Nature's Best Hope

Doug Tallamy
University of Delaware

To save life on earth, we must save half of the planet for nature.

HALF-EARTH

Our Planet's Fight for Life

EDWARD O. WILSON

WINNER OF THE PULITZER PRIZE

How could this be possible?


To realize E.O.’s dream,
we need a new approach
to conservation


Again


Temnothorax
curvispinosus

What’s my point?


Nature is built from millions of such specialized interactions.

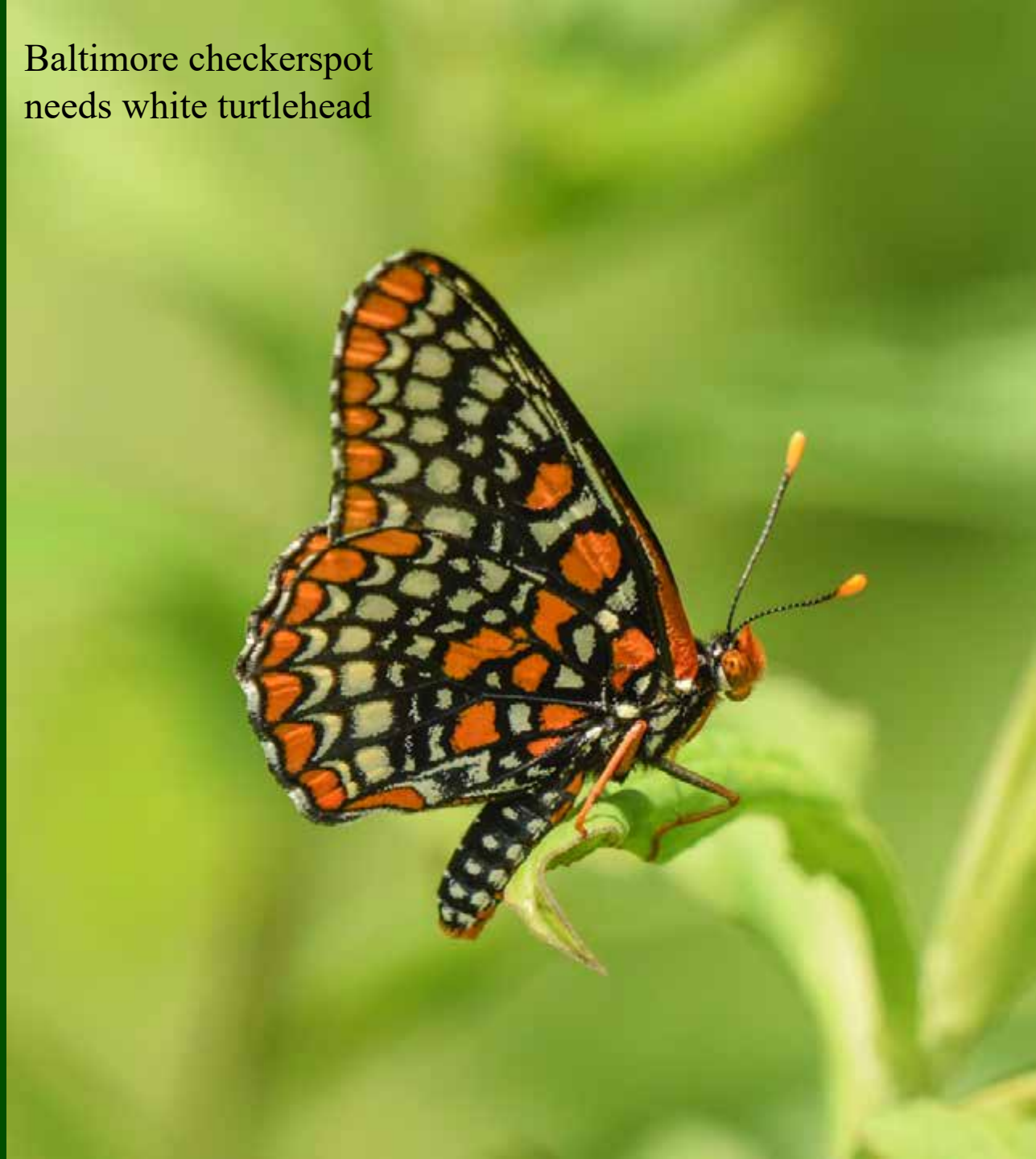
You won’t have breeding pileated woodpeckers without lots of carpenter ants

You won't have
Andrena phaceliae

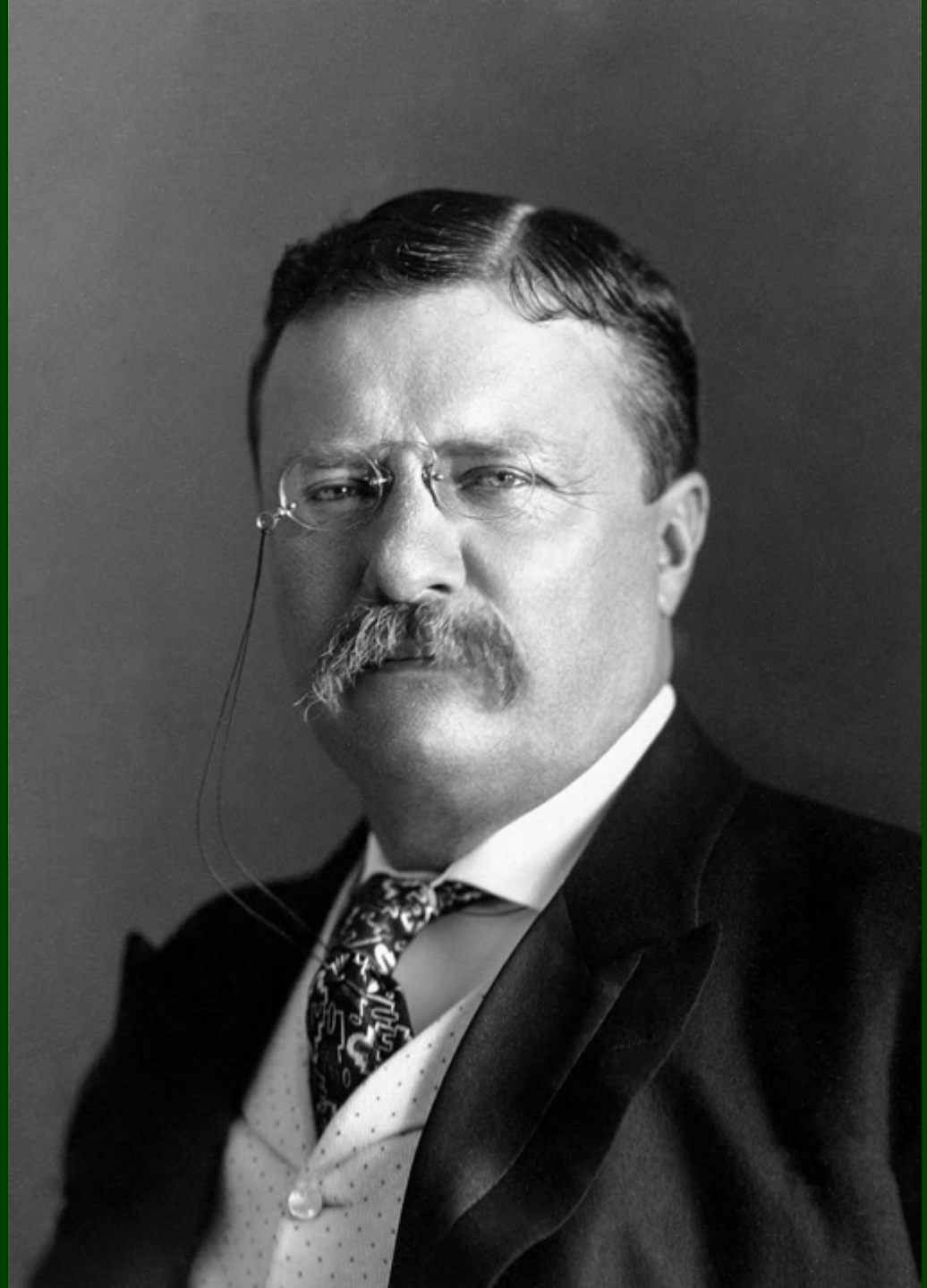

Phacelia

Nature is a series of specialized relationships

But today these relationships, and Nature itself, is on the ropes!



Nature is on the ropes because we didn't take Teddy Roosevelt's advice.




“Leave it as it is.”
Teddy Roosevelt

Only 5% of the lower 48 states is in anything close to a pristine ecological state.

Why have we done this??

We thought that our nest was so big, we could foul it forever without consequences.

But we were wrong

The New York Times

The Insect Apocalypse Is Here

What does it mean for the rest of life on Earth?

Nov 27 2018

The Washington Post

North America has lost 3 billion birds in 50 years

Rosenberg et al. 2019. *Science*
Vol. 365, Issue 6459, pp. 1228-1229

The Washington Post

One million species face extinction, U.N. report says.

And humans will suffer as a result!

I could go on….

but will deliver physical, psychological, and environmental benefits to all people.

The New York Times

The Insect Apocalypse Is Here

What does it mean for the rest of life on Earth?

Nov 27 2018

Edward O. Wilson

The Little Things That Run the World*
(The Importance and Conservation of Invertebrates)

On the occasion of the opening of the remarkable new invertebrate exhibit of the National Zoological Park, let me say a word on behalf of these little things that run the world. To start, there are vastly more kinds of invertebrates than of vertebrates. At the present time, on the basis of the tabulation that I have just completed (from the literature and with the help of specialists), I estimate that a total of 42,580 vertebrate species have been described, of which 6,300 are reptiles, 9,040 are birds, and 4,000 are mammals. In contrast, 990,000 species of invertebrates have been described, of which 290,000 alone are beetles—seven times the number of all the vertebrates together. Recent estimates have placed the number of invertebrates on the earth as high as 30 million, again mostly beetles—although many other taxonomically comparable groups of insects and other invertebrates also greatly outnumber vertebrates.

We don't know with certainty why invertebrates are so diverse, but a commonly held opinion is that the key trait is their small size. Their niches are correspondingly small, and they can therefore divide up the environment into many more little domains where specialists can coexist. One of my favorite examples of such specialists living in microniches are the mites that live on the bodies of army ants: one kind is found only on the mandibles of the soldier caste, where it sits and feeds from the mouth of its host; another kind is found only on the hind foot of the soldier caste, where it sucks blood for a living; and so on through various bizarre configurations.

Another possible cause of invertebrate diversity is the greater antiquity of these little animals, giving them more time to explore and fill the environment. The first invertebrates appeared well back into Precambrian times, at least 600 million years ago. Most invertebrate phyla were flourishing before the vertebrates arrived on the scene, some 500 million years ago.

Invertebrates also rule the earth by virtue of sheer body mass. For example, in tropical rain forest near Manaus, in the Brazilian Amazon, each hectare (or 2.5 acres) contains a few dozen birds and mammals but well over one billion invertebrates, of which the vast majority are not beetles this time but mites and springtails. There are about 200 kilograms dry weight of animal tissue in a hectare, of which 93 percent consists of invertebrates. The ants and termites alone compose one-third of this biomass. So when you walk through a tropical forest, or most other terrestrial habitats for that matter, or snorkel above a coral reef or some other marine or aquatic environment, vertebrates may catch your eye most of the time—biologists would say that your search image is for large animals—but you are visiting a primarily invertebrate world.

It is a common misconception that vertebrates are the movers and shakers of the world, tearing the vegetation down, cutting paths through the forest, and consuming most of the energy. That may be true in a few ecosystems such as the grasslands of Africa with their great herds of herbivorous mammals. It has certainly become true in the last few centuries in the case of our own species, which now appropriates in one form or other as much as 40 percent of the solar energy captured by plants. That circumstance is what makes us so dangerous to the fragile environment of the world. But it is otherwise more nearly true in most parts of the world of the invertebrates rather than the nonhuman vertebrates. The leafcutter ants, for example, rather than deer, or rodents, or birds, are the principal consumers of vegetation in Central and South America. A single colony contains over two million workers. It sends out columns of foragers a hundred meters or more in all directions to cut forest leaves, flower parts, and succulent stems. Each day a typical mature colony collects about 50 kilograms of this fresh vegetation, more than the average cow. Inside the nest, the ants shape the material into intricate sponge-like bodies on which they grow a symbiotic fungus. The fungus thrives as it breaks down and consumes the cellulose, while the ants thrive by eating the fungus.

The leafcutting ants excavate vertical galleries and living chambers as deep as 5 meters into the soil. They and other kinds of ants, as well as bacteria, fungi, termites, and mites, process most of the dead vegetation and return its nutrients to the plants to keep the great tropical forests alive.

*Address given at the opening of the invertebrate exhibit, National Zoological Park, Washington, D.C., on May 7, 1987.


Life as we know it
depends on insects

If insects were to disappear…

1) Most flowering plants would go extinct

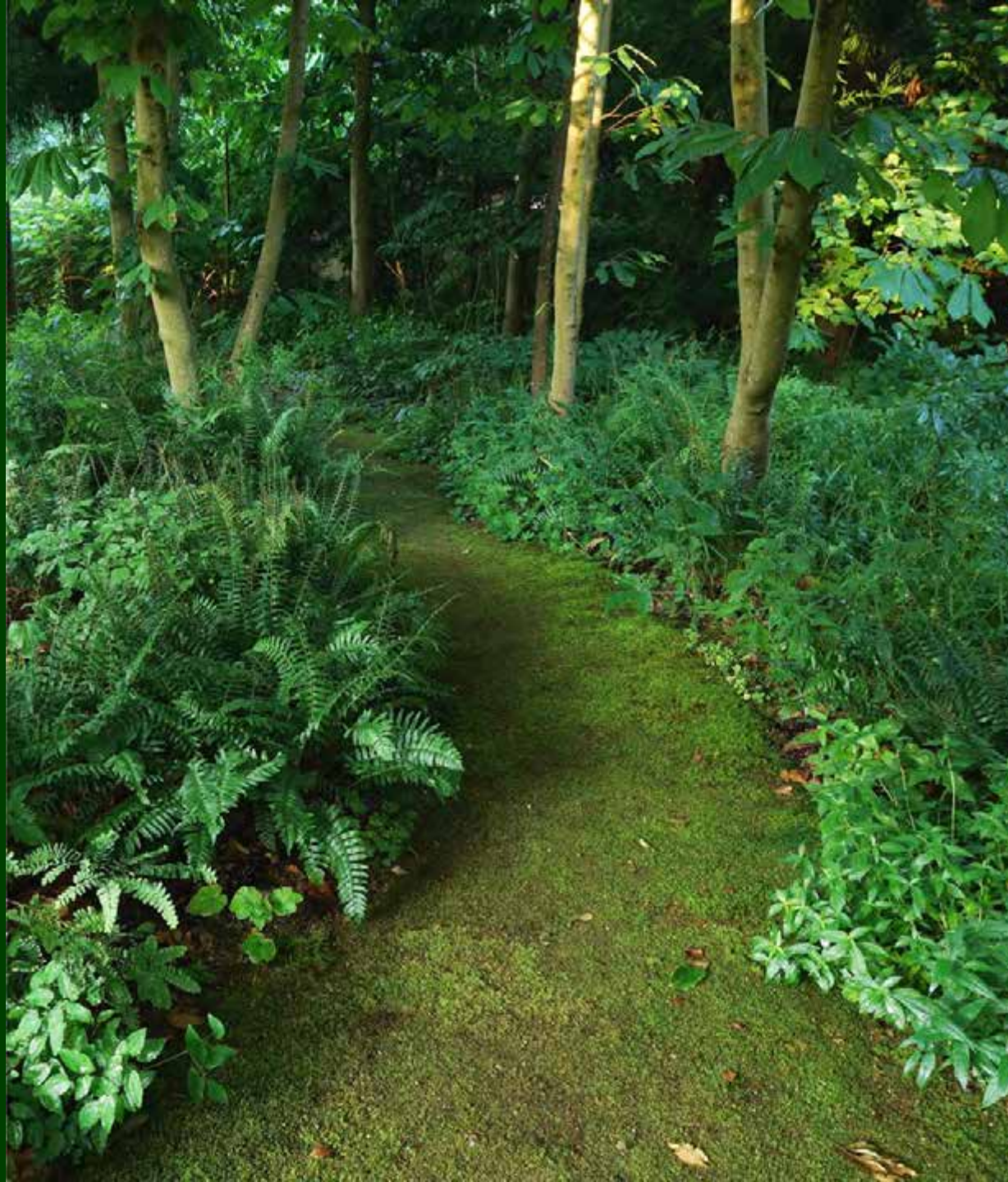
2) That would change the physical structure and energy flow of most terrestrial habitats

3) which would cause the rapid collapse of the food webs that support amphibians, reptiles, birds, and mammals

4) The biosphere would rot due to the loss of insect decomposers

5) Humanity would be doomed!

The good news is that we *can* save our insects, our birds, and nature itself …but we'll have to change the way we landscape to do it!



Humans are totally dependent on ecosystem services.

Ecosystem services from plants:

- Produce oxygen
- Clean water and slow its journey to the salty sea
- Capture carbon and pump it into the ground
- Build topsoil and hold it in place
- Prevent floods
- Dampen severe weather
- Convert sunlight into food

Ecosystem services from animals:

- provide pest control services
- pollinate nearly 90% of our flowering plants
- disperse plant seeds

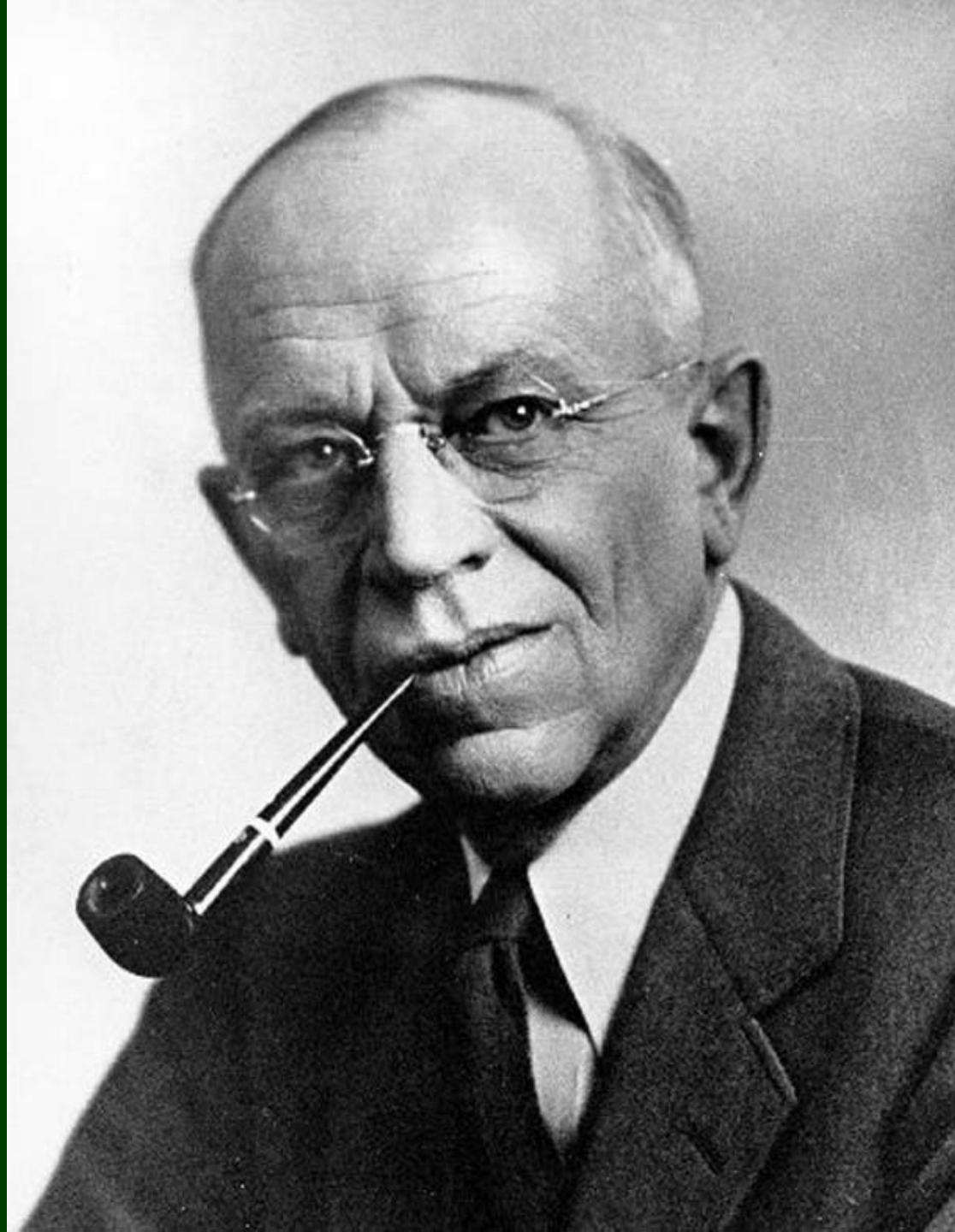
Designing landscapes that destroy ecosystem services is not an option

"The oldest task in human history is to live on a piece of land without spoiling it."

Aldo Leopold

Aldo dreamt of a time when humans had developed a “land ethic.”

In his dream, we would use the land…we would farm, lumber, graze, mine, and hunt ….but we would do it without destroying local ecosystems.



Curiously, he didn’t talk about developing a land ethic where we live.

The notion that humans and nature cannot coexist was so deeply embedded in our culture that Aldo didn't recognize it as an option.


But living with
nature IS an option
In fact, it is now
the only viable
option left to us

In the past conservationists worked exclusively where people *weren't*; we now need to save nature where people *are*.

We now need to find ways for nature to thrive in human-dominated landscapes!

Where shall we start?

85.6% of the U.S. east of the Mississippi is privately owned.

We need to renew all parts of nature, but for now, let's focus on its most important species.

i.e. the species that contribute the most to ecosystem function

To sustain flowering plants , we need bees


To sustain food webs, we
need caterpillars!


Caterpillars transfer more energy from plants to other animals than any other plant-eaters
Janzen 1988

Carolina chickadees, for example, rear their young almost exclusively on caterpillars.

In fact, most birds rear their young on caterpillars.

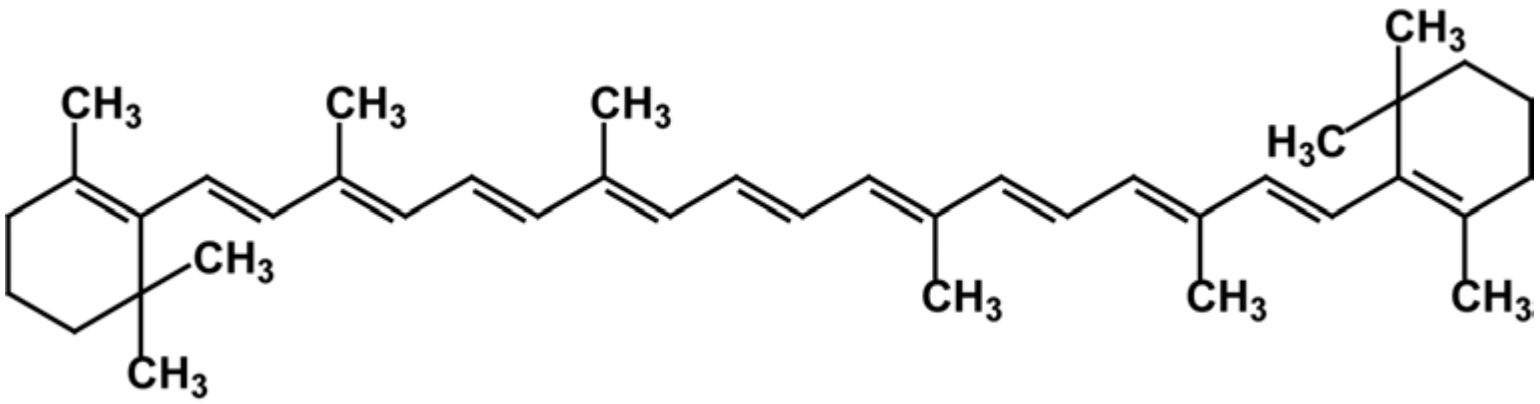

Why caterpillars?


1) soft

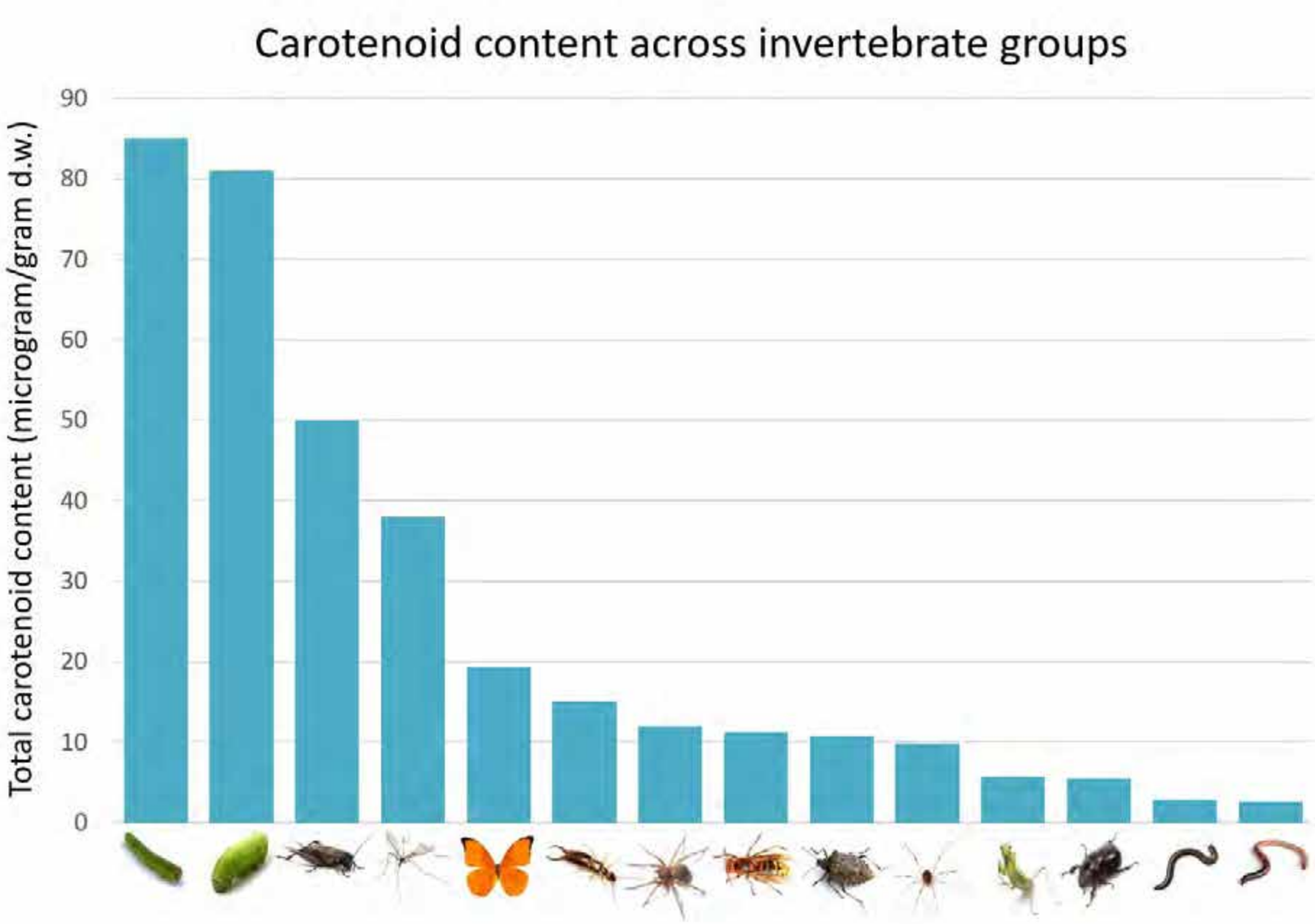

1) Soft
2) Large
3) Nutritious
4) Low % of chitin
5) Best source of carotenoids


1) Soft
2) Large
3) Nutritious
4) Low % of chitin
5) Best source of carotenoids

Essential carotenoids are only made by plants



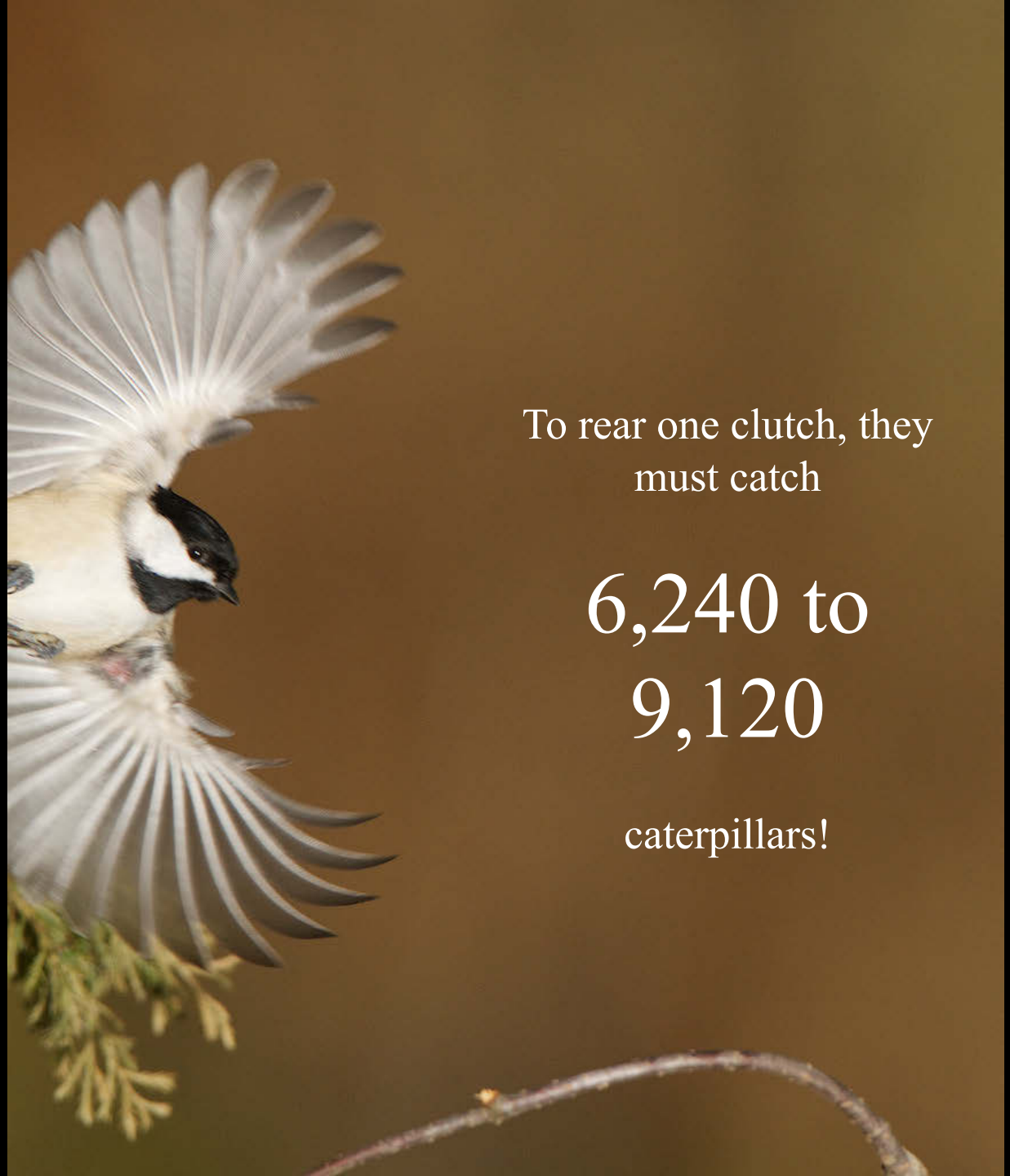
Yet they are essential components of our diet


Carotenoid content across invertebrate groups
Total carotenoid content (microgram/gram d.w.)
90
80
70
60
50
40
30
20
10
0

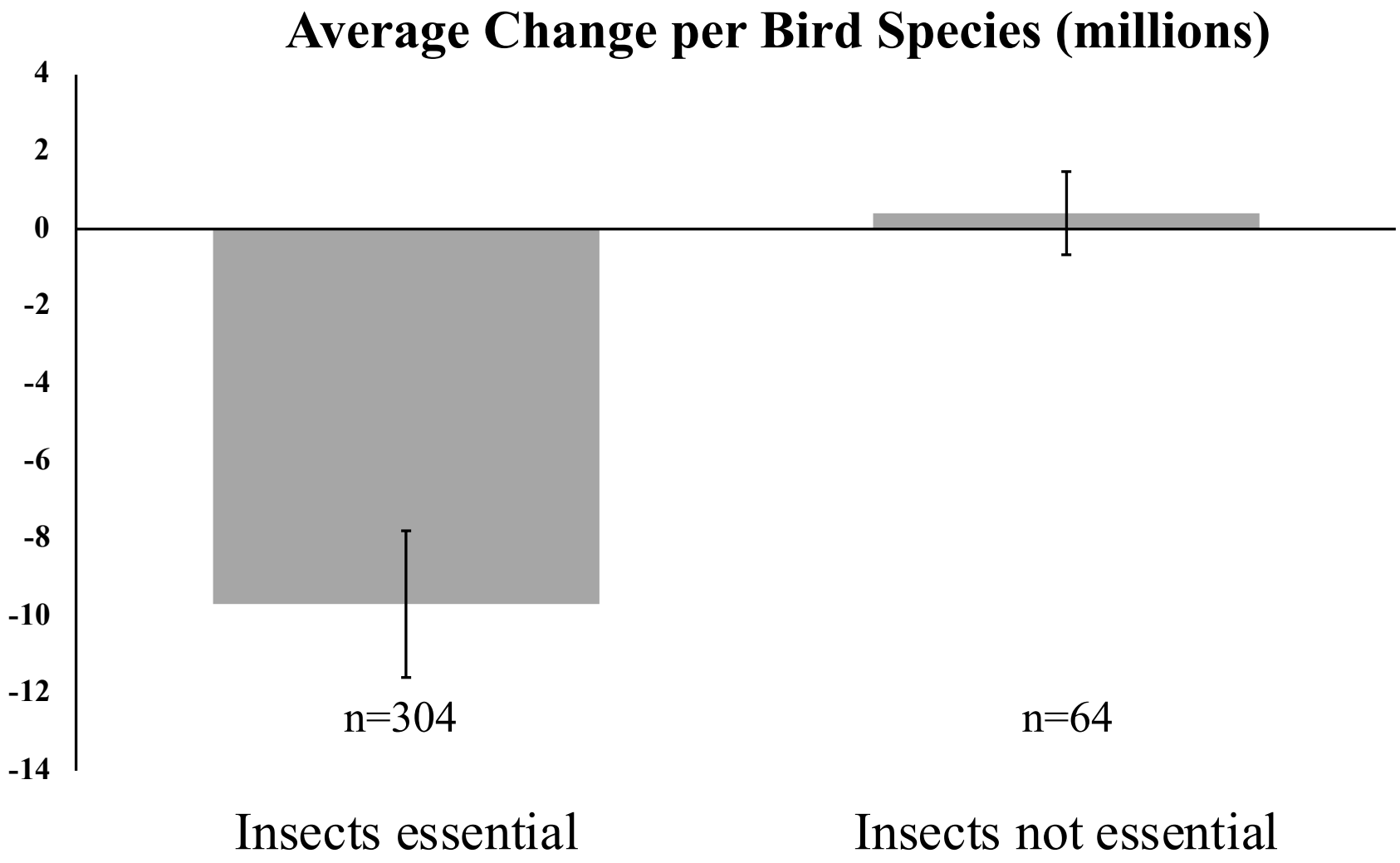
For most birds, caterpillars
are not optional!

But how many caterpillars do they need?

How many caterpillars does it take to make a nest of chickadees?


To rear one clutch, they must catch
6,240 to 9,120
caterpillars!


When insects decline,
birds decline.



Data from Rosenberg et al. 2019


How do we landscape for caterpillars?


We add caterpillars
to landscapes by adding
the plants that make them

But there's a catch.

Most plants don't support many caterpillars

Most caterpillars are host plant specialists…..

so we have to add the plants on which caterpillars have specialized!

Why are insect herbivores host plant specialists?

Plants
don’t want
to be eaten!

Plants defend
their tissues with
distasteful chemicals


But insects DO eat plants, so how do they do it?

They specialize on only a few types of plants!

Most insects that eat plants can develop
and reproduce only
on the plants with which they share
an evolutionary history.

(Forister et al. 2014)

There are three kinds of plants:

Contributors
Non-contributors
Detractors

Bob Croft
Grand Rapids


Contributors: plants that support local food webs

Non-contributors: plants that contribute little to food webs

Detractors: plants that degrade food webs


Plant choice matters!

Tallamy house; 10 acres in Oxford PA


Canadian owlet

Meadow Rue


Goldenrod
stowaway

Bidens aristosa


Hackberry emperor

Celtis occidentalis


Brown hooded owlet


Arcigera
flower moth


Goldenrod leafminer

Distinct
Sparganothis


Goldenrod gall moth

Virginia creeper


Pandora’s sphinx


Lettered sphinx

Hog sphinx


Abbot’s sphinx

Double-toothed Prominent

American Elm

Evening primrose moth

Evening primrose


Evening primrose


1257 species
of moths

62 species of birds have bred on our 10 acres!

WWF: Two-thirds of wildlife have vanished since 1970

Sept. 11, 2020


But can this work in suburbia?


Margy and Dan Terpstra

Terpstra Stats

0.6 acres in suburban Kirkwood, MO
Replaced invasive plants with 70 species of natives
Installed a bubbler
149 bird species
35 warbler species (we have recorded 8 species at our house)

Can it work in urban yards?


Pam Karlson

Karlson Stats

Lot is 1/10th acre, 3 times smaller than average U.S. lot.

It is ½ block from Chicago's Kennedy expressway.

It is directly adjacent to one of O'Hare airport's runways.

No connectivity with preserved land.

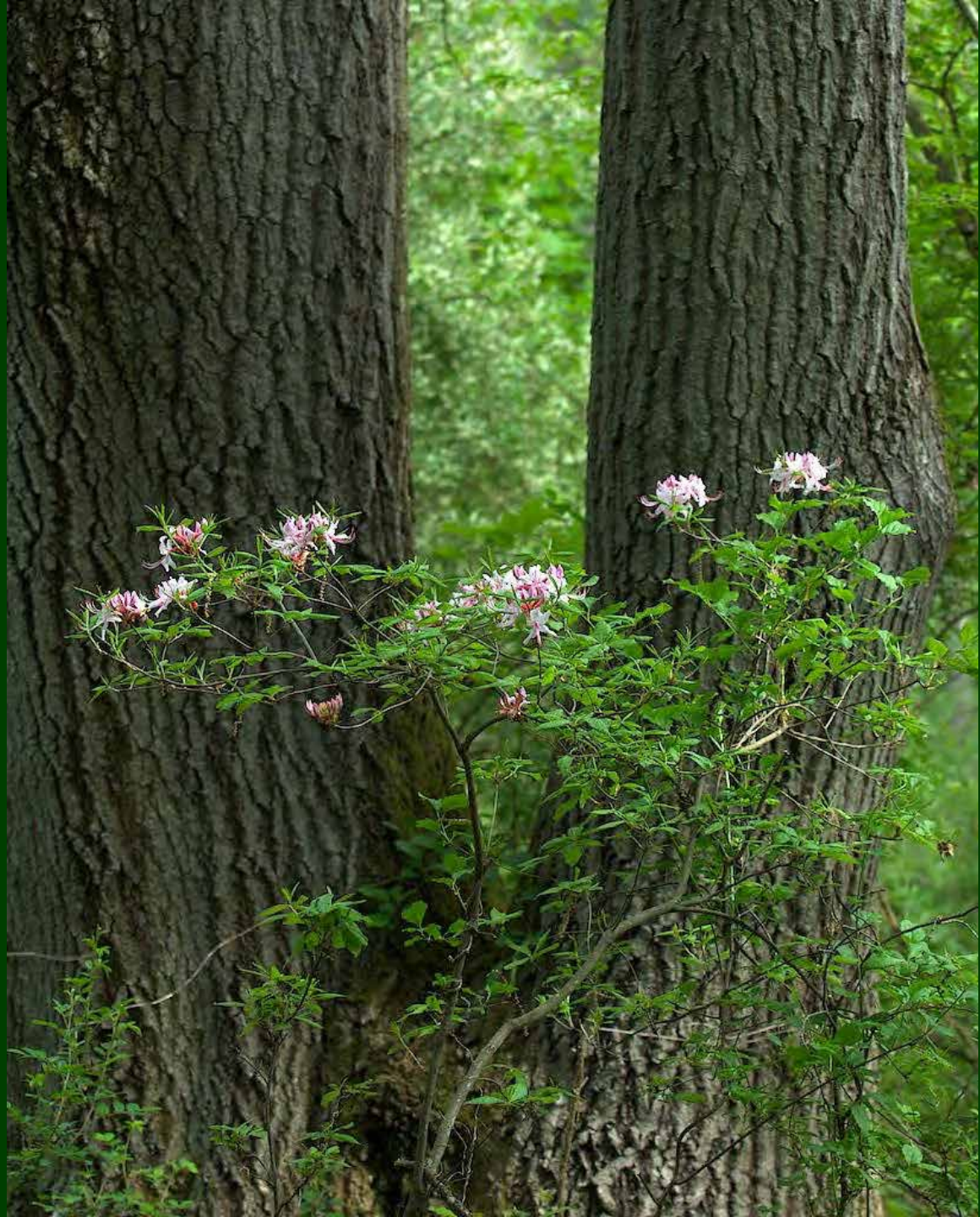
Pam added 60 native plant species and a water feature to her yard.

125 species of birds have used her yard, including a woodcock!


Four keys to
success


1) We must shrink the lawn
More than 40 million acres nationwide

If we replant half of the area now in lawn…..




Dan Getman

20 Million Acres:

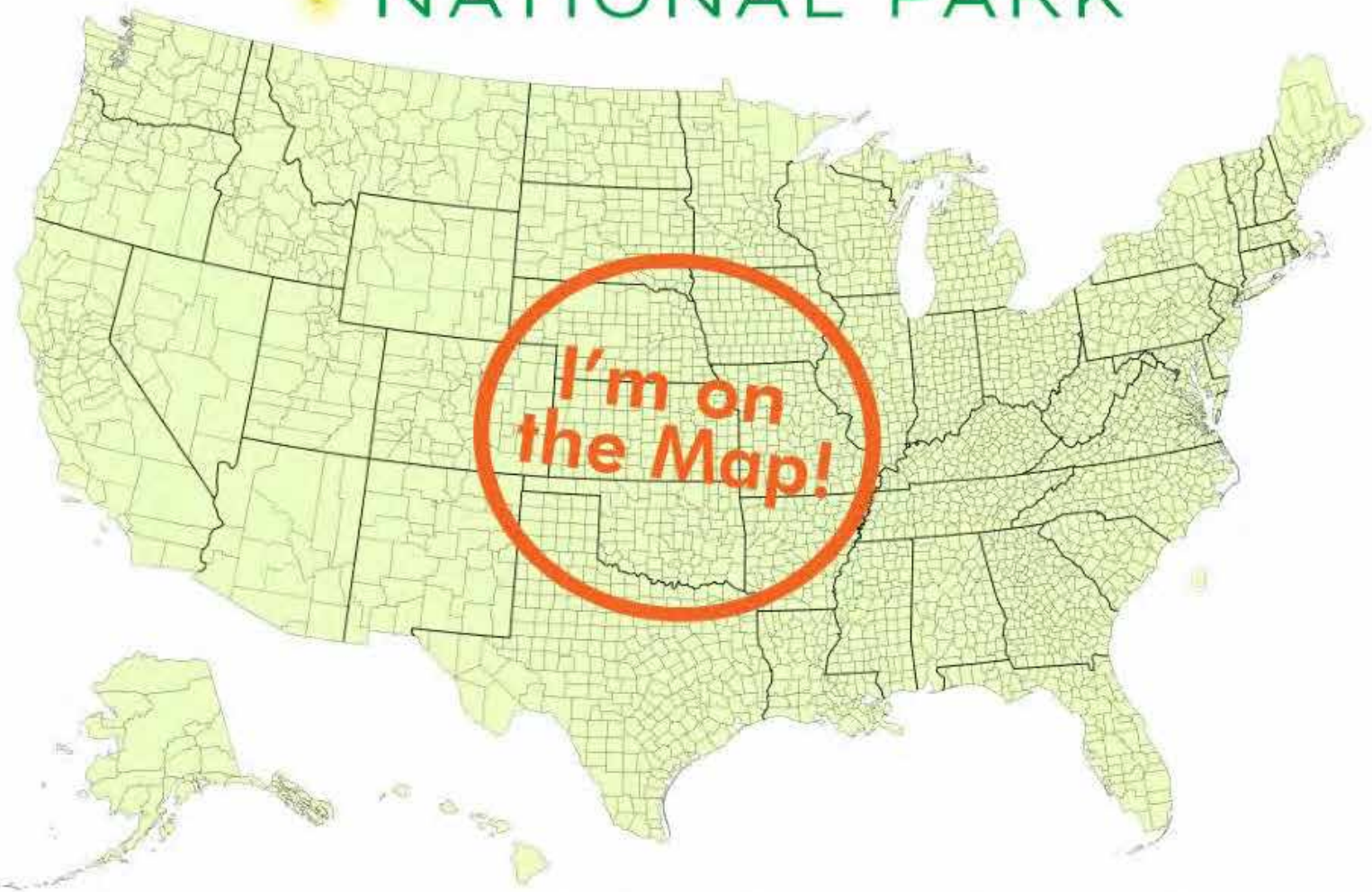
Adirondacks +
Yellowstone +
Yosemite +
Grand Tetons +
Canyonlands +
Mount Rainier +
North Cascades +
Badlands +
Olympic +
Sequoia +
Grand Canyon +
Denali +
Great Smoky Mountains

Benefits of building a park at home

1) You can develop a personal relationship with nature on your own time and at your own pace
2) Avoid crowds
3) It's free
4) Avoid travel hassles
5) Experience the natural world alone
6) Hunt lizards!

Start a new **HABITAT**™

HOMEGROWN NATIONAL PARK™



HomegrownNationalPark.org

What are we asking?

1) Reduce the area in lawn
2) Plant more natives
3) Remove invasives
4) Protect natural areas of their property

What are HNP's ecological products?

Significant increases in biodiversity

Measurable reduction in invasive species

Significant drawdown of atmospheric CO^2

The transformation of areas outside of preserves from no man's land to viable habitats.

What is HNP's sociological product?

National awareness, not just of the problem but of the solutions

A changed culture: recognition that nature is not optional and that everybody owns responsibility to sustaining it

Coverts hope into action!

Merges national conservation efforts (Audubon, NWF, Wild Ones, etc.) within one visual

2) Keystone plants are essential!

i.e., A few native plants are much better at supporting food webs than others.

Just 14% of our native plants make 90% of the caterpillar food that drives food webs

Keystone plants are the 2x4s of your ecological house

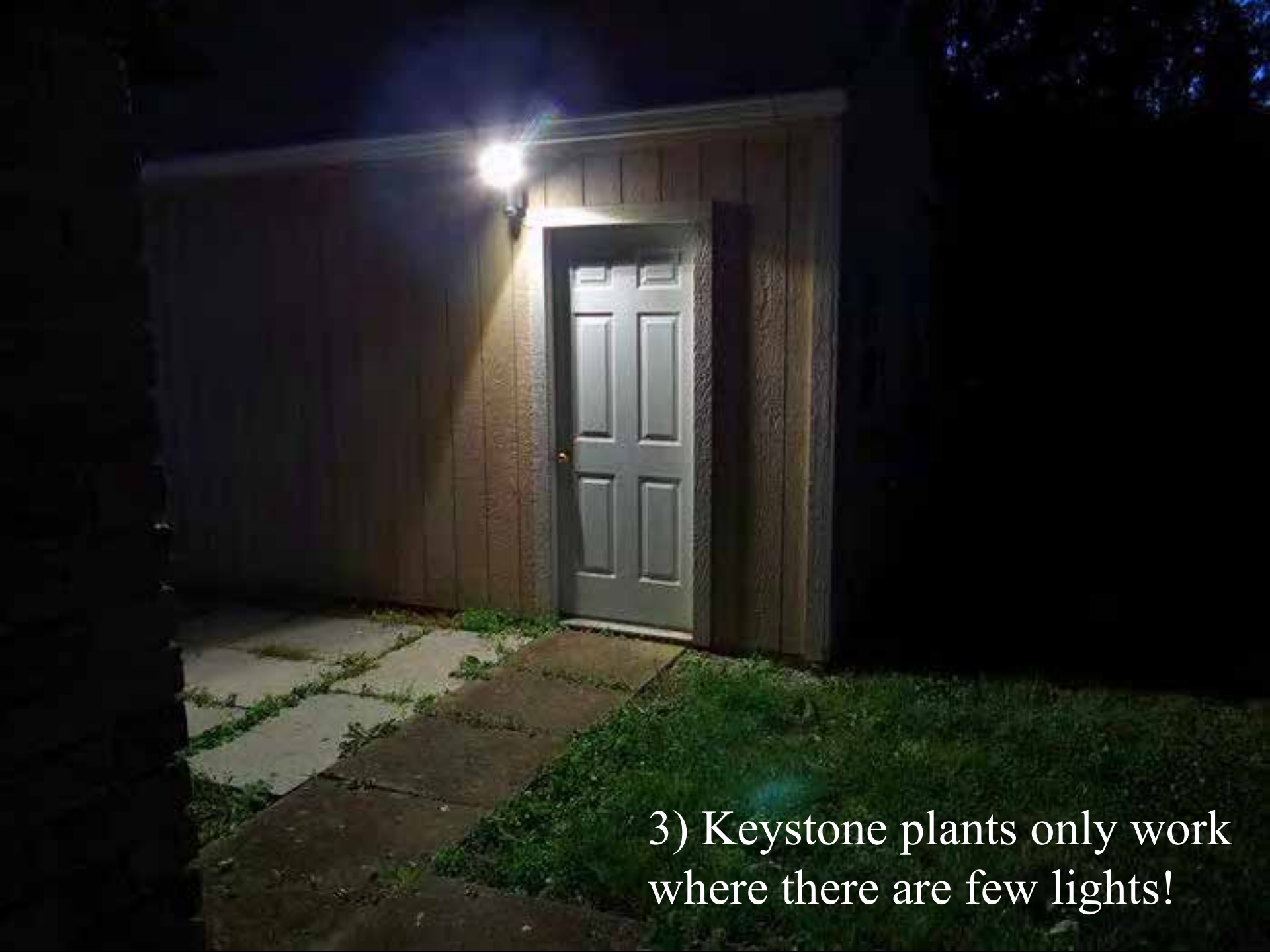
Oaks support 557 species of caterpillars in the mid-Atlantic and over 950 species nationwide

Keystone Species

"Native Plant Finder"
National Wildlife Federation
http://www.nwf.org/NativePlantFinder/

Quercus	Native oaks
Prunus	Native cherries
Salix	Native willows
Ulmus	Native elms
Betula	Native Birches
Acer	Native maples
Populus	Poplars

Solidago	Goldenrods
Aster genera	
Helianthus	Sunflowers
Solanum	Nightshade
Fragaria	Wild strawberry
Plantago	Plantain
Lactuca	Wild lettuce


3) Keystone plants only work
where there are few lights!

Light pollution reduces insect populations by:

Exhaustion
Collisions
Incineration
Dehydration
Increase predation
Blind insects
Misdirect oviposition
Disrupt circadian rhythms,
foraging, mating, and reproduction

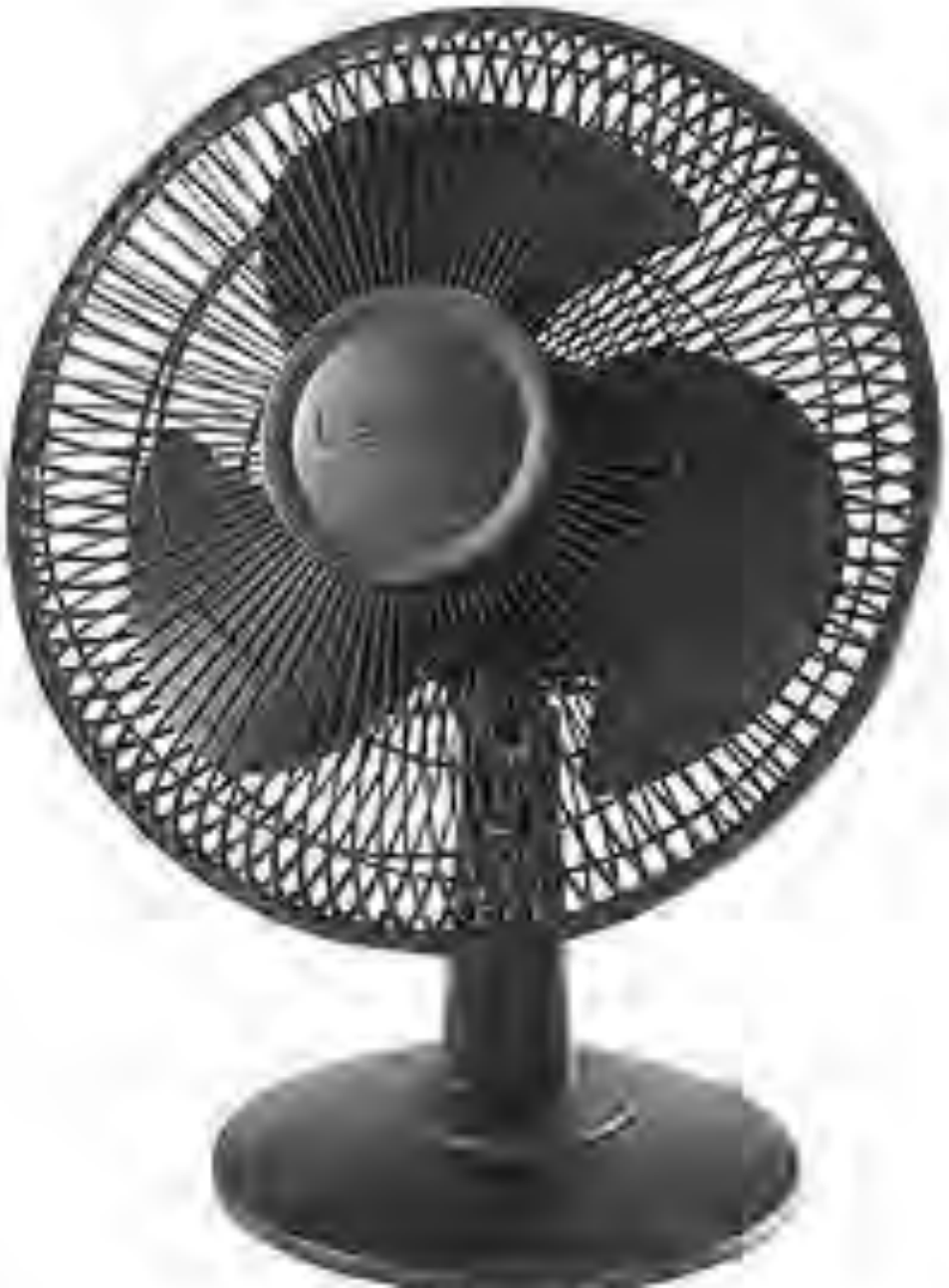
How to reduce light pollution

Put a motion sensor on security lights

Use yellow light bulbs

Mosquitos are best controlled in the larval stage

Mosquito dunk



4) We must allow caterpillars
to complete their development


511 species of caterpillars develop on oaks in Chester Co. PA

480 species (94%) pupate in the soil …


or in cocoons
in leaf litter

Goldenseal
Hydrastis canadensis

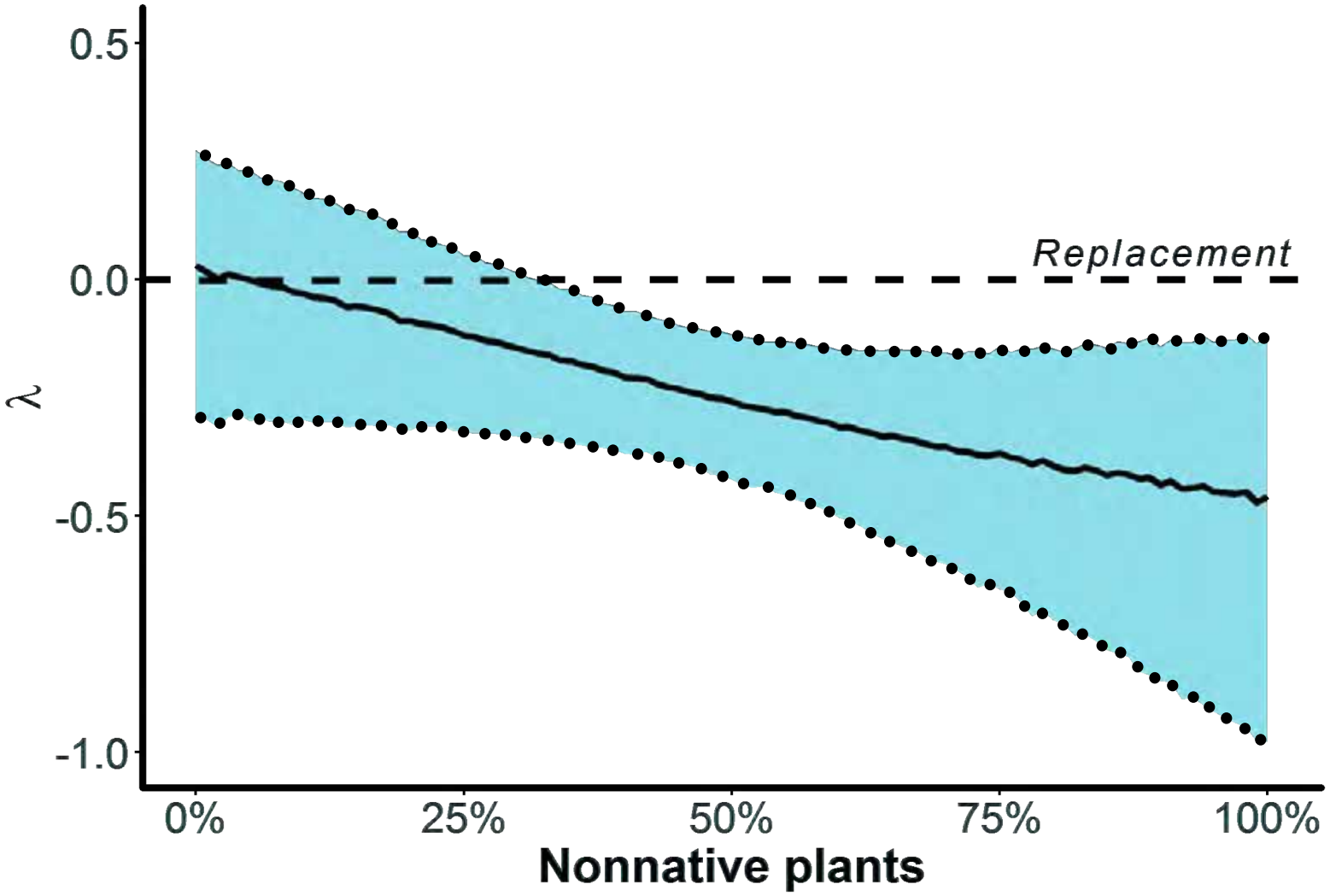
There is room for compromise!

Desiree Narango

Compared to native landscapes, yards dominated by introduced plants:

1) Produced 75% fewer caterpillars
2) Were 60% less likely to have breeding chickadees
3) Nests contained 1.5 fewer eggs
4) Clutches were 29% less likely to survive
5) Nests produced 1.2 fewer fledglings
6) Maturation was delayed by 1.5 days

Population Growth

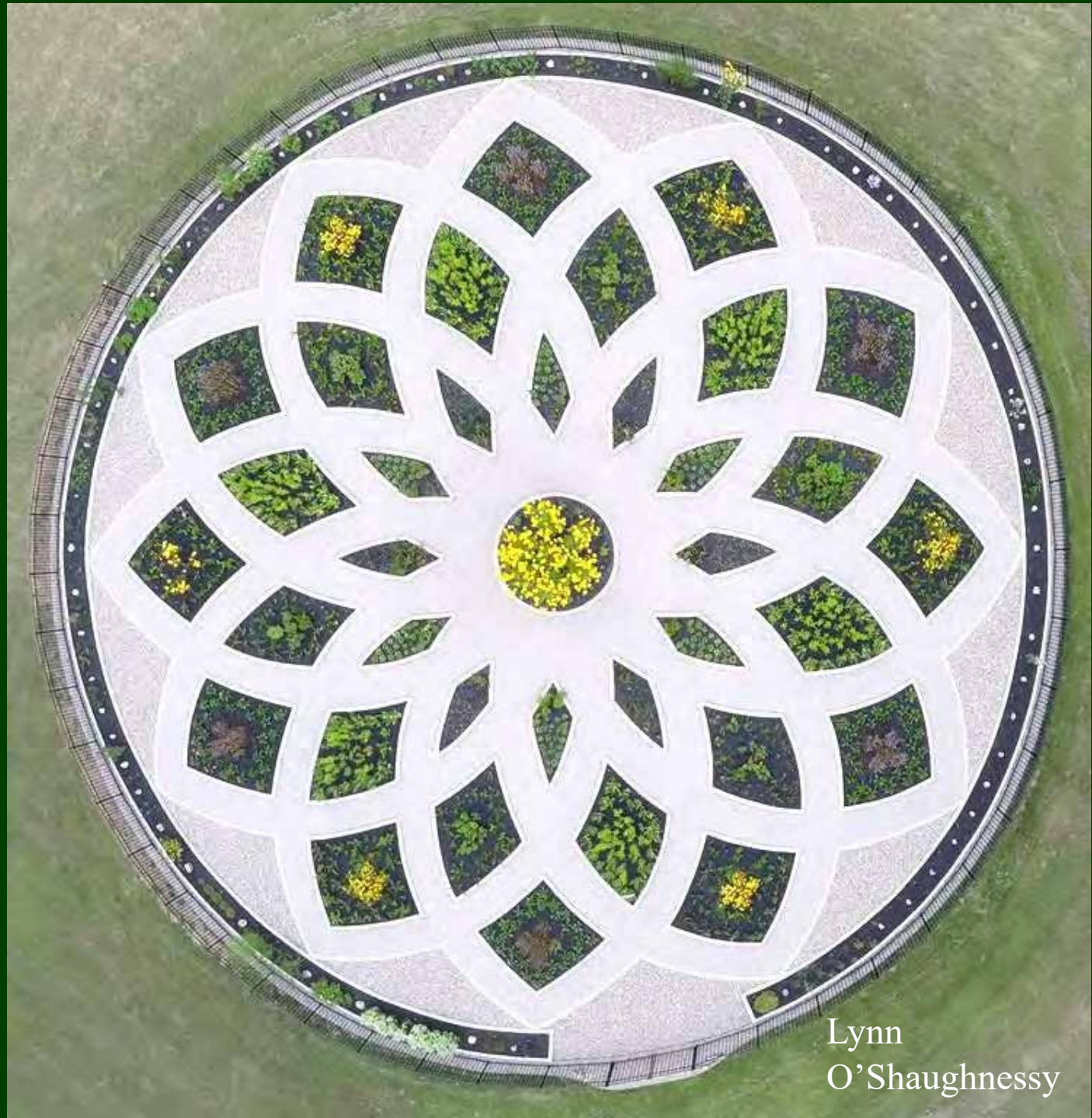



Dan Getman

It is not the presence of non-native plants that destroys food webs.

It is the absence of native plants.

Can native plants be used in formal designs?




NO
PARKING
THIS
SIDE

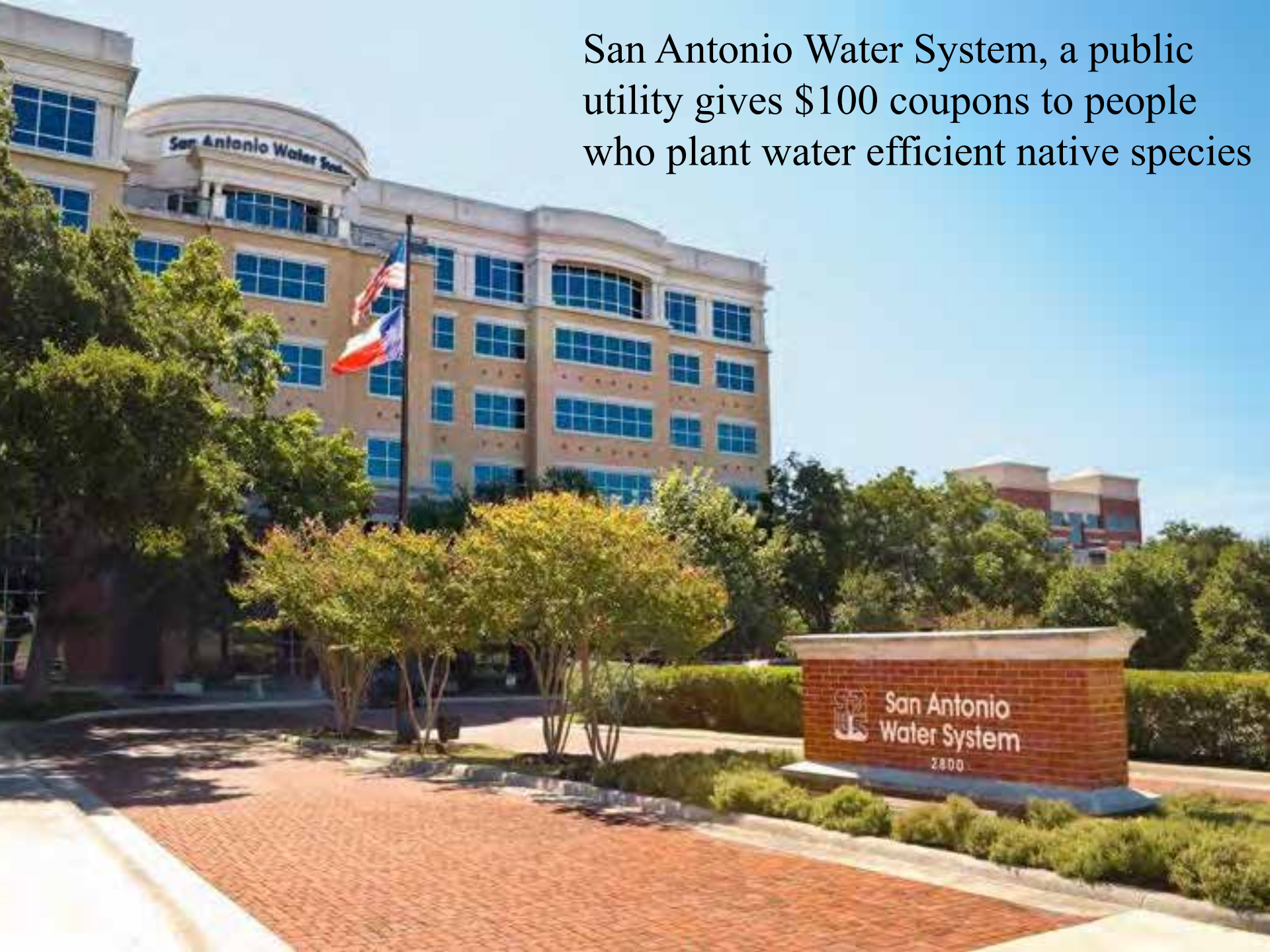

08/30/2015
Drew Lathin


Can municipalities
help us live with
nature?

Minnesota has a cost sharing plan to encourage homeowners to replace lawn with prairie

An island in Florida is paying its residents to allow the burrowing owl to burrow in their front lawns!

Missouri offers free replacement tree if you remove Callery pears



San Antonio Water System, a public utility gives $100 coupons to people who plant water efficient native species

DITCH YOUR GRASS. CLAIM YOUR REBATE.

RAKE IN
$2
OR MORE
PER SQ. FT.

Sustainability initiatives in 4 states

CA California Water Conservation
https://water.ca.gov/Water-Basics/Conservation-Tips/Removing-Your-Lawn
https://dpw.lacounty.gov/wwd/web/Conservation/CashForGrass.aspx

MN Minnesota Backyard Habitat
https://www.dnr.state.mn.us/privatelandhabitat/index.html
https://www.dnr.state.mn.us/privatelandhabitat/backyard-habitat.html
MN Minnesota Land and Water Conservation Fund (LAWCON)
https://www.dnr.state.mn.us/aboutdnr/lawcon/index.html
MN Minnesota Bee Pollinator Program
https://www.startribune.com/program-pays-minnesota-homeowners-to-let-their-lawn-go-to-the-bees/510593382/
https://www.dnr.state.mn.us/pollinator_resources/index.html
MN Minnesota 's Outdoor Heritage Fund
https://www.legacy.mn.gov/outdoor-heritage-fund

ND North Dakata's Outdoor Heritage Fund
https://www.nd.gov/ndic/outdoor-infopage.htm
https://www.nd.gov/ndic/out-agenda210615.html

PA Pennsylvania Lawn Conversion
https://www.dcnr.pa.gov/Conservation/Water/LawnConversion/Pages/default.aspx
PA Pennsylvania National Heritage Program
https://www.dcnr.pa.gov/Communities/HeritageAreas/Pages/default.aspx
https://www.govtrack.us/congress/bills/116/hr7239/text

Ralph Brueggemann

We have made three mis-steps in the early years of conservation.

1) We think nature is optional.

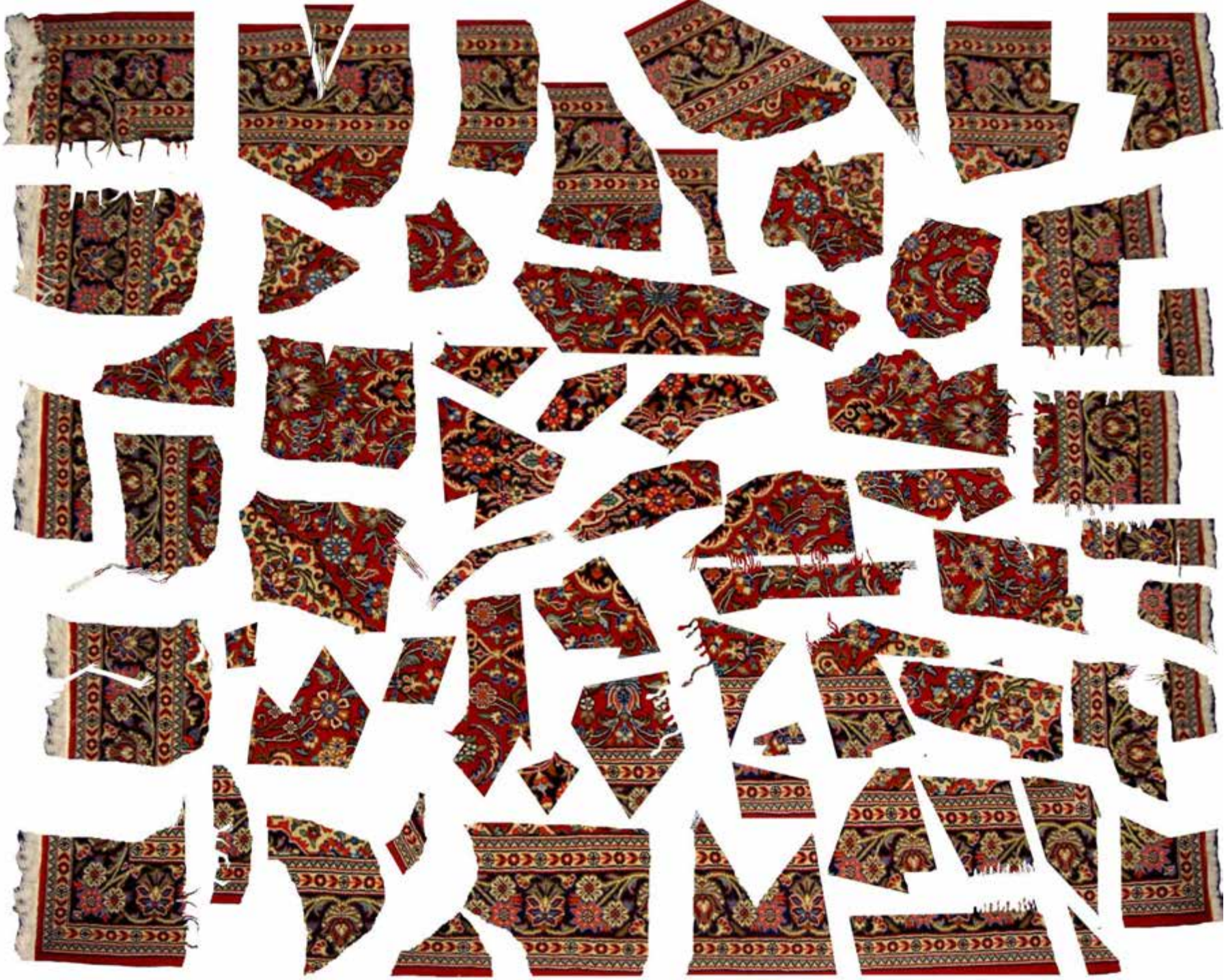

Saving Wildlife for Future Generations


Nature is not just for entertainment
Saving Wildlife for Future Generations

2) We have assumed that humans and nature cannot coexist.

By restricting conservation efforts to untouched areas, we have condemned them to ultimate failure, because such areas are too small and too isolated from each other.

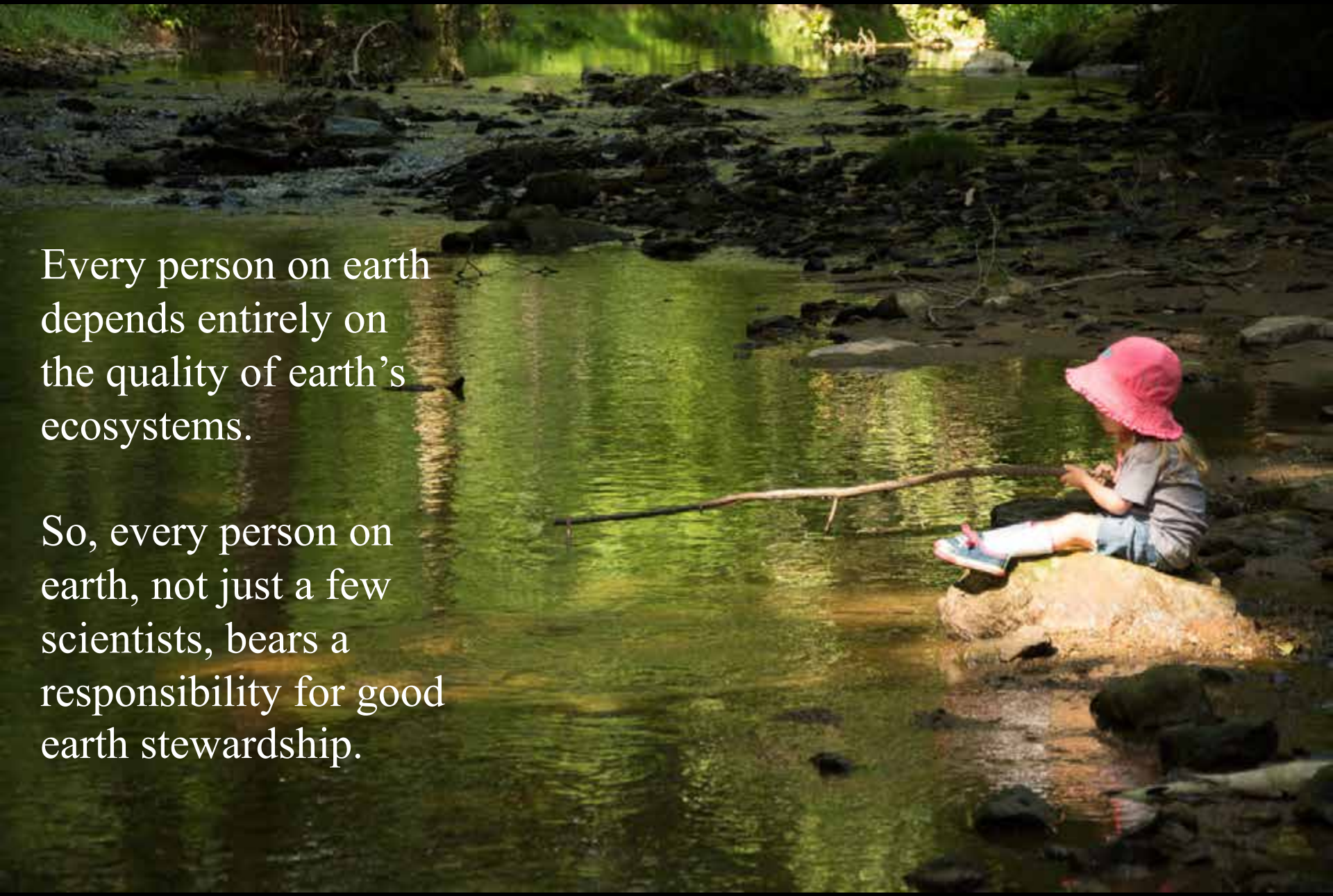
David Quammen compares ecosystems to a Persian rug

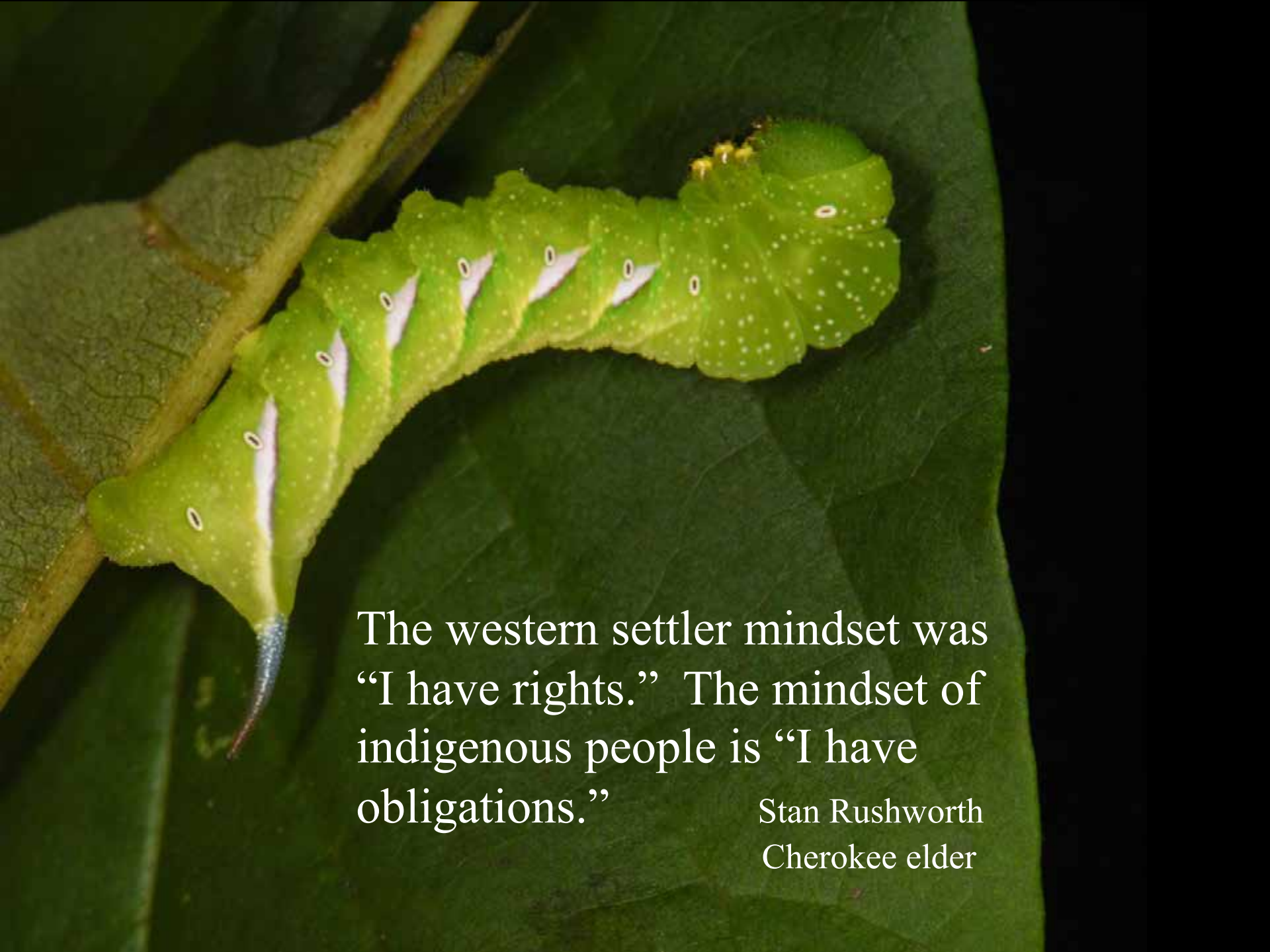


The U.N. designates Biosphere Reserves as places of ecological significance.

ALL places have ecological significance, even your yard!

3) Our third mis-step was to leave earth stewardship to a few specialists, not seeing it as an inherent responsibility of every human being.


Every person on earth depends entirely on the quality of earth's ecosystems.
So, every person on earth, not just a few scientists, bears a responsibility for good earth stewardship.


The western settler mindset was "I have rights." The mindset of indigenous people is "I have obligations."
Stan Rushworth
Cherokee elder

You don’t have
to save biodiversity
for a living, but you
can save it
where you live!

This approach empowers each one of us!

It also shrinks the problem to something manageable for each one of us.


As property owners or volunteers, each of us has the power - and the responsibility - to fix landscapes like this.

Whether or not we do so will determine nature's fate





30


YOUTH
ACADEMY


You

are nature's best hope!