



Sowing Biodiversity

Pollinators, Beneficial Insects, and
the Future of Nature on Farms



Eric Lee-Mäder

Agricultural Biodiversity Program Co-Director
The Xerces Society

Photos: Jessa Cruz, Rollin Colville, Eric Lee-Mäder

 [xerces.org](https://www.xerces.org)

© 2017 The Xerces Society, Inc. All rights reserved.

The Xerces Society

Protecting the Life that Sustains Us

The Xerces Society is a nonprofit organization that protects wildlife through the conservation of invertebrates and their habitat.



Photos: Xerces; Joel Sartore, Eric Lee-Mäder



Also

- Pesticide policy and regulation
- Endangered species
- Aquatic conservation

Pollinator conservation and agricultural biodiversity



Why Insect Conservation?

Insects as Ecosystem Engineers

- Pollination
- Soil production and carbon sequestration
- Nutrient cycling and decomposition
- Food source for other wildlife

Invertebrate animals are the most abundant and diverse life on earth



Photos: Nancy Adamson;; Elizabeth Cash

Why Focus on Farms?

- Agriculture is the single largest land use on Earth
- The future of biodiversity conservation is on farms



Photo: Eric Lee-Mader

Earth Without Animals

Part 1



Honey Bees in Decline

50% decline in managed hives since 1950

Causes: Disease, parasites, pesticides

National Research Council. 2007. *Status of Pollinators in North America*. National Academies Press, 326 pgs.



Photo: Scott Bauer, USDA-ARS



Photos: John Anderson, Johanna James-Heinz

Bumble Bees and Monarchs

25% of Bumble Bee Species At-Risk of Extinction

- Mass extirpation due to exotic diseases
- Among the most important wild pollinators of crops and native plants

Monarch Butterflies Decline 90% Since 1990s

- Decline linked to herbicide-tolerant corn in the Midwest which has eliminated wild milkweed plants
- Disappearance pattern resembles passenger pigeon

Evans, E.,R. Thorp, S. Jepsen, and S. Hoffman Black, 2009. Status Review of Three Formerly Common Species of Bumble Bee in the Subgenus *Bombus*. Xerces Society.

Cameron et al. 2011. Patterns of widespread decline in North American bumble bees. PNAS

Global Disappearance of Insects

New Research: Published October 2017

Between 1986 and 2016, insect biomass declined by 76% in German nature reserves

Hallmann, et al. 2017. More than 75 percent decline over 27 years in total flying insect biomass in protected areas.
PLoSOne.<https://doi.org/10.1371/journal.pone.0185809>.



Photo: Alex Wild

Living Planet Index - Meta Analysis

Earth Has Lost Half of its Wildlife in the Past 40 Years



Largest global analysis of thousands of animal species (birds, mammals, fish, reptiles, etc.)



TERRESTRIAL SPECIES DECLINED BY 39 PER CENT BETWEEN 1970 AND 2010



THE LPI FRESHWATER SPECIES SHOWS AN AVERAGE DECLINE OF 76 PER CENT



MARINE SPECIES DECLINED 39 PER CENT BETWEEN 1970 AND 2010

Ecosystems are degrading at a rate unprecedented in human history

World wildlife populations halved in 40 years - report

[COMMENTS \(57\)](#)

By Roger Harrabin
BBC environment analyst



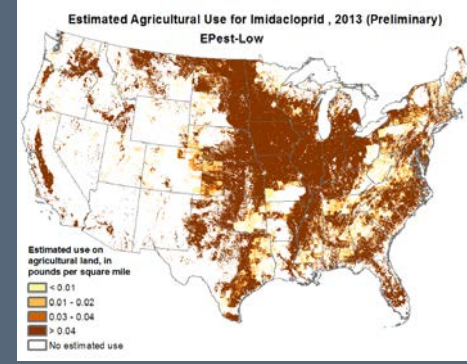
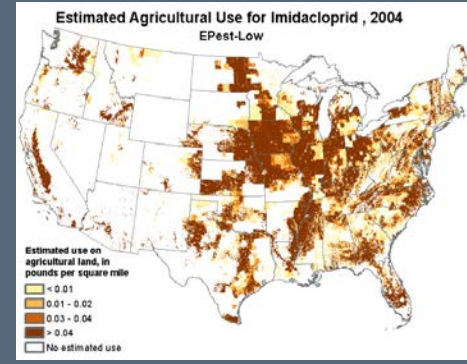
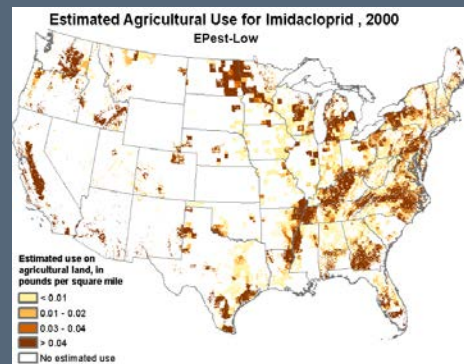
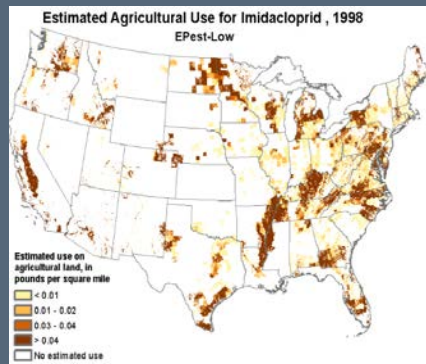
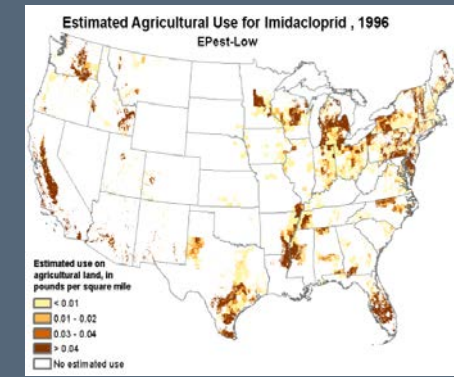
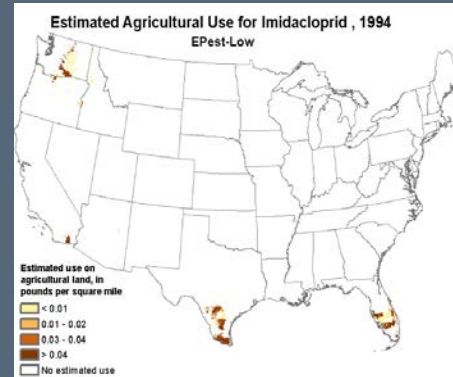
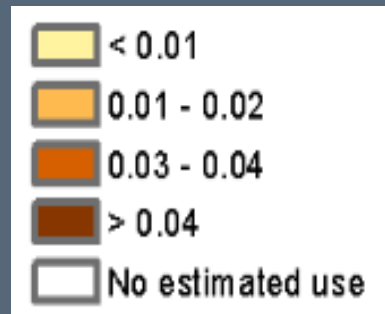
Habitat loss and hunting have reduced tigers from 100,000 a century ago to just 3,000

Photos: WWF, BBC, Gory Sowie

The Rise of New Insecticides

Neonicotinoid Insecticide Use 1994 to 2013

Estimated use on agricultural land in pounds per square mile over 10 years



Unprecedented Habitat Loss in the U.S.

- 10+ Million acres of grassland/prairie converted to cropland since 2008
- Largest conversion of habitat to cropland since just before the Dust Bowl




Photos: Griggs Dakota

The Value of Nature on Farms

Part 2



Photo: Marlin Harms

 xerces.org

© 2017 The Xerces Society, Inc. All rights reserved.

Pollination by Wild Bees

4000+ Species in North America

Wild bees fully
pollinate some crops
when more than
30% of the
immediate
landscape is natural
habitat



Photo: Mace Vaughan

Pest Suppression by Beneficial Insects

- \$4.5–12 billion annual value
- Observable throughout fields when more than 20% of a farm is diverse habitat

Losey & Vaughan. 2006. The Economic Value of Ecological Services Provided by Insects. *Bioscience* 56 (4). Pimental et al. 1997. Economic and Environmental Benefits of Biodiversity. *BioScience*:47 (11)



Bicyrtes sand wasp attacking brown marmorated stink bug

Photo Alex Surica

Decomposition by Dung Beetles

- Can reduce parasites by 75%
- Eliminate methane by up to 12%
- Eliminate e.coli



Fincher, G. T. 1975. Effects of dung beetle activity on number of nematode parasites acquired by grazing cattle. *Journal of Parasitology* 61: 759–762. (Available online at: <https://doi.org/10.2307/3279480> (verified 3 Oct 2017)).

Jones, M. S., S. Tadepalli, D. F. Bridges, V.C.H. Wu, and F. A. Drummond. 2015. Suppression of *Escherichia coli* O157:H7 by dung beetles (Coleoptera: Scarabaeidae) using the lowbush blueberry agroecosystem as a model system. *PLoS ONE* 10: e0120904.

Slade, E. M., T. Riutta, T. Roslin, and H. L. Tuomisto. 2016. The role of dung beetles in reducing greenhouse gas emissions from cattle farming. *Scientific Reports* 6: 18140. (Available online at: [10.1038/srep18140](https://doi.org/10.1038/srep18140))

Weed Suppression by Ground Beetles

- Lambsquarters, ragweed, pigweed, velvetleaf, foxtail, crabgrass, etc.
- 74 to 208 seeds consumed in 48 hours



Photo: University of Minnesota Extension

Lundgren, J. 2005. Ground beetles as weed control agents: effects of farm management. *American Entomologist*. 224-226.

Pest Control by Songbirds



Alfalfa Pests

33% reduction of pests when nearby habitat is available to support nesting/roosting (e.g. trees)

Kross, S. , T.R. Kelsey, C. McColl, J. Townsend. 2016. Field-scale habitat complexity enhances avian conservation and avian -mediated pest-control services in an intensive agricultural crop. *Agriculture, Ecosystems & Environment*. 225:140-149.



Photo: Gregory Heath

Making Land
USEFUL WILL

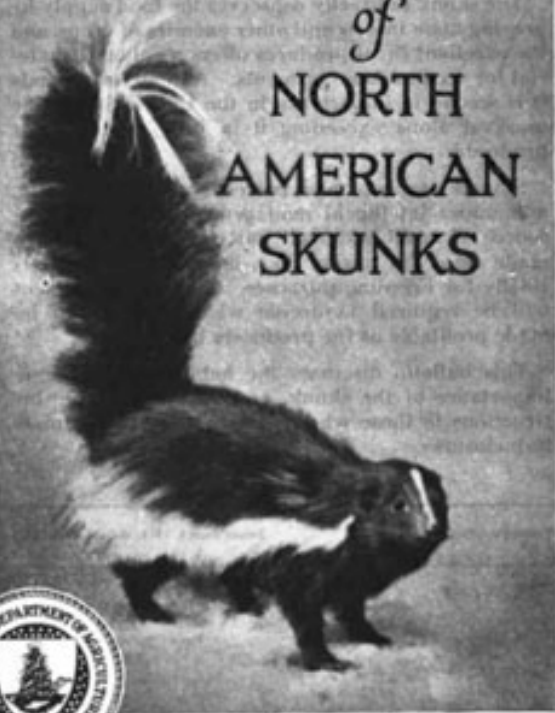


FEED

Farmers' Bull
U.S. Depart

U. S. DEPARTMENT OF
AGRICULTURE
FARMERS' BULLETIN No. 587
June 1950

ECONOMIC VALUE
of
NORTH
AMERICAN
SKUNKS



PA-126

...the skunk has now become a recognized asset in the communities it inhabits...

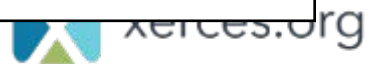
Fence rows
Field borders

Shelterbelts and windbreaks
Streambanks

The skunk conserves the food supply by preying upon insects and the other enemies of crops...

U.S. Conservation Service, Upper Mississippi Region, Milwaukee, Wis.

Issued June 1950



Biocultural Landscapes

Part 3

Biocultural Landscapes

Intertwined natural and human landscapes shaped over long periods of time by agriculture and low impact settlements



Photo: McKay Savage

Biocultural Landscapes in the Pacific Northwest

Camas Meadow Agriculture

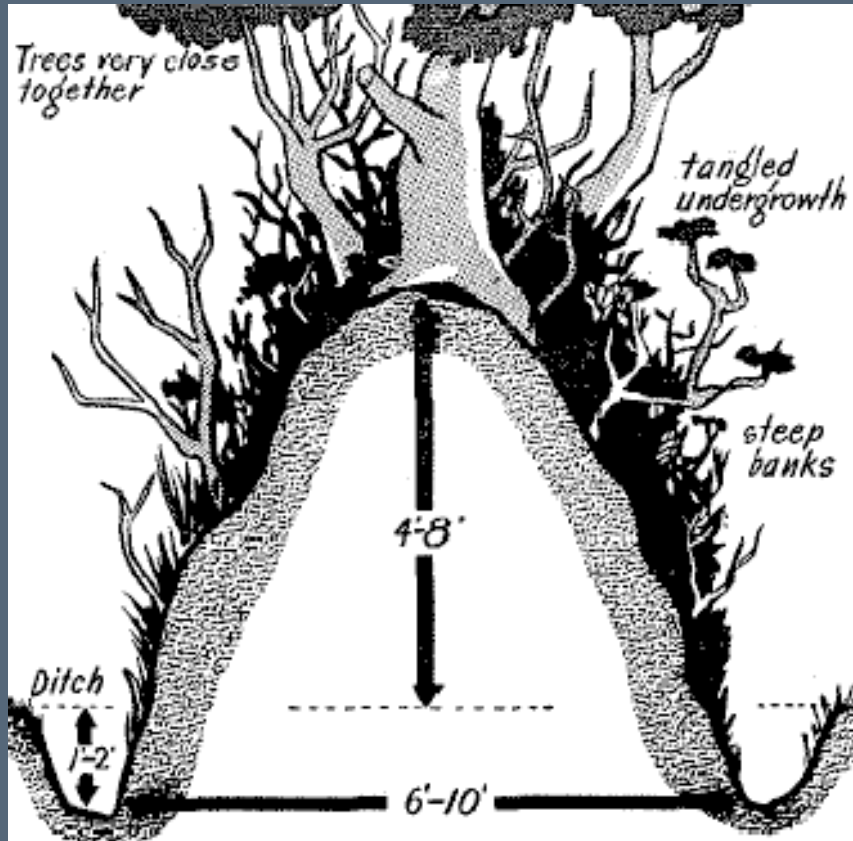
- *Camassia* spp.
- Staple native American food source
- Starchy edible bulbs



Photo: Roger Peterson, T. Abe Boyd

Biocultural Landscapes Hedgerows in Western Europe

- Artifact of bronze-age agriculture
- Persistence through multiple wars
- Still primary corridors for biological diversity



Photos: Sebastian Ballard, Michael Trolove, Derick, W. T

Biocultural Landscapes Satoyama in Japan



Satoyama

里 (country/village) 山 (mountain)

- Symbiosis of people and nature
- Co-evolution of farming with wild plants, animals, mushrooms
- Common forest ownership with renewable resources (forest leaves, timber, bamboo, wild foods)



Photo: 古峰

Deep Form Design

Lessons learned from centuries of careful, nature-informed design, can re-shape our tomorrows



Bringing Biodiversity Back to the Farm

Part 4



Deep Form Agriculture

Restoring Natural Habitat and Natural Ecosystems Where They No Longer Exist



Photo: Stephanie Frische

California Almond Orchard Field Border



Photo: Jessa Cruz © 2017 The Xerces Society, Inc. All rights reserved.

Vilicus Farm, Montana

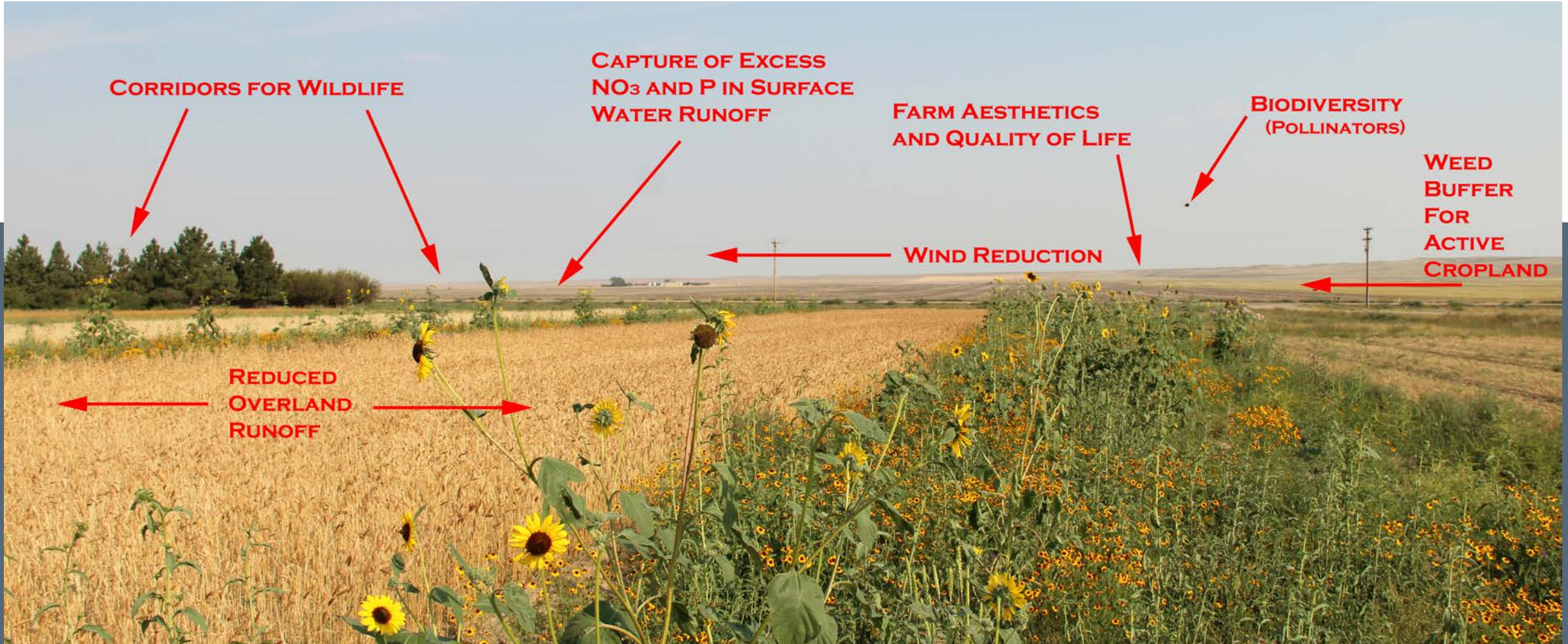


Photo: Jennifer Hopwood

Wisconsin Farm Field Border – Karner Blue Butterfly



Photo: Paula Kleintjes-Neff, Eric Lee-Mäder

California Orchard – Native Wildflower Cover Crop



Photo: Jessa Cruz

Native Prairie Grazing Lands, Nebraska



Photo: Chris Helzer, Sarah Foltz-Jordan

California Pollinator Hedgerow



Photo: Jessa Cruz

Grinnell Heritage Farm, Iowa – Beetle Bank



Photo: Grinnell Heritage Farm; Tess Grasswitz

Captain Blueberry – Oregon



Photo: Eric Lee-Mäder



New Hampshire Blueberry Farm

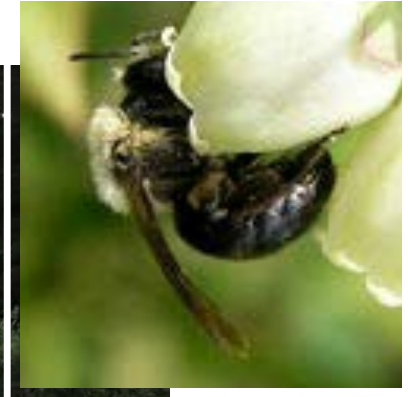


Photo: Don Keirstead

Conservation is Everyone's Job

Final Thoughts



Fukuoka on Bioculturalism

...the use of chemicals is not a problem for the entomologist alone.

Philosophers, men of religion, artists and poets must also help to decide whether or not to use chemicals in farming.



Photo: Larry Korn

Thank You!

eric@xerces.org



© 2017 The Xerces Society, Inc.

All content, including text, images and graphics, as well as the arrangement of these elements within this presentation is either the intellectual property of The Xerces Society, Inc. or is used in this presentation with the permission of the copyright holder. Neither this presentation, nor any individual element from this presentation, may be used without the prior written consent of the applicable copyright holder. All rights reserved.