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

© 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.

Also

- Pesticide policy and regulation
- Endangered species
- Aquatic conservation

Pollinator conservation and agricultural biodiversity

Photos: Xerces; Joel Sartore, Eric Lee-Mäder

xerces.org

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

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

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

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

xerces.org

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

Earth Without Animals

Part 1

Photo: Anne Stine, Xerces Society

xerces.org

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

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

xerces.org

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

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

xerces.org

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

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.

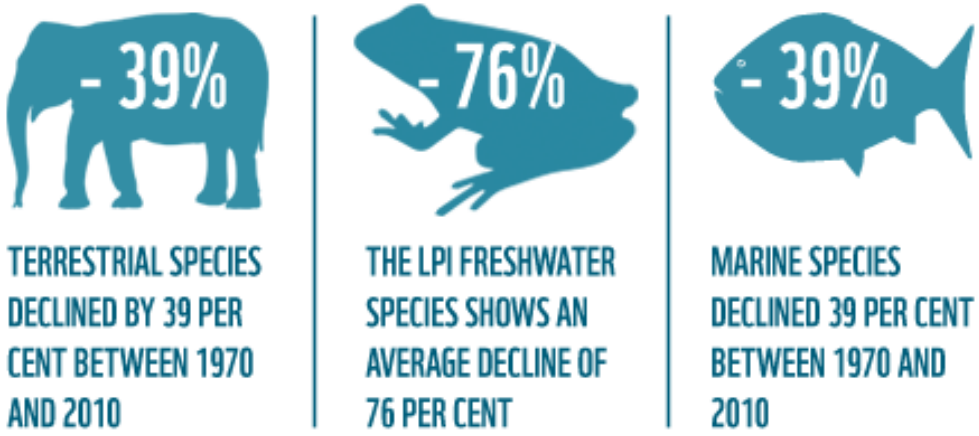
Photo: Alex Wild

xerces.org

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

Living Planet Index - Meta Analysis

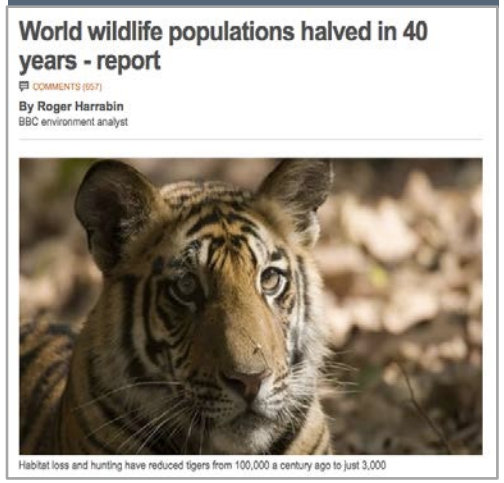
Earth Has Lost Half of its Wildlife in the Past 40 Years



Photos: WWF, BBC, Gory Sowie

Ecosystems are degrading at a rate unprecedented in human history

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



World wildlife populations halved in 40 years - report

COMMENTS (657)

By Roger Harrabin
BBC environment analyst

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

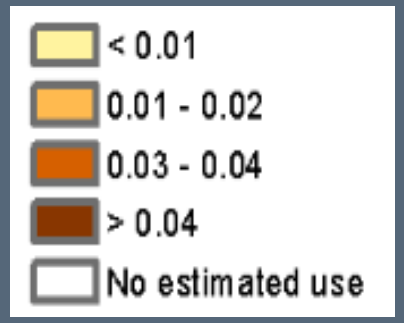
xerces.org

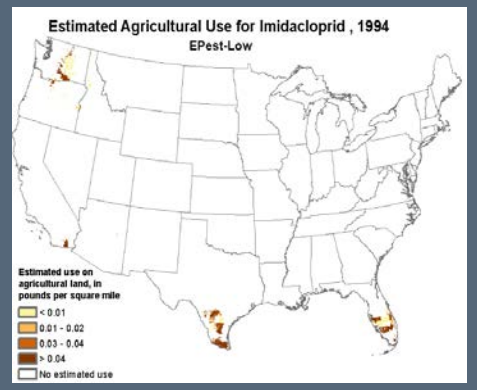
© 2017 The Xerces Society, Inc. All rights reserved.

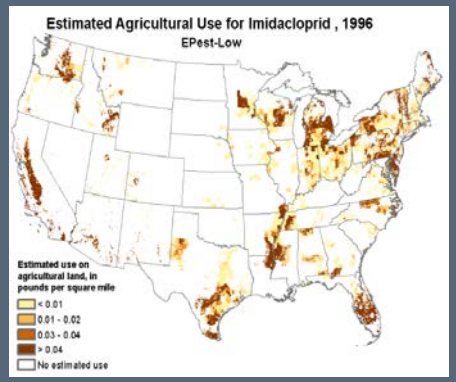
The Rise of New Insecticides

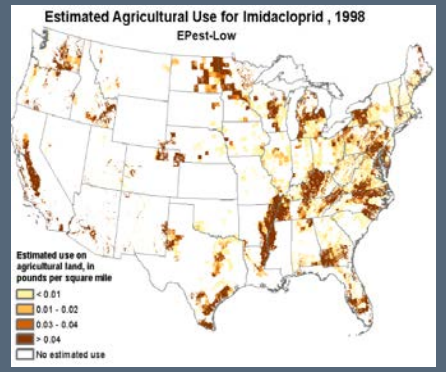
Neonicotinoid Insecticide Use 1994 to 2013

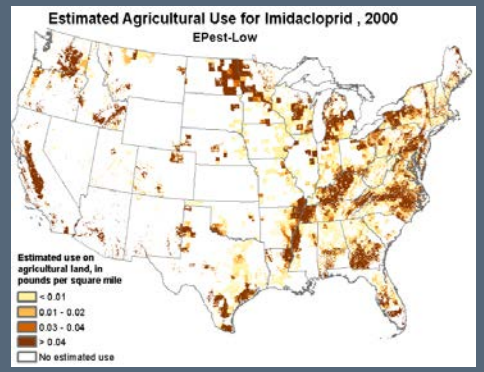
Estimated use on agricultural land in pounds per square mile over 10 years

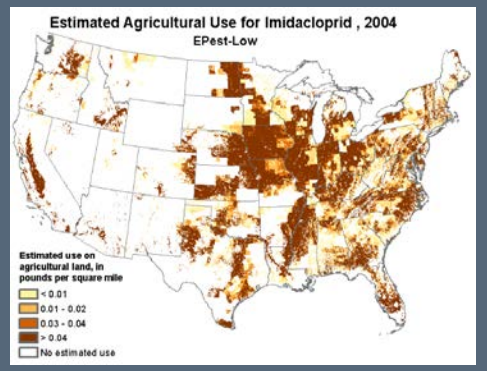


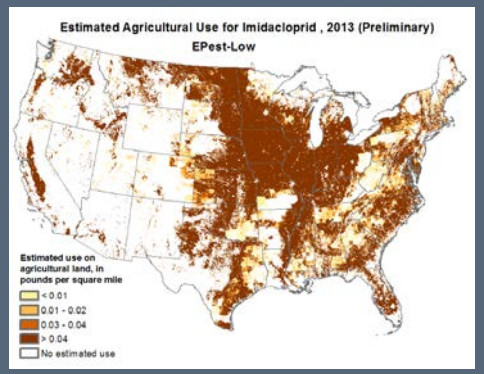












U.S. Geological Survey

xerces.org

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

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

xerces.org

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

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

xerces.org

Kremen, C. et al. 2004

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

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

xerces.org

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

Decomposition by Dung Beetles

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

Photo: Marc Barrison

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

xerces.org

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

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.

xerces.org

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

Pest Control by Songbirds

Alfalfa Pests

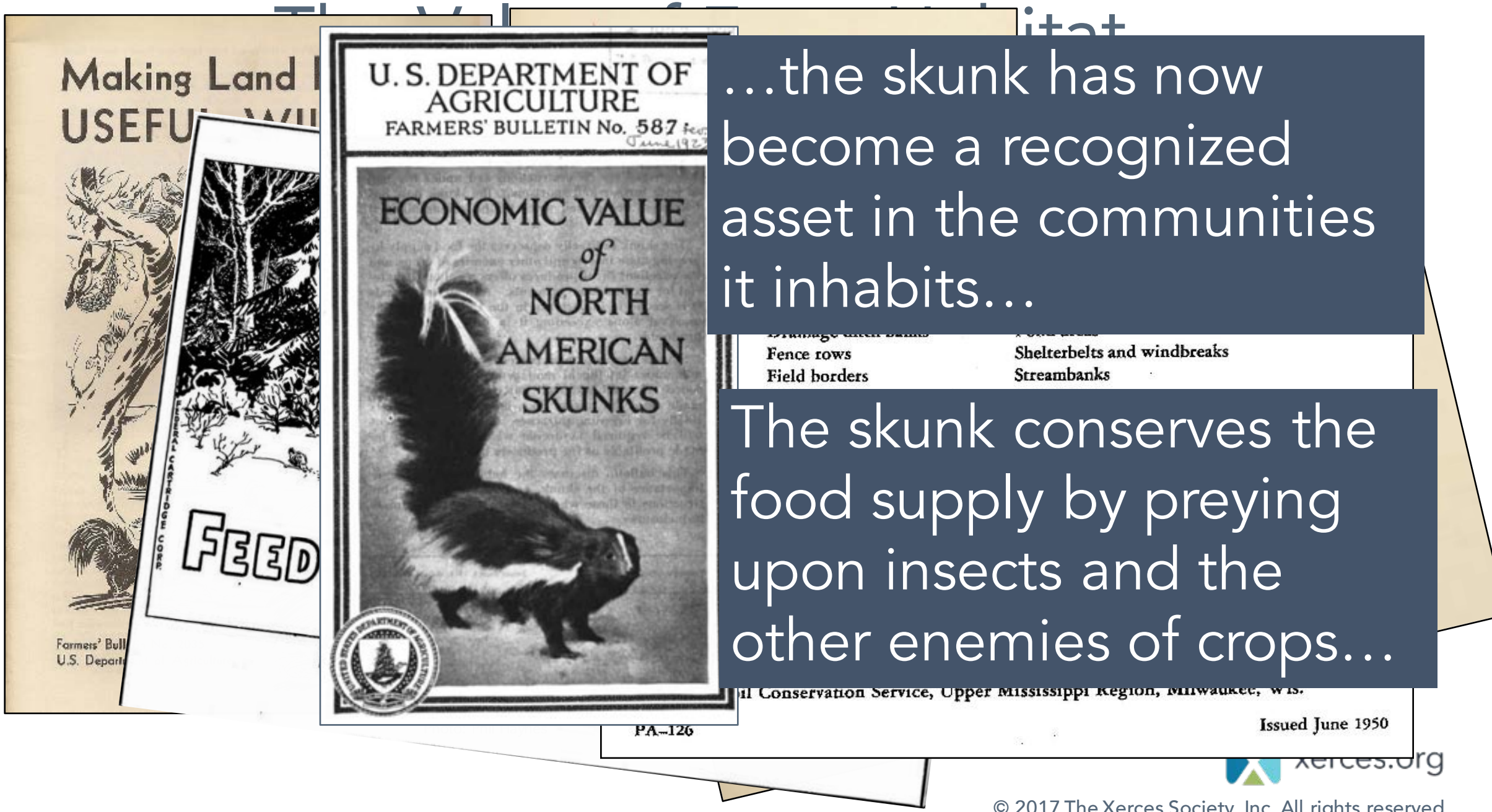
33% reduction of pests when nearby habitat is available to support nesting/roosting (e.g. trees)

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

xerces.org

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



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

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

xerces.org

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

Biocultural Landscapes

Part 3

Photo: 菊池市

xerces.org

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

Biocultural Landscapes

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

Photo: McKay Savage

xerces.org

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

Biocultural Landscapes in the Pacific Northwest

Camas Meadow Agriculture

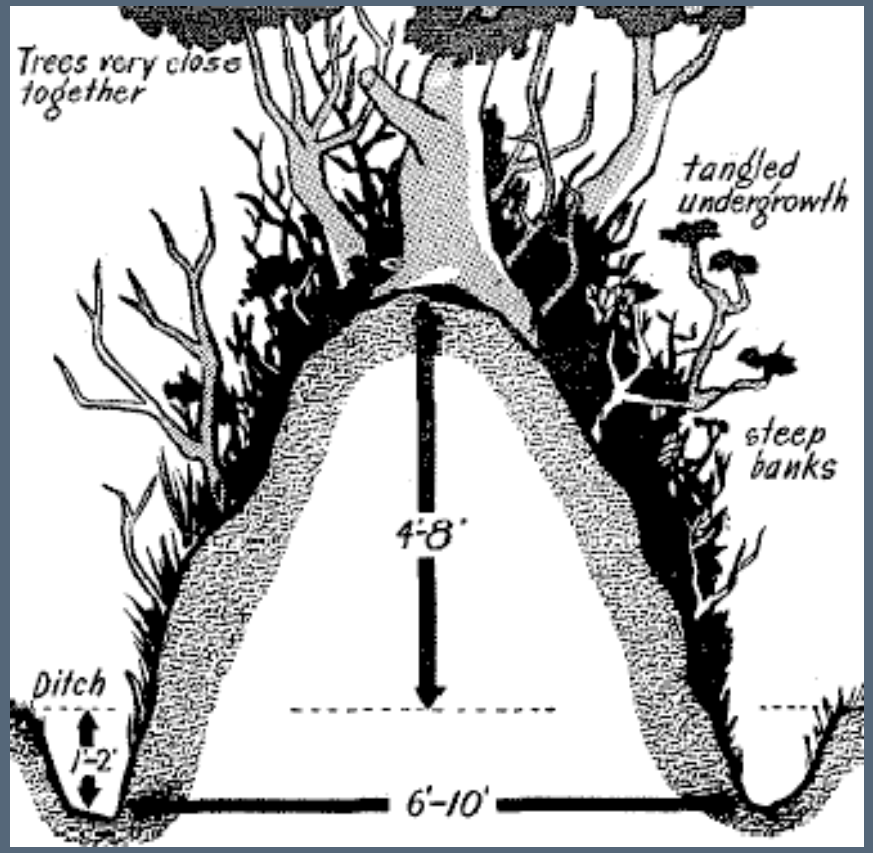
- Camassia spp.
- Staple native American food source
- Starchy edible bulbs

Photo: Roger Peterson, T. Abe Boyd

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

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

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

Biocultural Landscapes Satoyama in Japan

Photo: 古峰

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)

xerces.org

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

Deep Form Design

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

xerces.org

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

Bringing Biodiversity Back to the Farm

Part 4

Photo: Jessa Cruz

xerces.org

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

Deep Form Agriculture

Restoring Natural Habitat and Natural Ecosystems Where They No Longer Exist

Photo: Stephanie Frische

xerces.org

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

California Almond Orchard Field Border

GENERAL MILLS

OLAM

xerces.org

Photo: Jessa Cruz

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

Vilicus Farm, Montana

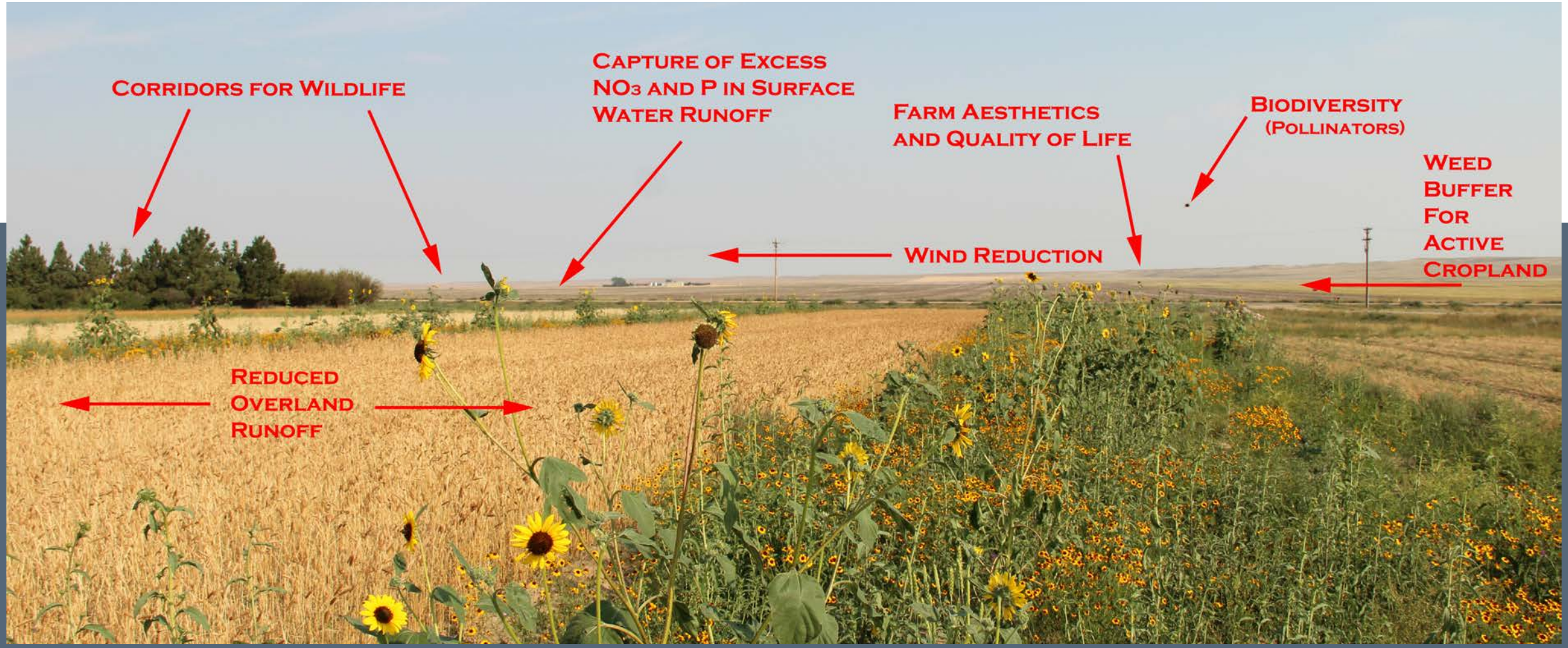


Photo: Jennifer Hopwood

xerces.org

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

Wisconsin Farm Field Border – Karner Blue Butterfly

Photo: Paula Kleintjes-Neff, Eric Lee-Mäder

xerces.org

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

California Orchard – Native Wildflower Cover Crop

Photo: Jessa Cruz

xerces.org

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

Native Prairie Grazing Lands, Nebraska

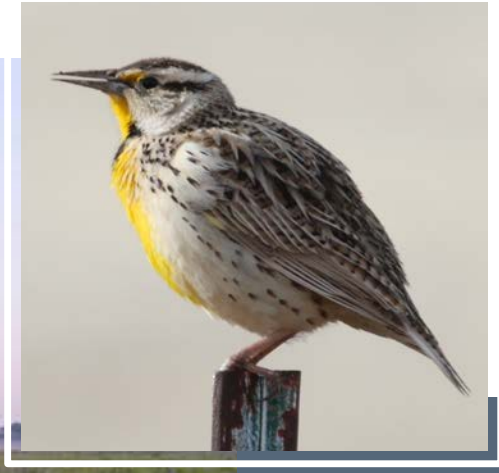


Photo: Chris Helzer, Sarah Foltz-Jordan

xerces.org

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

California Pollinator Hedgerow

Photo: Jessa Cruz

xerces.org

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

Grinnell Heritage Farm, Iowa – Beetle Bank

Photo: Grinnell Heritage Farm; Tess Grasswitz

xerces.org

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

Captain Blueberry – Oregon

Photo: Eric Lee-Mäder

xerces.org

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

New Hampshire Blueberry Farm

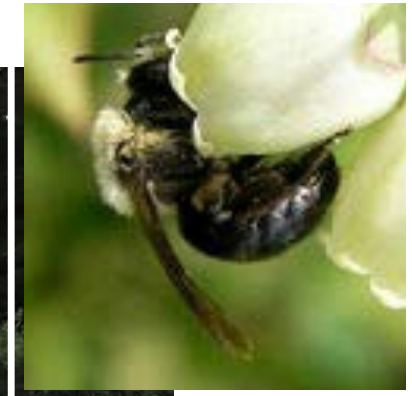


Photo: Don Keirstead

xerces.org

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

Conservation is Everyone's Job

Final Thoughts

Photo: **Jessa Cruz**

xerces.org

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

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

xerces.org

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

Thank You!

eric@xerces.org

XERCES SOCIETY
for Invertebrate Conservation

© 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 the applicable copyright holder. All rights reserved.