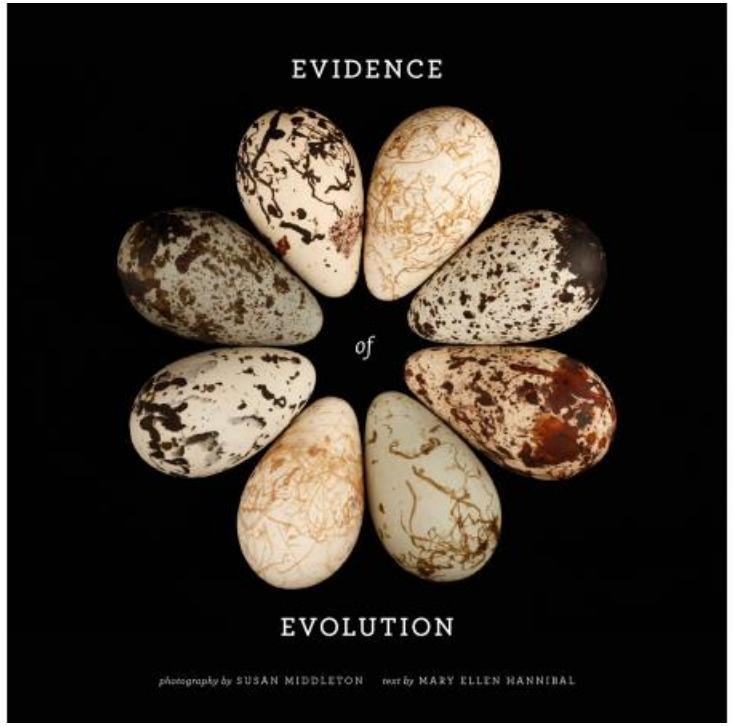
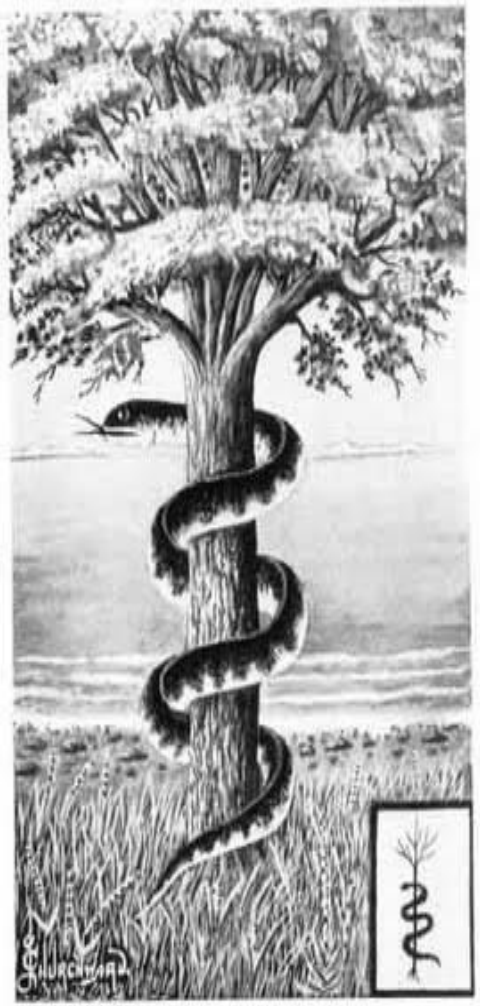
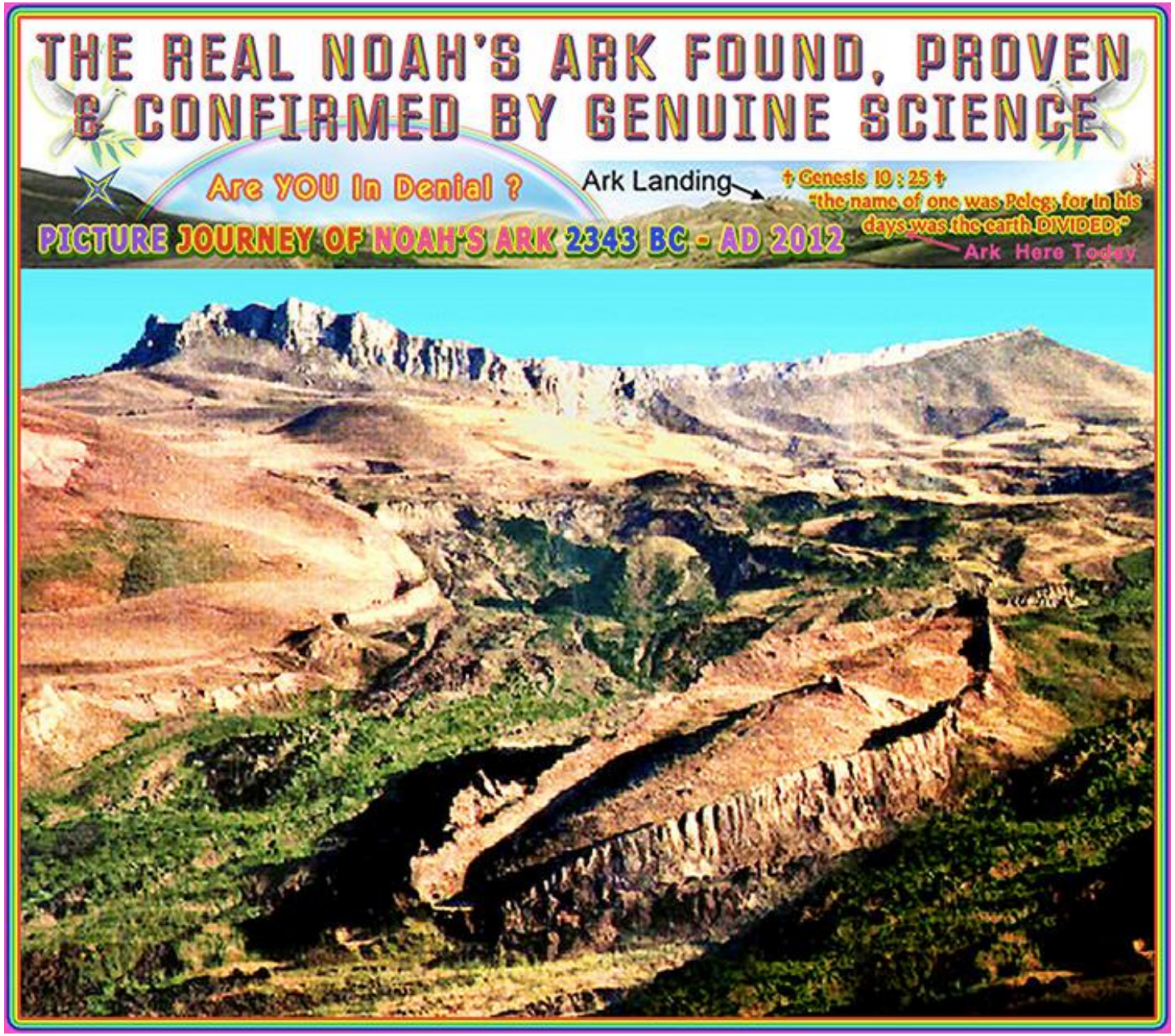
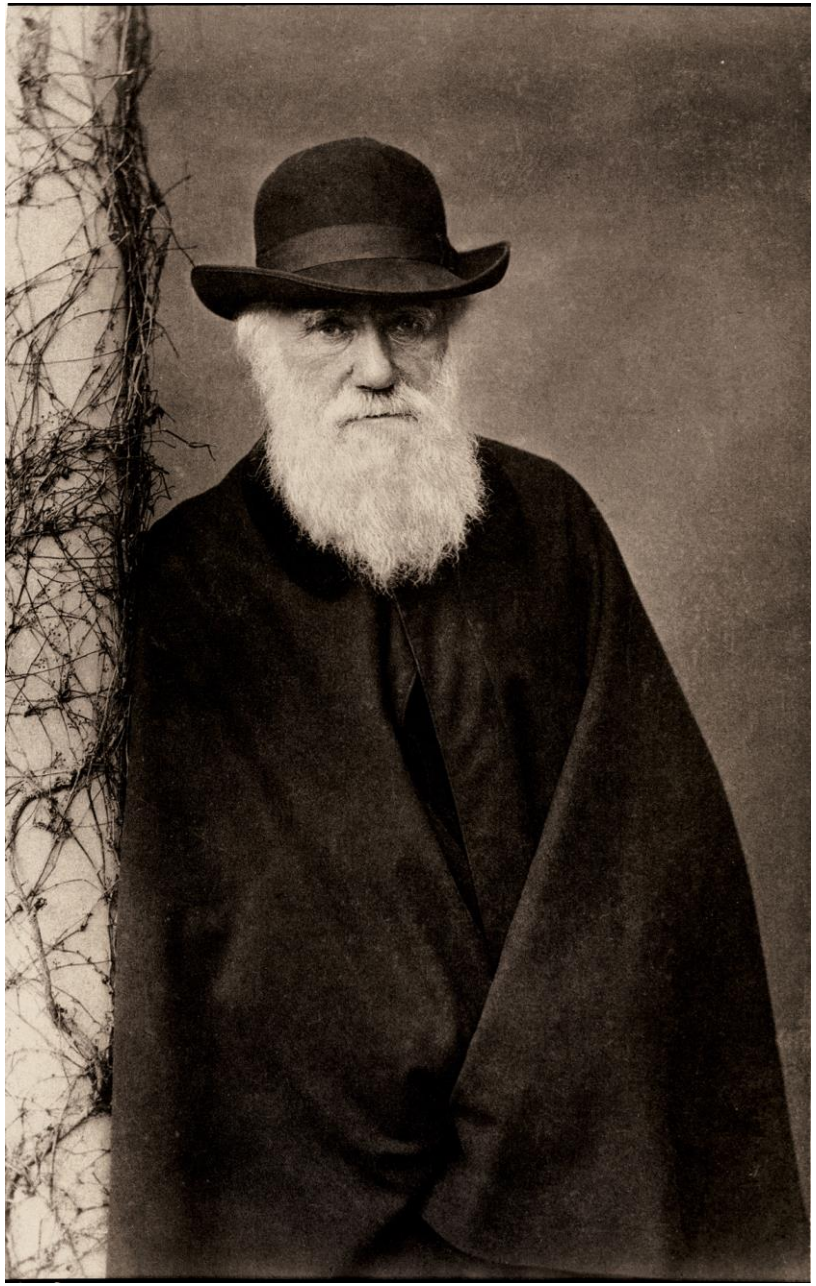
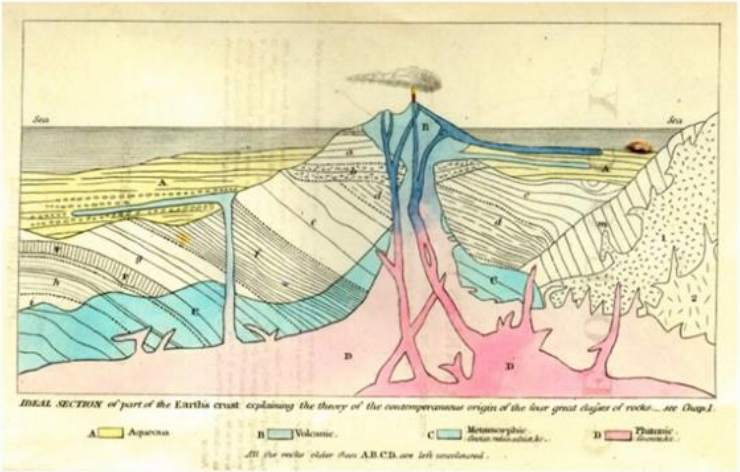

EVIDENCE
of
EVOLUTION
photography by SUSAN MIDDLETON
text by MARY ELLEN HANNIBAL

PARADISI IN SOLE
Paradisus Terrestris.




THE REAL NOAH'S ARK FOUND, PROVEN & CONFIRMED BY GENUINE SCIENCE
Are YOU In Denial ?
Ark Landing
† Genesis 10 : 25 †
"the name of one was Peleg; for in his days was the earth DIVIDED;"
PICTURE JOURNEY OF NOAH'S ARK 2343 BC - AD 2012
Ark Here Today

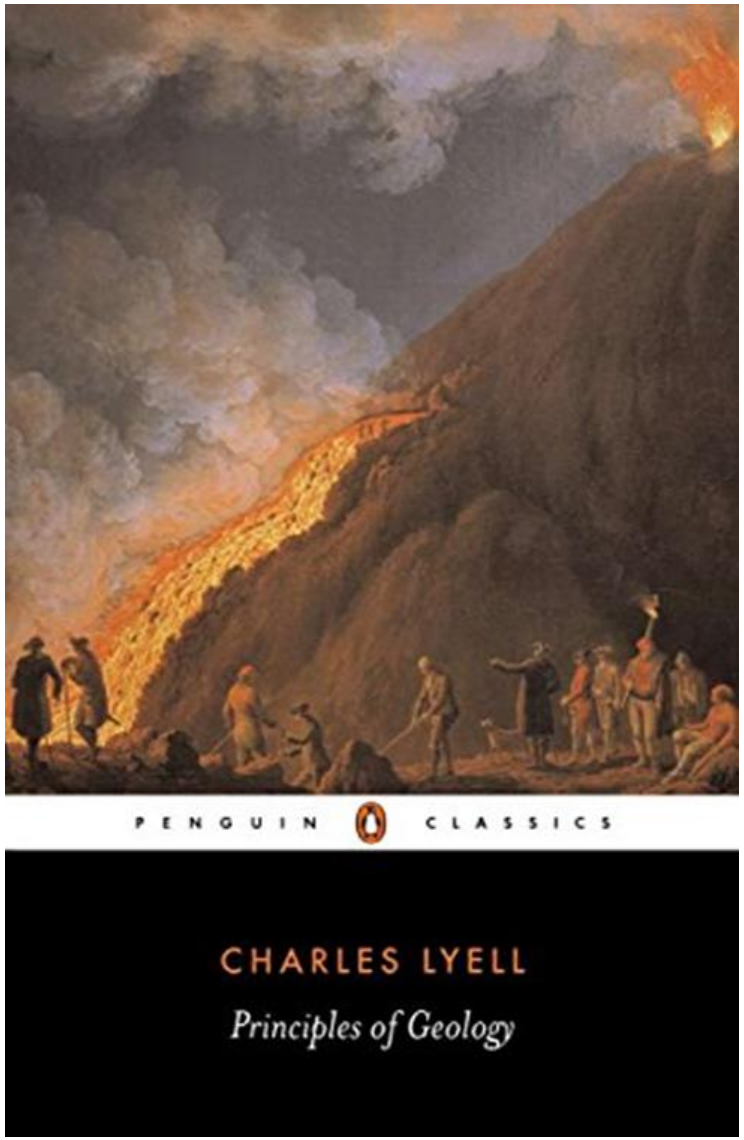


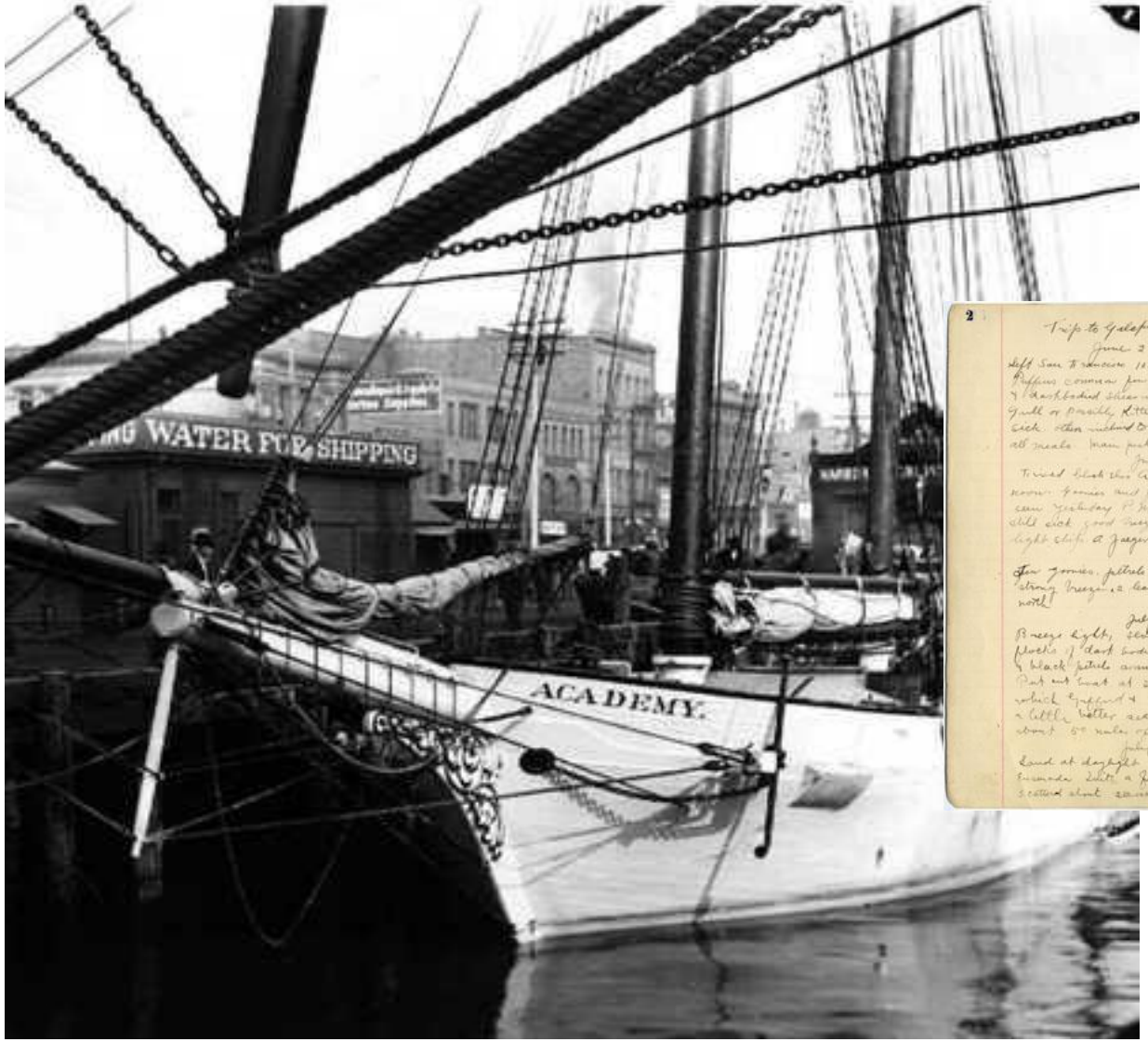


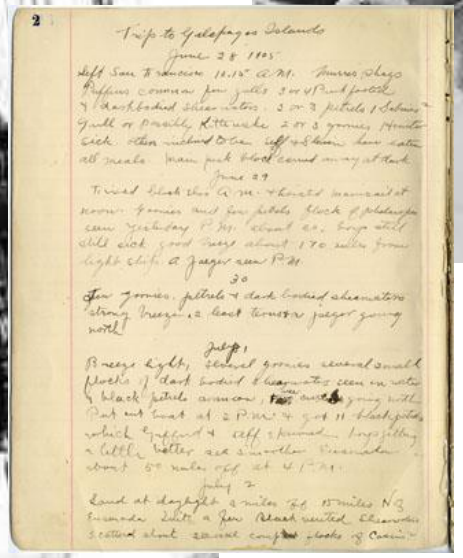
The frontispiece from Charles Lyell's Principles of Geology (second American edition, 1857), showing the origins of different rock types.

"Mr. Darwin labours to show, and with no small success, that all true classification in zoology and botany is, in fact, genealogical, and that community of descent is the hidden bond which naturalists have been unconsciously seeking, while they often imagined that they were looking for some unknown plan of creation."

– Charles Lyell, The Geological Evidences of the Antiquity of Man (1863)







2

Trip to Galapagos Islands

June 28 1905

Left San Francisco 10.15 A.M. Murres Shags Puffins common pin tails 3 or 4 Punk petrels & dark bodied shearwaters. 2 or 3 petrels 1 Sabine's Gull or possibly Kittiwake 2 or 3 gonies Hunter sick. other inclined to be seff & Sheron have eaten all meals. Main pick block carried away at dark

June 29

Tossed block thro A.M. & hoisted mainsail at noon. Gonies and few petrels flock of phalanges seen yesterday P.M. about 20. Boys still still sick good breeze about 170 miles from light ship. A jaeger seen P.M.

30

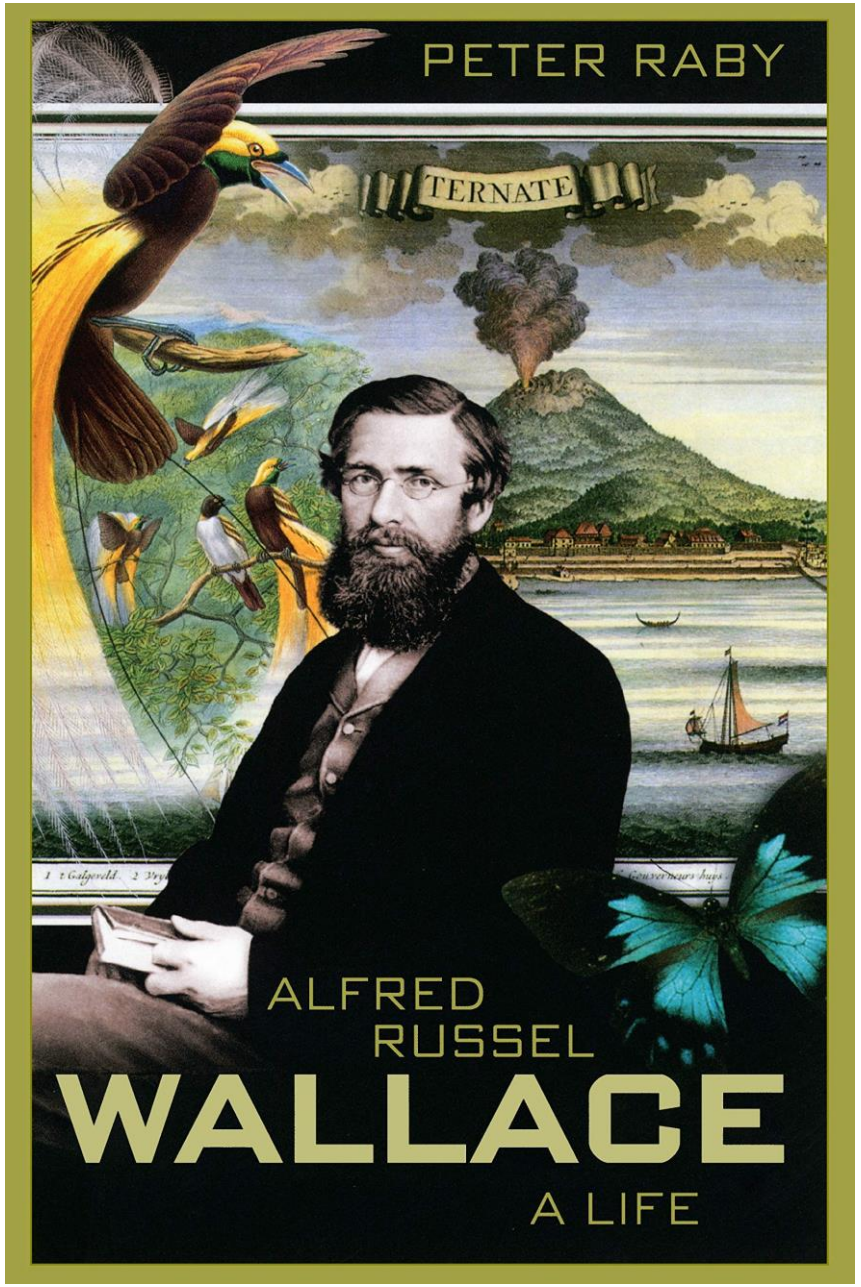
Few gonies, petrels & dark bodied shearwaters strong breeze, 2 least terns & a jaeger going north

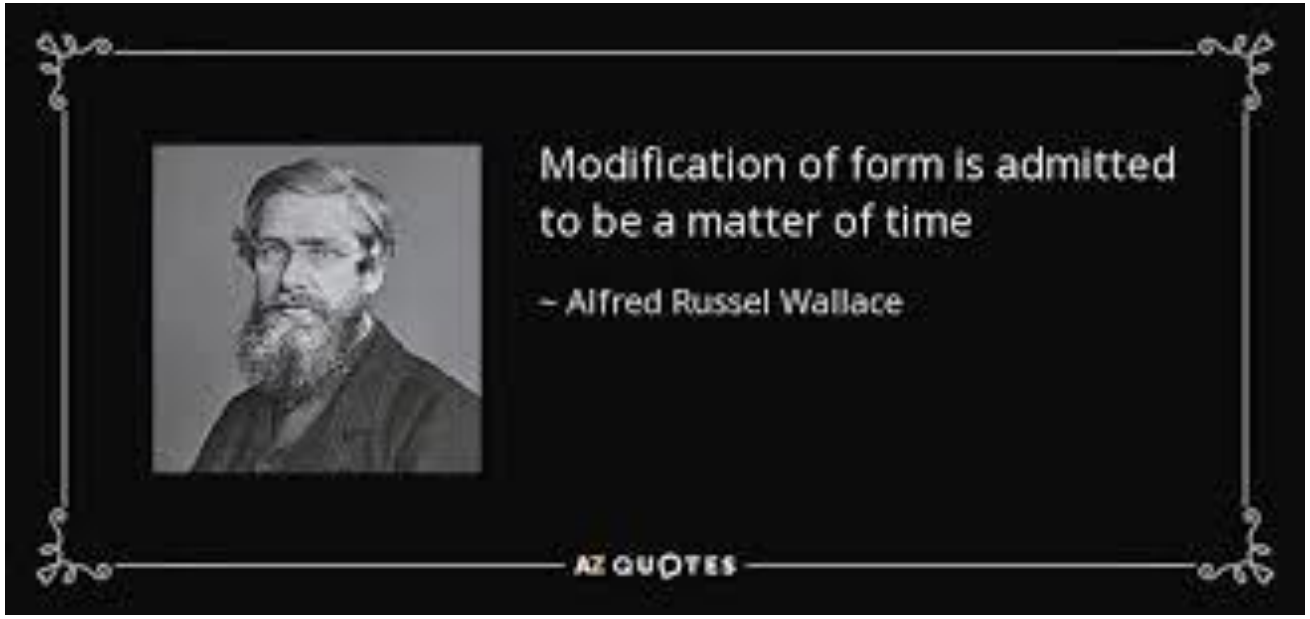
July 1

Breeze light, several gonies several small flocks of dark bodied shearwaters seen in water & black petrels common, [illegible] going north. Put out boat at 2 P.M. & got 11 black petrels which Gifford & Jeff & Hunter boys jetting a little better see smoother Ensenada about 50 miles off at 4 P.M.

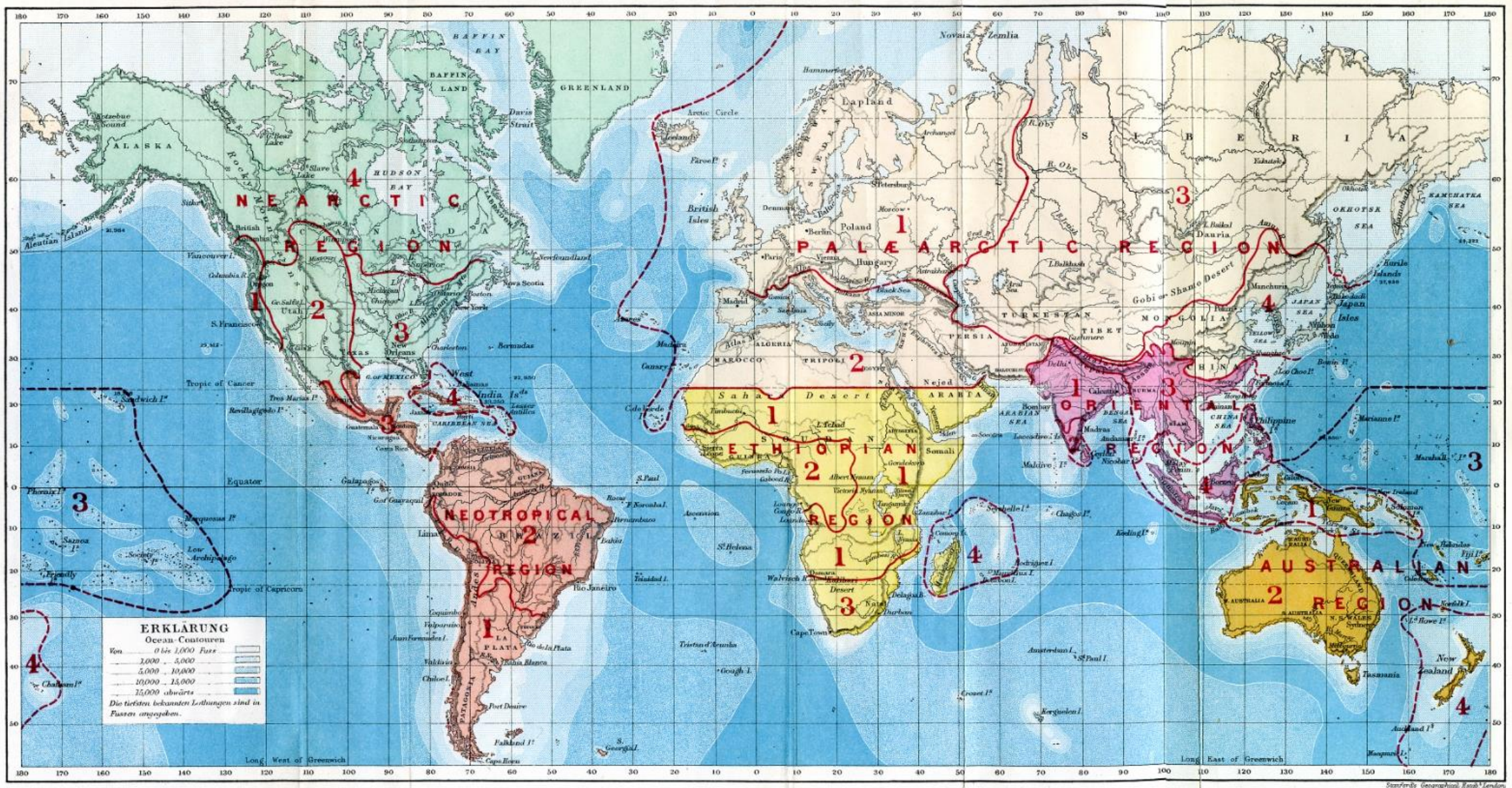
July 2

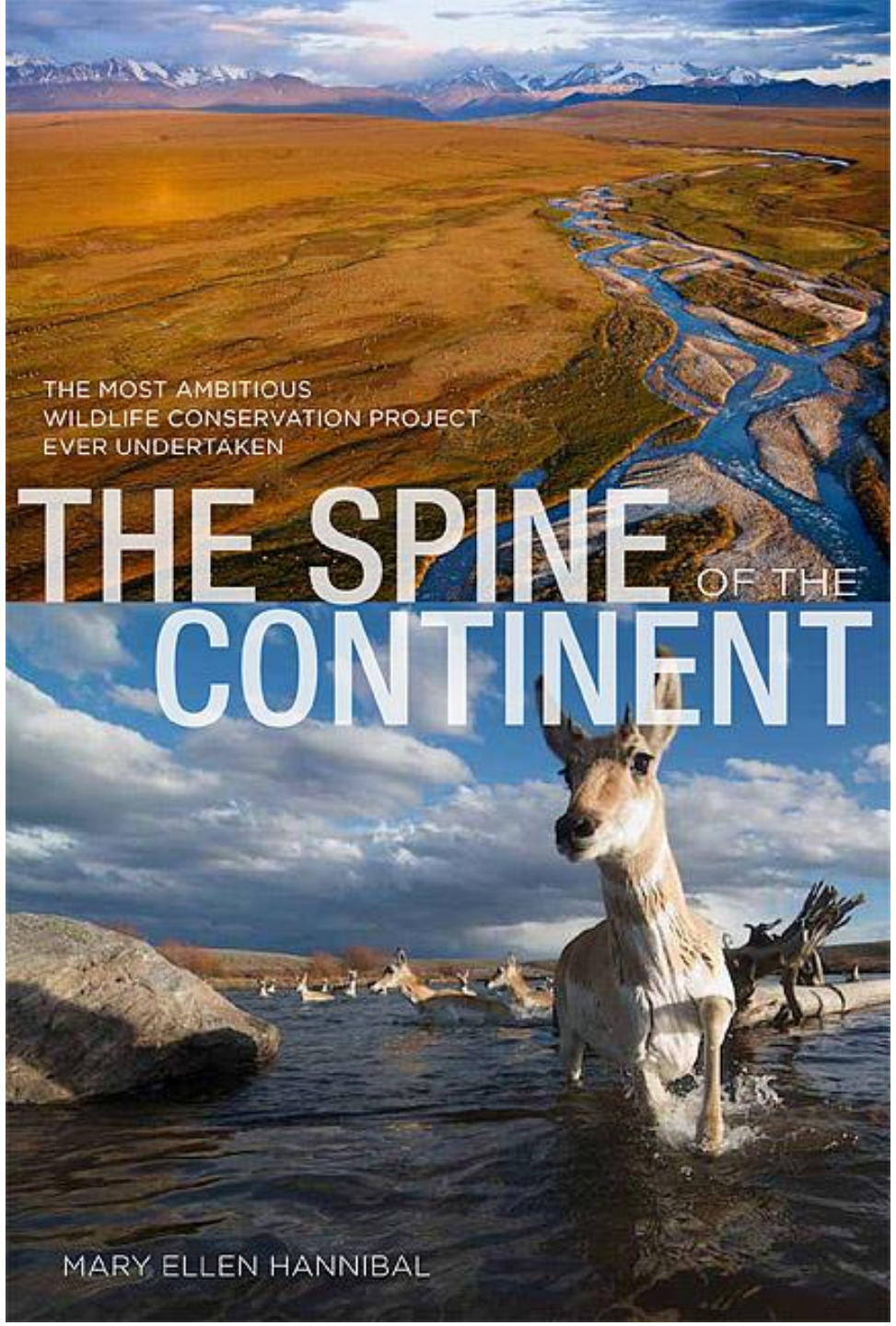
Land at daylight 2 miles off 15 miles N.E. Ensenada Quite a few Black vented Shearwaters scattered about several compact flocks of Casin's


PETER RABY
TERNATE
ALFRED
RUSSEL
WALLACE
A LIFE

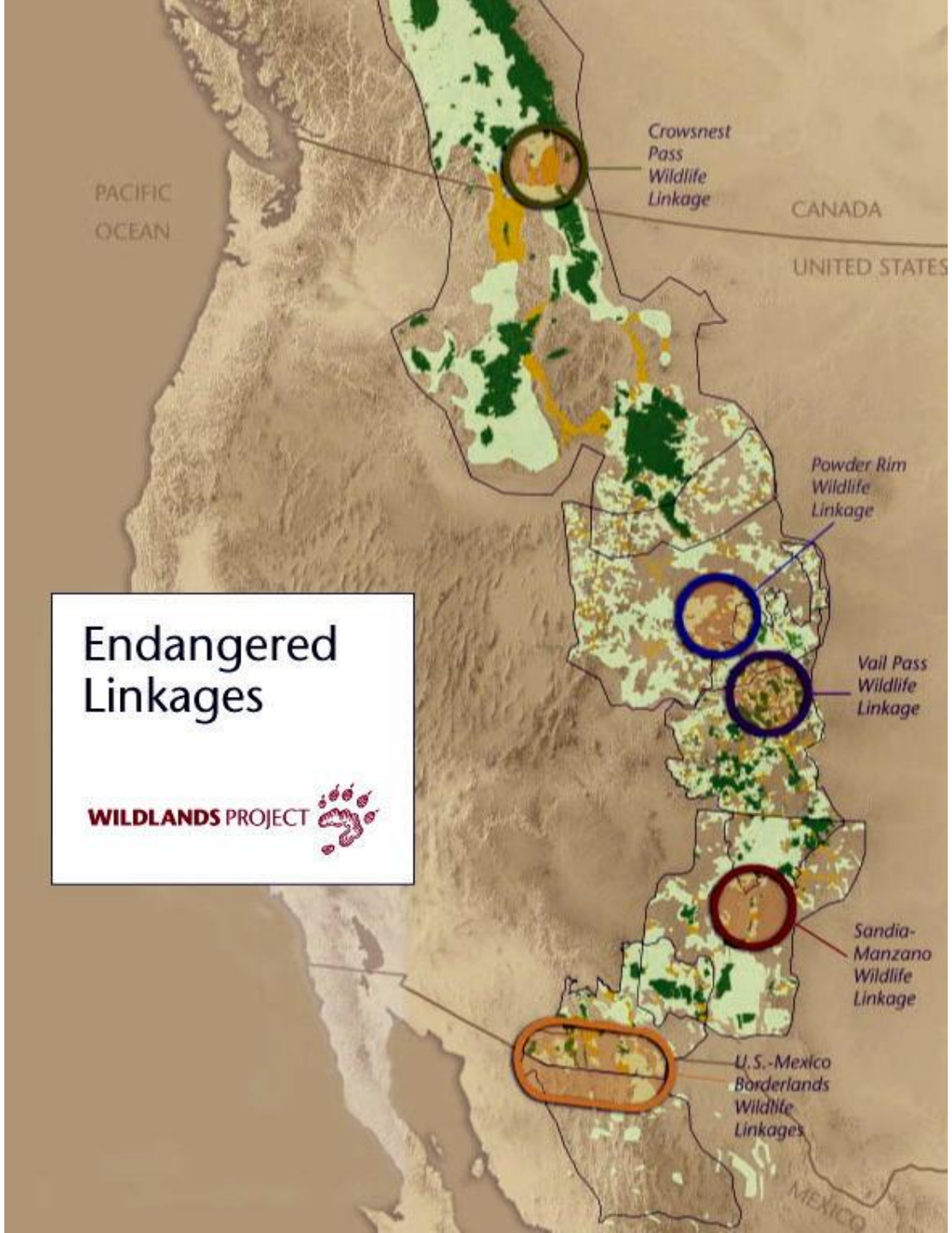

Modification of form is admitted
to be a matter of time
~ Alfred Russel Wallace
AZ QUOTES

DIE ERDE IN MERCATOR'S PROJECTION MIT DEN ZOOGEOGRAPHISCHEN REGIONEN UND DEN APPROXIMATIVEN SCHWANKUNGEN DES OCEAN-BETTES.




THE MOST AMBITIOUS
WILDLIFE CONSERVATION PROJECT
EVER UNDERTAKEN
THE SPINE OF THE CONTINENT
MARY ELLEN HANNIBAL

Interstate Highway
Interstate Highway
0 150 300 450
Miles
Federal Highway Administration, U.S. DOT


Endangered Linkages
WILDLANDS PROJECT
PACIFIC OCEAN
CANADA
UNITED STATES
MEXICO
Crowsnest Pass Wildlife Linkage
Powder Rim Wildlife Linkage
Vail Pass Wildlife Linkage
Sandia-Manzano Wildlife Linkage
U.S.-Mexico Borderlands Wildlife Linkages

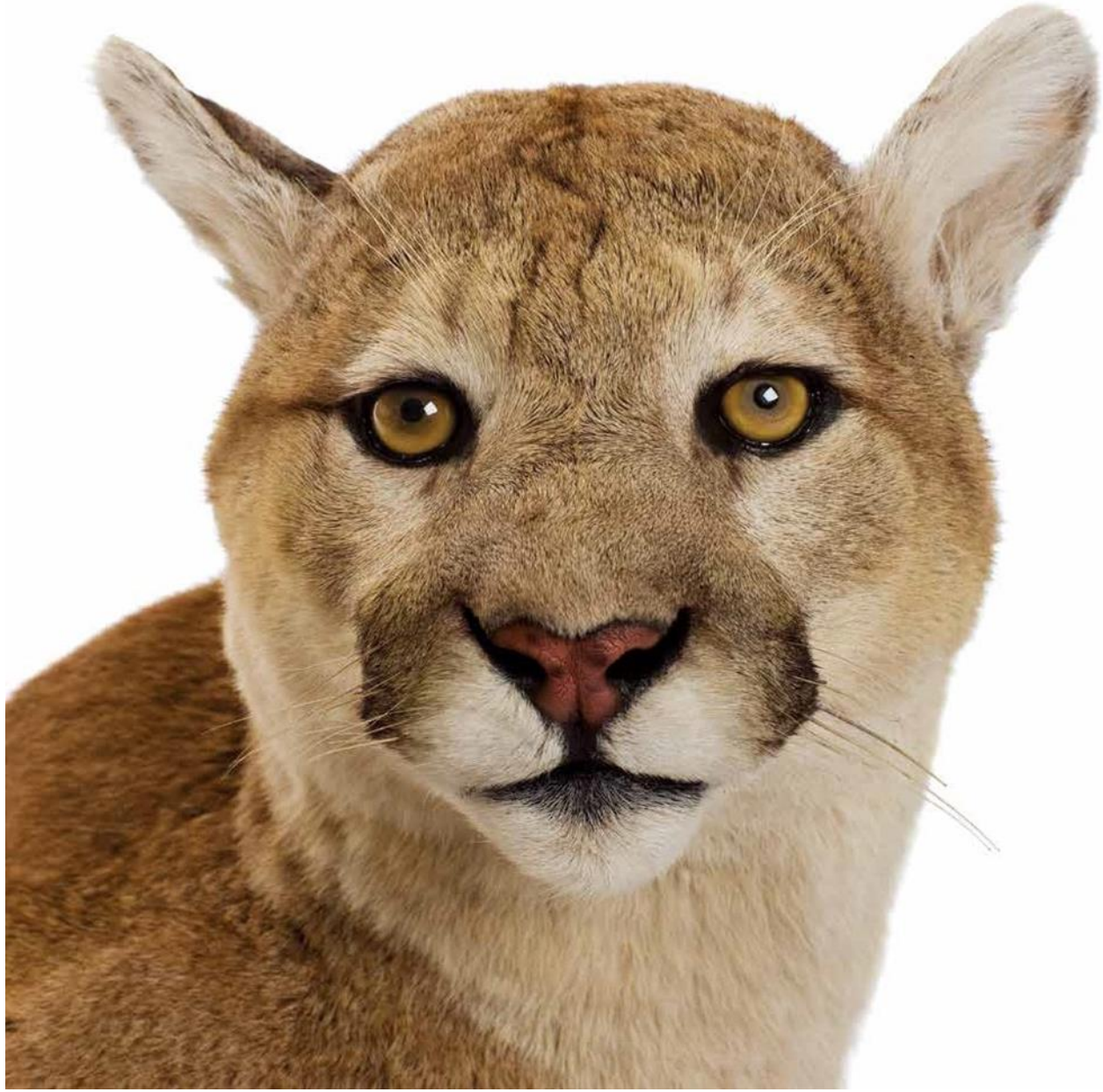
PATTERNS OF EVOLUTION

BIOGEOGRAPHY

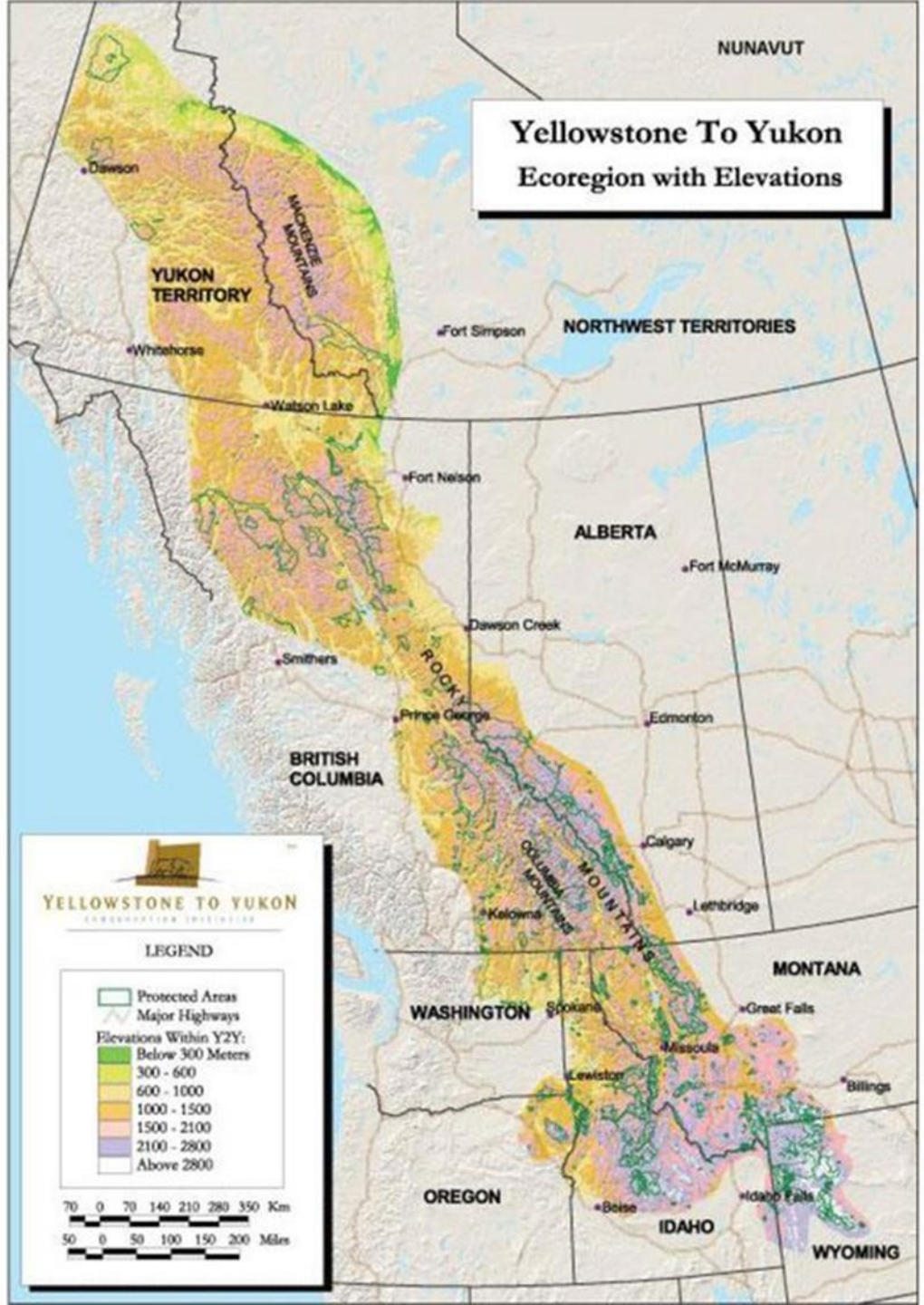
Darwin was an agonizer. He knew full well that *On the Origin of Species* would make a frontal assault on the prevailing orthodoxies of his time. He might have been even more reluctant to publish his ideas about natural selection were it not for Alfred Russel Wallace, a naturalist/explorer in the great tradition of the nineteenth century. In 1858, Wallace sent Darwin his paper, *On the Tendency of Varieties to Depart Indefinitely from the Original Type*, its thesis, a variant of Darwin's own, is summarized in a passage taken from Wallace's autobiography. One day, ill with fever, he pondered the various adaptations of species that he had observed in his travels, as well as Malthus's ideas about checks to population growth. "[W]hy do some die and some live? And the answer was clearly, that on the whole the best fitted live." Wallace concluded that adaptations emerge in response to changing conditions, "and [that] in the very process of this modification the unmodified would die-out, and thus the definite characters and the clear isolation of each new species would be explained." Recognizing the similarities in their work, Darwin quickly joined with Wallace to present the concept of natural selection to the Linnaean Society. Amazingly, the president of the society later commented that nothing "striking" had been discovered that year.

Wallace is often referred to as a kind of shadow figure by the side of the vaunted Darwin, some even claim Wallace has been cheated of his rightful status as the first to conceptualize natural selection, although by most measures, including Wallace's own, Darwin's is the more comprehensive explanation of natural selection—and deserves first billing. The relationship between the two men has its fascinations. Darwin was a moneyed man of leisure and status, with all the time in the world to reflect and write; Wallace, from scrappier stock—and despite great scientific accomplishments—was always scrabbling for financial support. Darwin seems to have felt guilty and anxious about Wallace, he knew he had the upper hand in the relationship and worried that he was exploiting the other man. Darwin and Wallace were, however, congenial and generous toward each other, and both benefited from their connection. Wallace's dimmer star is often attributed to the fact that, although he was a staunch defender of Darwin and natural selection his whole life, he put evolution within a spiritual framework and deferred to a "higher intelligence" as the ultimate mover. Darwin's response, "I hope you have not murdered too completely your own and my child," at once denounces Wallace's belief and testifies to the intimate connection between the two men and their idea.

The author of several perennially influential books (Joseph Conrad called Wallace's *The Malay Archipelago* his "favorite bedside companion" and used it as source material), Wallace is now, in a way, having his due. His 1876 *The Geographical Distribution of Animals* established the science of biogeography, arguably the most compelling context in which evolutionary biology now operates. Biogeography looks at species distribution and the relationships among species themselves and in relation to geography—who lives where, who lives next to whom, and how they got there in the first place. It also incorporates the long time-scale—the fossil evidence of paleontology, the age of the Earth, the dynamism of ocean and continent movements. Its resonance today primarily has to do with conservation, as scientists seek to understand the connections among species survival, climate, and habitat.



Susan Middleton



This female Grey Wolf named “Pluie” inspired the Y2Y conservation initiative.

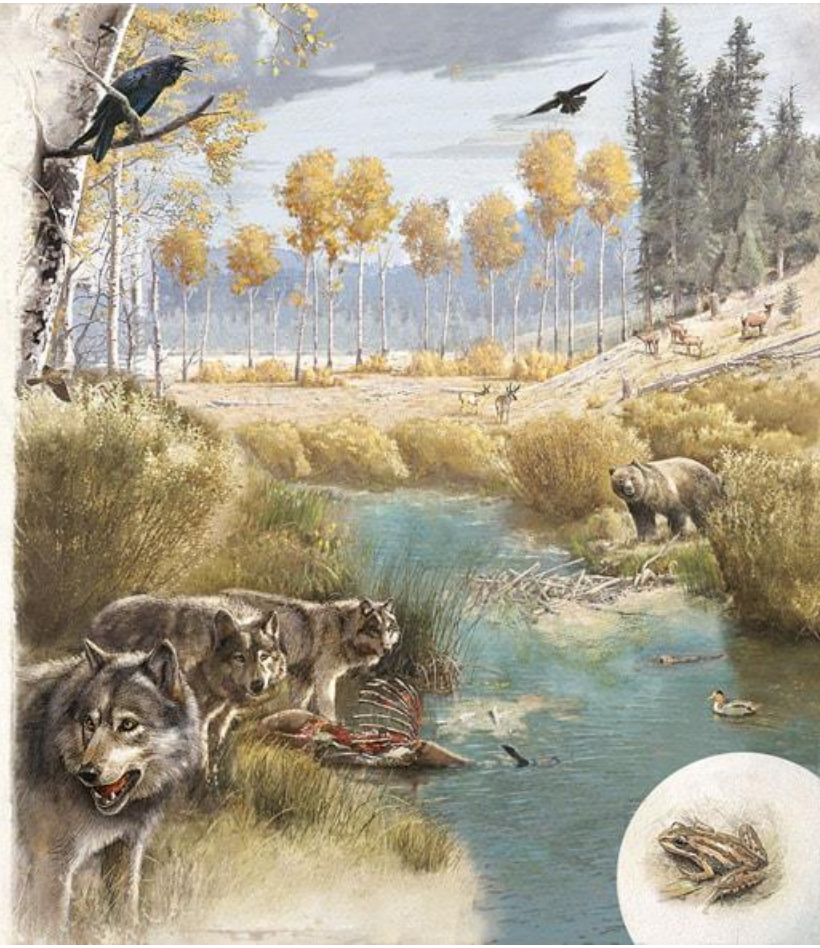
Approximate route of Pluie's journey
Banff National Park
ALBERTA
Yoho National Park
Banff
Calgary
BRITISH COLUMBIA
Fernie
CANADA
U.S.
Glacier National Park
MONTANA
Spokane
Coeur d'Alene
Missoula
IDAHO
WASH.
Lewiston
0
Miles
100

WITHOUT WOLVES

The wolves of Yellowstone National Park were eliminated by 1926, influencing a cascade of changes that altered the park's entire ecosystem.

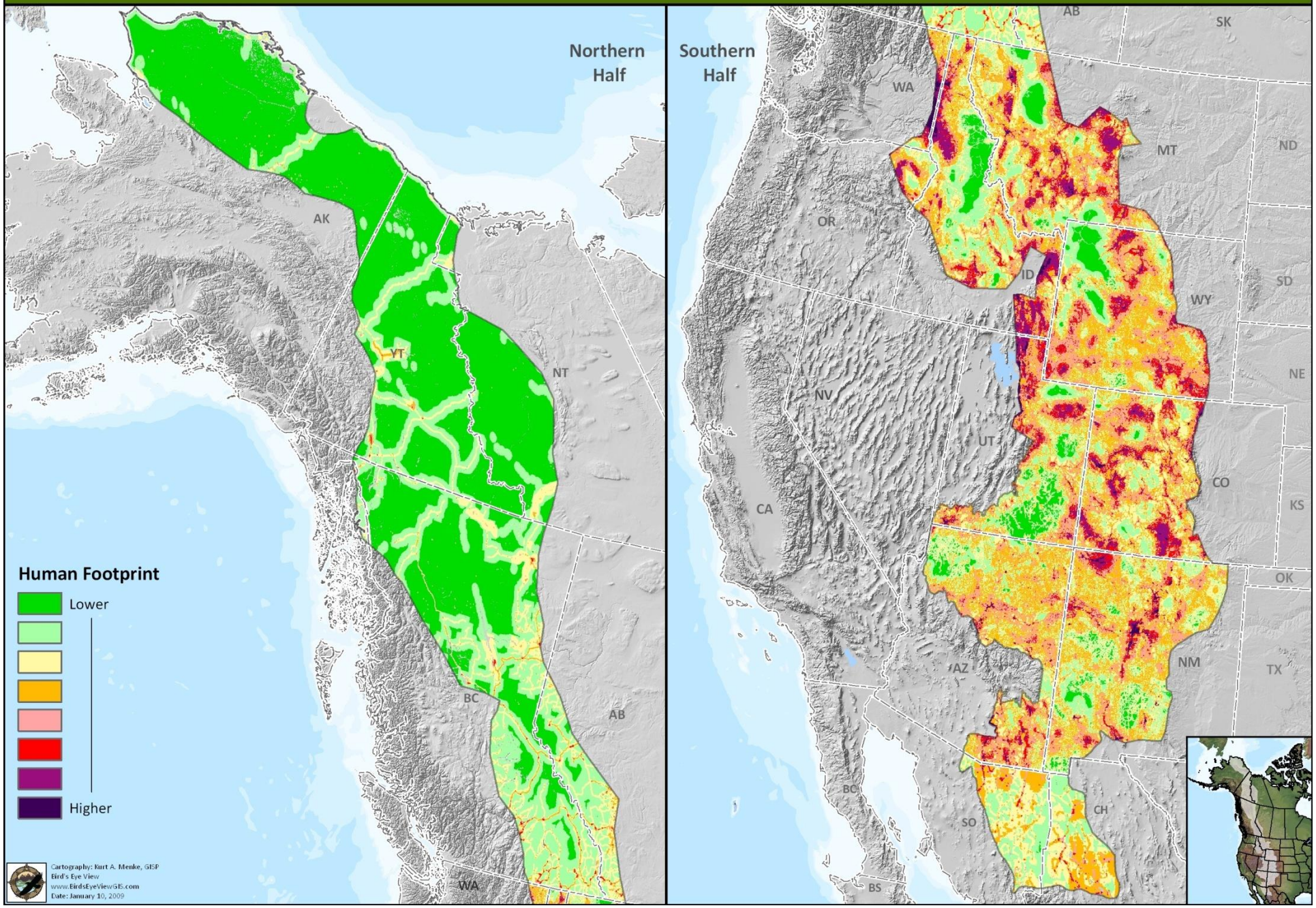
WITH WOLVES

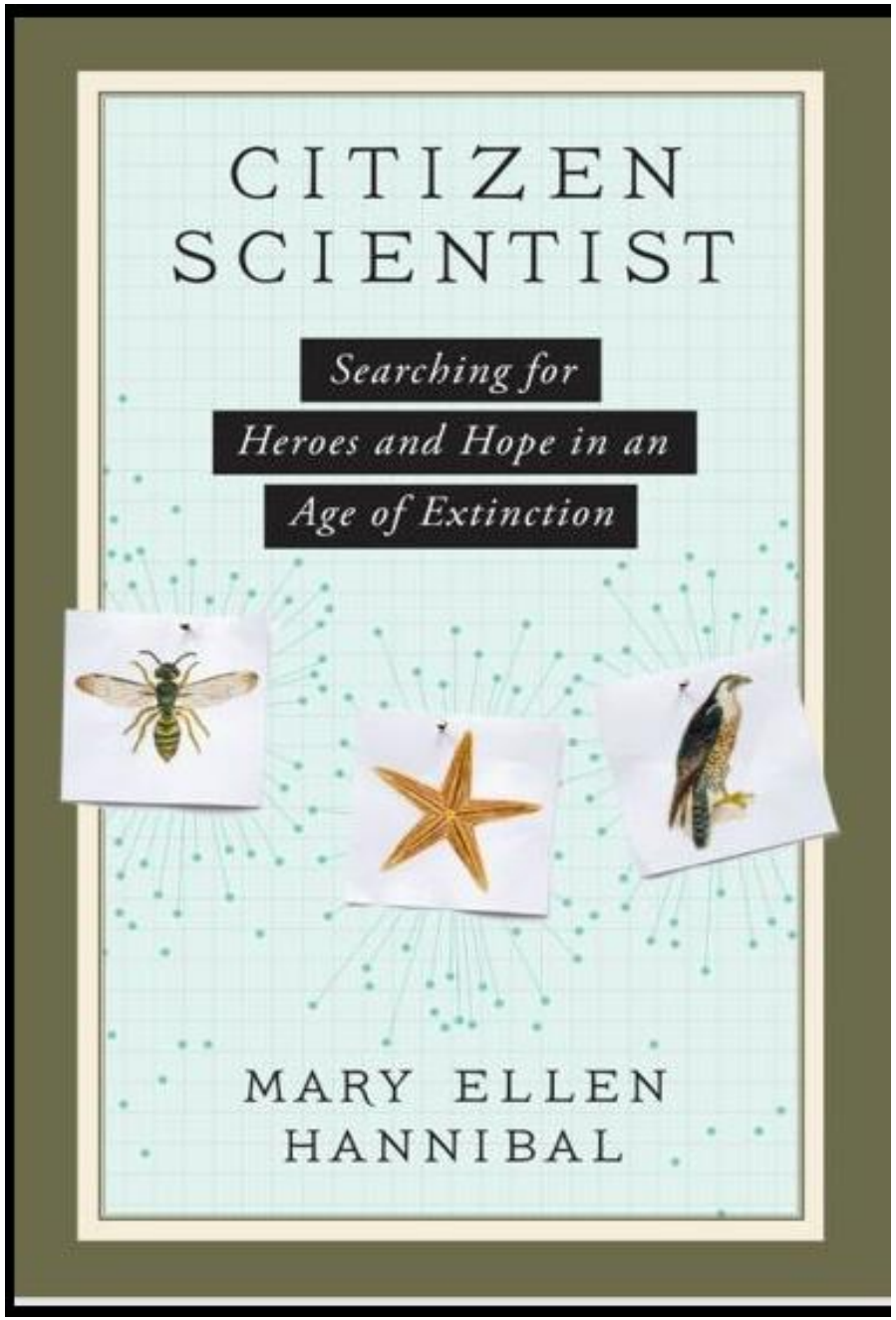
Wolves, now returned to their original habitat, play a vital role in keeping the world of predator and prey in balance.



WOLVES KEEP
YELLOWSTONE
IN BALANCE
gray WOLF
IN THE 1920S, government policy allowed the extermination of Yellowstone's gray wolf — the apex predator — triggering an ecosystem collapse known as *trophic cascade*.
IN 1995 — through use of the Endangered Species Act — the conservation community reintroduced the gray wolf to restore balance.
The impact is dramatic.
ELK
Elk populations exploded without their primary predator, resulting in severe overgrazing of willows and aspen needed by beavers for food, shelter and dam building.
EAGLE
RAVEN
BEAR
Various scavenger species suffered without year-round wolf kills to feed on.
Today, biodiversity is enriched and scavenger species reap the benefits of regular, wolf-supplied meals.
COYOTE
Without wolves, the coyote become an apex predator, driving down populations of pronghorn antelope, red fox and rodents, and birds that prey on small animals.
BEAVER
Beavers virtually disappeared in the northern range. Dams disintegrated, turning marshy ponds into streams. Massive loss of mature willows and aspens. Heavy stream erosion. Many plant and animal species affected.
amphibians
FISH
SONG BIRDS
After wolf reintroduction, in the northern range, elk numbers drop and beaver colonies increase from 1 to 12. Insects, songbirds, fish, and amphibians thrive.
ANTELOPE
Vole
FOX
As the wolf returns, coyote numbers drop by half, allowing antelope, rodents and fox populations to increase.
SOURCES: OSU Trophic Cascades Program, NWF, NRDC, Predator Defense, "The Wolf's Touch."

Human Footprint




CITIZEN SCIENTIST
Searching for Heroes and Hope in an Age of Extinction
MARY ELLEN HANNIBAL

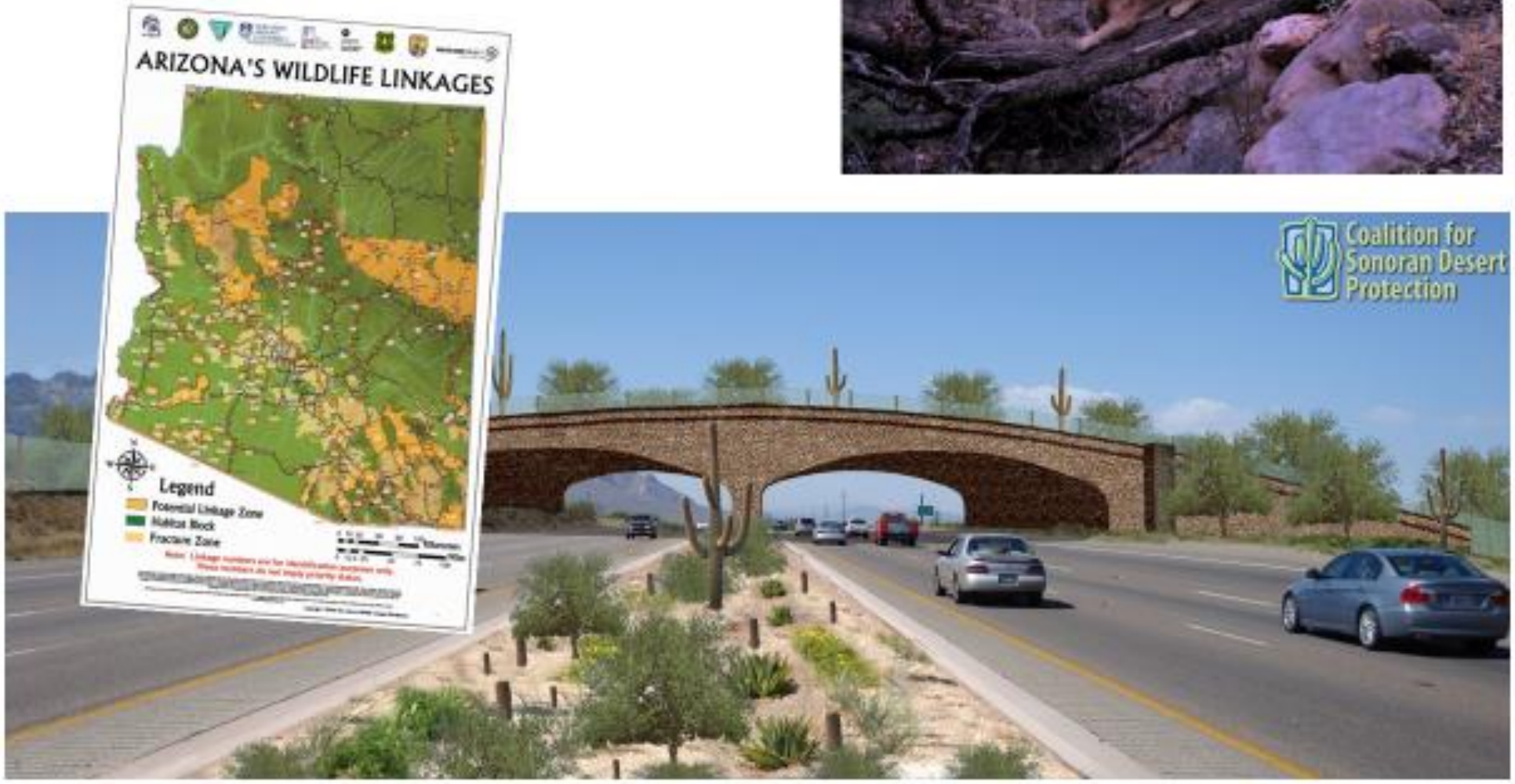
© 2010 Sky Island Alliance / El Aribabi

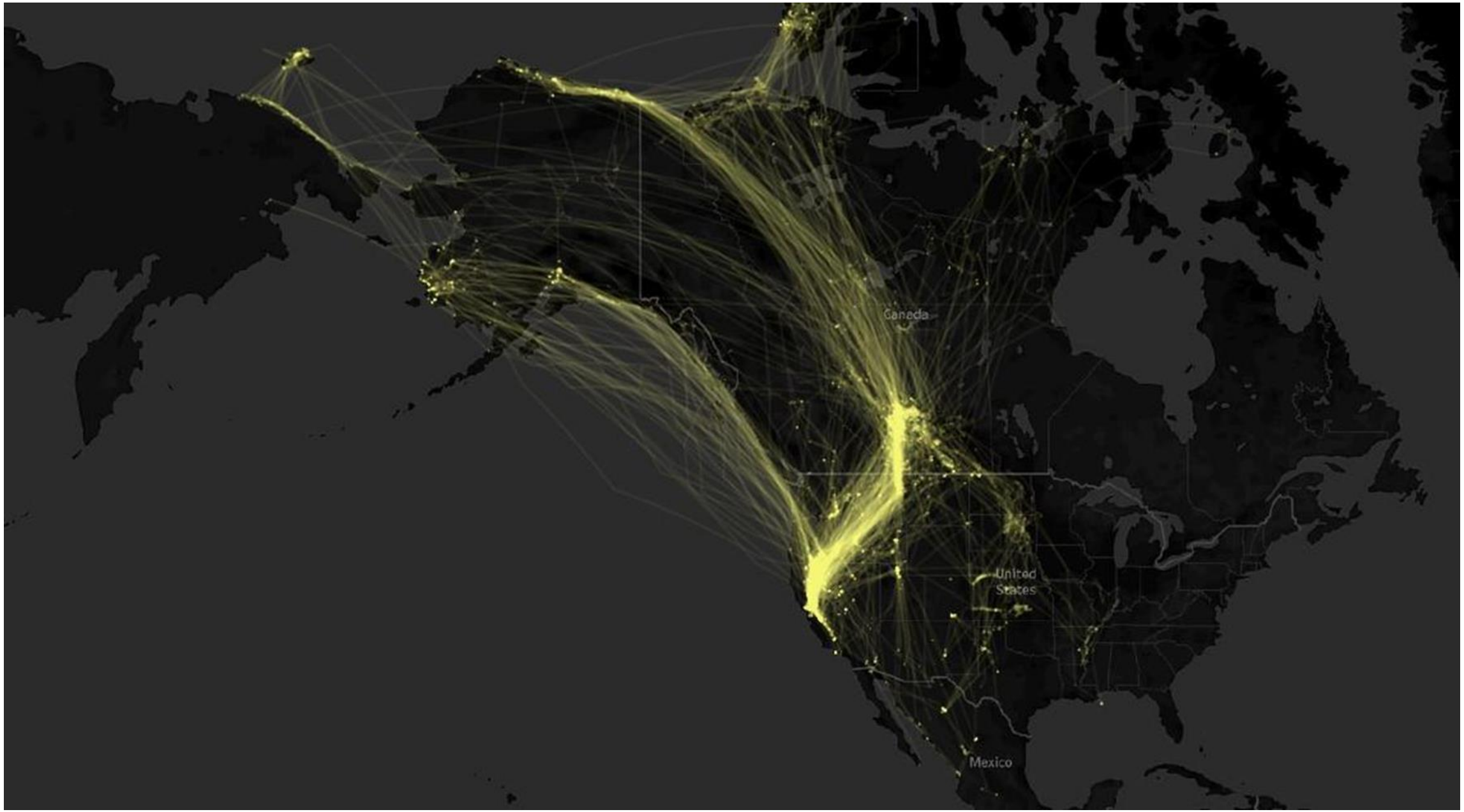
Date: 12/12/04
Datapoint: 49FNW-01
Coordinates:
Species: Black Bear
Route Name: 49 wash west
Location:
© Keeping Track®, Inc. 802-434-7000 • www.keepingtrackin

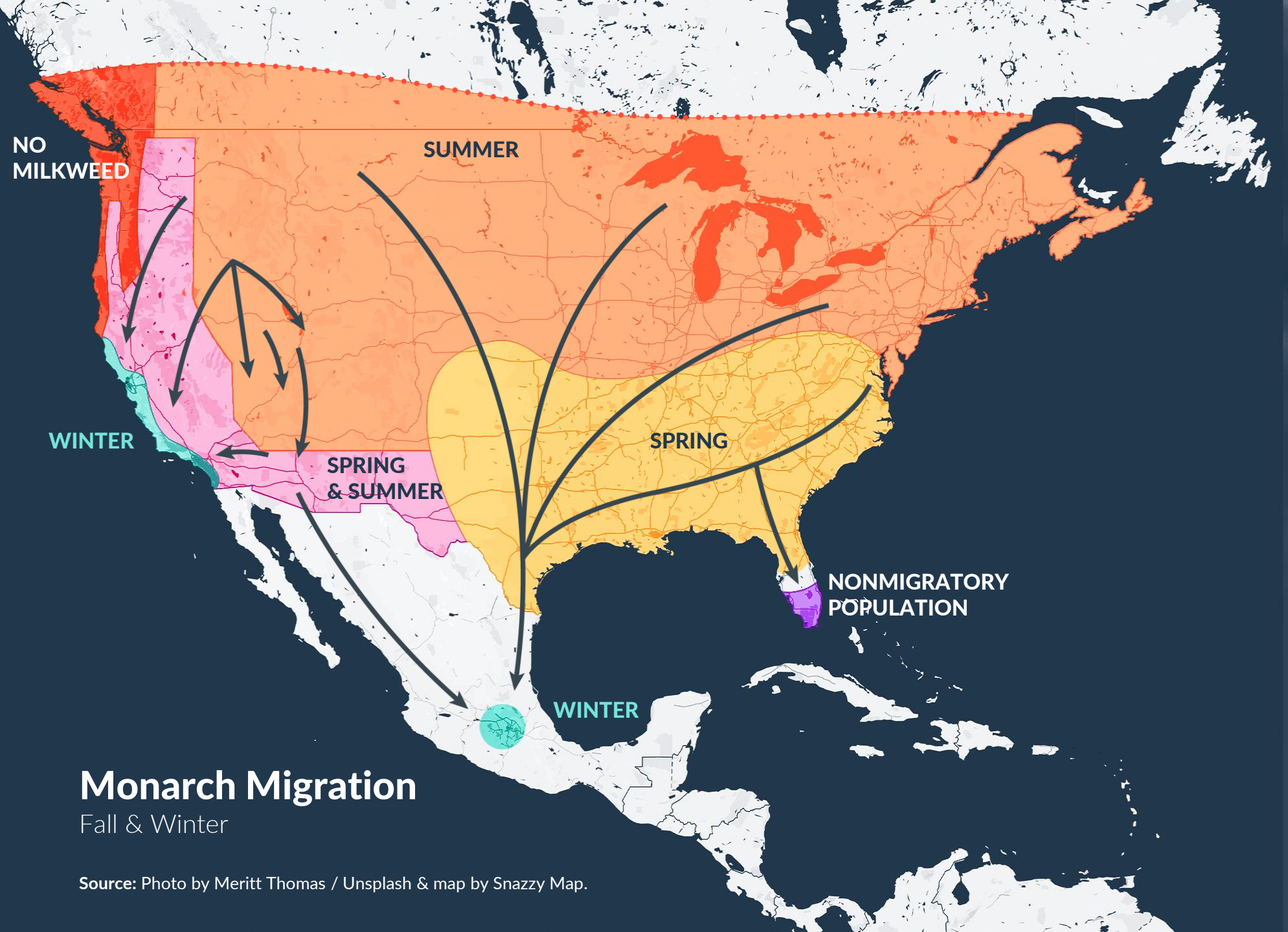
© Sky Island Alliance

Renderings © Coalition for Sonoran Desert Protection

CONNECT


ARIZONA'S WILDLIFE LINKAGES
Legend
Potential Linkage Zone
Habitat Block
Fracture Zone
Coalition for Sonoran Desert Protection


Canada
United States
Mexico



Monarch Migration

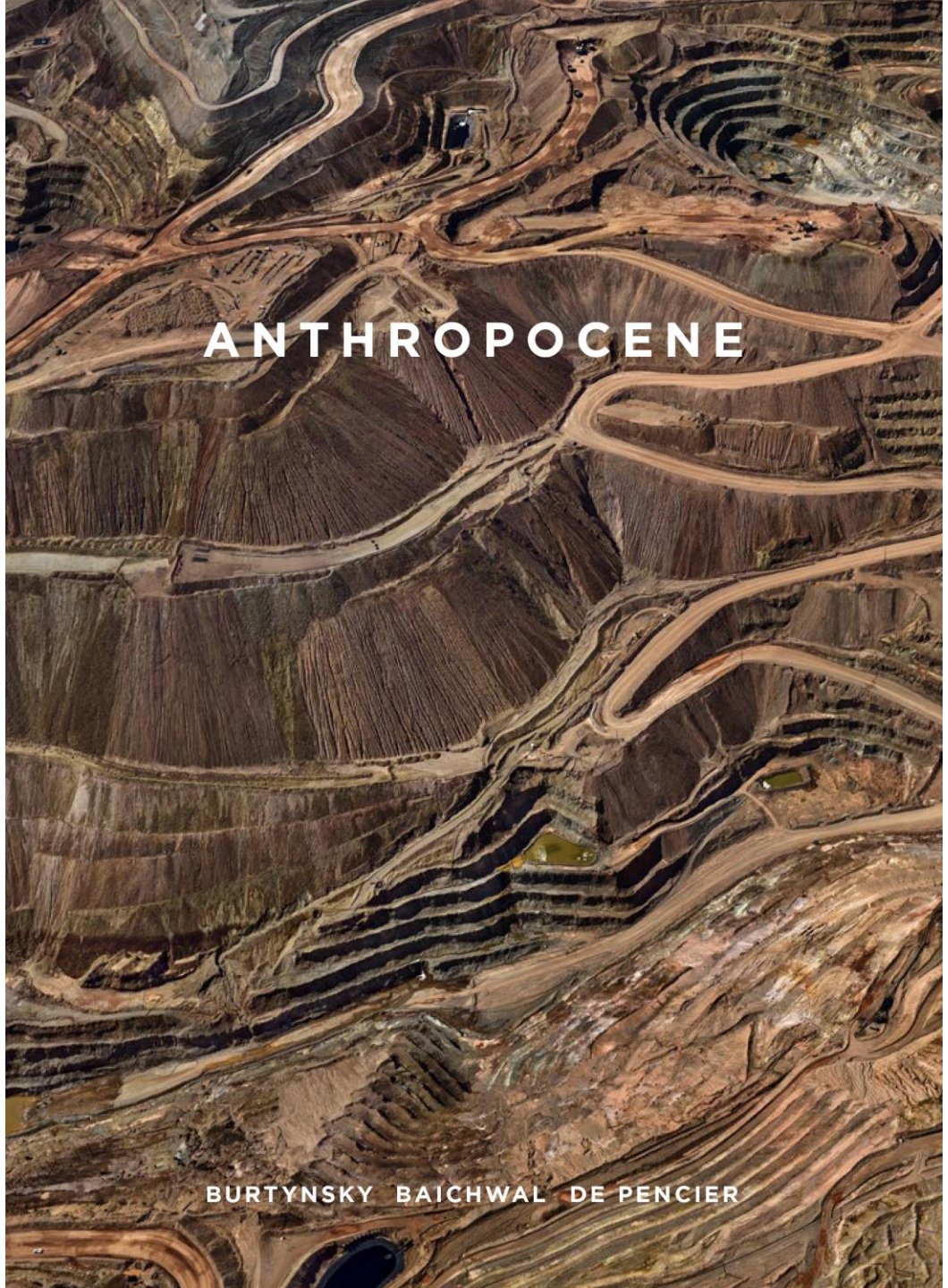
Fall & Winter

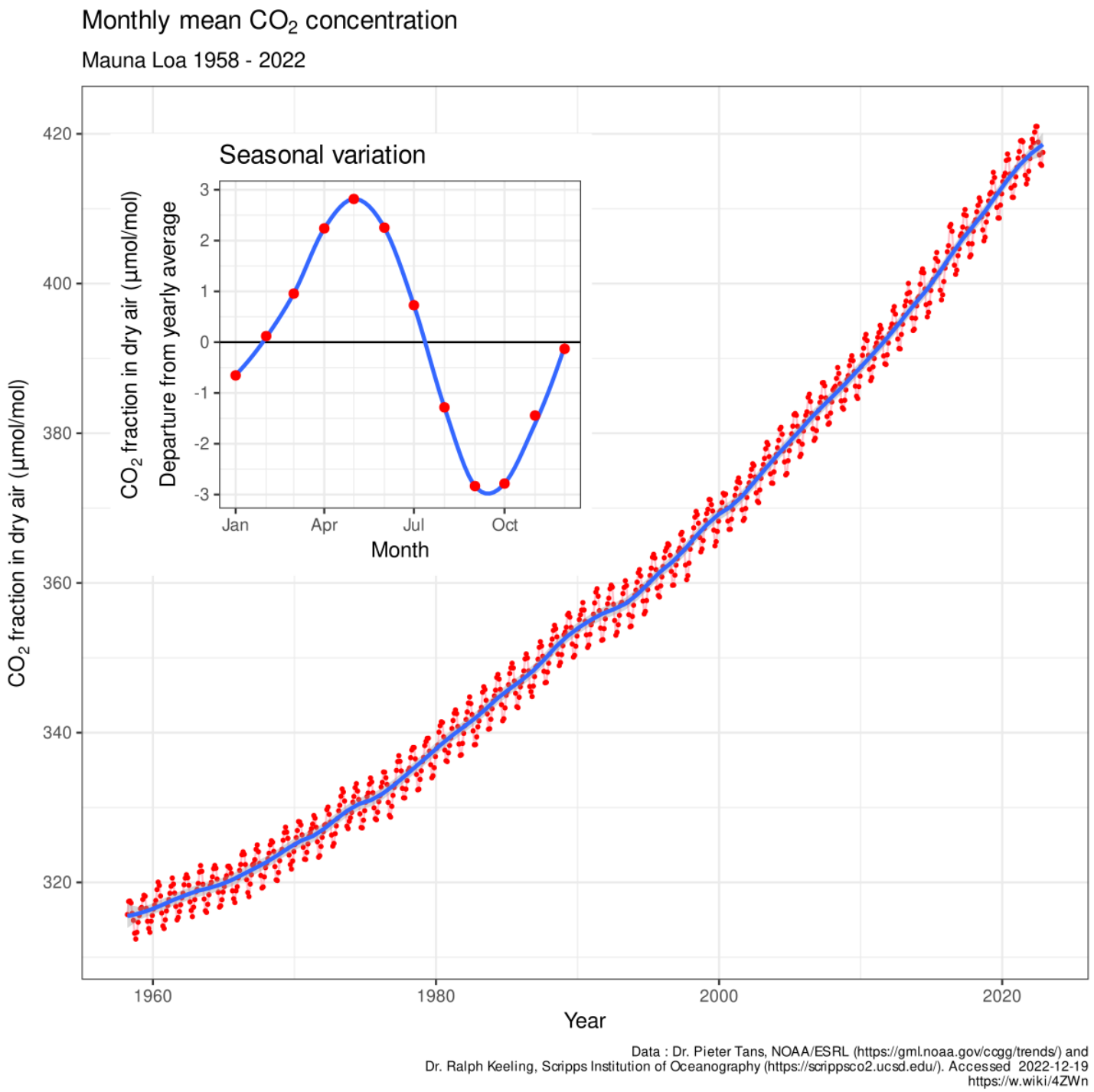
Source: Photo by Meritt Thomas / Unsplash & map by Snazzy Map.

Monarch

Butterfly

“The only way to understand nature today is in the context of the Anthropocene.” Elizabeth Hadly, Stanford University

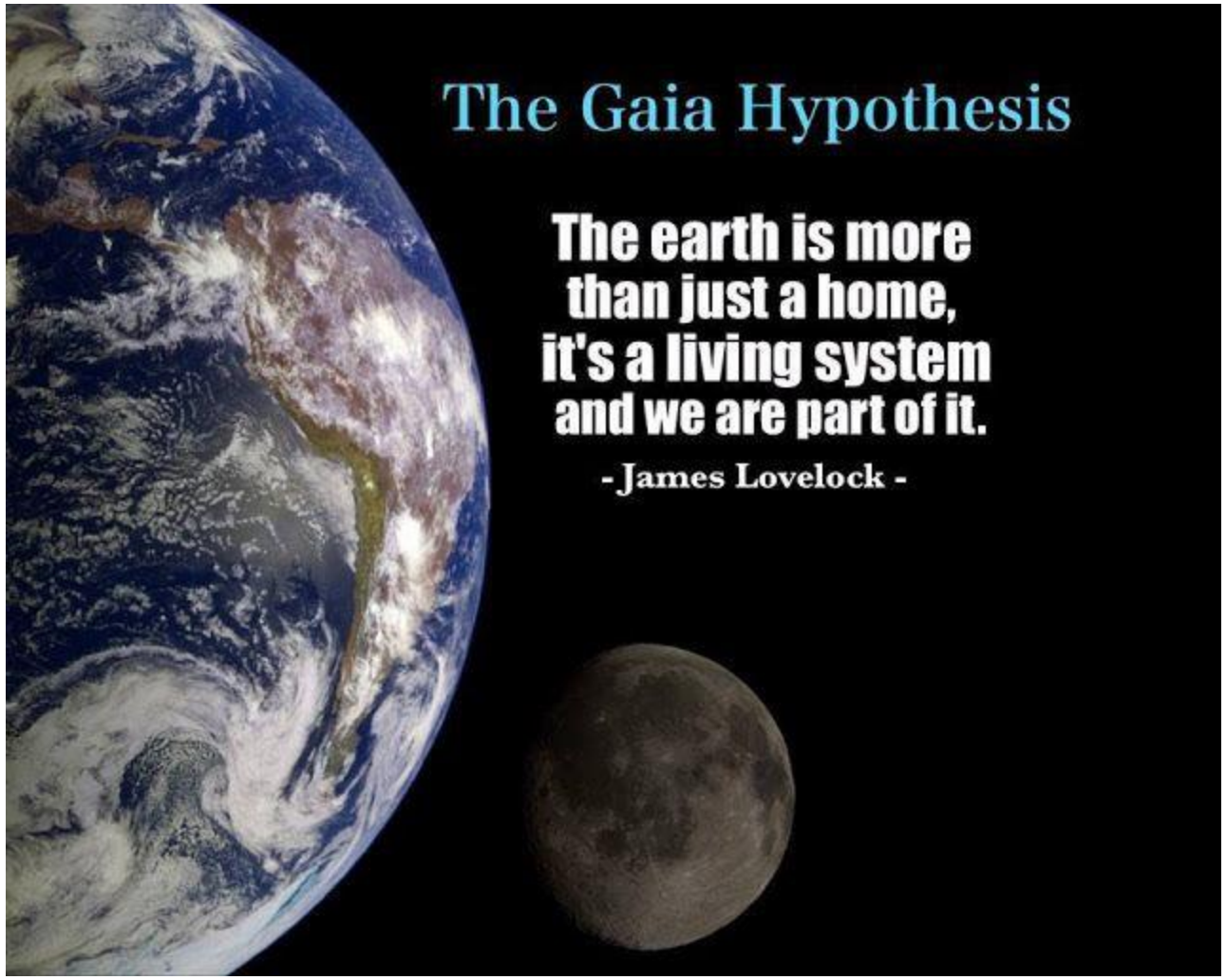



Monthly mean CO_2 concentration
Mauna Loa 1958 - 2022
Seasonal variation
CO_2 fraction in dry air (µmol/mol)
Departure from yearly average
3
2
1
0
-1
-2
-3
Jan
Apr
Jul
Oct
Month
420
400
380
360
340
320
CO_2 fraction in dry air (µmol/mol)
1960
1980
2000
2020
Year
Data : Dr. Pieter Tans, NOAA/ESRL (https://gml.noaa.gov/ccgg/trends/) and
Dr. Ralph Keeling, Scripps Institution of Oceanography (https://scrippsco2.ucsd.edu/). Accessed 2022-12-19
https://w.wiki/4ZWn

ANTHROPOCENE
NOW!
11,700 YEARS AGO
2.6
MILLIONS OF YEARS AGO
5.3
23
33.9
56
66 MY.A.
145.5
201.3
252.17
298.9
323.2
358.9
419.2
443.8
485.4
541
2.5 BILLION
4 BILLION
CENOZOIC
MESOZOIC
PALEOZOIC
PRE-CAMBRIAN
QUATERNARY
NEOGENE
PALEOGENE
HOLOCENE
PLEISTOCENE
PLIOCENE
MIOCENE
OLIGOCENE
EOCENE
PALEOCENE
CRETACEOUS
JURASSIC
TRIASSIC
PERMIAN
PENNSYLVANIAN
MISSISSIPPIAN
CARBONIFEROUS
DEVONIAN
SILURIAN
ORDOVICIAN
CAMBRIAN
PROTEROZOIC
ARCHEAN
EARTH FORMS 4.567 BILLION YEARS AGO
RAY TROLL 2017

Paul Crutzen, Nobel Prize-winning chemist for work on the ozone layer

Credit: Radhika Gupta


The Gaia Hypothesis
The earth is more than just a home, it's a living system and we are part of it.
- James Lovelock -

EARTH SPHERES

Lithosphere

solid Earth

Atmosphere

the gases that surround the Earth (its air)

Hydrosphere

all water found on, under, and over the surface of Earth

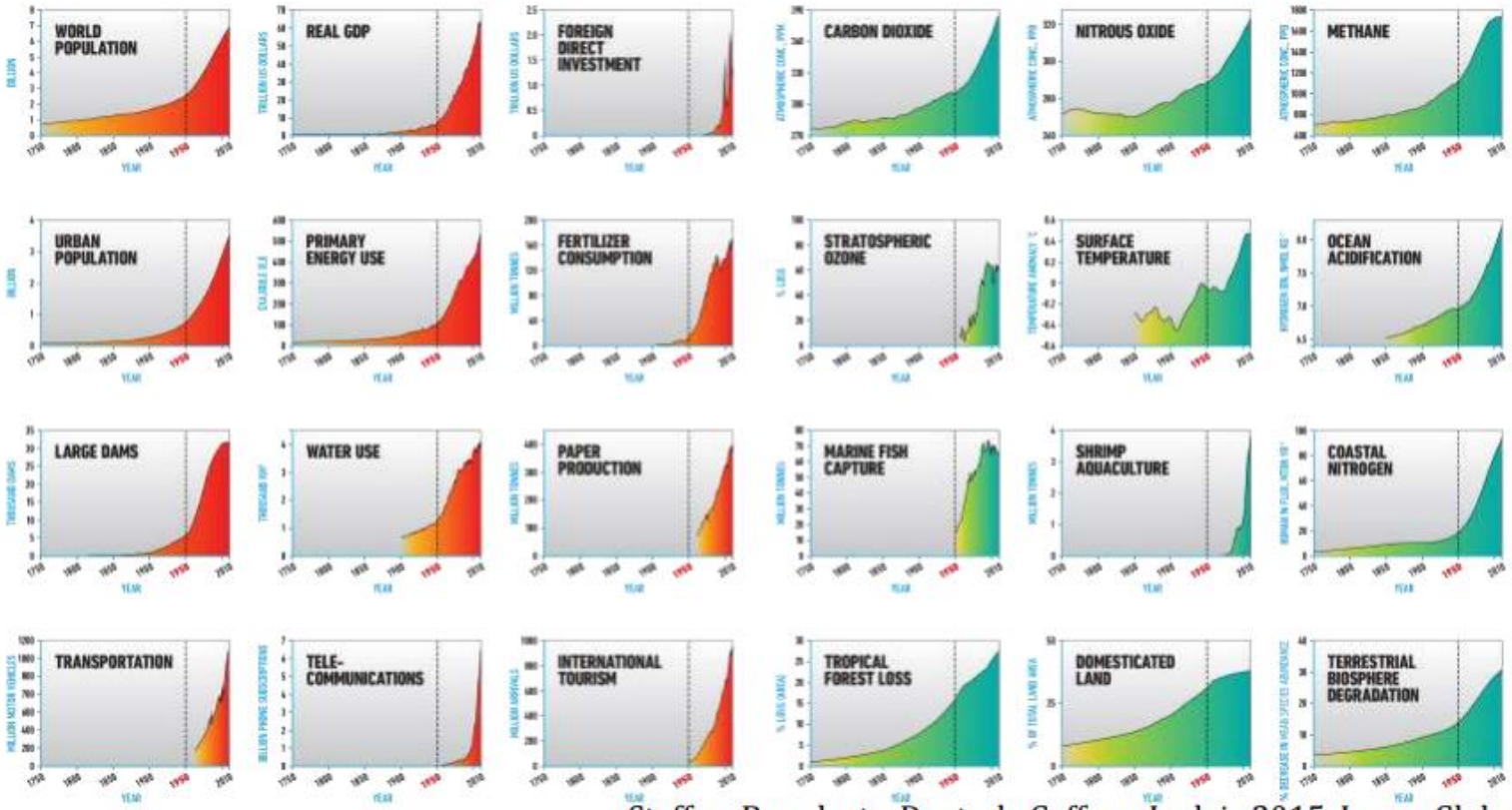
Biosphere

all life on Earth

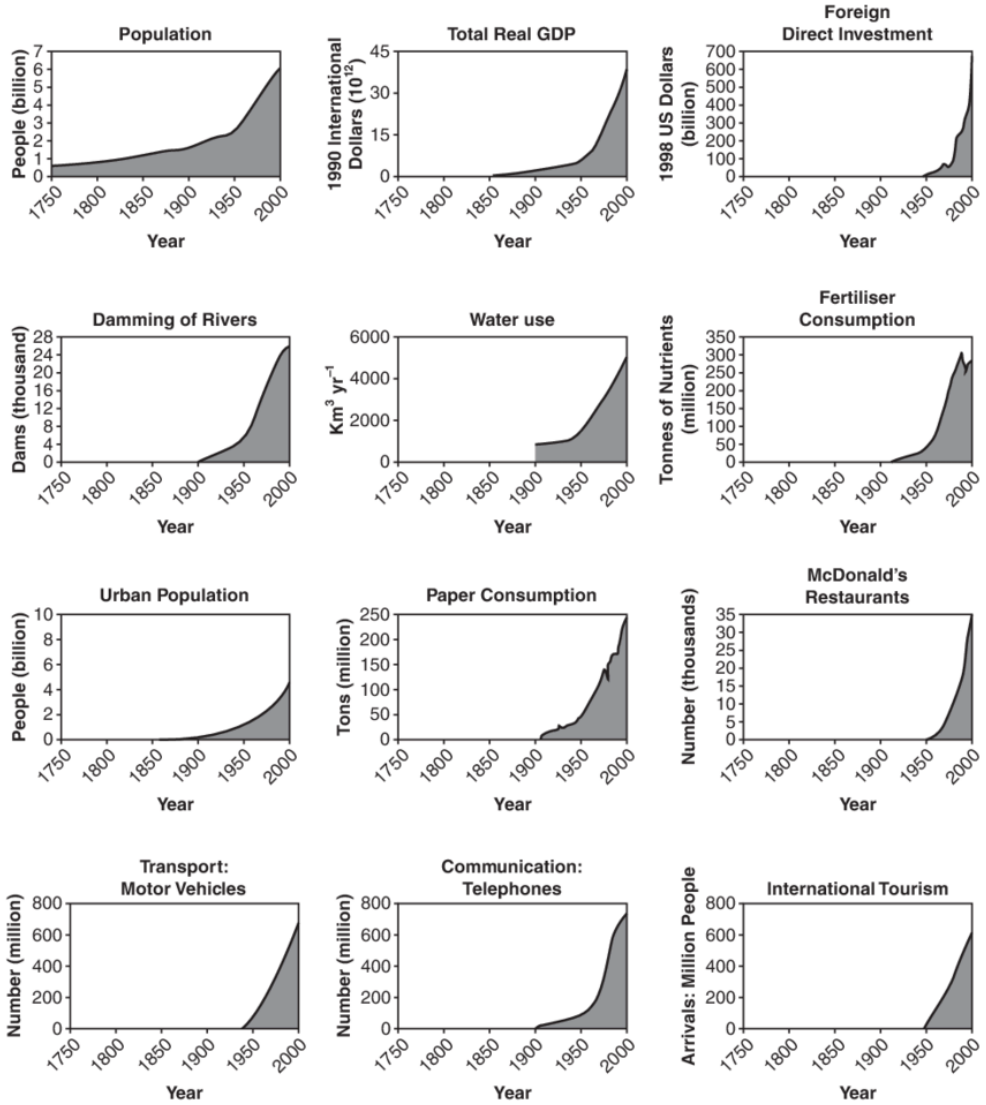
Earth System Science

Interaction of the lithosphere, atmosphere, biosphere, and hydrosphere

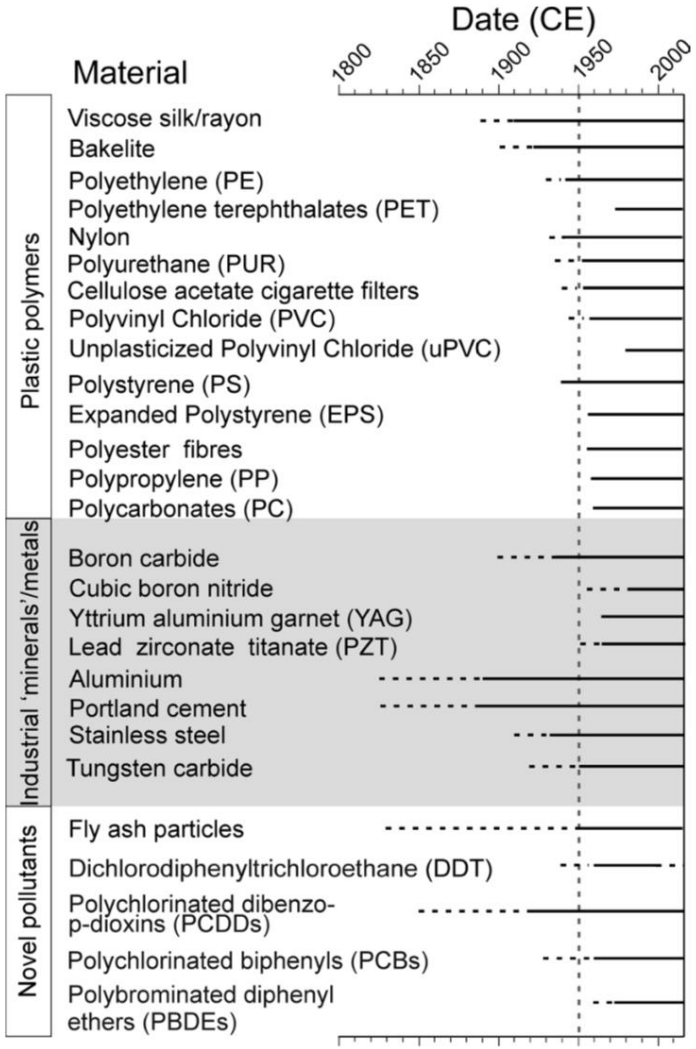
The Great Acceleration since the 1950s



Steffen, Broadgate, Deutsch, Gaffney, Ludvig 2015. Image Globaia.



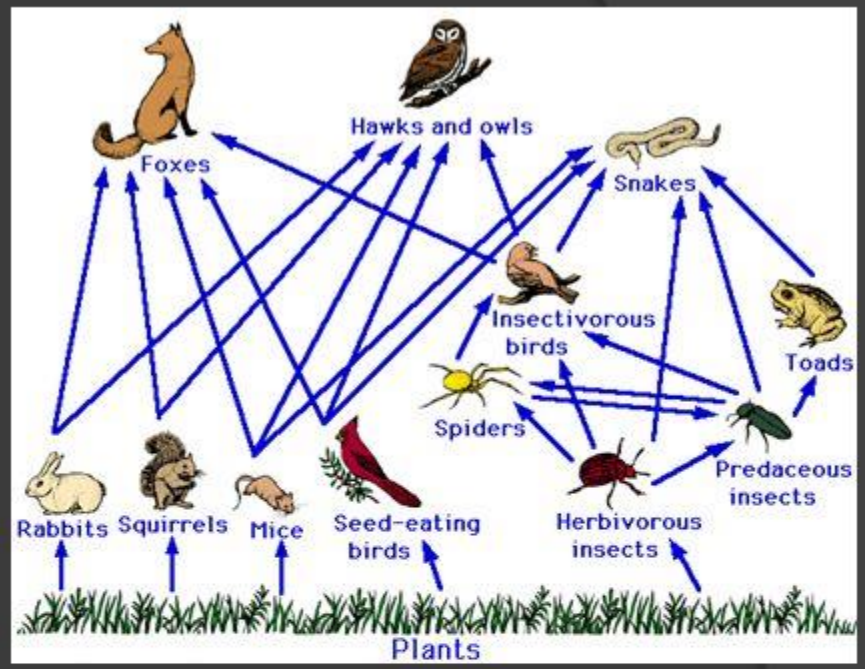
Steffen *et al*. 2015

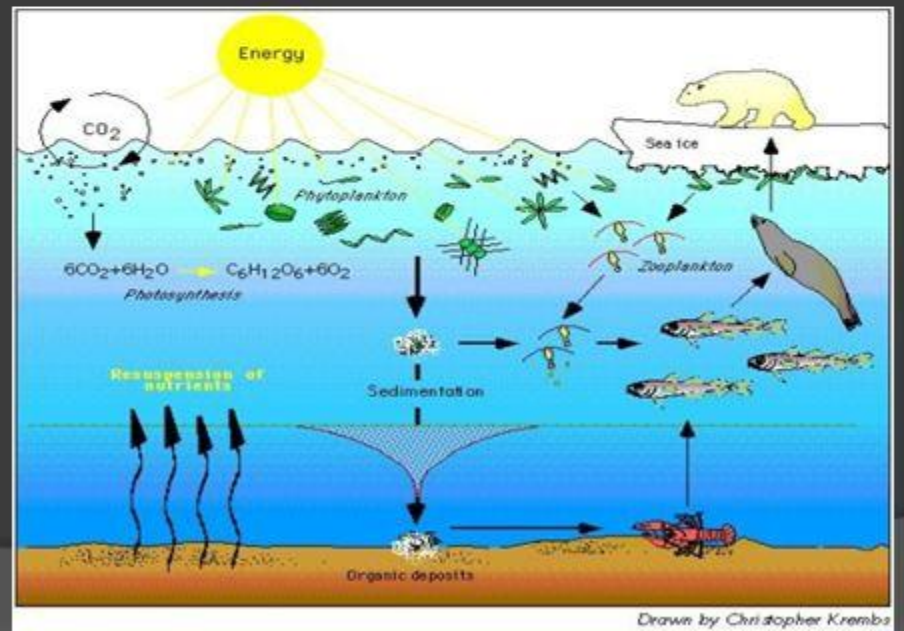


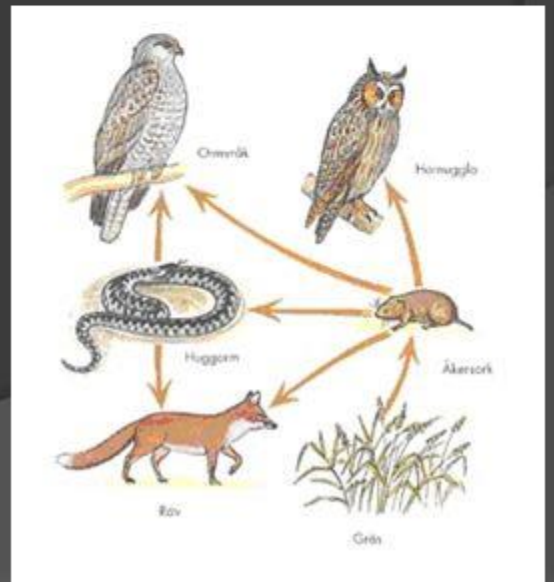
Waters *et al*. 2018

Anthropocene Working Group

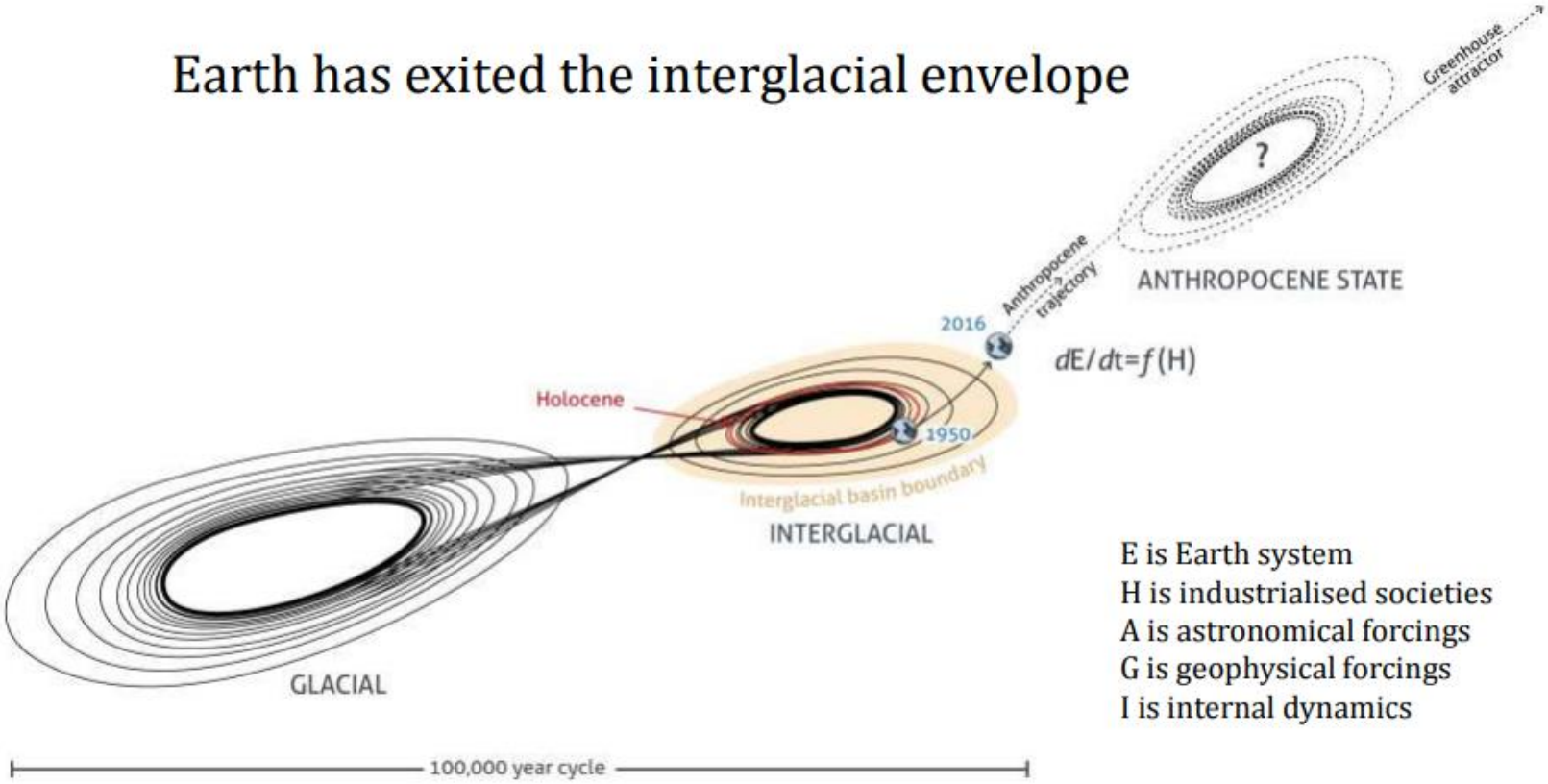
Energy Flow in Ecosystems







Earth has exited the interglacial envelope



E is Earth system
H is industrialised societies
A is astronomical forcings
G is geophysical forcings
I is internal dynamics

$dE/dt=f(A,G,I)$

The Anthropocene equation, Gaffney & Steffen, Anthropocene Review 2017

REVIEW

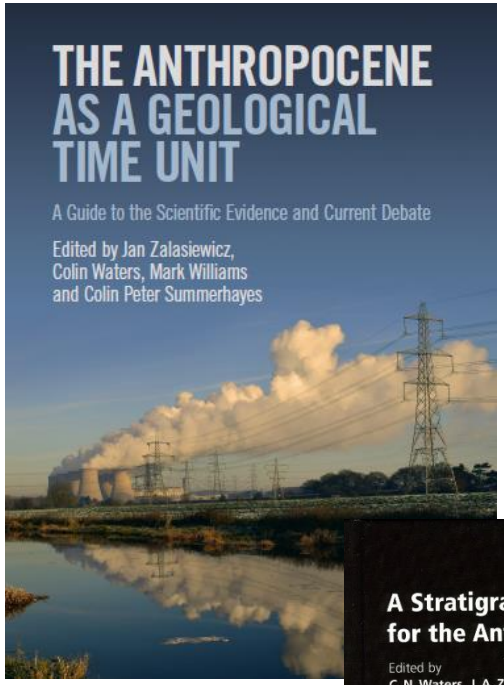
EARTH HISTORY

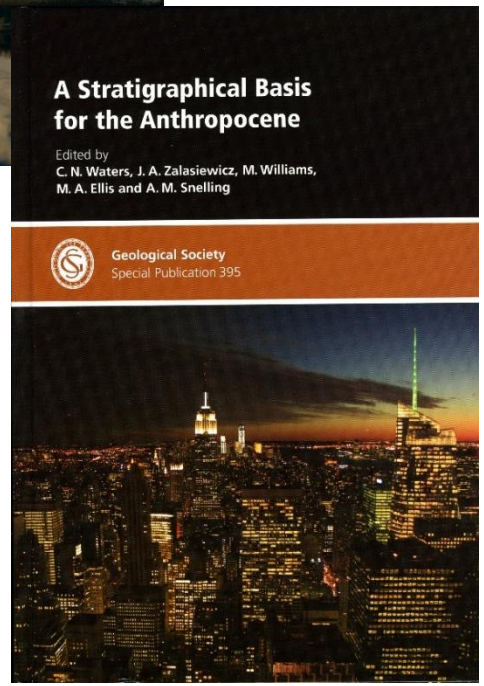
The Anthropocene is functionally and stratigraphically distinct from the Holocene

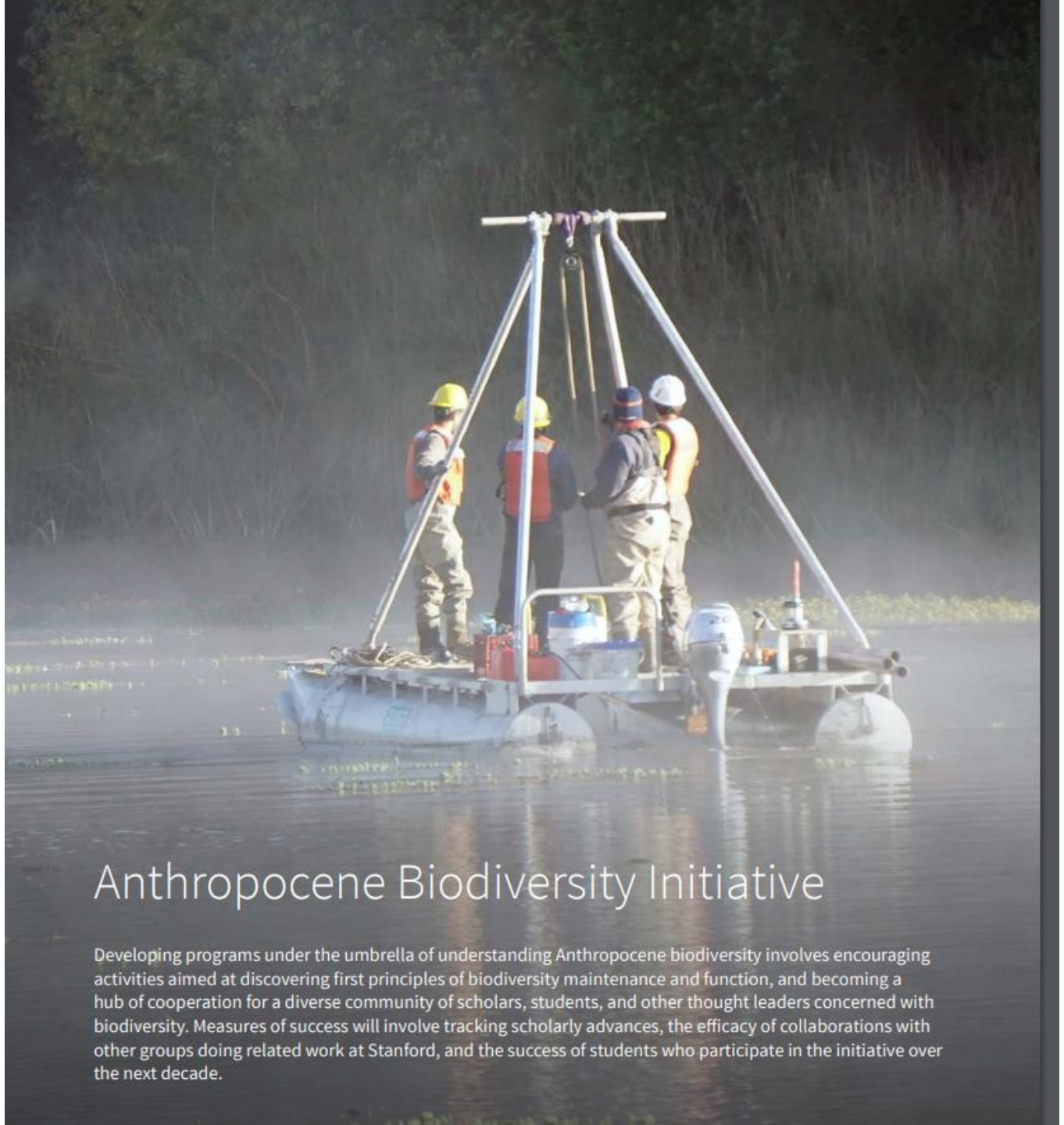
Colin N. Waters,[1*] Jan Zalasiewicz,[2] Colin Summerhayes,[3] Anthony D. Barnosky,[4] Clément Poirier,[5] Agnieszka Gałuszka,[6] Alejandro Cearreta,[7] Matt Edgeworth,[8] Erle C. Ellis,[9] Michael Ellis,[1] Catherine Jeandel,[10] Reinhold Leinfelder,[11] J. R. McNeill,[12] Daniel deB. Richter,[13] Will Steffen,[14] James Syvitski,[15] Davor Vidas,[16] Michael Wagreich,[17] Mark Williams,[2] An Zhisheng,[18] Jacques Grinevald,[19] Eric Odada,[20] Naomi Oreskes,[21] Alexander P. Wolfe[22]

Human activity is leaving a pervasive and persistent signature on Earth. Vigorous debate continues about whether this warrants recognition as a new geologic time unit known as the Anthropocene. We review anthropogenic markers of functional changes in the Earth system through the stratigraphic record. The appearance of manufactured materials in sediments, including aluminum, plastics, and concrete, coincides with global spikes in fallout radionuclides and particulates from fossil fuel combustion. Carbon, nitrogen, and phosphorus cycles have been substantially modified over the past century. Rates of sea-level rise and the extent of human perturbation of the climate system exceed Late Holocene changes. Biotic changes include species invasions worldwide and accelerating rates of extinction. These combined signals render the Anthropocene stratigraphically distinct from the Holocene and earlier epochs.

Waters *et al*. Science, 2016



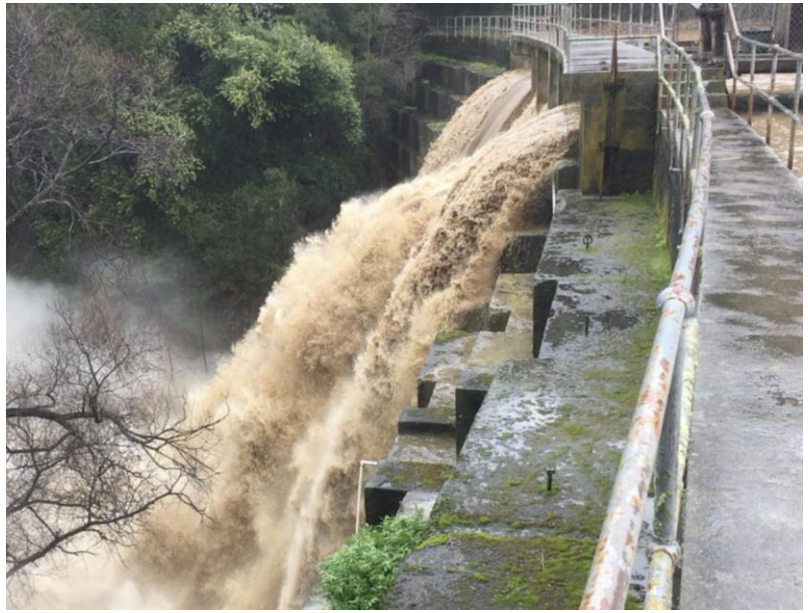


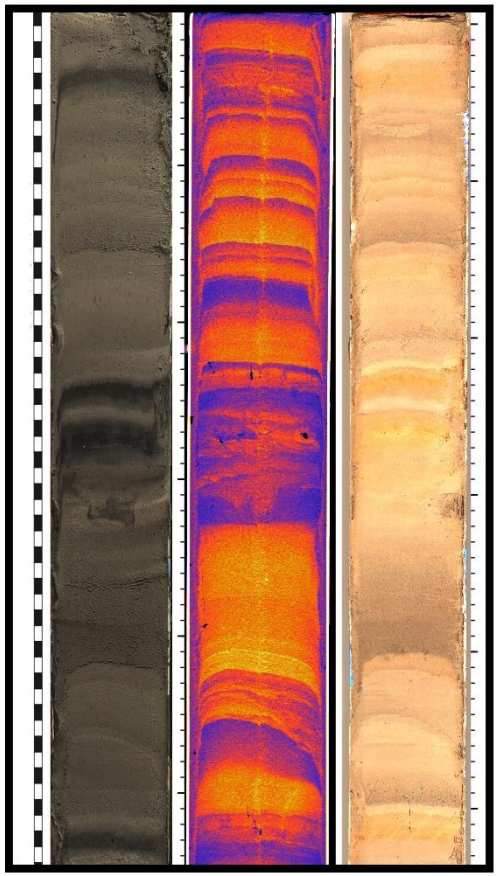


Anthropocene Biodiversity Initiative

Developing programs under the umbrella of understanding Anthropocene biodiversity involves encouraging activities aimed at discovering first principles of biodiversity maintenance and function, and becoming a hub of cooperation for a diverse community of scholars, students, and other thought leaders concerned with biodiversity. Measures of success will involve tracking scholarly advances, the efficacy of collaborations with other groups doing related work at Stanford, and the success of students who participate in the initiative over the next decade.

Searsville Lake GSSP





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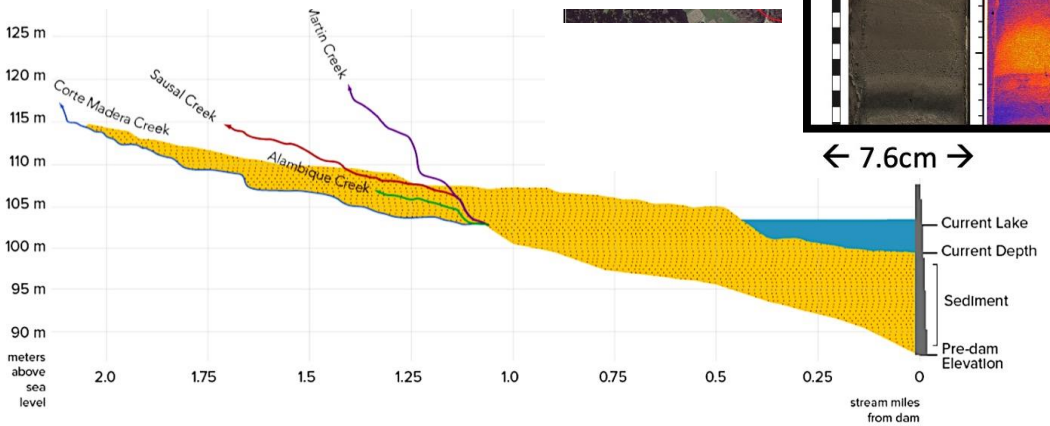


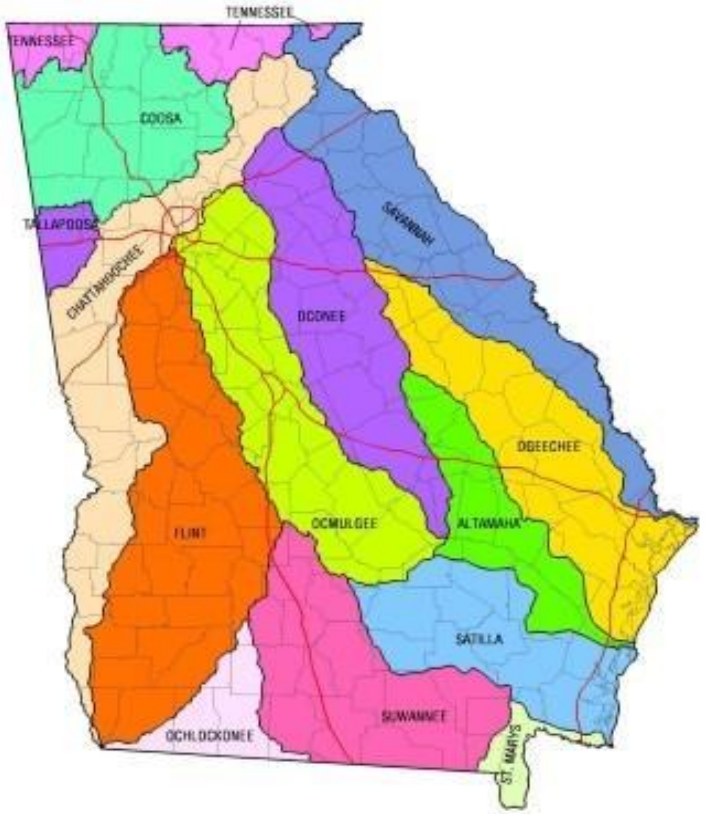
Searsville Lake, CA, USA Lake sediments	
Annual laminae	
Novel materials	
Plastics	YES
Fly ash (SCPs), BC	YES
Geochemical Markers	
$\delta^{18}O$	
$\delta^{13}C$	YES
NO_3, $\delta^{15}N$	YES
S & SO_4	
Heavy metals	YES
PAH, DDT, pharms.	YES
Radioisotopes	YES
Biotic Markers	
Ostracods, pollen, diatoms	YES

GEORGIA

Adopt-A-Stream

Department of Natural Resources
Environmental Protection Division
Spring 2008

Getting to Know Your Watershed



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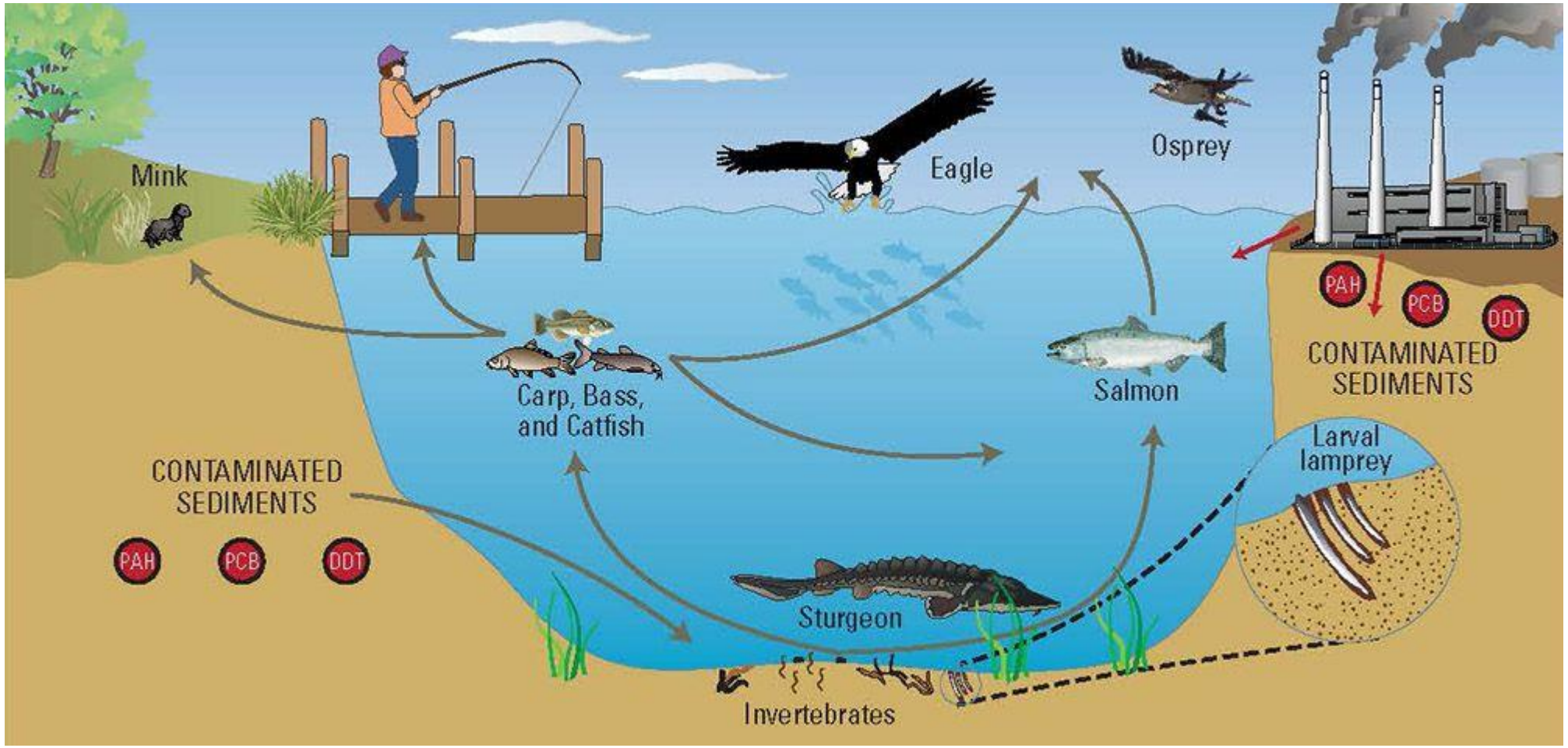
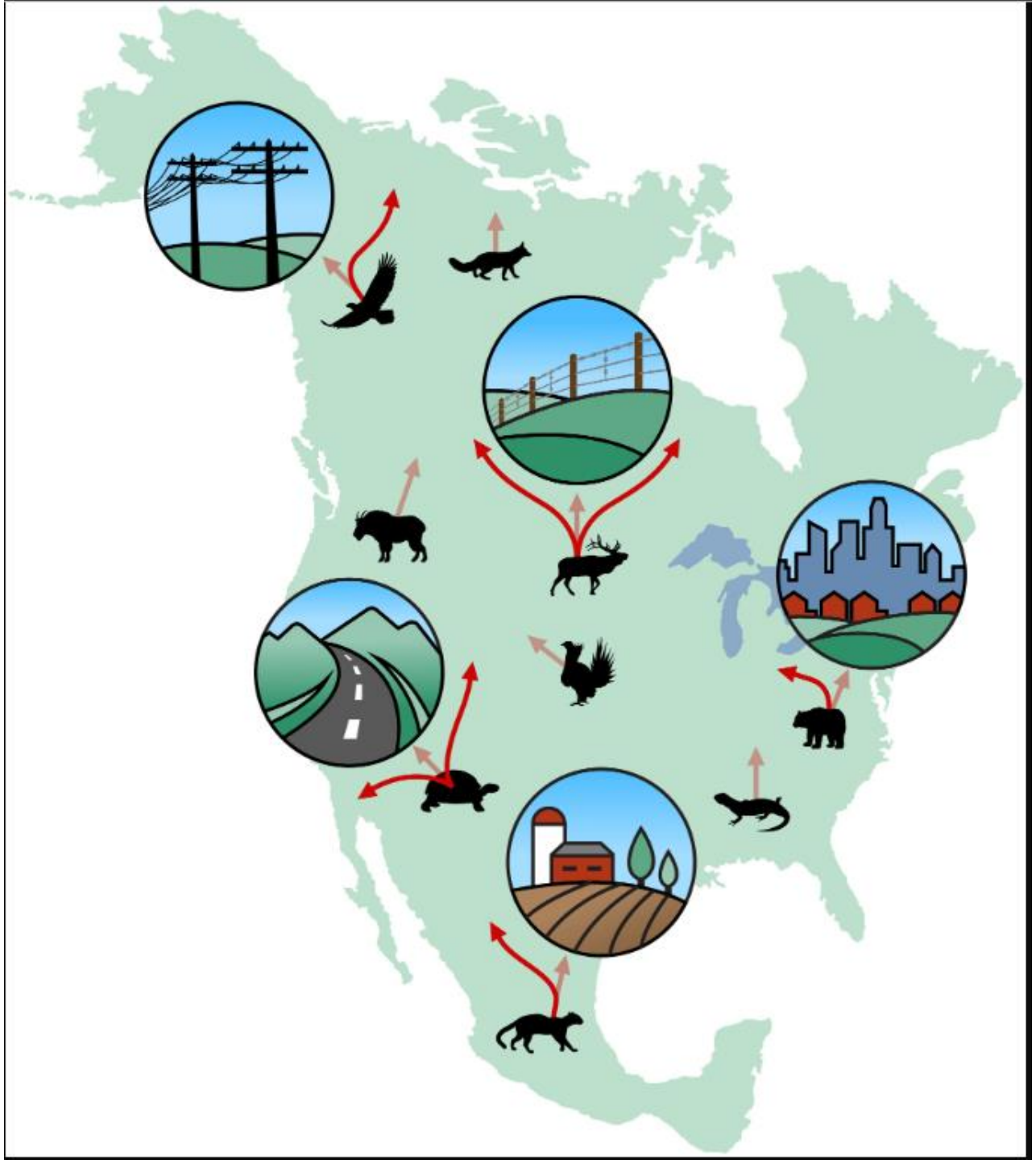
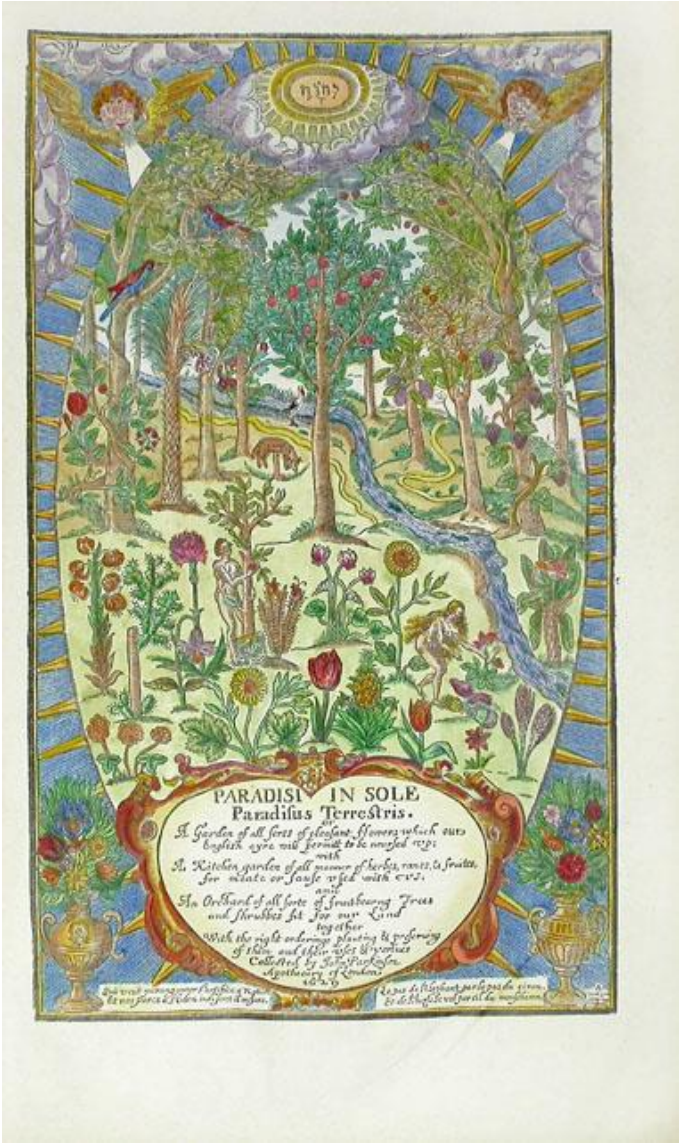
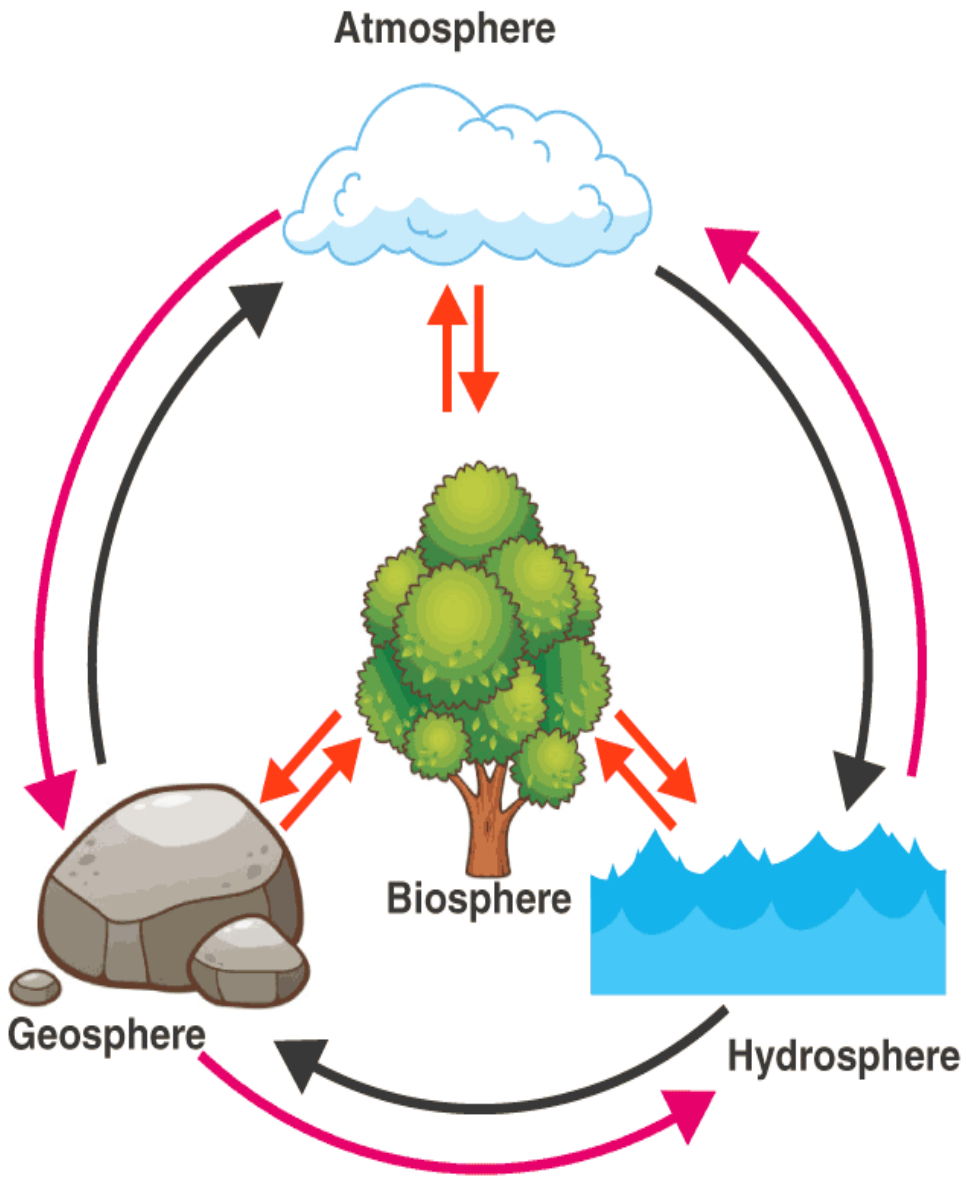
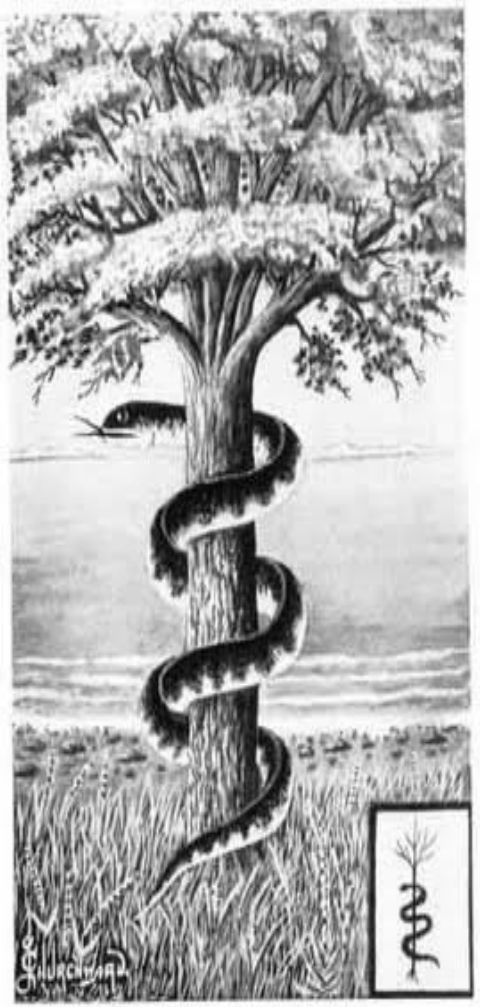

Mink
Eagle
Osprey
PAH
PCB
DDT
CONTAMINATED SEDIMENTS
Carp, Bass, and Catfish
Salmon
Larval lamprey
CONTAMINATED SEDIMENTS
PAH
PCB
DDT
Sturgeon
Invertebrates



McGuire, Jenny et al. “The Past as a Lens for Biodiversity Conservation on a Dynamically Changing Planet.” PNAS, Feb 14, 2023. Figure: Duncan MacGruer


PARADISI IN SOLE
Paradisus Terrestris.


Atmosphere
Biosphere
Geosphere
Hydrosphere