Pollinators in our Communities

XERCES SOCIETY for Invertebrate Conservation

Nancy Lee Adamson, PhD
Senior Pollinator Conservation Specialist
Xerces Society & USDA-NRCS ENTSC

Photos: Nancy Adamson; inset Margo Connor

Thanks to NACD members for supporting healthy, beautiful communities!

…and many excellent scientists, conservationists, and farmers

Financial support from

- Xerces Society Members
- NRCS East National Tech Center
- Turner Foundation
- Disney Worldwide Conservation Fund
- C.S. Fund
- Whole Foods Market & their vendors
- Organic Valley FAFO
- Organic Farming Research Foundation
- Nat'l Institute of Food & Agric., USDA
- Cinco
- Clif Bar Family Foundation
- Alice C. Tyler Perpetual Trust
- Sarah K. de Coizart Article TENTH Perpetual Charitable Trust
- The Edward Gorey Charitable Trust
- EarthShare (CFC #18360)
- Endangered Species Chocolate
- The Metabolic Studio
- The Ceres Foundation
- & many others…

bumble bee on flowering raspberry *Rubus odoratus*

Photo: Nancy Adamson

Talk Outline

- Importance of pollinators
- Health update
- Protecting & enhancing habitat
- Habitat needs--Basic bee & other insect biology
- Additional resources

bumble bee on blazing star,*Liatris spicata*

Photo: Nancy Adamson

Xerces Society for Invertebrate Conservation partnering with NRCS

Xerces-NRCS partner biologists support pollinator habitat protection and creation with Farm Bill Programs, which benefits other beneficial insects and wildlife

Since 1971, the Xerces Society has worked to protect wildlife through the conservation of invertebrates and their habitat.

Xerces blue butterfly (*Glaucopsyche xerces*), the first U.S. butterfly to go extinct due to human activities.

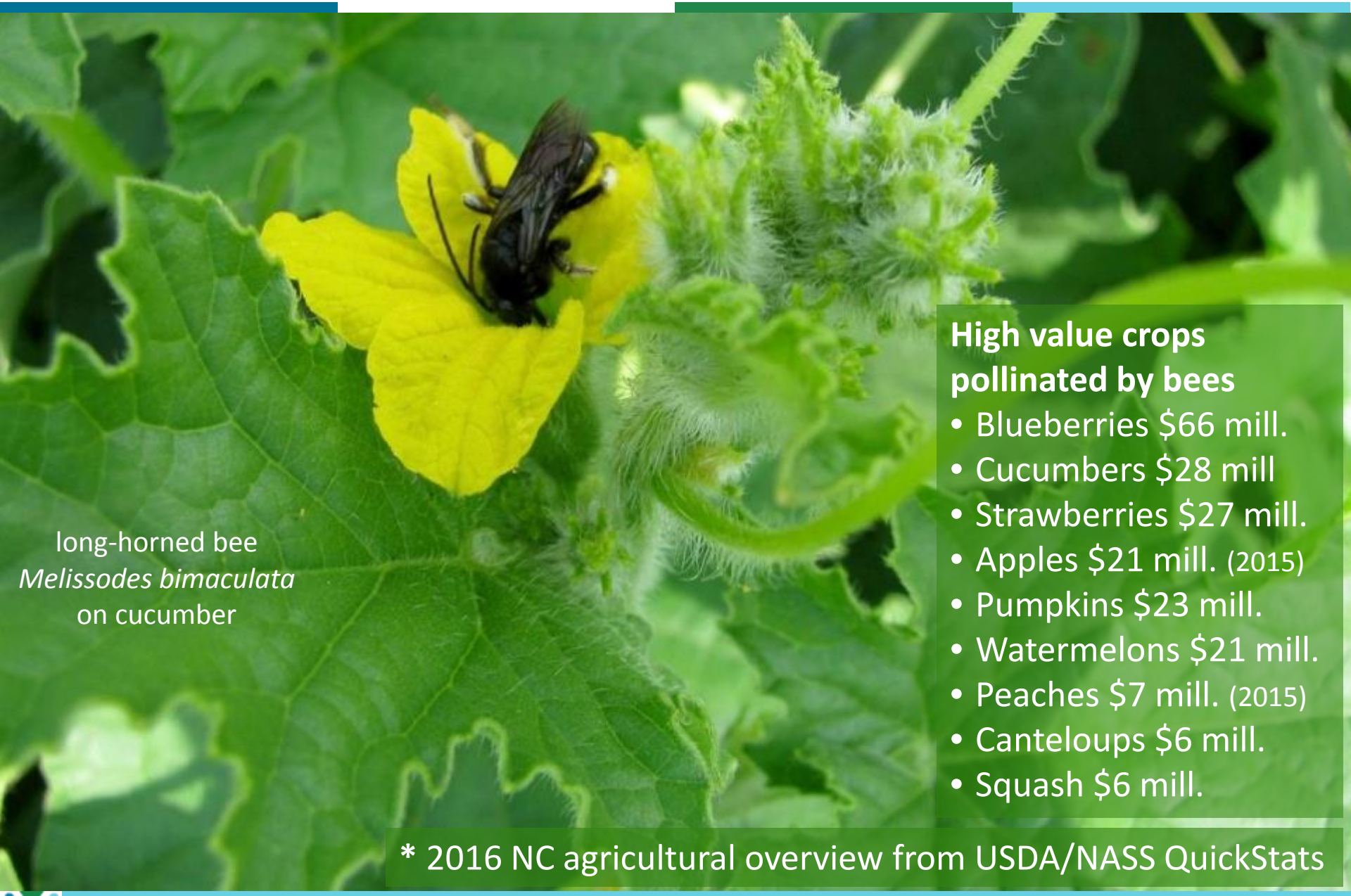
www.xerces.org

XERCES SOCIETY for Invertebrate Conservation

meadow near Carthage, NC

Photo: Nancy Adamson

Importance of Pollinators: NC Agriculture Example*



long-horned bee
Melissodes bimaculata
on cucumber

High value crops pollinated by bees

- Blueberries $66 mill.
- Cucumbers $28 mill
- Strawberries $27 mill.
- Apples $21 mill. (2015)
- Pumpkins $23 mill.
- Watermelons $21 mill.
- Peaches $7 mill. (2015)
- Canteloups $6 mill.
- Squash $6 mill.

* 2016 NC agricultural overview from USDA/NASS QuickStats

*https://www.nass.usda.gov/

Photo: Nancy Adamson

Importance of Pollinators: NC Agriculture Example*

Improved yield with cross-pollination**

- Soybeans $572 mill.
- Tomatoes $52 mill.
- Cotton $109 mill.
- Cottonseed $ 20 mill.
- Bell peppers $19 mill.
- Snap beans $6 mill.

*2016 NC agricultural overview from USDA/NASS QuickStats
**10-15% increased yield for soybeans and cotton

Depend on alfalfa or clover seeds

- Cattle $332 mill.
- Dairy prod. $165 mill.
- Alfalfa hay ~$5 mill.

bumble bee on
pinkeye purple hull pea

*https://www.nass.usda.gov/

Photo: Nancy Adamson

Importance of Pollinators: Pollinators and Ice Cream!

Stewardship Materials c/o NACD
http://www.nacdnet.org/general-resources/stewardship-and-education-materials/2015-local-heroes-hard-working-pollinators/

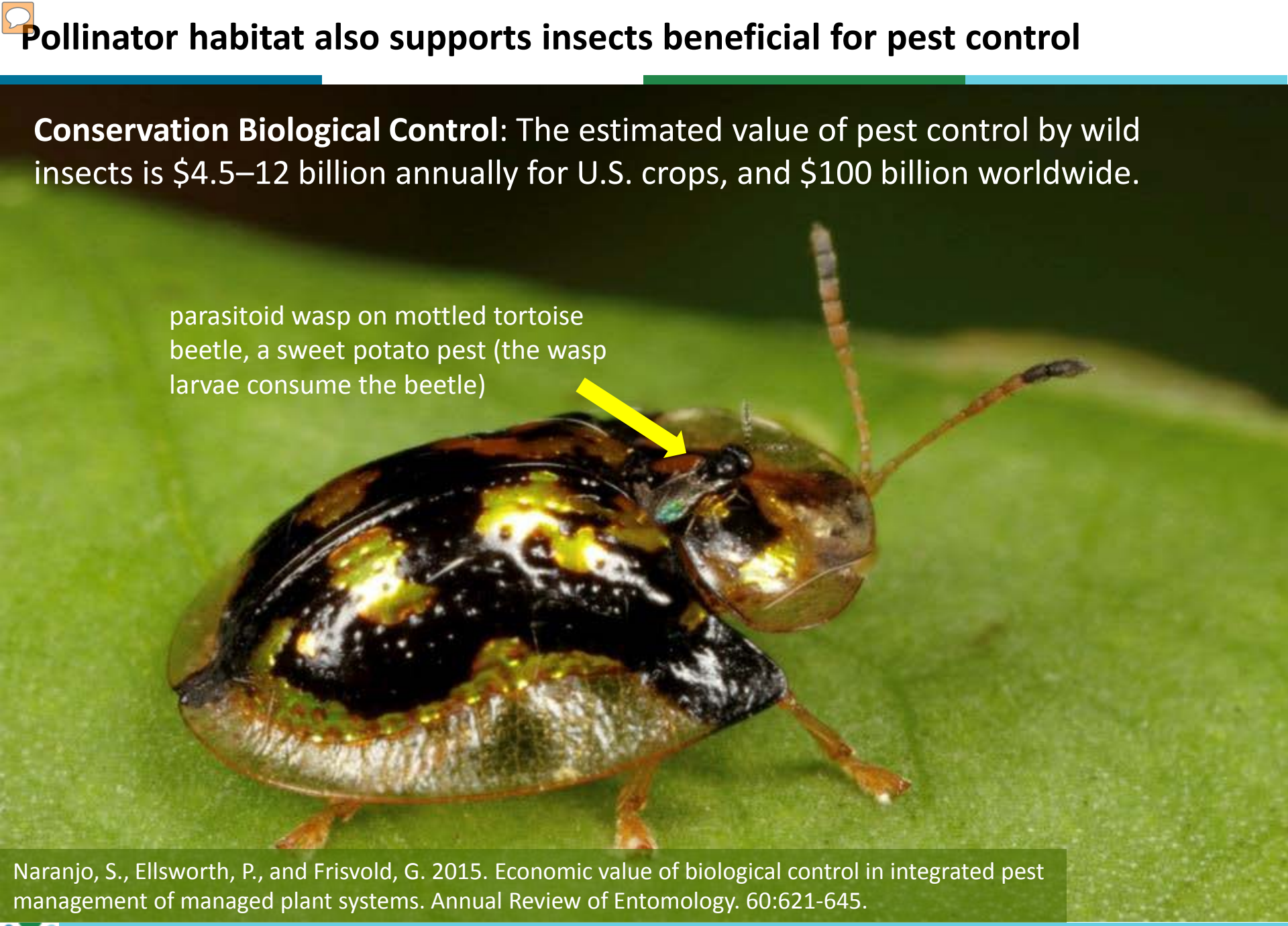
Name _____

Pollinators and Ice Cream

I like  (ice cream), do you? Pollinators help us have good food.  (ice cream) is made with  (milk) and it comes from  (cows). A lot of  (cows) eat alfalfa hay.  (Bees) help us have hay and  (ice cream). Some people like  (pineapple) with their  (ice cream). The pollinator that helps us have  (pineapple) is a  (bird). Do you like hot fudge sundaes? Fudge is made with  (chocolate) and  (flies) help us have it! Did you know that you can make a banana split with  (bananas) and  (ice cream)?  (Bats) help us have  (bananas). Pollinators work very hard to help us have good food!

Pollinator habitat also supports insects beneficial for pest control

Conservation Biological Control: The estimated value of pest control by wild insects is $4.5–12 billion annually for U.S. crops, and $100 billion worldwide.



Naranjo, S., Ellsworth, P., and Frisvold, G. 2015. Economic value of biological control in integrated pest management of managed plant systems. Annual Review of Entomology. 60:621-645.

Common Beneficial Insects (Arthropods & Others)

Pollinators

Bees, flies, wasps, beetles, butterflies, moths, ...

Insect Predators

Beetles, bugs, flies, lacewings, solitary & social wasps…

Insect Parasitoids

Solitary wasps, tachinid flies…

Non-insects

Spiders, harvestmen, centipedes, mites, pseudoscorpions, nematodes, entomopathogenic fungi, …

lacewing larva eating milkweed aphids
(among mummies parasitized by wasps)

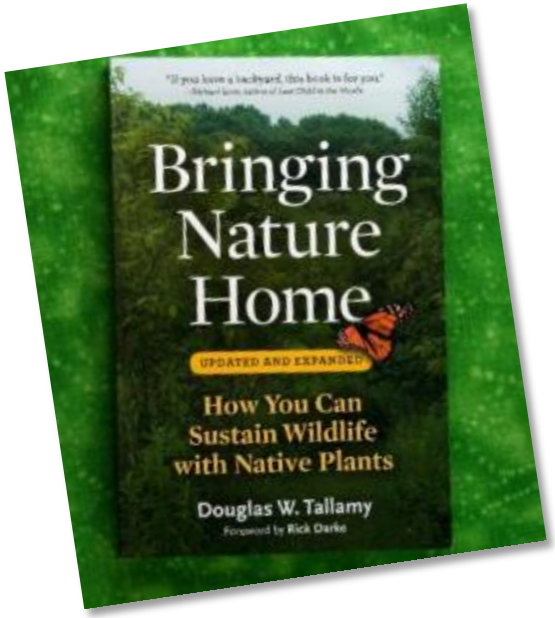
http://www.myrmecos.net/2010/08/28/a-voracious-aphid-lion/

Photo credit: Alex Wild

Bugs drive the system—more than 85% of plants require pollinators

Benefits to Other Wildlife:

- Pollinator-produced fruits and seeds comprise 25% of the global bird and mammal diets
- Pollinators=food for other wildlife
- Pollinator habitat supports other wildlife, such as songbirds



Ollerton, J., R. Winfree, and S. Tarrant. 2011. How many flowering plants are pollinated by animals? Oikos 120: 321-326.
World Wide Fund for Nature and Zoological Society of London (ZSL). 2014. Living Planet Report 2014. http://bit.ly/1ssxx5m

Health Update

bumble bee
on wingstem,
Verbesina alternifolia

Photo: Nancy Adamson

2016 UN report highlights continued threats to pollinators & food supply

Large scale loss of pollinator diversity

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

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)
http://www.ipbes.net/article/press-release-pollinators-vital-our-food-supply-under-threat

Photo: Phil Hauck

Overall decline in wildlife populations around the globe

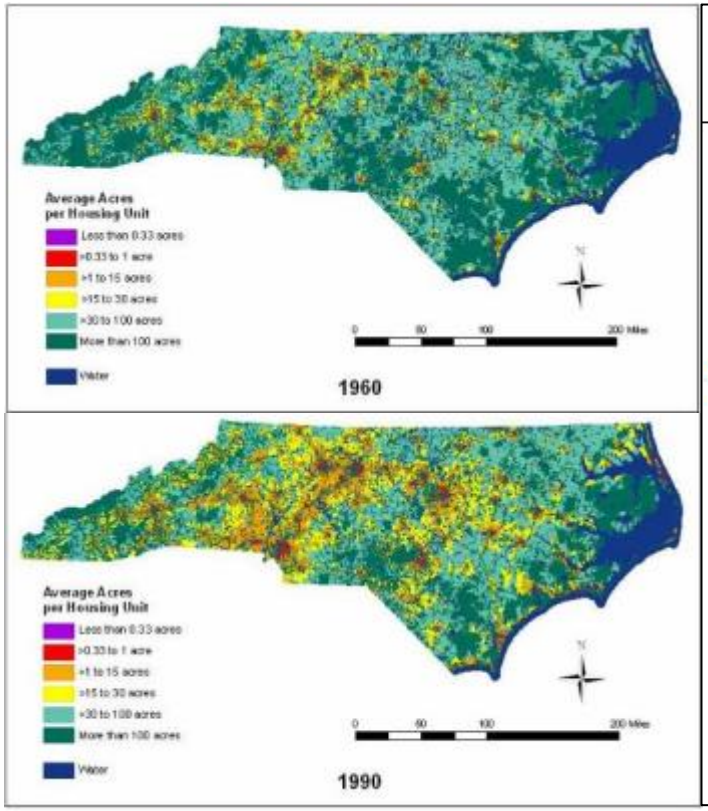
Between 1970 and 2010 populations of mammals, birds, reptiles, amphibians, and fish around the globe dropped 52%

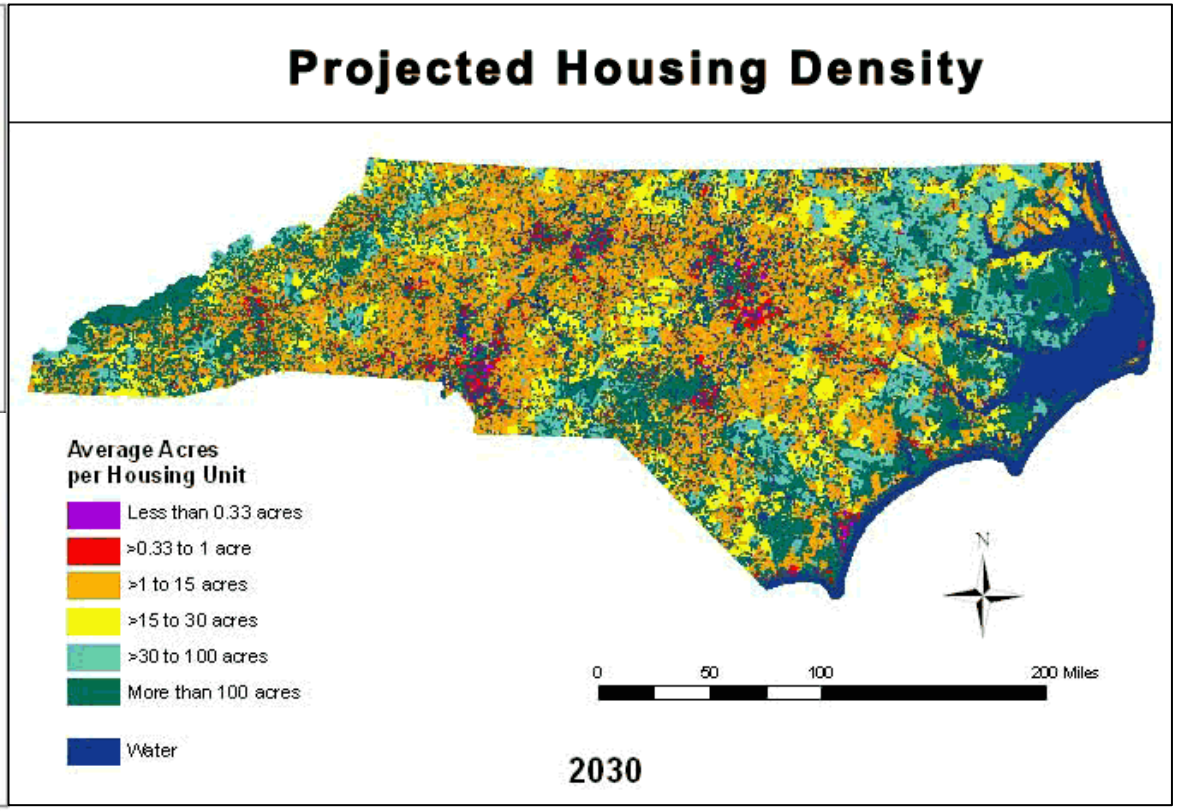
World Wide Fund for Nature and Zoological Society of London (ZSL). 2014. Living Planet Report 2014. http://bit.ly/1ssxx5m

Photo credit: Kelly Gill, The Xerces Society

Vital to protect and create habitat in our gardens and landscapes!

Ex.: North Carolina housing density in 1960 and 1990, and projected density in 2030.

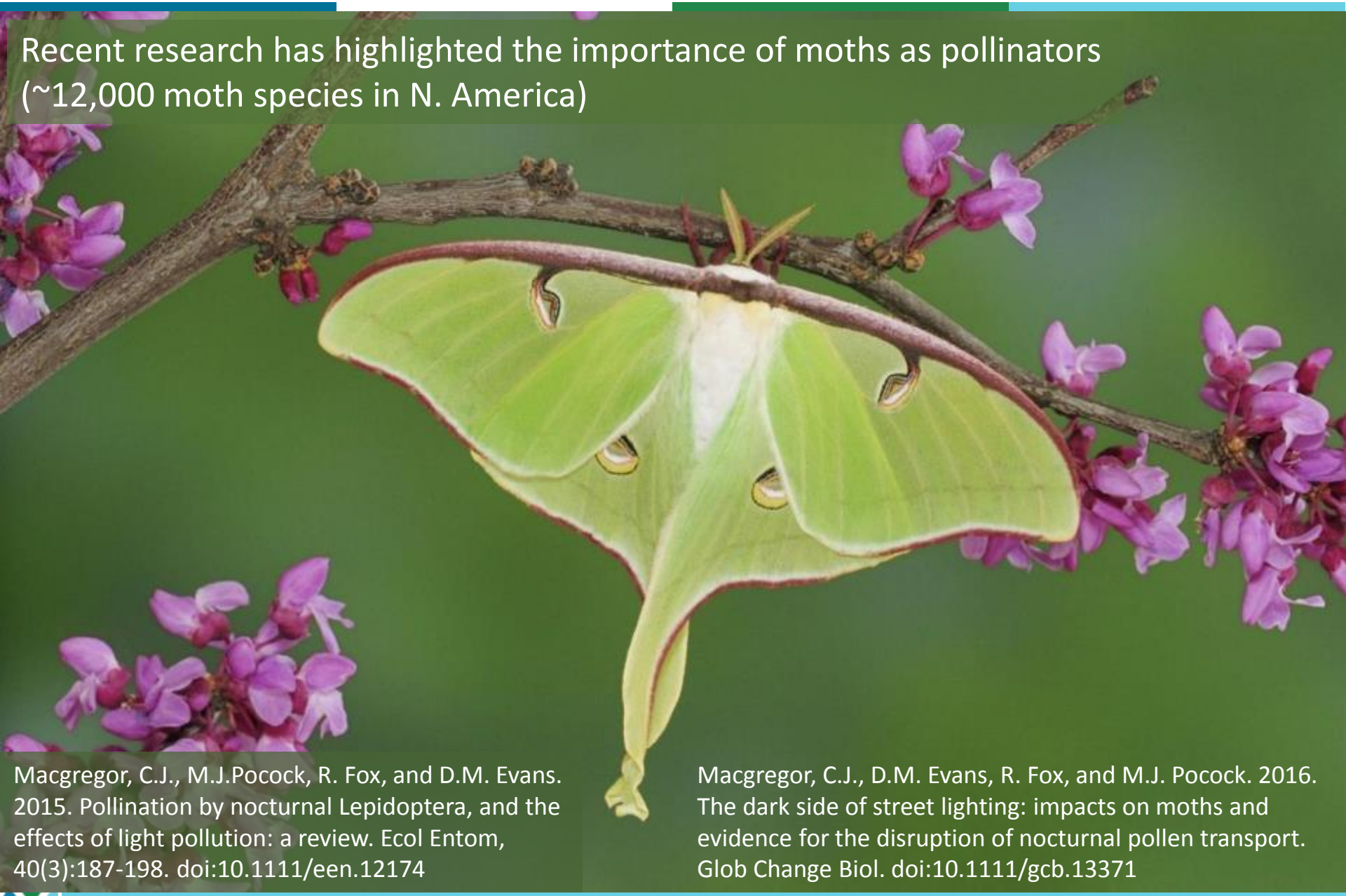




Maps courtesy of the Conservation Trust of North Carolina and Dr. Volker Radeloff, University of Wisconsin-Madison, published in the NC Wildlife Resources Commission Green Growth Toolbox http://www.ncwildlife.org/Conserving/Programs/GreenGrowthToolbox/WhyGreenGrowth.aspx.

Light pollution reducing moth pollen transport

Recent research has highlighted the importance of moths as pollinators (~12,000 moth species in N. America)



Macgregor, C.J., M.J.Pocock, R. Fox, and D.M. Evans. 2015. Pollination by nocturnal Lepidoptera, and the effects of light pollution: a review. Ecol Entom, 40(3):187-198. doi:10.1111/een.12174

Macgregor, C.J., D.M. Evans, R. Fox, and M.J. Pocock. 2016. The dark side of street lighting: impacts on moths and evidence for the disruption of nocturnal pollen transport. Glob Change Biol. doi:10.1111/gcb.13371

Photo: Meogui, bloggang.com

Climate change impact on pollinators—protecting corridors is vital!

The seasonal activity of many species is projected to change differentially, disrupting life cycles and interactions between species.

bee fly on sandhill milkweed, *Asclepias humistrata*

Assessment Report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services on Pollinators, Pollination and Food Production (2016).

http://www.ipbes.net/sites/default/files/downloads/pdf/spm_deliverable_3a_pollination_20161124.pdf

Photo: Nancy Adamson

How can we better support pollinators & other insects?

Strengthen habitat and pesticide protection to support *diverse* pollinators & other wildlife—

- Plant & conserve native plants (or cover crops, herbs, and other non-invasive plants)
- Reduce pesticide use

Photos: Nancy Adamson

Diverse flowers and structure is best--wildflowers, shrubs, and trees

Crop pollination by wild bees and natural enemy activity is greater in landscapes with diverse habitats

Pollinator planting at Dirt Works Incubator Farm, a project of Lowcountry Local First at Rosebank Farms near Charleston, SC

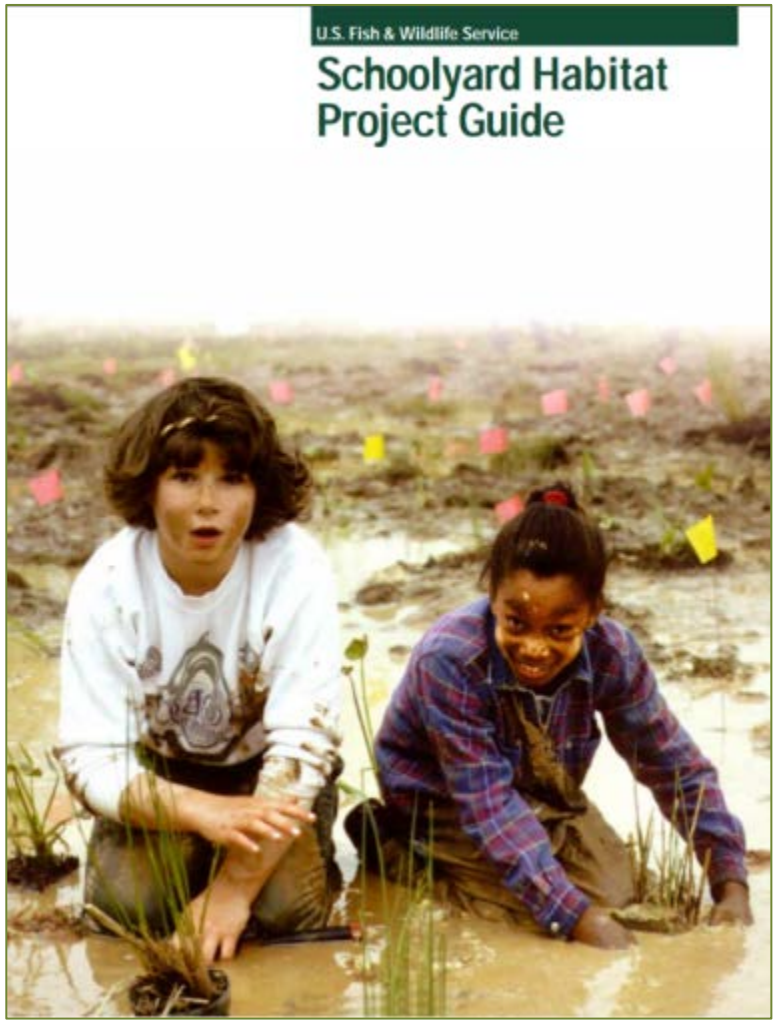
Bianchi, F. J. J. A., C. J. H. Booij, and T. Tscharntke. 2011. Sustainable pest regulation in agricultural landscapes: a review on landscape composition, biodiversity and natural pest control. *Proc. R. Soc. B* 273: 1715-1727.
Forehand, L. M., D. B. Orr, and H. M. Linker. 2006. Insect communities associated with beneficial insect habitat plants in North Carolina. *Environmental Entomology* 35 (6): 1541-159.

Photo: Nikki Siebert

Community & Schoolyard Habitat Resources

Maryland's Department of Natural Resources has created a great set of resources, working closely with the USFWS and Chesapeake Bay Trust

- **Set up a Habitat Team** - Who will help with implementation?
- **Create a Vision** - What are your site goals?
- **Survey Existing Elements** - What do you already have in place? What can be improved upon?
- **Assemble a Plan** - What needs to be accomplished? What is your budget and timeframe? Where can you find the resources needed to complete your project?
- **Assemble the Elements** – Where can you find materials? How will you engage students and volunteers in the creation of the project?
- **Integrate Learning** - What outdoor learning opportunities will students engage in? How can these activities fit in with classroom learning?
- **Ensure Continued Success** - How will the site be maintained? Who will monitor the site? How can parents get involved?



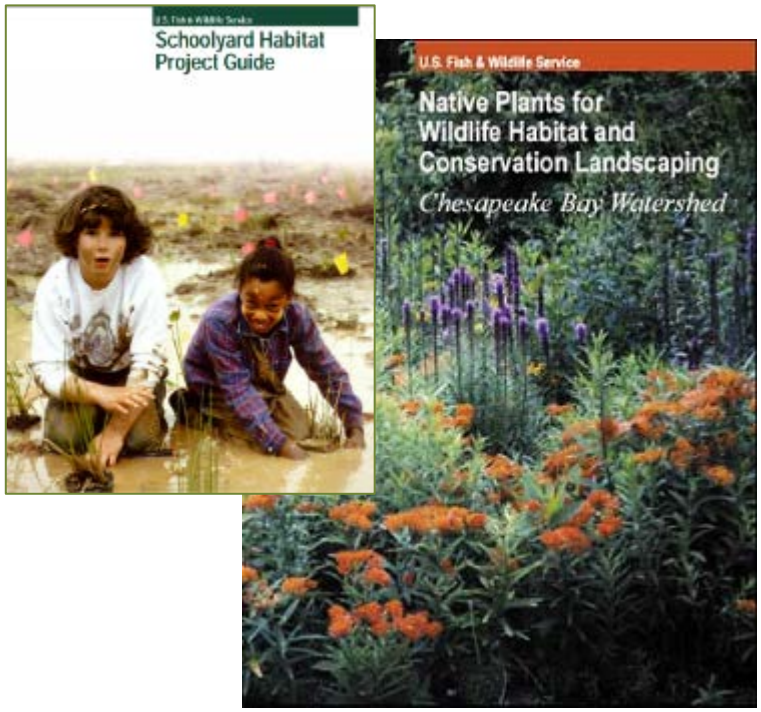
http://dnr2.maryland.gov/wildlife/Pages/Education/Schoolyard-Wildlife-Habitat-Create.aspx

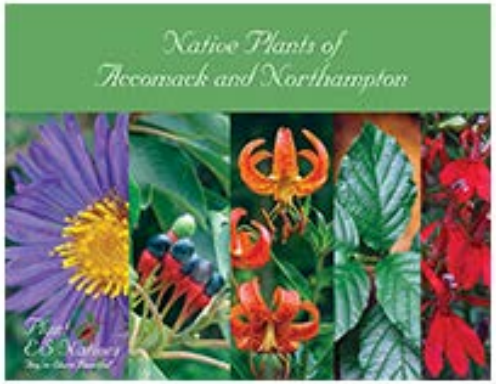
Inspiration: Community & Schoolyard Habitat Resources

Chesapeake Bay Trust—Provides grants for restoration projects, environmental education, and community engagement and outreach

License-plate funded grant program-- Mini-grants w/match (in-kind)

Wetlands mitigation funds targeted at schoolyard habitat creation





Virginia Native Plant Promo **www.PlantVirginiaNatives.org**

http://dnr2.maryland.gov/wildlife/Pages/Education/Schoolyard-Wildlife-Habitat-Funding.aspx

Ex. Partnership: Proactive Native Plants for Beauty Campaign by Virginia DEQ

Regional Native Plant Marketing Campaigns

In spring 2009, the Virginia Coastal Zone Management (CZM) Program and its partners launched the *Plant ES Natives* campaign using proven social marketing tools and techniques with a focus on making planting natives fun, easy and popular. It has been a model for development of other regional campaigns initiated and funded by the Virginia CZM Program - *Plant NOVA Natives*, *Plant NNK Natives*, and *Plant Central Rapp Natives*. Components of the *Plant ES Natives* Campaign strategy, such as a regional plant guide, have been easily transferrable to address barriers common in all the regions to planting natives. Each region however is unique and the planning teams are continuously evaluating which place-based approaches are most effective in reaching their gardening population.

Plant ES Natives
They're Shore Beautiful!

Plant HR Natives

Plant NoVA Natives
Naturally Beautiful!

Plant NNK Natives
Go Native – Grow Native

Plant Central Rapp Natives
BEAUTIFUL
BENEFICIAL
SUSTAINABLE

Local and beautiful messaging fits with local ag support!

http://www.deq.virginia.gov/Programs/CoastalZoneManagement/CZMIssuesInitiatives/NativePlants.aspx

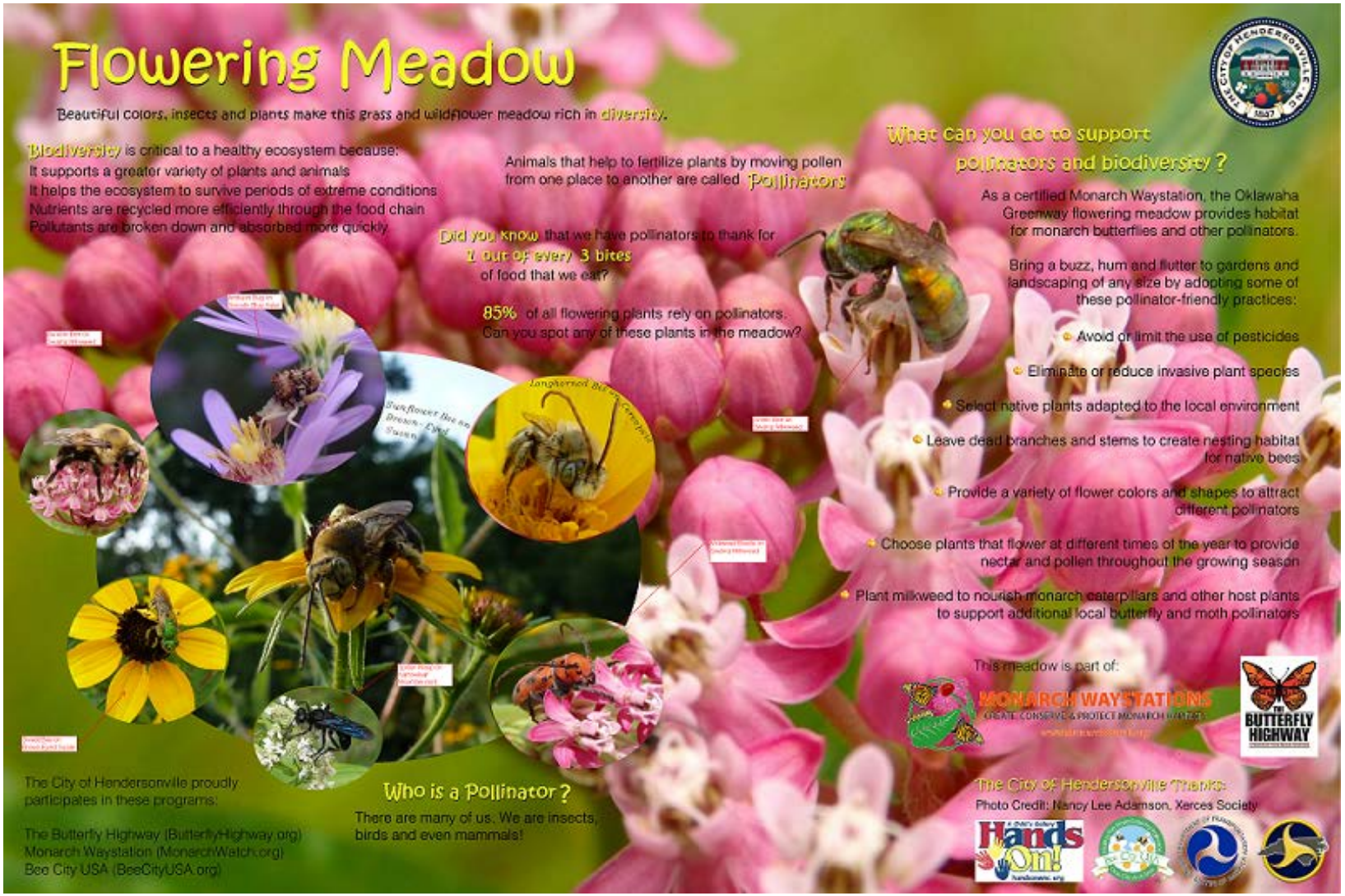
Involve the grounds crew from the get-go for long term success

One of the hardest lessons to implement can be ensuring the landscape/ground maintenance team is part of the planning team—this benefits long term management

Photo: Nancy Adamson

Signage can be interactive

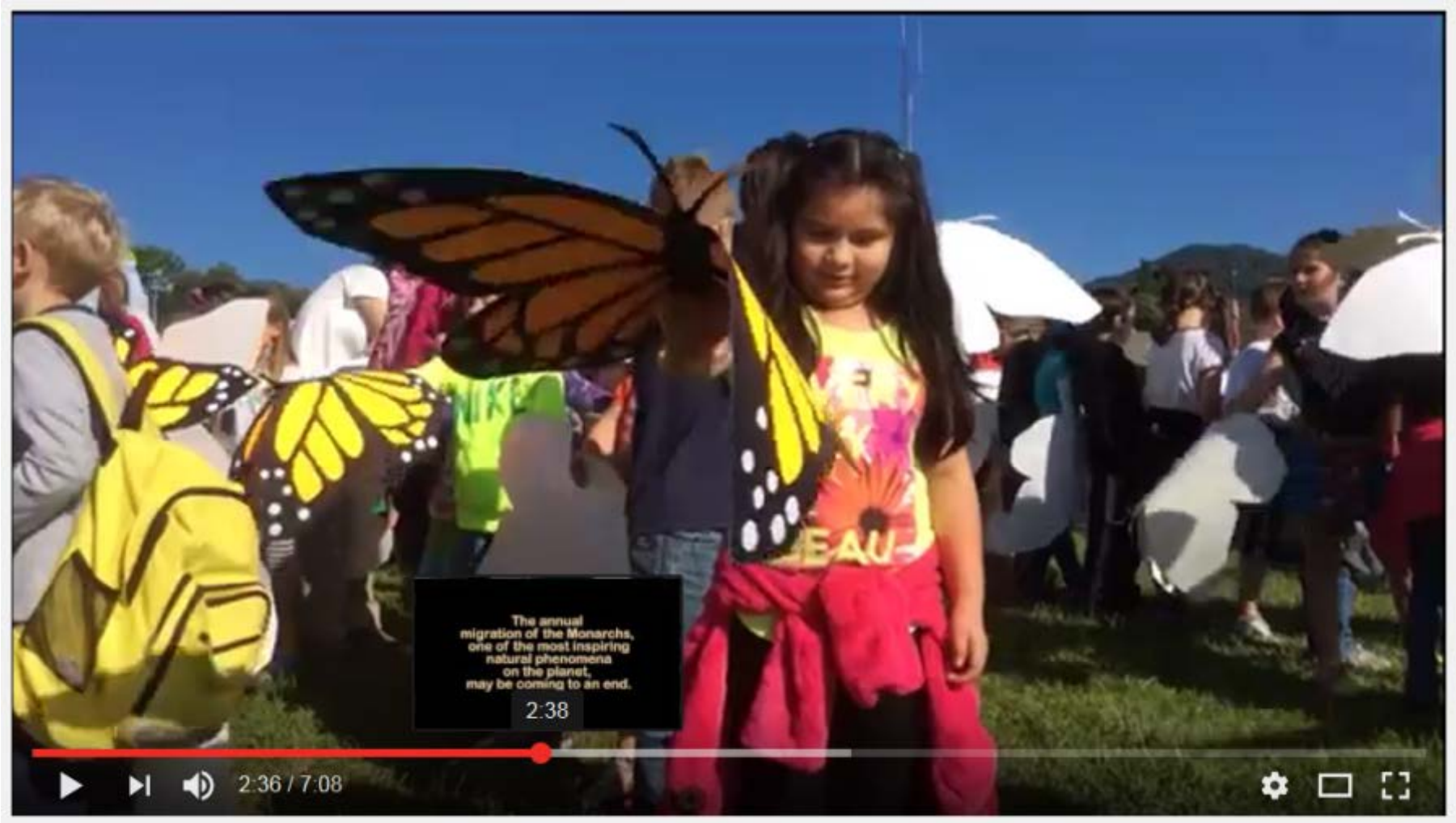
Signs start conversations, let people know unmown areas are cared for (intentional), can be interactive (link to podcasts, factsheets…games) & acknowledge partnerships



http://www.hendersonvillenc.gov/bee-city and http://www.beecityusa.org/

Art can be the best teacher & community builder

250 children from several schools made a journey across Black Mountain, NC, created art and haiku for an exhibit at the butterflies' destination (90% symbolized their loss)



Thanks to teacher Libba Tracy, the Black Mountain Center for the Arts, Bring Back the Monarchs Black Mtn!

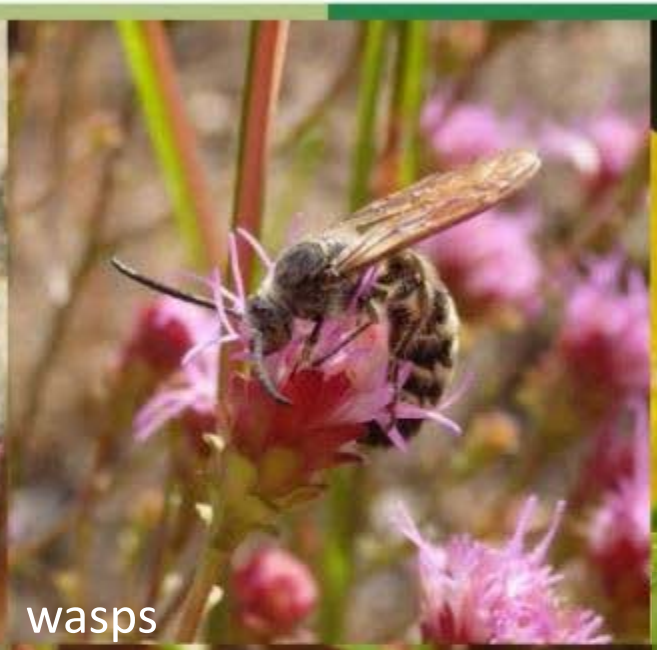
Bring Back the Monarchs: https://www.youtube.com/watch?v=GtZ-ZS-jBPw

Art can be the best teacher & community builder

One of the art pieces & haiku

Bring Back the Monarchs: https://www.youtube.com/watch?v=GtZ-ZS-jBPw

Get to know and love your pollinators (kids can help us all with this)



Photos: Nancy Adamson

Pollinators: Agricultural focus is bees--the great pollen movers

Bee diet (pollen & nectar) & hairiness make them especially effective pollinators

bumble bee
on squash

NEW: integrated crop pollination video https://www.youtube.com/watch?v=yMP5dTDRi6g

Photo: Nancy Adamson

Native bee diversity

>3,600 native bee species in the US—most are **solitary species**, not colonial

southeastern
blueberry bee
Habropoda laboriosa

Specialist bees eat pollen only from one genus or family, but may collect nectar from other plants.
Solitary bees ***are not defensive*** around their nests--no sisters, young larvae, or queen to protect.
No bees, wasps or other insects are defensive on flowers—they fly away or hide if you approach.

Photo: Sam Droege, USGS, Bee Inventory and Monitoring Lab, www.flickr.com/usgsbiml

Help educate your communities: Bees & wasps on flowers fly away

Only social bees and wasps are defensive near their nests—they have young larvae, a queen, and sisters living together

Use a fake wasp nest to deter social wasps from nesting nearby

It doesn't deter birds from nesting!

This works because they need a big territory to find enough food!

The vast majority of bees and wasps are solitary

Photo: Nancy Adamson

Our main group of native social bees: Bumble bees, *Bombus* spp.

- 45 species in U.S.
- Social colonies founded by single queen
- Annual colonies--last only one season
- Nest may contain 25-400 workers
- Nests in abandoned rodent burrows or under lodged grasses

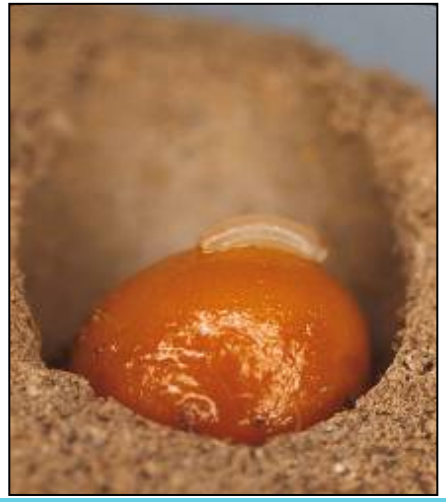
Conserve brush piles, un-mowed areas

Bombus vagans on clover

Bumble bee nest photos: Elaine Evans. Bumble bee on clover photo: Nancy Adamson

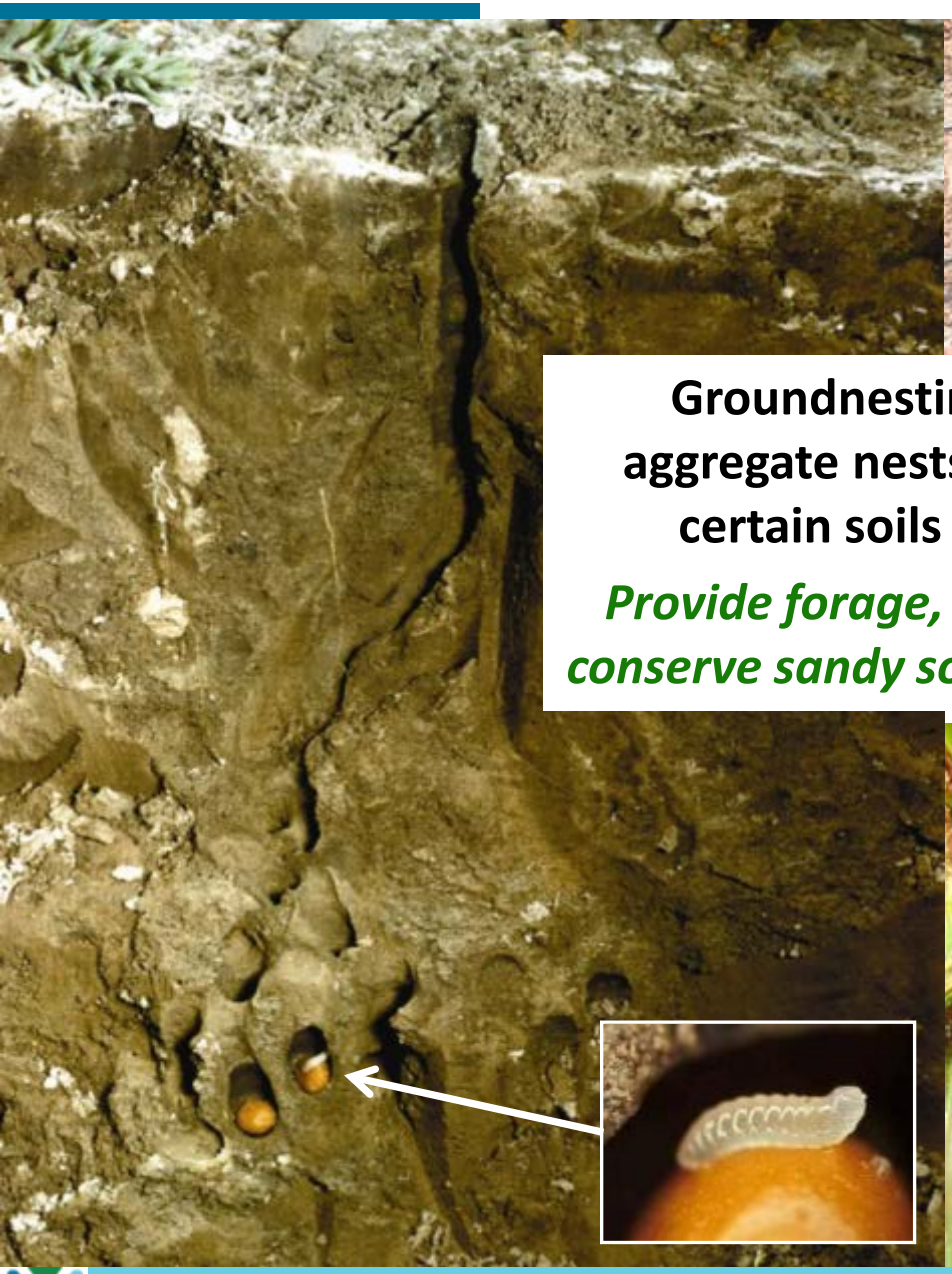
Life cycle of a solitary bee--ground-nesting species

Mining bee (*Andrena* sp.): a year in its underground nest as egg, larva, and pupa before emerging to spend a few weeks as an adult.



Photos: Dennis Briggs, Nancy Adamson

70 % of native bees are solitary and nest underground



anthophorid bee
Anthophora abrupta

Groundnesting bees may aggregate nests because only certain soils are suitable

Provide forage, scout for nests, conserve sandy soil & bare ground

mining bee
Andrena barbara

Underground nest & larva photos: Jim Cane, Dennis Briggs. Anthophorid bees photo: Florrie Funk. Mining bee photos: Nancy Adamson

Life cycle of a solitary bee--cavity or tunnel nesting species

Hollow stem example:

Cross-section of silk cocoons

Larva Pupa Adult

Pollen mass Egg Mud wall

Mud cap closure

Silk cocoons with dormant bees inside

30% are solitary and nest in cavities (natural or provided)

Hollow or pithy plant stems, or old beetle borer holes (or canes or drilled woodblocks set out by people)

Provide forage, conserve snags, brush piles & pithy-stemmed plants. Leave dead plant material over winter.

small carpenter bees ↑↓

Tree snag photo: Matthew Shepherd. Larva & adult photo: © Edward Ross. Adult in blackberry: Nancy Adamson

Help educate your communities: Solitary vs. social (or colonial) bees & wasps

Solitary bees and wasps are single moms—they collect food, lay an egg, seal closed the cell; repeat. They never see their young. No queen or live young to defend. No sisters to replace them. **Never defensive! Fun & safe to observe up close!**

mason bee nesting

(max

andrenid (mining or digger) bee on peach

Photos: Nancy Adamson

Other cavity-nesters: solitary predatory & parasitoid wasps—not defensive!

Photo: Nancy Adamson

Lepidoptera food needs: Adults need nectar plants

- Different needs as larvae and adults
- Adult nectar plants (caterpillar host plants)
- Excellent teaching tools for experiential understanding of co-evolution and why native plants are vital to wildlife

Photos: adult monarch Doug Tallamy; monarch caterpillar © Mace Vaughan (Xerces Society)

Lepidoptera food needs: Many caterpillars are host specific

Co-evolution has led to many specialists

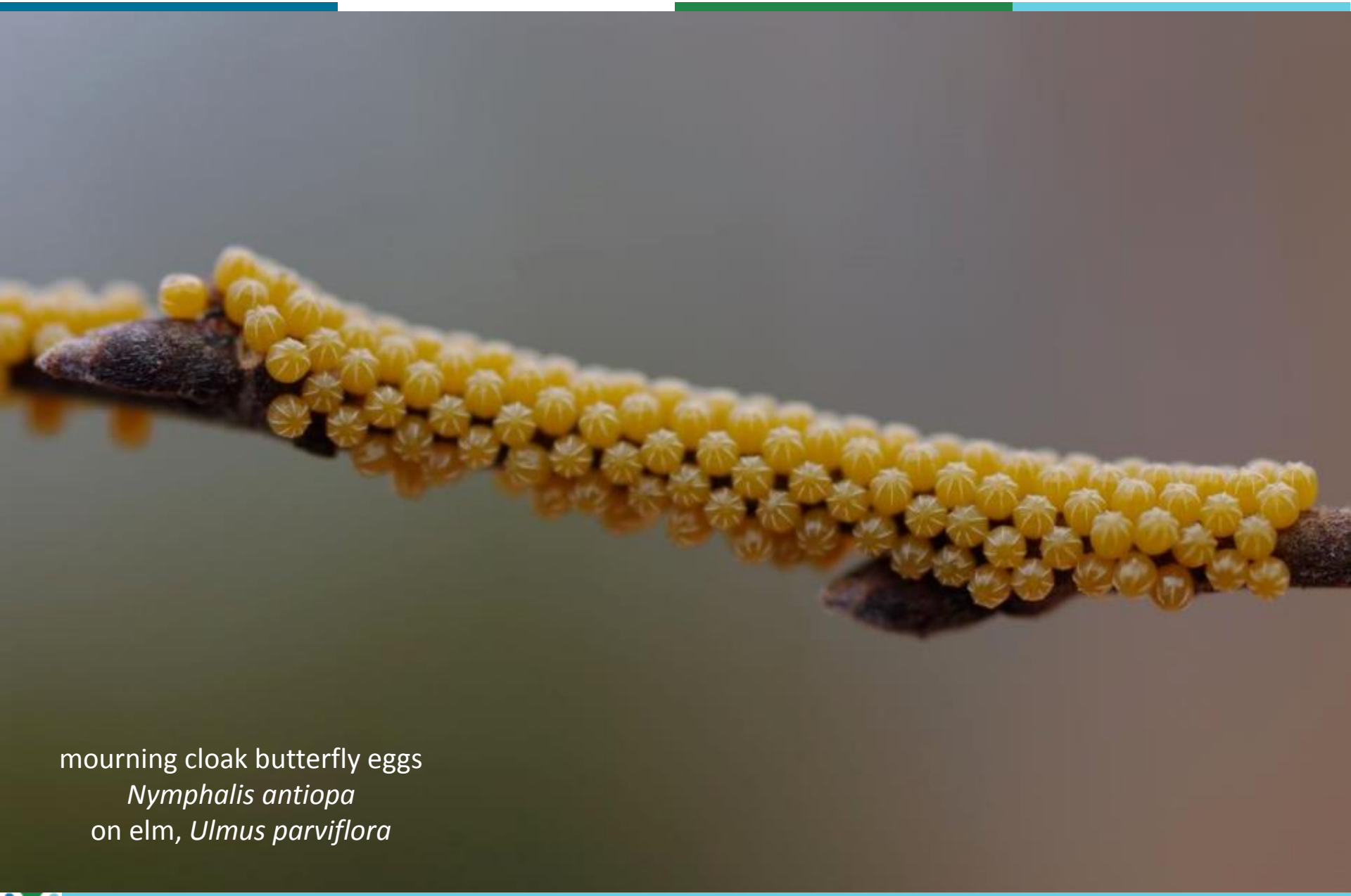
Ladybird Johnson Wildflower Center has an excellent system for finding host plants
http://www.wildflower.org/collections/

NOTE: There are also some flowers with pollen specialist bees
http://www.illinoiswildflowers.info/flower_insects/
http://jarrodfowler.com/specialist_bees.html

yucca moths,
Tegeticula yuccasella

Photo: Nancy Adamson

Lepidoptera nesting—as easy to miss as bees nesting…more fire sensitive



mourning cloak butterfly eggs
Nymphalis antiopa
on elm, *Ulmus parviflora*

Photo: Mark Rose, NC Native Plant Society

Remember: It's easy to miss some of the life we're supporting…

Photo: Nancy Adamson

Protect, Enhance, & Create Habitat

male sweat bees, *Halictus ligatus,* sheltering from the rain under wingstem flowers

Photo: Nancy Adamson

Reducing harm from neonicotinoids & other pesticides

- Avoid prophylactic use
- Avoid applying before or during bloom
- Avoid repeat annual use, esp. in perennial crops (applications can persist 4-5 years)
- NOTE: Some recommended neonic product rates on household vs. ag products 100X ag rates, so lethal (*homeowners don't realize home products less regulated than ag*)
- Stop "cosmetic" (vs. ag) use (http://www.beecityusa.org/)

bumble bee on blueberry

Photo: Nancy Adamson

Habitat through the growing season—native trees, shrubs, and wildflowers

Pollinators, predators, & parasitoids need **food (nectar, pollen, or prey) and refuge** when crops are harvested or pesticides used.

Photos: Elaine Haug NRCS, Matthew Shepherd; Mace Vaughan, Eric Mader, Jeff McMillan NRCS, Berry Botanic Garden, Nancy Adamson

Common cover crops, herbs, & annuals for beneficials

Cover crops

- **Legumes**: red, white, crimson clover; Austrian winter pea; alfalfa; alfalfa, vetch, soybean
- **Broadleaf forbs**: buckwheat, phacelia
- **Grasses**: rye, oats, Sudangrass

Herbs

- **Annual**: basil, borage, tulsi (holy basil), dill, cilantro
- **Perennial**: catmint, spearmint, oregano, sage

Annuals

- Annual sunflower, zinnia, cosmos, scarlet sage

Photos: Nancy Adamson

Help educate your community: About pollen and allergies

Pollinator plants do not cause allergies—they have sticky, heavy pollen that needs an insect or other pollinator to carry from flower to flower or plant to plant.

mining bee
on apple

Photo: Nancy Adamson

Help educate your community: About pollen and allergies

Plants that cause hay fever are **wind pollinated**, with dry light pollen

- Trees in spring such as pine and oak
- Grasses when in flower in spring and early summer such as ryegrass and Timothy
- Herbaceous plants in fall such as ragweed
- Molds/fungal spores depending on weather conditions

bumble bee on sugar maple (a “moderate” allergen,
hedging its bets with wind and pollinators in very early spring)

Bees and other pollinators may collect pollen and nectar from some wind pollinated plants.

Photo: Nancy Adamson

Help educate your community: About pollen and allergies

Plants needing a pollinator have **sticky, heavy pollen**

You will never see an insect pollinated plant (such as apple or goldenrod) listed in the newspaper's pollen forecast

bumble bee on goldenrod

See goldenrod pollination video at http://www.discoverlife.org/goldenrod/

Photo: Nancy Adamson

Unmown grass covers (not just corn) provide food and shelter

Cool & warm season grasses are multipurpose: Fibrous-rooted, some deep-rooted, attract beneficials, provide green manure & living mulch

bumble bee loading up on corn pollen—many bees, including honey bees will gather the pollen

CAUTION: Keep adjacent crops or crop rotation in mind

Dunbar, M.W., O'Neal, M.E. and Gassmann, A.J. 2016. Increased risk of insect injury to corn following rye cover crop. Journal of Economic Entomology, 1-7. DOI: 10.1093/jee/tow101.

Photo: Nancy Adamson

Native plants support natural enemies of pests

Sand wasps feed brown marmorated stink bugs to their young (research in progress at Penn. State University)

Nectar sources include milkweed (*Asclepias* spp.), mountain mint (*Pycnanthemum* spp.) & spotted bee balm (*Monarda punctata*); **solitary wasps** not defensive

PENNSTATE College of Agricultural Sciences

Research by Dave Biddinger, Penn State University

Photos: Alex Suricia, Nancy Adamson Jennifer Hopwood, Scott Seigfried

Simply leaving fallow areas can support pollinators & increase production

Fallow Area Case Study: Canola in Canada

In the absence of honey bees, canola growers make more money on their land if 30% is in natural habitat, rather than planting it all.

Morandin, L., and M. Winston. 2006. Pollinators provide economic incentive to preserve natural land in agroecosystems. Agriculture, Ecosystems and Environment 116:289-292.

Photo: Mace Vaughan

Beetle banks with perennial grasses reduce weed pressure & reduce pests

Example: Grinnell Heritage Farm Beetle Bank, Iowa

- Permanent native grass strips intercropped with vegetables
- These also support spiders, bumble bees, & other beneficials

Pasimachus ground beetle

Firefly beetle

Blake, R.J., Woodcock, B.A., Westbury, D.B., Sutton, P. and Potts, S.G. 2013. Novel management to enhance spider biodiversity in existing grass buffer strips. Agricultural and Forest Entomology, 15(1):77-85.

Photo: Grinnell Heritage Farm; Bugwood

Reduce tillage or tillage depth to support groundnesters

- Tillage negatively impacts both larval & adult ground beetles that eat weed seeds
- Tilled areas reduced egg-laying rate by female ground beetles
- Reducing tillage also benefits groundnesting bee populations

Blubaugh, C and Kaplan, I. 2015. Tillage compromises weed seed predator activity across developmental stages. Biological Control. 81:76-82.

Photo: Thelma Heidel-Baker

Messy" edges provide great habitat (add a habitat sign!)

Daisy fleabane, *Erigeron,* attracts *Lygus* bugs and its parasitoid away from cotton; plus excellent for pollinators

Halloran, S.T., Mauck, K.E., Fleisher, S.F. and Tumlinson, J.H. 2013. Volatiles from intact and *Lygus*-damaged *Erigeron annu*us (L.) Pers. are highly attractive to ovipositing *Lygus* and its parasitoid *Peristenus relictus* Ruthe. *Journal of chemical ecology*, *39*(8):1115-1128.

Photos: Nancy Adamson

Grasses are host plants, provide shelter, and are fuel for prescribed fire

Grasses are vital in fire adapted communities as fine fuel.
They shelter groundnesting birds, bumblebees, and other wildlife.
They are host plants for larvae of grass skippers and some true butterflies.

gemmed satyr
Enodia anthedon

Gemmed satry larvae (caterpillars) eat river oats, *Chasmanthium* spp.

Photo: Dennis Burnette, Carolina Butterfly Society

Additional Resources

mining bee, *Andrena accepta*, a sunflower specialist on a perennial sunflower

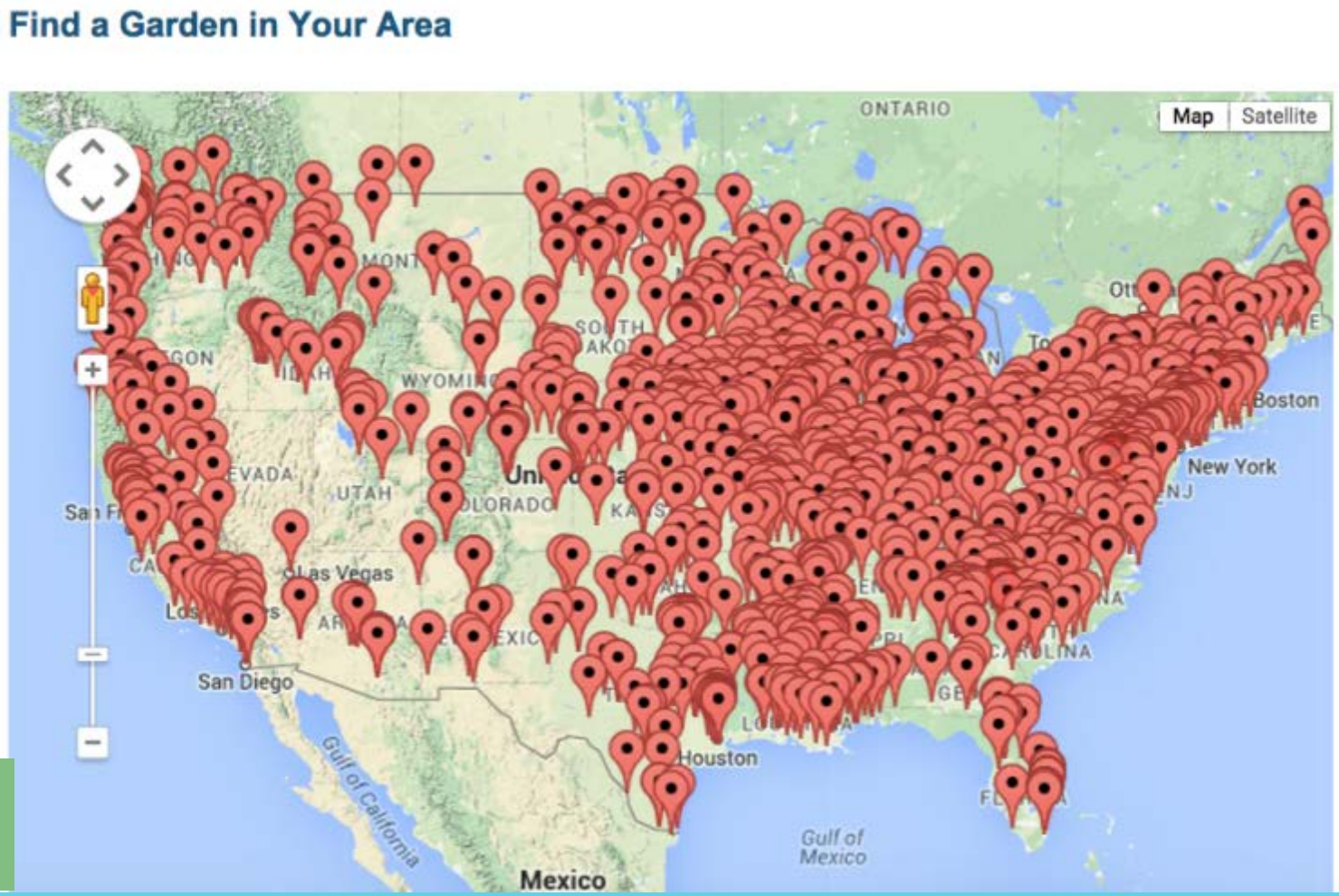
Photo: Nancy Adamson

The People's Garden Initiative*

A collaborative effort of over 700 local and national organizations all working together to establish community and school gardens across the country.*

NRCS Plant Materials Centers established demonstration gardens and technical resources at http://go.usa.gov/3PVzd

- Plants for insects and pollinators
- Community garden guides
- Urban conservation and sustainable landscaping

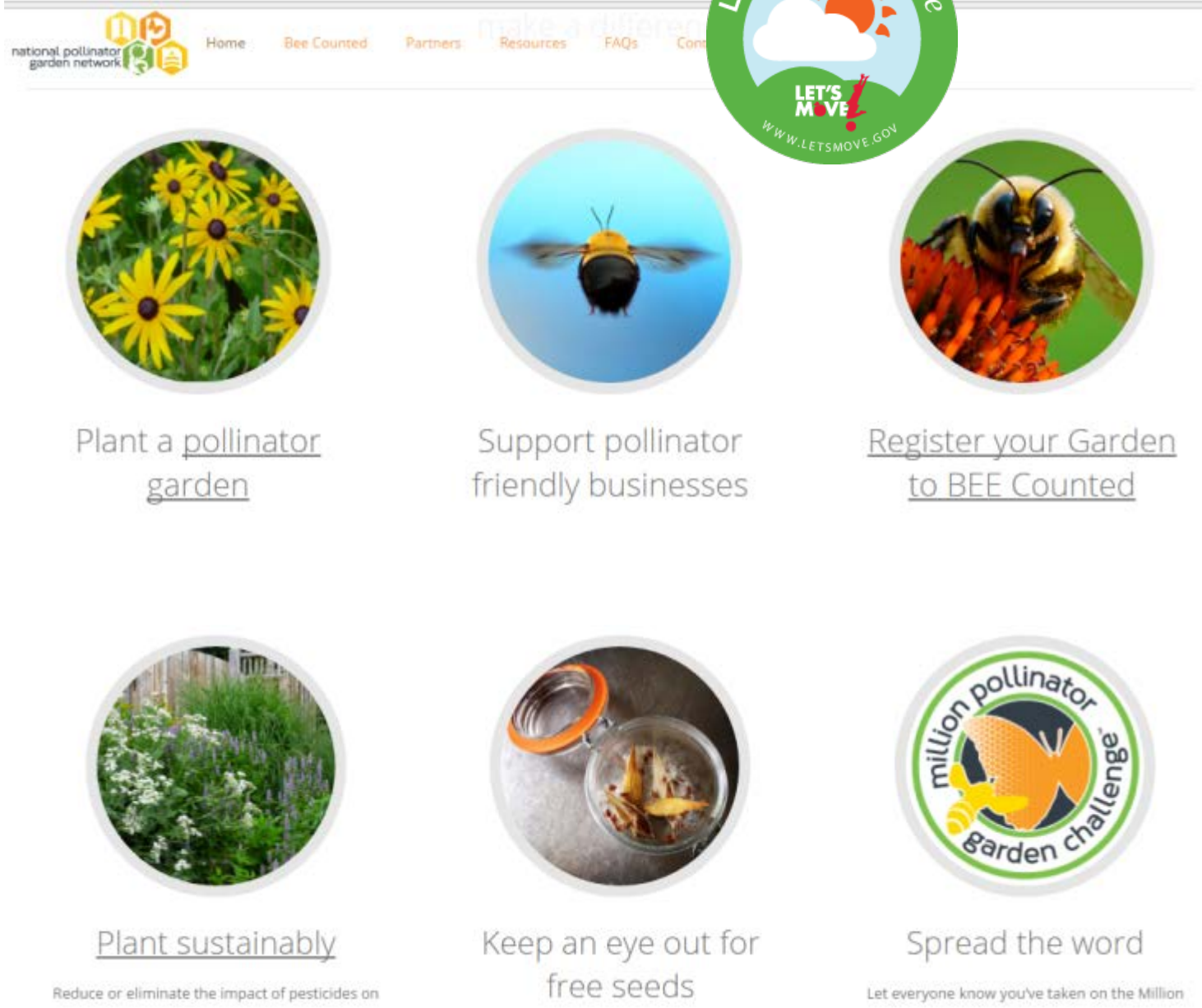


*Started by Secretary Vilsack in 2009

The Million Pollinator Garden Challenge

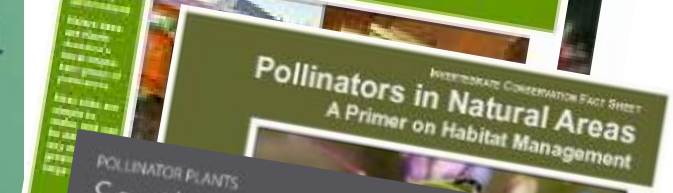
In parallel with the White House's Pollinator Health Task Force, Michelle Obama launched this challenge in 2015 when students from "Let's Move" organizations around the country came to help harvest vegetables from the White House Kitchen Garden.

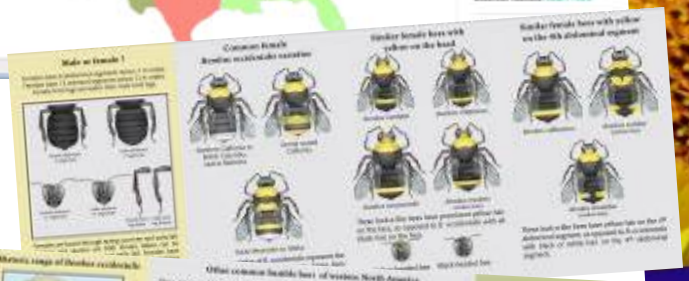
Let's Move encourages children and their families to eat healthy & get active.



http://millionpollinatorgardens.org/

Further Information: the Xerces Society www.xerces.org





Three Steps You Can Take to Bring Back the Pollinators

1. Sign the Pollinator Protection Pledge.

2. Install a Pollinator Habitat sign.

3. Spread the word!

www.xerces.org

Bring Back The Pollinators

A Xerces Society Conservation Campaign

Photo: Matthew Shepherd

The Xerces Society: Citizen Science

Bumble Bees

Aquatic Invertebrates

Migratory Dragonflies

Overwintering Monarchs

Questions? Comments?

I'd love to hear from you!

Dr. Nancy Lee Adamson
nancy@xerces.org
nancy.Adamson@gnb.usda.gov
336-370-3443

Photo: Nancy Adamson