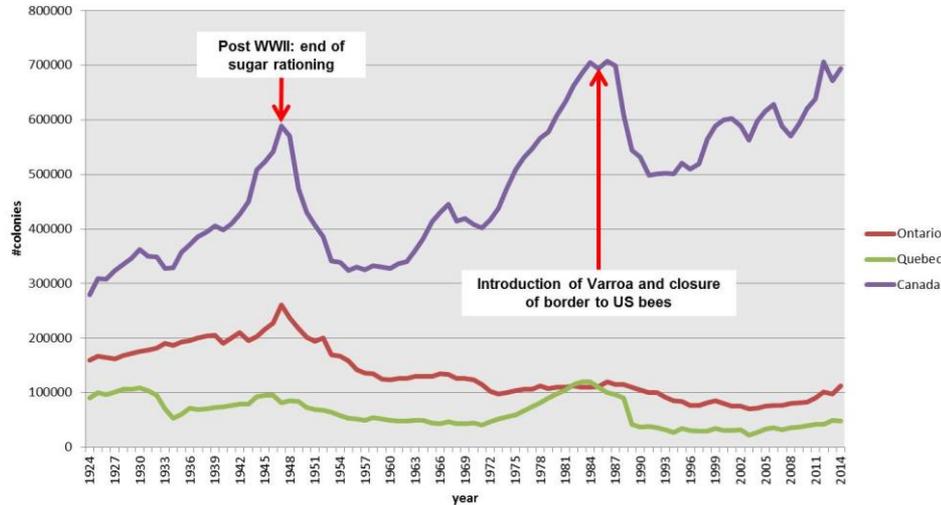
- Alfalfa:
 - field expansion
 - leafcutting bee technology
- Blueberries:
 - pesticides
 - lack of wild pollinators
 - add honeybees & leafcutting bees
- Apples:
 - pesticides
 - lack of wild pollinators
 - add honeybees
 - orchard design

Pollinators in Agriculture:

Honeybees: Trends

Canada

Managed honey bee colonies since 1927



Pollinator Protection: *Health of Honeybees*

- **Problems**

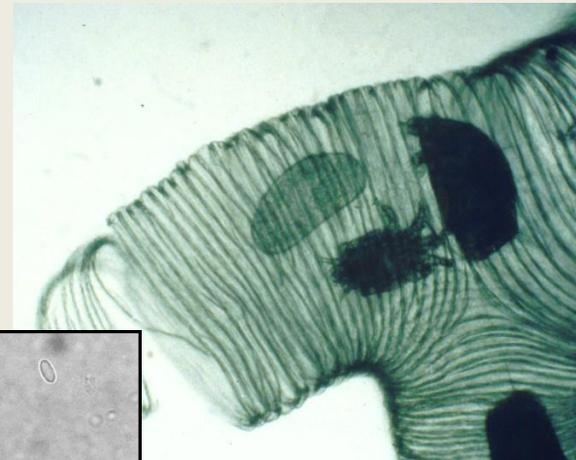
- Winter
- Pesticides
- Diseases
- Parasites
- Honey price
- Diet
(monocultures)



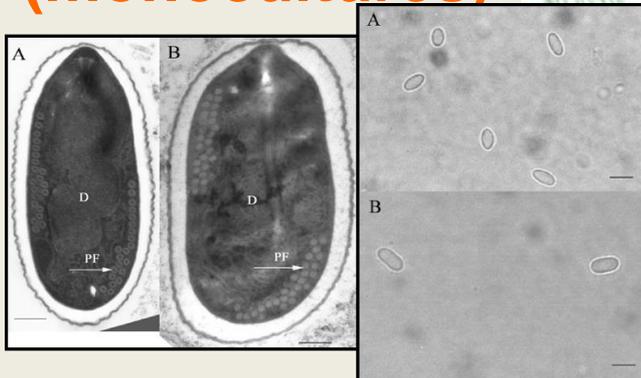
Chalk brood (fungus)



Tracheal mite



Varroa mite



Nosema apis & *N. ceranae* (protozoa)

Honeybee Problems in Ontario



Overwintering management, feeding, and health



Insecticides kill insects: Bees are insects!

Dust from treated seed being seeded: problem with neonics!

Direct applications to flowering crops, including corn!

Diseases: Varroa & virus complex



Honeybees in Urban Areas



By All Means!



Neighbours

By-Laws

Permissible or not?

Distances to property line?

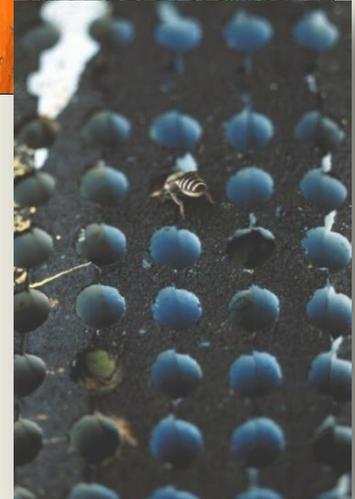
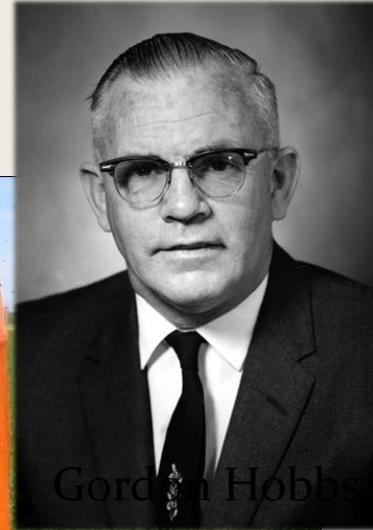
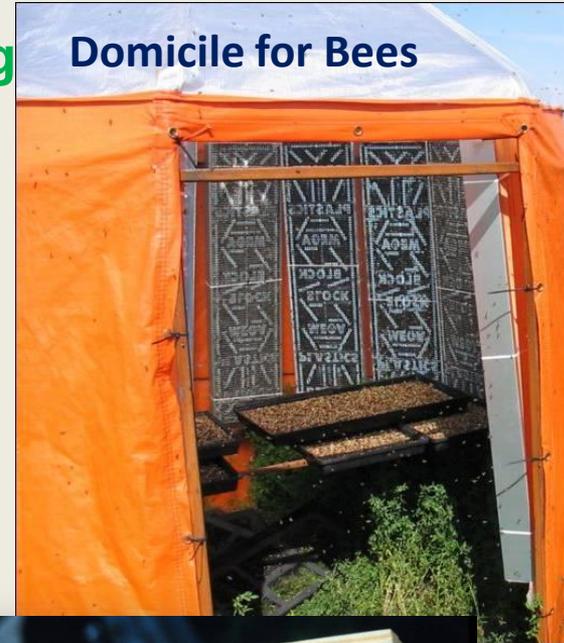
Liability





Pollinators in Agriculture: *Alfalfa Leafcutting Bees*

- **Pollination deficits**
- Huge alfalfa fields, no bee nesting habitat, except around edges
- Seed Yields drop: 1000 to 15 kg/ha (Stephen 1955)
- Alfalfa leafcutting bee husbandry operational by 1960s



Pollinators in Agriculture:

Bumble Bees



Bumblebees in Gardens

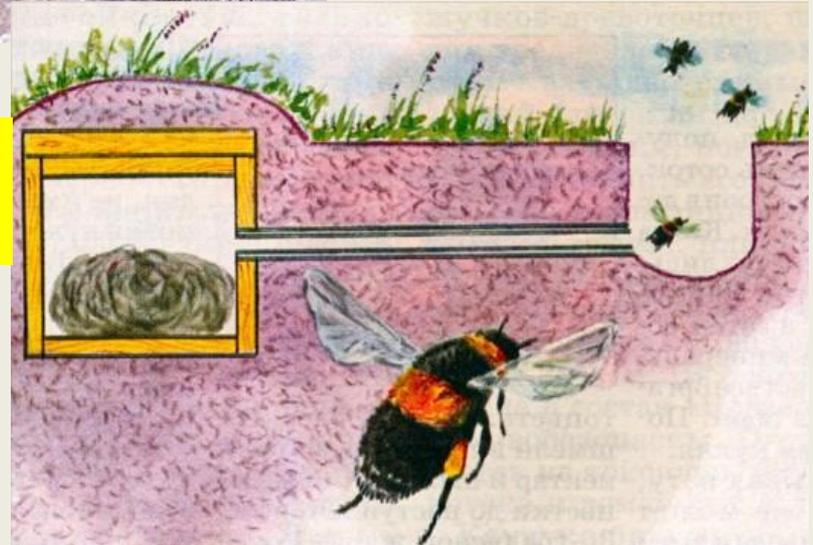


**Rockeries,
Flagstones
Wood piles**



**Mouse
nests!**

**Build your own
for the Bumbles**



Pollinators for Food:

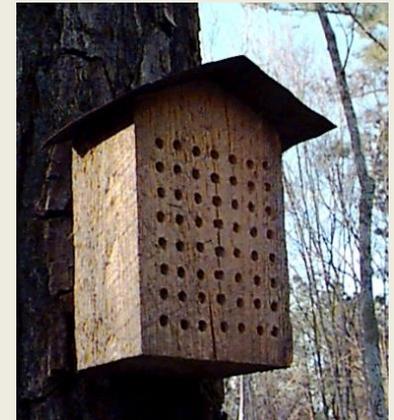
Other Managed Bees (Orchard bees)



Efficient
Cold tolerant
No stings
Easy management



© S. Bamba



Solitary Wild Bees in Gardens

- Twig & Hole Nesters



Solitary Wild Bees in Gardens

- **Ground nesters**



**Some bare ground
No mulch madness
Pathways & between flagstones
Try to make a bee nesting bed**



Pollinators for Food:

Wild Pollinators (Hoary Squash Bee)

- **Male & Female Flowers**
 - On same plants
- Open pre-dawn (1 day only)
 - How to pollinate?
- **Female squash bees**
 - Active from nests in pre-dawn
 - Gathering pollen & nectar
 - Provision nests
- Nests 25 – 30 cm deep in ground
- **Pollination complete by mid-morning**
- **Male squash bees** (Life of Riley!)
 - Sleep in flowers
 - Wake up mid-morning
 - Drink nectar
 - Chase females
 - Sleep in flower



Conserving Squash Bees



**Conventional vs.
low or no Tillage:**

**Encourages ground nesting
pollinating bees
(e.g. Hoary squash bee)**



Pollinators for Food:

Wild Pollinators (Blueberries)

- Maritimes & Quebec
- Canadian production
 - 300 Million Kg/yr
- Exports = \$360 Million in 2013

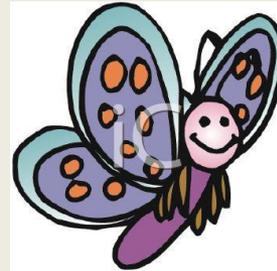
- Must be pollinated by bees
 - Buzz pollination best
 - Wild bees (70+ species)
 - Incl. Bumblebees
 - Honeybees
 - Combination of bees best



Garden Plantings for Pollinators



Not pollinator friendly!



Pollinator Friendly!
Lots of choice



Nectar
Pollen
“Double cultivars” usually lacking
Diversity
Spring thru’ Fall
Sun – Shade

ONTARIO'S POLLINATOR PALS

POLLINATOR-FRIENDLY PLANTS FOR YOUR GARDEN

| FLOWERS | SHRUBS | TREES |
|---------------------|-------------------|-----------------|
| BEE BALM | WITCH-HAZEL | SUGAR MAPLE |
| LAVENDER | NEW JERSEY TEA | EASTERN HENLOCK |
| EVINGING PRIMROSE | CRACK CHERRY | BLACK CHERRY |
| WOODLAND SANDFLOWER | COMMON NINE BARK | HAWTHORN |
| FLAXWEED | SERRULEBERRY | RED MAPLE |
| MILKWEED | COMMON ELDERBERRY | STAGHORN SUMAC |
| NEW ENGLAND ASTER | NANNYBERRY | BLACK WILLOW |

Ontario Nature
To learn more about pollinators, visit ontariounature.org/pollinators

Pollination by *Wind*



Rye in flower



Wheat in flower



Sorghum pollen in the wind!



Trapping airborne pollen

Observing Wind Pollination



- **Megastigma trap:**
 - Easy to make
 - Collect traplets
 - Count pollen (microscope)
 - Graph results
- **Observe pollen** release times and conditions (tap grass heads)
- **Watch for stigma** exsertion

Role & Importance of Pollination in Food Security & Ecosystem Sustainability

- **Pollination: an Essential Natural Service**

Pollination Relations are Central to:

Fruits & Vegetables

Oil seeds

Forage for livestock

Trees & Shrubs (nuts and fruits)

Biocontrol

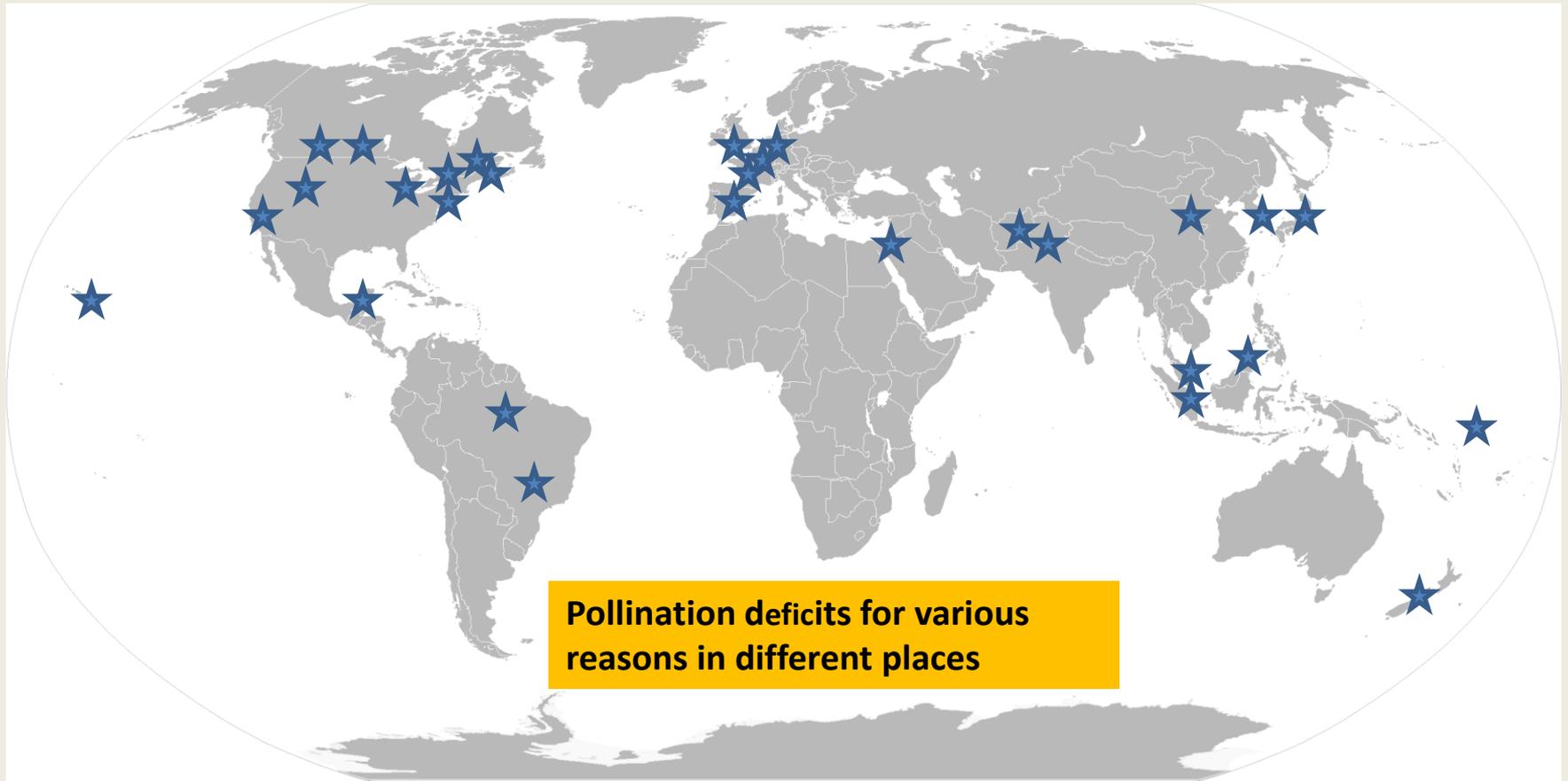
Natural Food Webs

Natural Ecosystem Function

Insect pollination has an estimated worth for food and fibre production of over \$217 Billion/year globally!

1 in 3 bites of food: Thank a pollinator!

Some Hotspots of Pollination Deficits



Pollination in Natural Ecosystems:

Foodwebs, Productivity, Ecosystem Function



◎ Migratory & Winter-Resident Birds

– Forest seeds & fruits for energy stores

◎ Black bears & forest berries

– Sows feed on berries → gain fat (2kg/day) for hibernation → milk for cubs → strong & healthy in spring: **Too few berries** → ...!

The Pollination Crisis: Fact or Fiction: Is there a shortage of pollinators?

Yes! Lots of examples, even from Canada!

Most examples are local or regional for both human food production and ecosystem sustainability.

Are shortages large enough to affect human food security or broad-scale ecosystem function?

- Global statistical analyses suggest not. At least “not yet”!**
- Modern global food production statistics are more complete.**
- Pollination technologies have adapted to production needs.**
- Local/Regional problems are not large enough to register globally.**
- Ecosystem function, integrity, and sustainability inadequately monitored**

Are We Listening? Yes!



NRCanada (1981) Pesticide Pollinator Interactions



AgCanada (1989) National Workshop, Winnipeg



ESC (1997) Pollinators & Mother Earth



Canadian participation in International (1992, 1995-1999, 1998-2006)



Review of Canadian Legislation (2007)



US NRC (2007) *Status of Pollinators in North America*



Canadian Pollination Initiative (NSERC-CANPOLIN) (2009 – 2014)

- Major reviews and projects in Europe



Canadian Senate Review 2013 - 2015



Intergovernmental Platform on Biodiversity & Ecosystem Services (IPBES) 2014 – 2016 (later this year!) Science & Policy

What needs to be done?

- R & D for Managed Pollinators
- *Diversification of Managed Pollinators*
- *Monitoring Managed and Wild Pollinators*
- Understanding crop pollination systems
- *Understanding centrality of pollination in managed and wild ecosystem integrity*
- Land management for pollinators & pollination
- Gardens & Urban Pollinator Friendly Actions

Thank you for getting in on the Action

Over to you,
Vern!



Thank you!



The Scope of Pollination: The Canadian View on the Pollination Crisis

- **NRCanada (1981) Pesticide Pollinator Interactions**
- **AgCanada (1989) National Workshop, Winnipeg**
- **ESC (1997) Pollinators & Mother Earth**
- **Canadian participation in International & US meetings (1992, 1995-1999, 1998-2006)**
- **Review of Canadian Legislation**
- **US NRC (2007) *Status of Pollinators in North America***

- ◎ **Wild pollinator diversity**
- ◎ ***Managed pollinator health & sustainability***
- ◎ **Plant reproductive needs**
Insect & wind pollination
- ◎ ***Ecosystem function, complexity & conservation***
- ◎ **Predictions**
Climate & land-use changes
Economics & Policy issues

January 2009 -December 2013

