Protecting Pollinators and Beneficial Insects for Arborists and Landscapers

Dave Smitley, March 30, 2017
Michigan State University
Bee declines driven by combined stress from parasites, pesticides, and lack of flowers

Dave Goulson, * Elizabeth Nicholls, Cristina Botías, Ellen L. Rotheray

Over 170 scientific papers are cited.
According to Professor Dave Goulson, director of the Bumblebee Conservation Trust at the University of Stirling in Scotland, Britain once boasted 25 native bumblebee species. Three have disappeared in the last 50 years, 10 are currently "severely threatened", and two are "are teetering on the edge of extinction and could be gone in five to 10 years quite easily".
Total US managed honey bee colonies Loss Estimates

- Acceptable Winter Loss
- Total Winter Loss
- Total Annual Loss

<table>
<thead>
<tr>
<th>Year</th>
<th>Winter Loss (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006-07</td>
<td>10%</td>
</tr>
<tr>
<td>2007-08</td>
<td>30%</td>
</tr>
<tr>
<td>2008-09</td>
<td>25%</td>
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<tr>
<td>2009-10</td>
<td>30%</td>
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<tr>
<td>2010-11</td>
<td>20%</td>
</tr>
<tr>
<td>2011-12</td>
<td>40%</td>
</tr>
<tr>
<td>2012-13</td>
<td>45%</td>
</tr>
<tr>
<td>2013-14</td>
<td>50%</td>
</tr>
<tr>
<td>2014-15</td>
<td>35%</td>
</tr>
<tr>
<td>2015-16</td>
<td>30%</td>
</tr>
</tbody>
</table>
Honey bee mortality in Europe

The honey bee research association collects data on colony losses over the 2015-16 winter:

- Data were collected from 29 countries
- Collectively, all responding beekeepers managed 399,602 honey bee colonies. The overall proportion of colonies lost was estimated as 11.9%.
Seed coating with a neonicotinoid insecticide negatively affects wild bees in Sweden

Maj Rundlöf1, Georg K. S. Andersson1,2, Riccardo Bommarco3, Ingemar Fries3, Veronica Hederstroem1, Lina Herbertsson2, Ove Jonsson4,5, Bjoern K. Klatt2, Thorsten R. Pedersen6, Johanna Yourstone1 & Henrik G. Smith1,2

Conclusions:
• Clothianidin seed coating in oil seed rape (canola), has negative effects on wild bees.

• Bumble bees are more sensitive than honey bees.
Impacts of neonicotinoid use on long-term population changes in wild bees in England

Ben A. Woodcock, Nicholas J.B. Isaac1, James M. Bullock, David B. Roy, David G. Garthwaite, Andrew Crowe & Richard F. Pywell

We find evidence of increased population extinction rates in response to neonicotinoid seed treatment use on oilseed rape. Species foraging on oilseed rape benefit from the cover of this crop, but were on average three times more negatively affected by exposure to neonicotinoids than non-crop foragers.
What Concentrations of Imidacloprid are Toxic to Honey Bees?

- **Oral LD50** (in nectar, sugar water, pollen): 180 ppb
- **Chronic LD50** (continuous exposure): 50 ppb
- **Debilitating concentration**: > 20 ppb
- **Sublethal effects (disorientation, etc)**: 5 – 20 ppb
Which Insecticide Products are Neonicotinoids?

Technically, according The IRAC mode of action classification system, it is all insecticides in the 4A category. This includes:

- acetamaprid (Tristar), but Tristar is not toxic to bees
- dinotefuran (Safari, Dinotefuran, Sagacity),
- thiomethoxam (Flagship)
- chlothianidin (Arena)
- imidaclorpid (Marathon, Benefit, Discus, Imigold, Bounty, and others usually with imidaclorpid in the product name).
June 2014

Gardeners Beware 2014: Bee-Toxic Pesticides Found in “Bee-Friendly” Plants Sold at Garden Centers Across the U.S. and Canada

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Report Summary (of a 60 page report):
• Plants were purchased from retail nurseries, including Home Depot, Lowe's, Walmart, and Orchard Supply Hardware in 18 cities across the U.S., as well as three provinces in Canada.
• They then sent the plants off to a laboratory to measure the presence and concentration of pesticides in the greenery.
• Testing showed that 51 percent of store-bought plants had levels of a group of harmful pesticides known as neonicotinoids that were high enough to kill honey bees, bumble bees, and other pollinators "outright."
Gardeners Beware Report

Oral LD50
- 180 ppb, acute
- 50 ppb, chronic

Destructive
- > 20 ppb
Gardeners Beware 2016: Bee-toxic Pesticides Found in “Bee-friendly” Plants Sold at Garden Centers Across the U.S.

Comparison of 2016 results to 2013 and 2014 results indicates that progress is being made towards reducing the use of neonicotinoids in ornamental plants; only 23 percent of plants were found to contain neonicotinoids in 2016, compared with slightly more than 50 percent in 2013 and 2014.
• **Honey Bees:** Reduce honey bee colony losses during winter (overwintering mortality) to no more than 15% within 10 years.

• **Monarch Butterflies:** Increase the Eastern population of the monarch butterfly to 225 million butterflies occupying an area of approximately 15 acres (6 hectares) in the overwintering grounds in Mexico, through domestic/international actions and public-private partnerships, by 2020.

• **Pollinator Habitat Acreage:** Restore or enhance 7 million acres of land for pollinators over the next 5 years through Federal actions and public/private partnerships.

https://www.whitehouse.gov/sites/default/files/microsites/ostp/Pollinator%20Health%20Strategy%202015.pdf

**Note:** Some have criticized the report for the lack of discussion about the role of pesticides in causing bee decline.
The Monarch Butterfly—a threatened species?
Monarch butterfly lifecycle
https://www.youtube.com/watch?v=1b87rwtXGzA

Monarch migration
https://www.youtube.com/watch?v=RFoSpaNqgeQ
What are the suspected causes of decrease in the Monarch butterfly population in North America?

• Loss of milkweed habitat to cleaner agricultural fields
• Loss of overwintering habitat in Mexican mountains
• A rare freeze event two years ago
• Pesticides?
Recent Developments on Neonics and Bees

• Maryland ban of neonics
• Cities that have banned neonics: Boulder (Colorado), Seattle, Skagway (Alaska), Eugene (Oregon), Spokane (Washington)
• Dozens of cities have banned neonics for use on public land
• US Fisheries and Wildlife ban on neonics on their land

• Lowe’s to phase-out neonics by 2019
• Home Depot to phase-out neonics by 2018
• Grower survey: 64% of Home Depot growers (greenhouse and nursery) not planning to use neonics in 2016
A state ban on consumer use of neonicotinoid pesticides is slated to take effect Jan. 1, 2018, after Maryland Gov. Larry Hogan (R) announced that he will allow S.B. 198/H.B. 211 to become law without his signature.

The legislation, which includes exceptions for certified applicators, farmers and veterinarians, makes Maryland the first state to adopt such a ban on consumer use, according to a coalition of environmental organizations operating as Smart on Pesticides Maryland.
Rusty Patched Bumblebee: Proposed Endangered Species

No other bees or bumblebees are listed under the Endangered Species Act, and the move comes amid growing concern about the decline of honeybees.
First National Conference on Protecting Pollinators in Ornamental Landscapes

Held October 12-14, 2015
Kanuga, North Carolina

• 185 people attended, mostly educators and some researchers
• 22 speakers from 11 universities and 3 countries
• Keynote speaker: Dave Goulson, UK
• 80% of attendees plan to come again in 2017
• Next conference will be in Michigan (October 2017), and it will include state reports on pollinator protection programs, and a session on butterflies.
PROTECTING POLLINATORS IN URBAN AND RURAL LANDSCAPES

Date: October 9-11, 2017 Location: Park Place Hotel – Traverse City, Michigan

Hosted by Michigan State University and North Carolina State University, this conference is for extension educators, academic and industry researchers, arborists, landscapers, and representatives of related industries involved with ornamental plant and urban green spaces.

Visit the Pollinator website for more information:
http://ecoipm.org/
Presentations at the Pollinator Conference Were Used to Address This Issue:

How to Protect Pollinators AND Manage Exotic Pests

fyi.uwex.edu

royalalbertamuseum.ca

Cornell University
New online publication for the North Central United States

Protecting and enhancing pollinators in urban landscapes for the US North Central Region

by David Smitley, Diane Brown, Erwin Elsner, Joy Landis - Michigan State Univ.; Paula M. Shrewsbury – Univ. of Maryland; Daniel A. Herms - The Ohio State Univ.

Available on the Internet at: bit.ly/IPMpollinators

Which flowers, shrubs and trees we select and how we care for them can make a difference in supporting bees and butterflies. This document is for landcapers and gardeners who want to attract pollinators and protect them during pest management tactics or pesticide applications.

This colorful 30-page PDF resource includes:
• Plants, shrubs, trees known to create better pollinator habitat.
• How to select plants to provide flowers throughout the season.
• Problem-prone plants you may want to avoid.
• Best Management Practices to protect pollinators and other beneficial insects during pest management.
Protecting and enhancing pollinators in urban landscapes
for the US North Central Region

bit.ly/IPMpollinators

- Factors that threaten pollinator health
- Creating pollinator-friendly habitat
- Better habitat for bees
- Flowers throughout the year
- Selection and care of trees and shrubs
- How to control invasive pests
- Do not spray attractive plants
- Avoid spraying flowers with fungicides
- Best Management Practices
Major factors that threaten pollinator health

• Parasites and pathogens
• Loss of habitat (flowers)
• Pesticides
Which Annuals And Perennials Are Good For Pollinators?
## Annuals

<table>
<thead>
<tr>
<th>Annuals</th>
<th>Value in 2014 ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petunias</td>
<td>262,959</td>
</tr>
<tr>
<td>Geraniums (from vegetative cuttings)</td>
<td>223,954</td>
</tr>
<tr>
<td>Pansies (Violas)</td>
<td>186,024</td>
</tr>
<tr>
<td>Begonia</td>
<td>133,349</td>
</tr>
<tr>
<td>Impatiens, other (I. wallerana)</td>
<td>114,829</td>
</tr>
<tr>
<td>Impatiens, New Guinea</td>
<td>99,950</td>
</tr>
<tr>
<td>Marigold</td>
<td>82,362</td>
</tr>
<tr>
<td>Combination planter/color bowl</td>
<td>81,344</td>
</tr>
<tr>
<td>Geraniums (from seeds and plug seedlings)</td>
<td>46,657</td>
</tr>
<tr>
<td>Calibrachoa</td>
<td>44,592</td>
</tr>
<tr>
<td>Vinca (Catharanthus roseus)</td>
<td>42,236</td>
</tr>
<tr>
<td>Coleus</td>
<td>19,900</td>
</tr>
<tr>
<td>Zinnia</td>
<td>16,472</td>
</tr>
<tr>
<td>Verbena</td>
<td>15,863</td>
</tr>
<tr>
<td>Gerbera daisy</td>
<td>14,261</td>
</tr>
<tr>
<td>Salvia, annual</td>
<td>13,977</td>
</tr>
<tr>
<td>Fuchsia</td>
<td>13,805</td>
</tr>
<tr>
<td>Caladium</td>
<td>12,639</td>
</tr>
<tr>
<td>Dahlia</td>
<td>12,533</td>
</tr>
<tr>
<td>Snapdragon</td>
<td>12,119</td>
</tr>
<tr>
<td>Alyssum, sweet (Lobularia)</td>
<td>11,381</td>
</tr>
<tr>
<td>Lobelia</td>
<td>11,259</td>
</tr>
<tr>
<td>Portulaca</td>
<td>9,606</td>
</tr>
<tr>
<td>Dianthus</td>
<td>7,736</td>
</tr>
</tbody>
</table>

### The Top Five Annuals are not the Most Attractive to Pollinators
### Annuals attractive to bees table

<table>
<thead>
<tr>
<th>Common name</th>
<th>Genus species (scientific name)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue salvia (mealycup sage)</td>
<td><em>Salvia farinacea</em></td>
</tr>
<tr>
<td>Borage or starflower</td>
<td><em>Borago officinalis</em></td>
</tr>
<tr>
<td>Calendula</td>
<td><em>Calendula officinalis</em></td>
</tr>
<tr>
<td>Clary sage</td>
<td><em>Salvia sclarea</em></td>
</tr>
<tr>
<td>(biennial)</td>
<td></td>
</tr>
<tr>
<td>Common lantana</td>
<td><em>Lantana camara</em></td>
</tr>
<tr>
<td>Common sunflower</td>
<td><em>Helianthus annuus</em></td>
</tr>
<tr>
<td>Cornflower</td>
<td><em>Centaurea cyanus</em></td>
</tr>
<tr>
<td>Cosmos</td>
<td><em>Cosmos bipinnatus</em></td>
</tr>
<tr>
<td>Dahlia (open types)</td>
<td><em>Dahlia</em> cv.</td>
</tr>
<tr>
<td>Garden heliotrope</td>
<td><em>Heliotrope arborescens</em></td>
</tr>
<tr>
<td>Mignonette</td>
<td><em>Reseda odorata</em></td>
</tr>
<tr>
<td>Pentas</td>
<td><em>Pentas</em> spp.</td>
</tr>
<tr>
<td>Pineapple sage</td>
<td><em>Salvia elegans</em></td>
</tr>
<tr>
<td>Popcorn plant</td>
<td><em>Cassia didymobotrya</em></td>
</tr>
<tr>
<td>Snapdragon</td>
<td><em>Antirrhinum majus</em></td>
</tr>
<tr>
<td>Spider flower</td>
<td><em>Cleome</em> spp.</td>
</tr>
<tr>
<td>Sweet William</td>
<td></td>
</tr>
</tbody>
</table>

*Additional notes:*
- *Dianthus barbatus*
- Sweet alyssum *Lobularia maritima*
- Tithonia *Tithonia rotundifolia*
- Vervain *Verbena bonariensis*
- Zinnia *Zinnia elegans*
Herbaceous perennials
attractive to bees

Common name (scientific name)

Anise hyssop *Agastache foeniculum*
Aromatic aster *Symphyotrichum oblongifolium*
Aster *Aster novae-angliae* – ‘Purple Done’
Astilbe, false spirea *Astilbe* spp.
Basil, sweet basil (annual)
*Ocimum basilicum*
Bee balm *Monarda* spp.
Bellflower *Campanula* spp.
Betony *Stachys monieri*
Bigleaf ligularia *Ligularia dentate*
Black-eyed Susan, coneflower
*Rudbeckia* spp.
Blanket flower *Gaillardia*
Blazing star *Liatris spicata*
Butterfly bush *Buddleja* or *Buddleia*

Butterfly weed *Asclepias tuberosa*
Calamint *Calamintha nepeta*
Carolina lupine *Thermopsis villosa*
Catmint *Nepeta* spp.
Chrysanthemum (open types)
*Chrysanthemum*
Anise hyssop
Shrubs attractive to bees
Common name (scientific name)
Black chokeberry *Aronia melanocarpa*
Bottlebrush buckeye *Aesculus parviflora*
Buttonbush *Cephalanthus occidentalis*
Common witch-hazel *Hamamelis virginiana*
Cotoneaster *Cotoneaster*
Dwarf fothergilla *Fothergilla gardenia*
Eastern ninebark *Physocarpus opulifolius*
Elderberry *Sambucus* spp.
Mockorange *Philadelphus coronarius*
Potentilla (bush cinquefoil) *Potentilla fruticosa*
Privet *Ligustrum vulgare*
Raspberry, blackberries *Rubus* spp.
Silky, gray, redosier dogwoods, *Cornus* spp.

Spicebush *Lindera benzoin*
Spirea *Spiraea* spp.
Sumacs *Rhus* spp.
Summersweet, sweet pepperbush
* Clethra alnifolia
Viburnums *Viburnum* spp.
Wild prairie rose *Rosa arkansana*
Trees attractive to bees

Common name Genus species (scientific name) Bloom
Eastern redbud *Cercis canadensis* April
Red maple *Acer rubrum* April
Alternate-leaved, pagoda or green osier dogwood *Cornus alternifolia* May
Black tupelo, blackgum *Nyssa sylvatica* May
Callery pear *Pyrus calleryana* May
Cherry, peach, plum, almond *Prunus* spp. (many) May
Crabapple, apple *Malus* spp. (many) May
Hawthorn *Crataegus* spp. (many) May
Serviceberry *Amelanchier* spp. May
Willow *Salix* spp. May
Wind-pollinated trees attractive to bees

Common name (scientific name)
Ash *Fraxinus* spp. Somewhat attractive
Birch *Betula* spp. Somewhat attractive
Elm *Ulmus* spp. Very attractive
Hickory *Carya* spp. Somewhat attractive
Oak *Quercus* spp. Very attractive
Poplar *Populus* spp. Very attractive
Maple *Acer* spp. Highly attractive
Willow *Salix* spp. Highly attractive

Red maple
Are Annuals, Perennials and Woody Ornamentals Sold at Garden Centers Safe for Pollinators?
Systemic Insecticides are Rarely Used on Flowers Grown in Flats
The Greatest Potential Risk to Pollinators are Highly Attractive Flower Types (annuals, perennials, shrubs, trees) Grown in Pots Treated With a Soil-Applied Systemic Insecticide in Spring of the Same Year that They are Sold
Experiment I: bumble bee colonies in screen tents with annual flowers for 3 weeks
Bombus impatiens
Then put in shelters and allowed to forage freely the rest of the summer.
Conclusions

Imidacloprid drench to potted annuals applied in greenhouses during the spring growing period is devastating to bumble bees feeding on treated plants for one week in June
Smitley lab Experiment (2014 – 2015): *Tilia* trees drenched with imidacloprid the previous year
Then put in shelters and allowed to forage freely the rest of the summer
Impact of Imidacloprid Basal Drench of Linden Trees Applied after Petal Fall in 2014 to Bumble Bees 12 months later

Changes that may have improved survival:
- CO₂ instead of cold room
- 10 days in screen tents
- Water-based paint dots

Screen cage exposure period

June 19

Aug. 29

Bees Per Colony

Control

Imidacloprid drench in July, 2014
Conclusion

• Imidacloprid drench of *Tilia* trees growing in containers had no impact on bumble bees *the following year*
Avoid problem-prone plants likely to need insecticide or fungicide treatment to remain healthy

- Ash
- Austrian pine
- Colorado spruce
- Common lilac
- Crabapple
- European mountain ash
- European white birch
- Purpleleaf plum

- Poplars
- Russian olive
- Siberian elm
- Willow
- Wintercreeper euonymus
Best Management Practices to Protect Pollinators: Focus on Highly Attractive Plants

• Avoid pesticides as much as possible

• Do not spray flowers of plants attractive to bees

• Do not apply soil drenches of imidacloprid or other systemic insecticides to plants attractive to bees

• Use low impact pesticides (soaps, oils, etc.)
Selective products to minimize impact on pollinators

- Insecticidal soap
- Horticultural oil
- B.t.

**Chlorantraniliprole.** This EPA Reduced Risk chemical interrupts the normal muscle contraction of insects resulting in paralysis and death. It has systemic activity and can be applied as a foliar spray or through the soil. It is labeled against turf pests including caterpillars, white grubs, crane fly, billbugs, annual bluegrass weevil, and spittlebugs; and pests of ornamentals including leaf-feeding caterpillars, lace bugs, aphids, birch leafminer, and as a bark spray for clearwing borers.
Selective products to minimize impact on pollinators

Acetamiprid is in the Neonicotinoid class of chemicals and is classified as reduced risk by EPA. It kills insects by disrupting nerve function. Acetamiprid is a systemic and absorbed through the foliage. It is labeled to control a broad range of pest insects on ornamental plants including aphids, adelgids, caterpillars, European pine sawfly, mealybugs, leafhoppers, armored and soft scales, plant bugs, whiteflies, fungus gnat larvae, thrips, and leafmining flies.
Hexythiazox is a mite growth regulator that disrupts the normal development of mites. It is effective against immature spider mites and eggs, has long residual activity and applied at low rates. Hexygon (a.i. hexythiazox) is selective for spider mites in the Tetranychidae family which includes arborvitae spider mite, European red mite, honeylocust spider mite, Pacific spider mite, Southern red mite, spruce spider mite, strawberry spider mite, two-spotted spider mite, and Willamette mite. There is no bee precautionary statement on the label of Hexygon and it is generally considered nontoxic to bees, although there is a caution that there may be a short residual (~2 hr) effect on alfalfa leafcutting and alkali bees.
When an Insecticide is Necessary Adjust Timing of Application to Minimize the Impact on Pollinators:

AFTER FLOWERING IS OVER
Japanese beetle feeding on linden leaves

Linden (*Tilia* spp.) trees in flower

Foliar spray applied if defoliation is expected to exceed 30% of total leaf area
Lesions appear on leaves and fruit of Crabapple (\textit{Malus} spp.) trees in flower from April to October. To avoid pollinators, apply fungicides after leaf buds open and before flowers open (best timing) or after the flowers drop.
Ash trees in flower

EAB adults and foliage feeding

EAB larvae tunnel Under the bark

April  May  June  July  August  September  October

Make trunk injections in late May after trees are done flowering
Michigan State University Extension
Department of Entomology
Michigan Pollinator Initiative