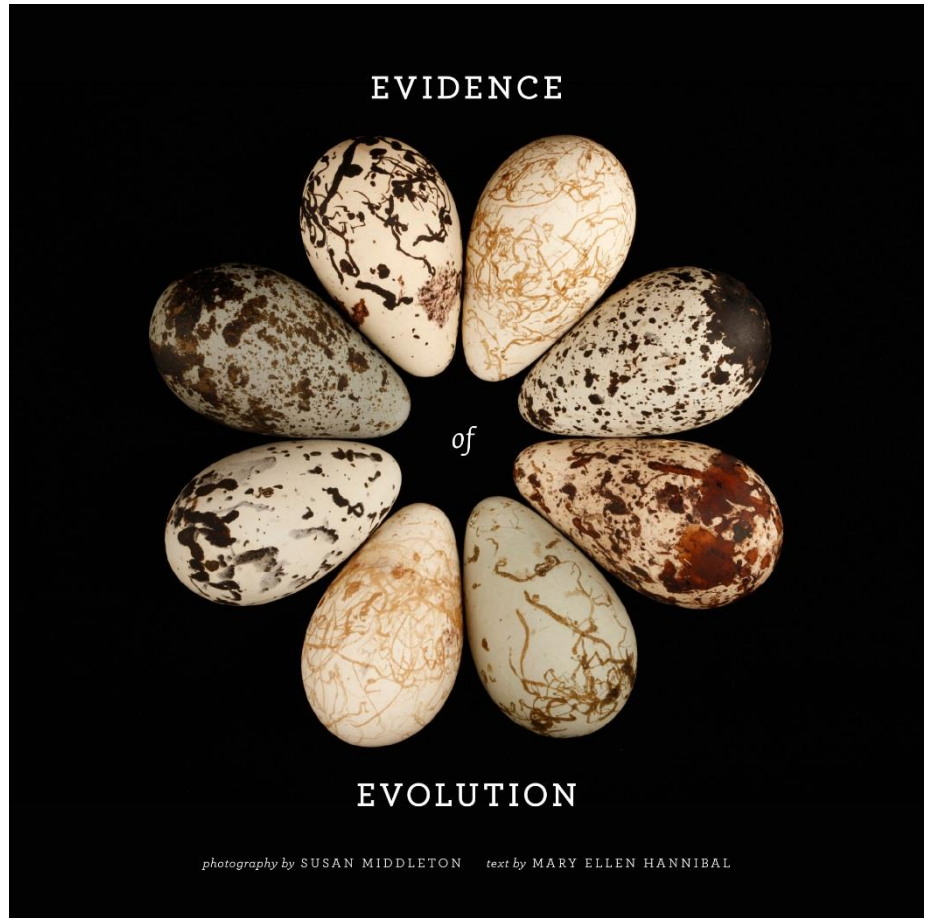
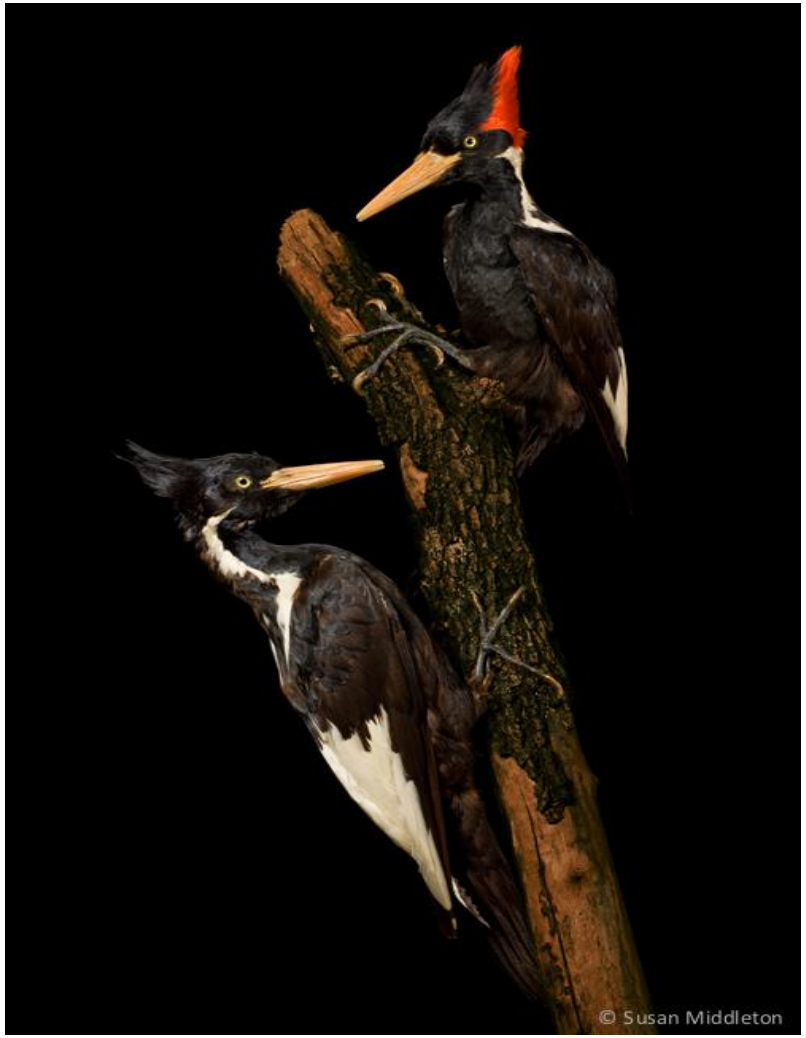
Only Connect

Extinction and its Discontents


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

© Susan Middleton


© Susan Middleton

AUDIENCA DE
GUADALAJARA,
NOVA MEXICO
CALIFORNIA &c.
Per N. Sanson
MAR
DEL
SUD,
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PACIFICUM.
Linea sub Tropico Cancri
CALIFORNIA
INSULA
MAR
VERMEJO
NOVA
MEXICO
APACHES DE NAVAJOX
APACHES DE XILA
APACHES VAQUEROS
APACHES DE PERILLO
MARATA
Zuni
Cibola
Moqui
Amejes
Taosij
Tomi
Tigues
Hubales
Nueva Mexico
Peici
Tompires
Gorretes
Manses
Hanes
Sumes
Tomites
Tepoanes
Tarrahumares
Astatlan
Ometlan
Tobosses
Iapies
Aixai
Xabotai
Passaguates
Conches
QUIVIRA
FLORIDA
AUDIENCA
GUADALAJARA
CULIACAN
ZACATECAS
CHIAMETLAN
MECHOACAN
MEXICO
XALISCO
Septentrio

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115 NASSAU ST NEW YORK

Map
Satellite
Greenland
Northwestern Passages
Hudson Bay
Canada
United States
Mexico
Gulf of Mexico
Caribbean Sea
North Pacific Ocean
Cuba
Puerto Rico
Guatemala
Nicaragua
AK
YT
NT
NU
AB
BC
SK
MB
ON
QC
NL
NB
PE
NS
ME
NH
MA
NY
WA
OR
CA
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IN
KY
TN
AL
OH
WV
GA
FL
SC
NC
VA
PA
DE
HI
high
observed
low
not observed
2013 data
Map data ©2014 Google, INEGI
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HOW DOES LIFE WORK?

Most of us use the term "evolution" as synonymous with change, but the word is from the Latin *evolvere*, meaning "to unfold." Evolution is a series of relationships connecting all life on Earth at this moment and back through time, both a history and a picture of what comprises life now. We establish these relationships through various means, but tangibly through the evidence of specimens. An evolutionary biologist first determines exactly what a specimen is and where it fits within densely articulated classification systems. Most disciplines, like botany, use something called a dichotomous key to begin placing a specimen within a genus and to identify it further as a particular species.

Dichotomous means "divided into two," and thus the key lays out a set of either/or questions that quickly sort the features of the specimen: Is a leaf evergreen or deciduous; does it have six lobes or four? These either/or questions get specific down to the chemical compounds found in the plant's metabolic pathways, down to the molecular structure of its DNA. Every answer helps determine where the specimen belongs, what it is related to, and its age. Sometimes, however, the scientist cannot fit all the details of a specimen into a previous picture and experiences the thrill of discovering something new. Once the identity of a specimen has been firmly determined, it takes its place in the vast jigsaw puzzle science is constructing to depict this unfolding of life on Earth.

The basic framework for understanding evolution is the fact that all living things have parents (mostly two, but not always). Darwin's terminology "descent with modification" refers to the fact that new variations in individuals result from transmission of traits, half contributed by a mother and half by a father. He was unaware of Gregor Mendel's work on inheritance of traits in pea plants, although the two men lived at the same time. Mendel identified how hereditary factors sort out and come back together; called genetics, this science is integral to the pattern Darwin identified.

Later work in the field showed that change occurs not only from new combinations of genes, but through a process known as genetic drift. Cells divide by replicating themselves, a copying process that is frequently imperfect. The copies end up being slightly different from their originals. Some scientists say the resulting mutation is caused by "mistakes" in genetic copying, but since there is no intention on the part of cells, it seems more accurate simply to say that "changes" are made during genetic copying. Change, whether effected through new combinations of genes or genetic drift, is fundamentally necessary to evolution, providing the raw materials for innovative forms. Over time, changes in a population's genetic makeup accumulate to the point that a species is effectively separate from its ancestors. One of the central goals of evolutionary biologists is to locate the point at which this divergence occurs.

Opposite: This Puma concolor was donated to the California Academy of Sciences by the U.S. Fish and Wildlife Service; it was likely given to this agency when it became illegal to hunt and mount endangered species. The puma is threatened by habitat loss.

Overleaf, left: Venus arose from a scallop shell, ordinarily the home of a bivalve, which propels itself away from predators by contracting its adductor muscle and clapping its two shells open and closed.

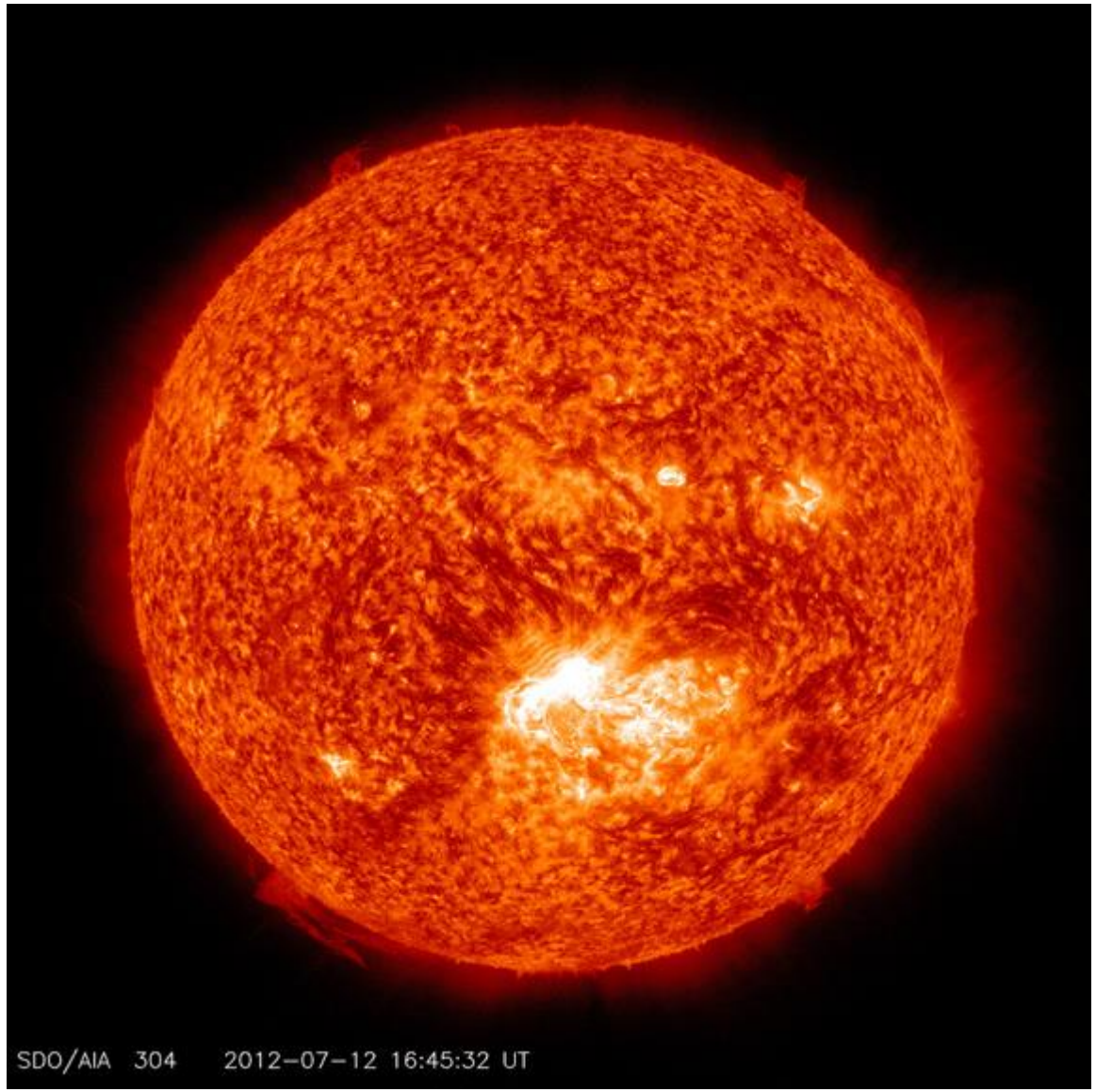
PATTERNS OF EVOLUTION

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 ideas.

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 lived 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.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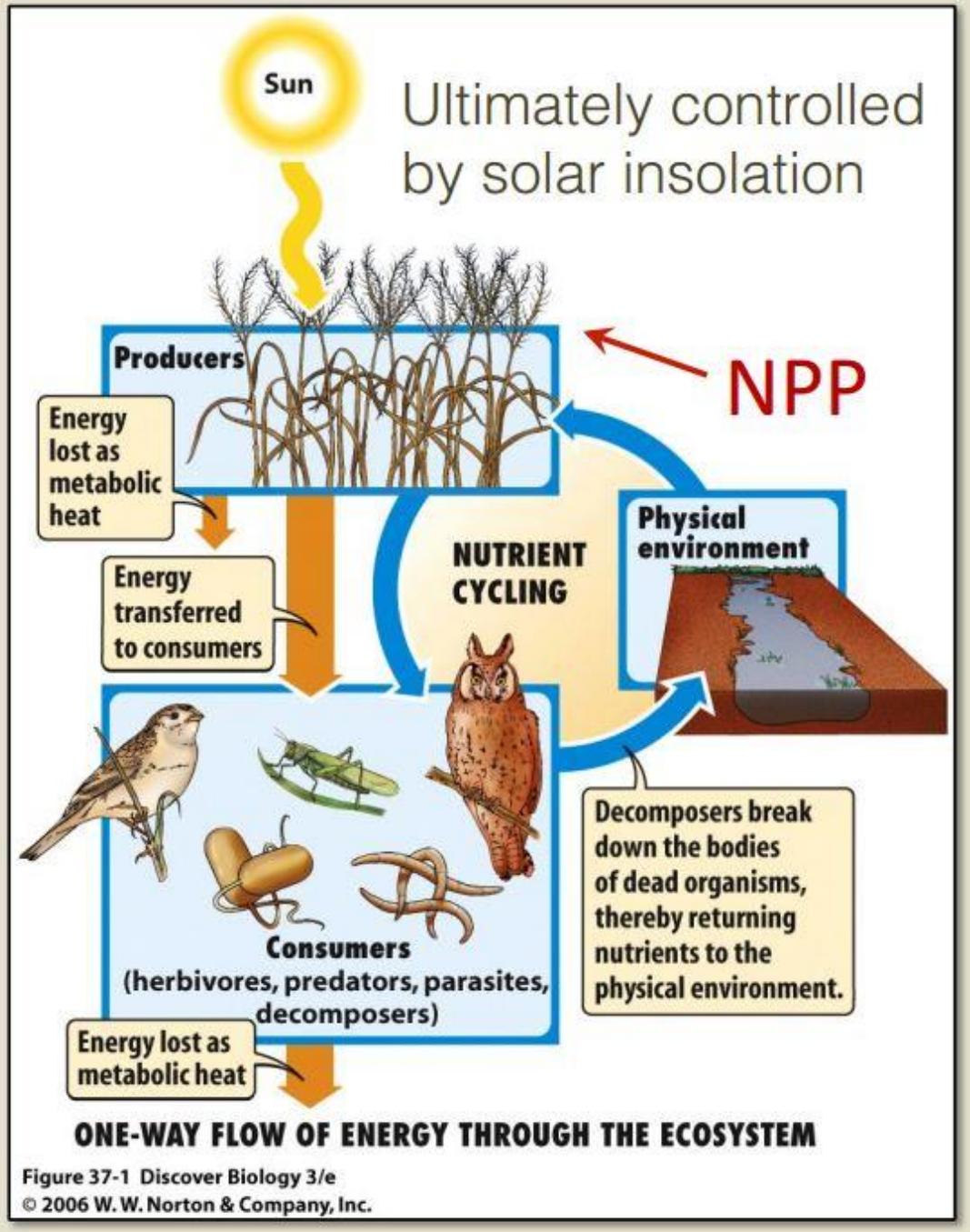
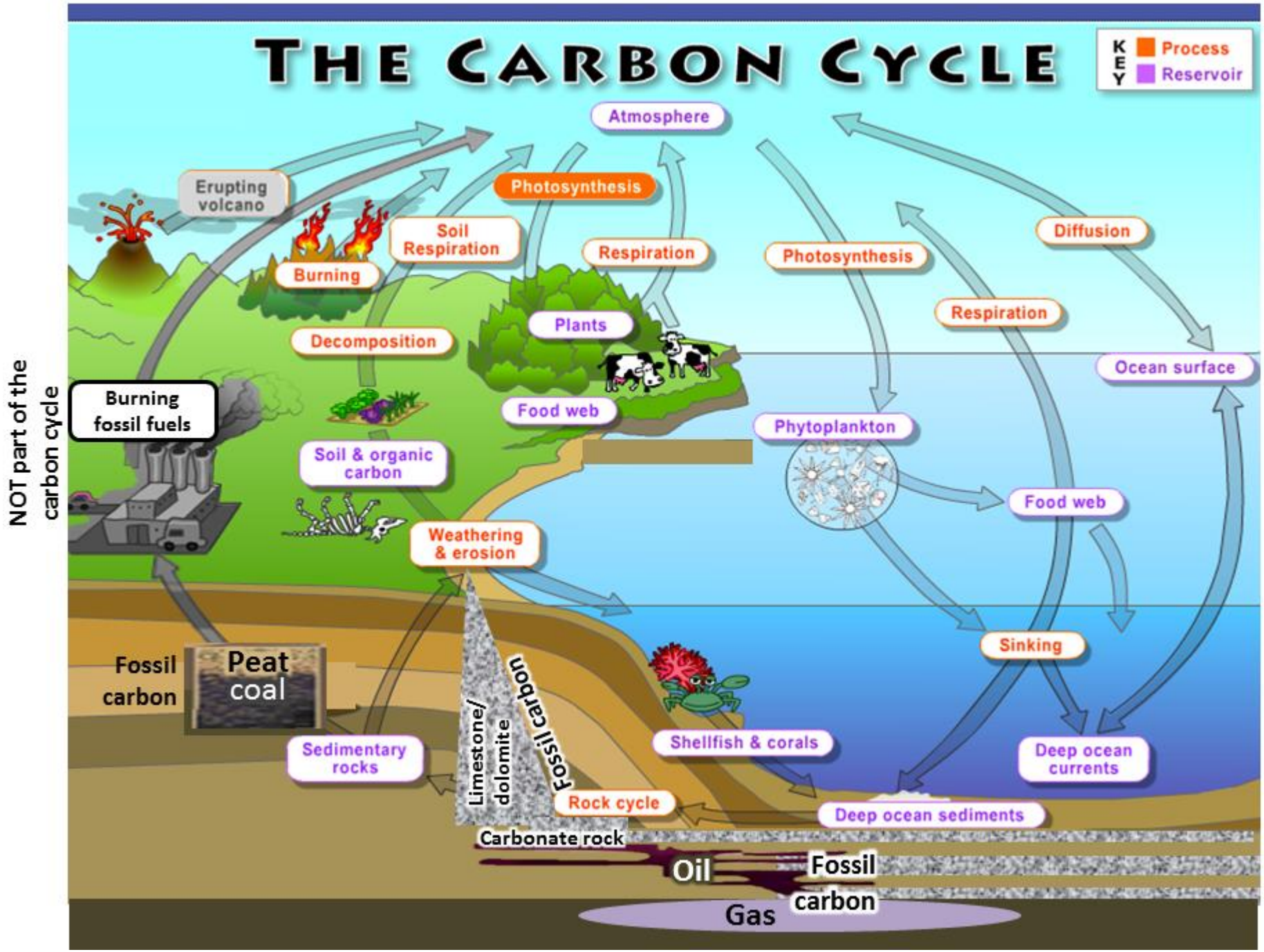
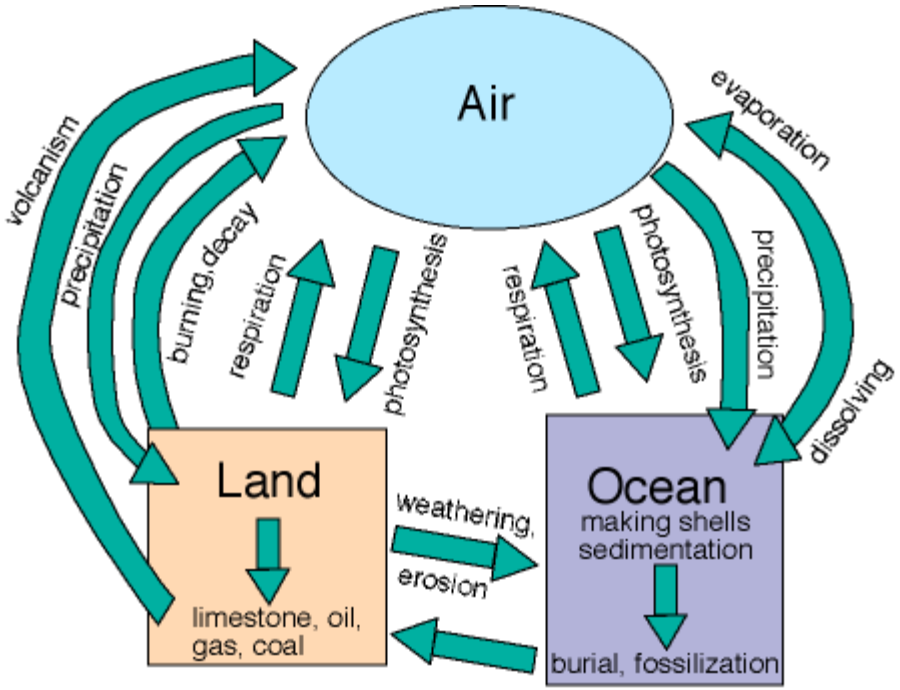


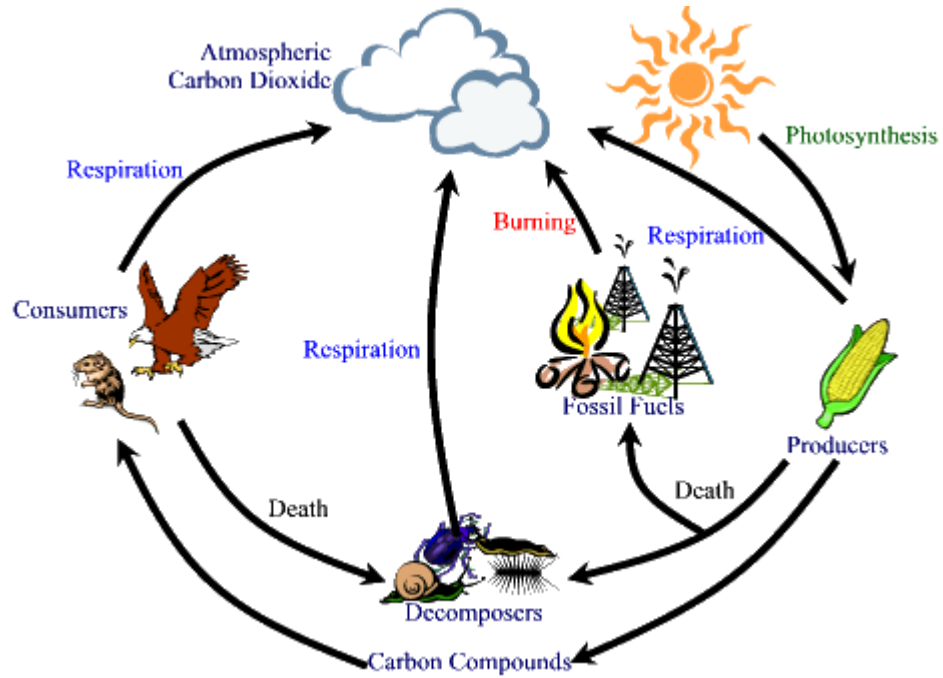
The global energy budget

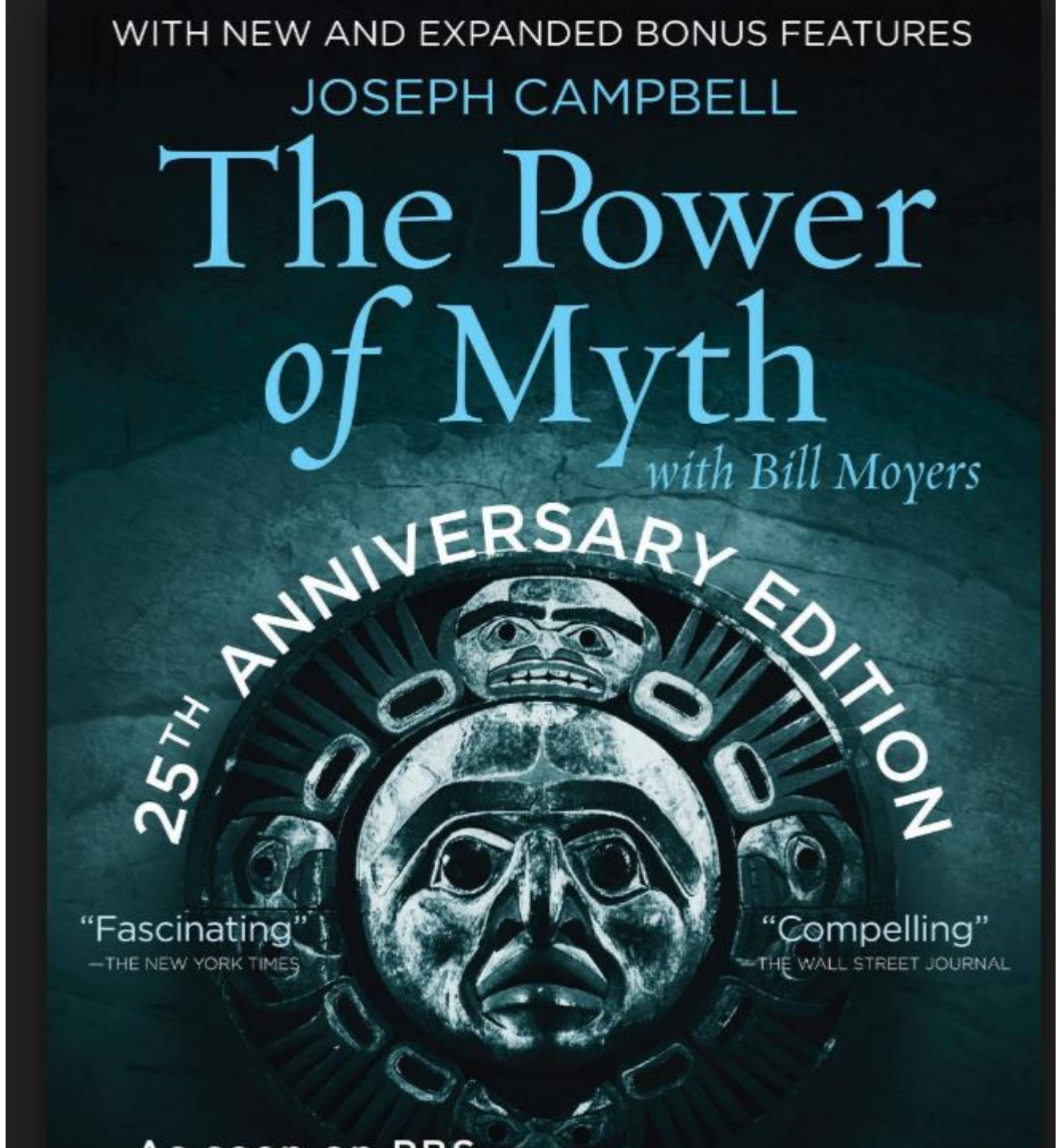
http://www.csus.edu/indiv/l/loom/wk%2014/energy%20flow.jpg

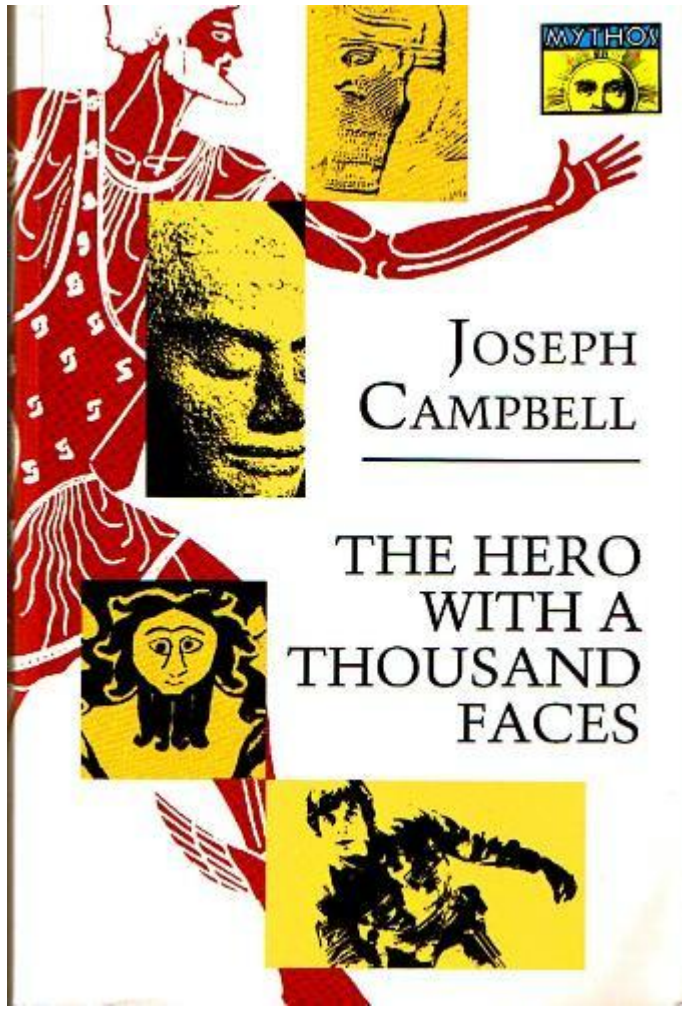

THE CARBON CYCLE
KEY
Process
Reservoir
Atmosphere
Erupting volcano
Photosynthesis
Soil Respiration
Respiration
Burning
Photosynthesis
Diffusion
Respiration
Plants
Decomposition
Ocean surface
Burning fossil fuels
Food web
Phytoplankton
Soil & organic carbon
Food web
Weathering & erosion
Sinking
Fossil carbon
Peat
coal
Limestone/ dolomite
Fossil carbon
Shellfish & corals
Deep ocean currents
Sedimentary rocks
Rock cycle
Deep ocean sediments
Carbonate rock
Oil
Fossil carbon
Gas
NOT part of the carbon cycle

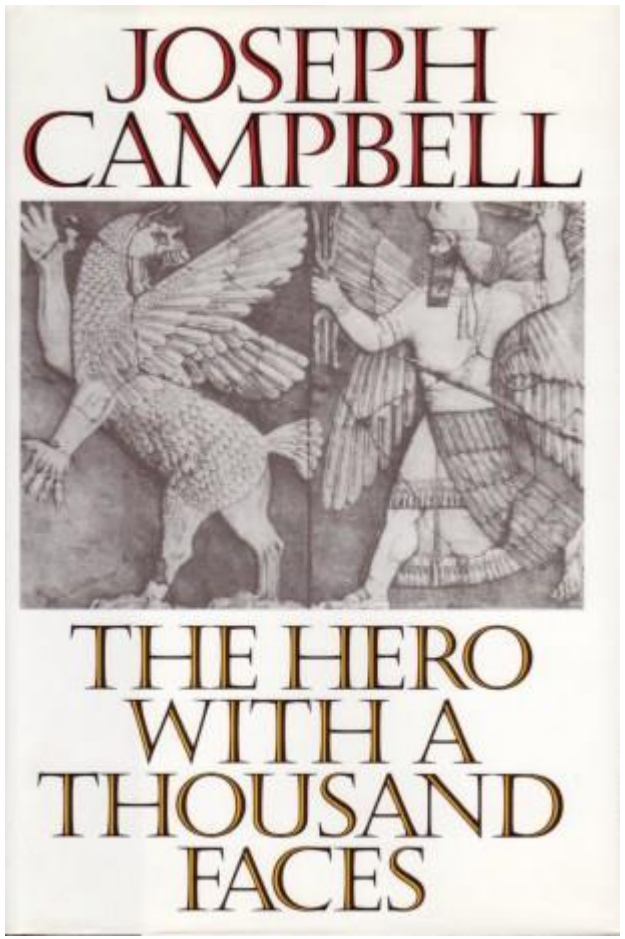


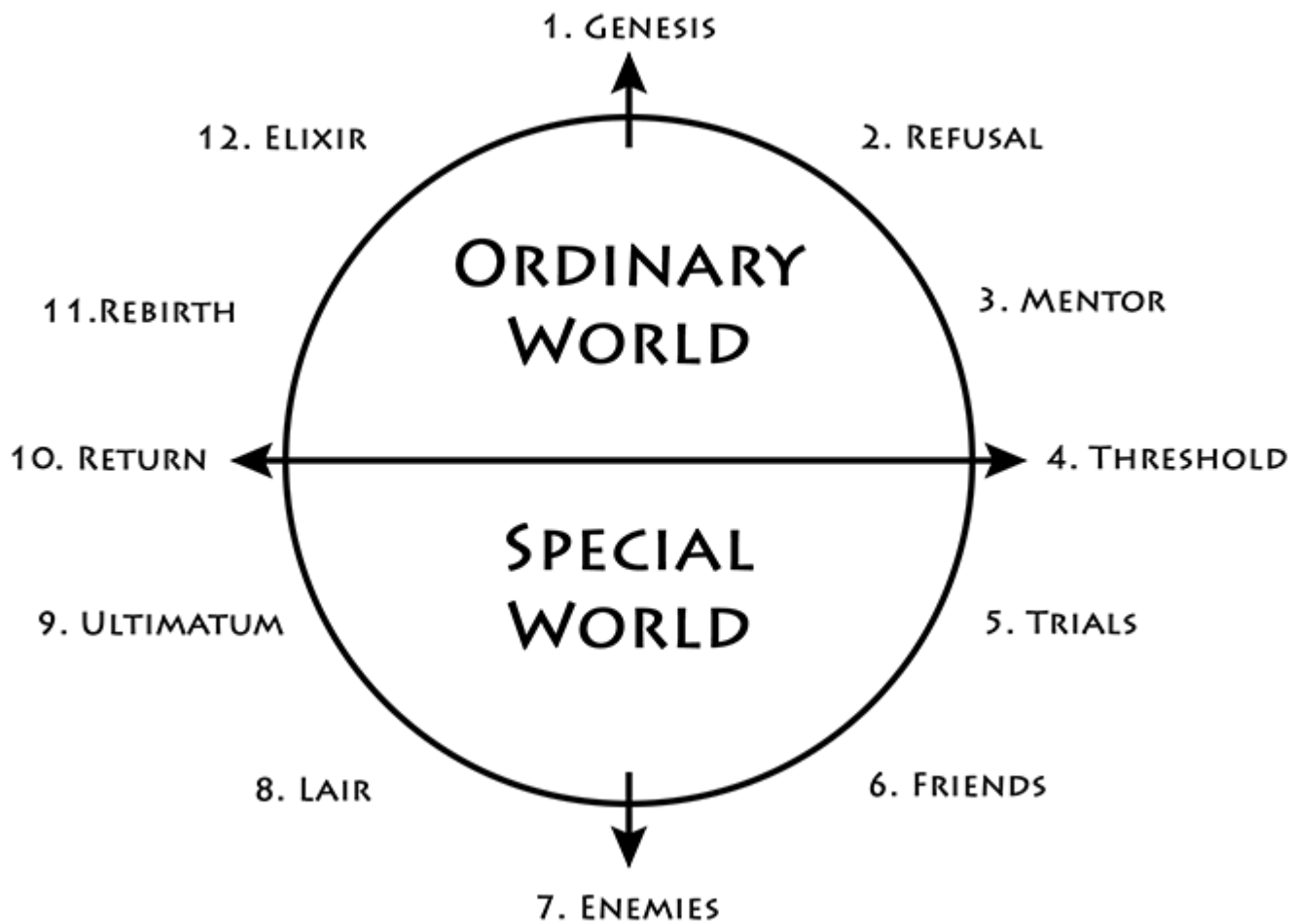
The carbon cycle on Earth




WITH NEW AND EXPANDED BONUS FEATURES
JOSEPH CAMPBELL
The Power of Myth
with Bill Moyers
25TH ANNIVERSARY EDITION
"Fascinating"
—THE NEW YORK TIMES
"Compelling"
—THE WALL STREET JOURNAL


JOSEPH
CAMPBELL
THE HERO
WITH A
THOUSAND
FACES


JOSEPH
CAMPBELL
THE HERO
WITH A
THOUSAND
FACES

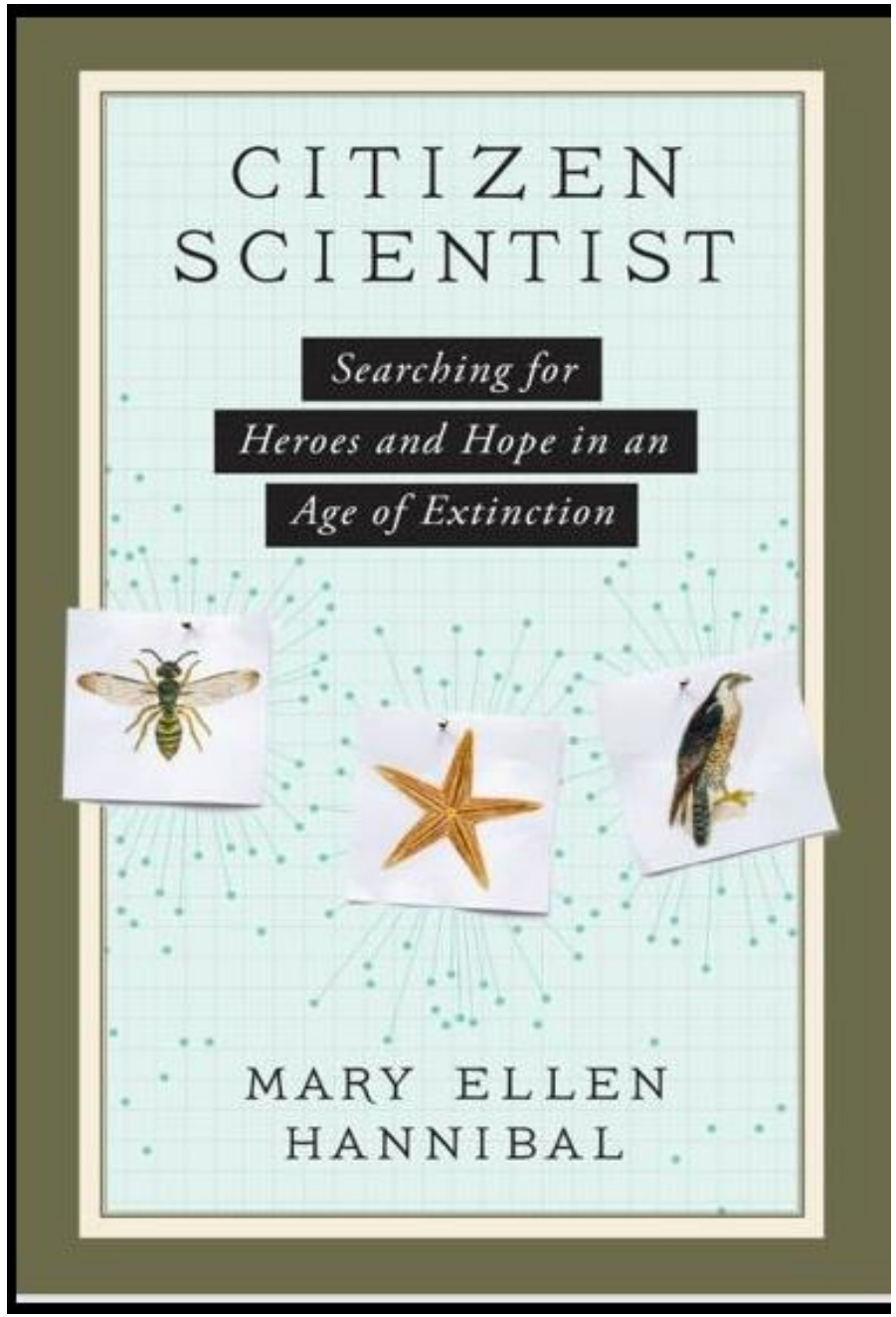

1. Genesis
2. Refusal
3. Mentor
4. Threshold
5. Trials
6. Friends
7. Enemies
8. Lair
9. Ultimatum
10. Return
11.Rebirth
12. Elixir
Ordinary World
Special World

Stocksy

The Hero's Journey

From the *Odyssey*, to *Robinson Crusoe*, to *Star Wars* — why are we drawn to stories about heroes? And what do they tell us about ourselves? This hour, TED speakers explore what makes a hero's journey.

Illustration © Cheng (Lily) Li


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

Urgent data needs: Scalable framework for assembling colonization and extirpation data

Data collection must scale

Presence/absence data

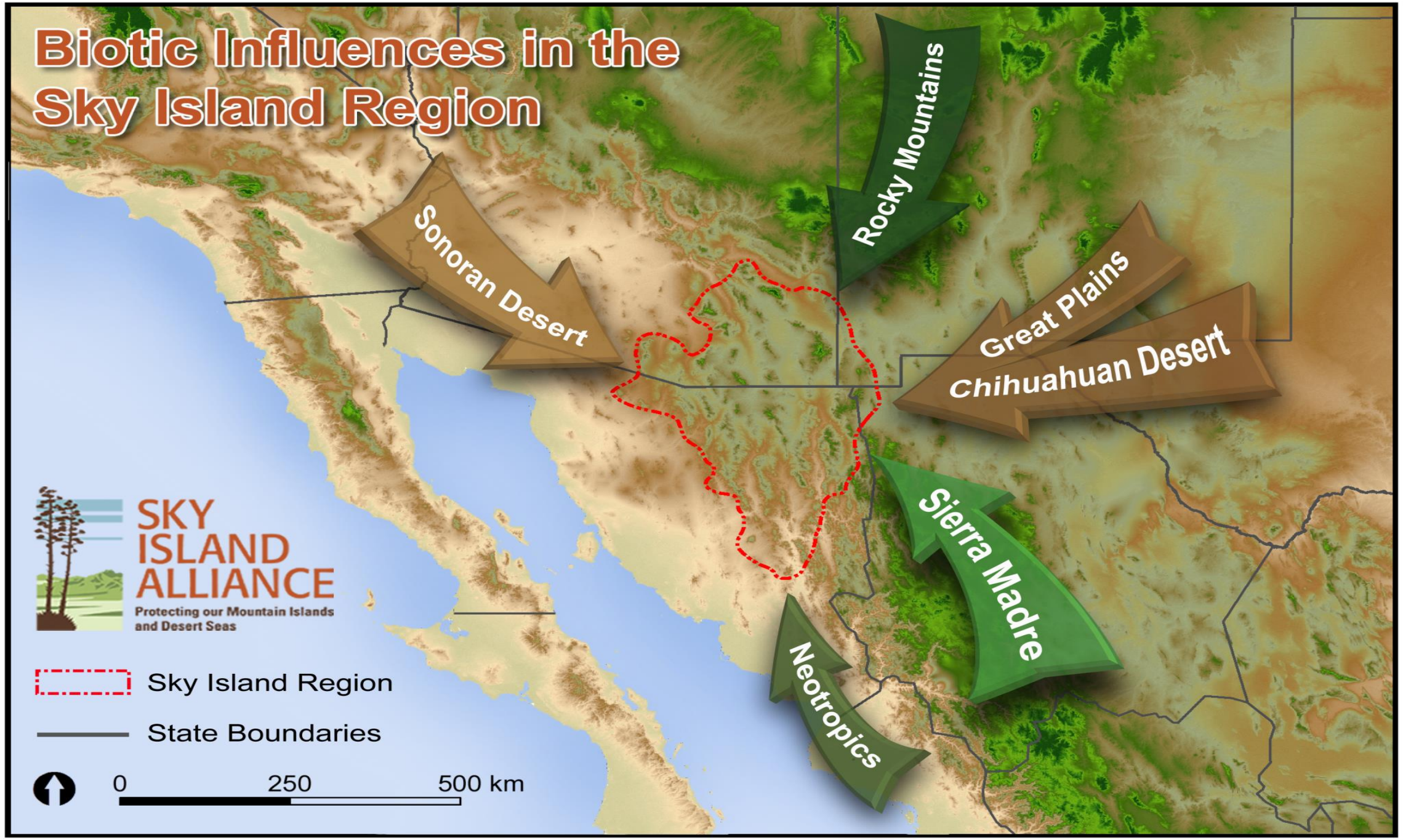

Biotic Influences in the Sky Island Region
Rocky Mountains
Sonoran Desert
Great Plains
Chihuahuan Desert
Sierra Madre
Neotropics
SKY ISLAND ALLIANCE
Protecting our Mountain Islands and Desert Seas
Sky Island Region
State Boundaries
0
250
500 km

Photo: Paul Hirt

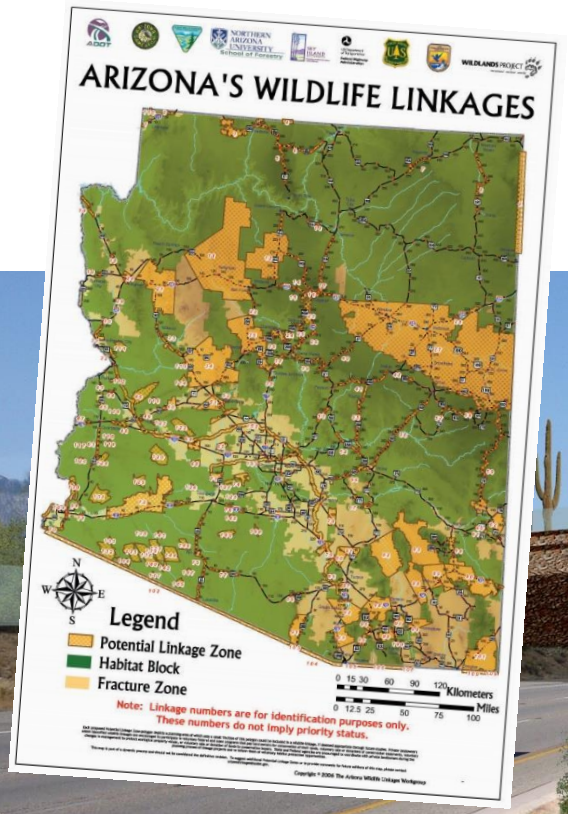
© 2010 Sky Island Alliance / El Aribabi

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

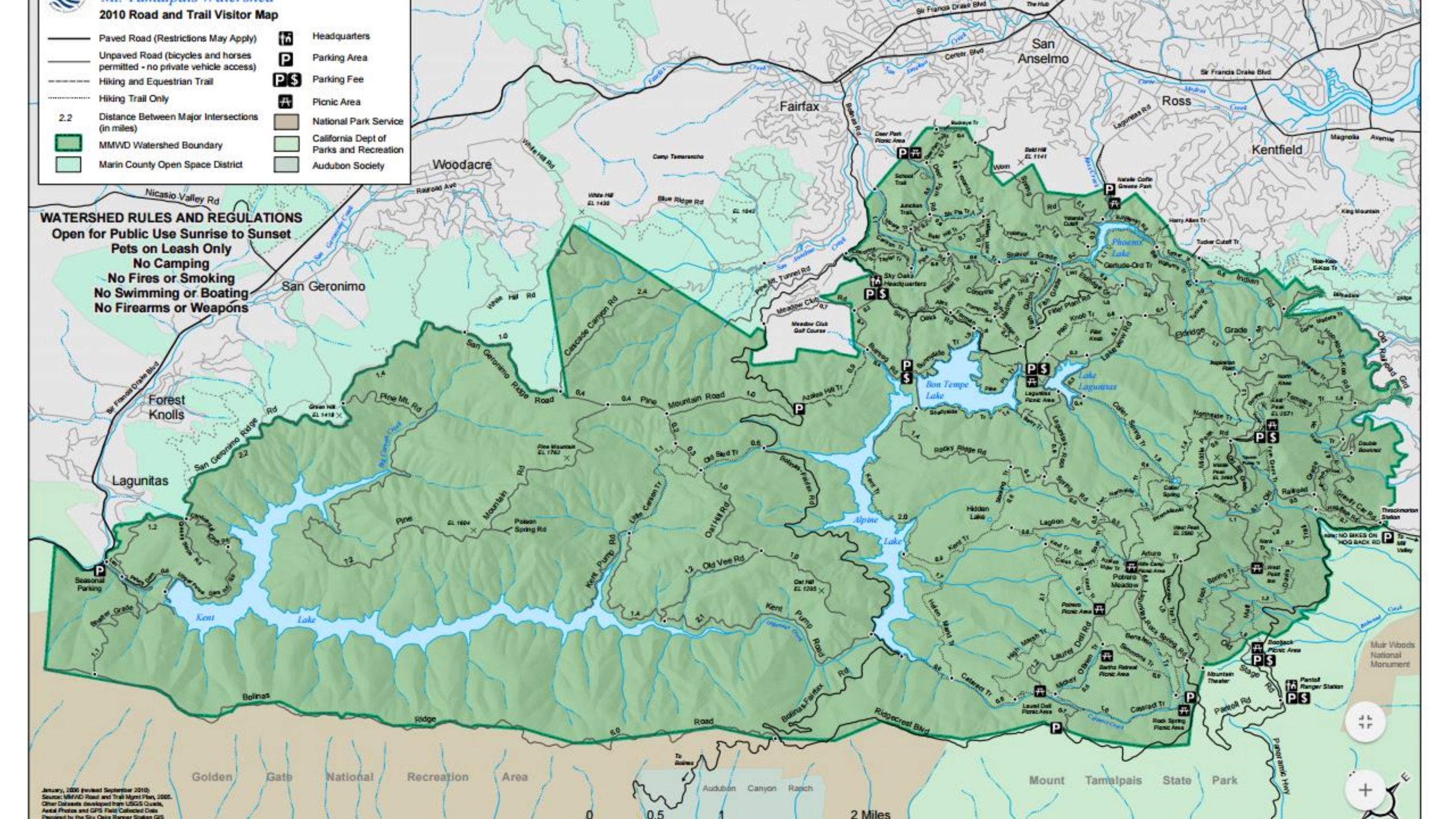
© Sky Island Alliance

Renderings © Coalition for Sonoran Desert Protection

CONNECT


ARIZONA'S WILDLIFE LINKAGES
Legend
Potential Linkage Zone
Habitat Block
Fracture Zone
Note: Linkage numbers are for identification purposes only.
These numbers do not imply priority status.
Kilometers
Miles

Coalition for
Sonoran Desert
Protection

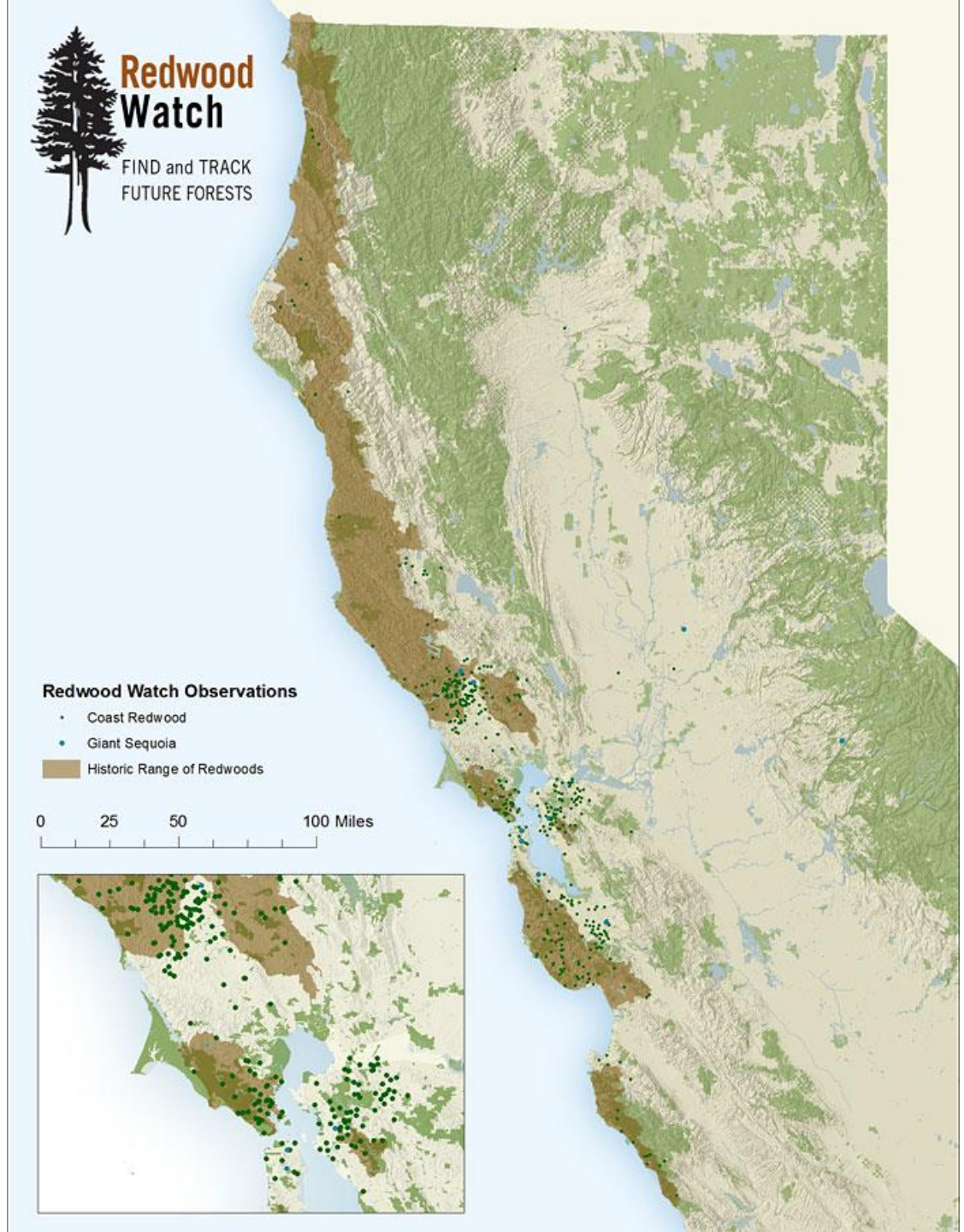


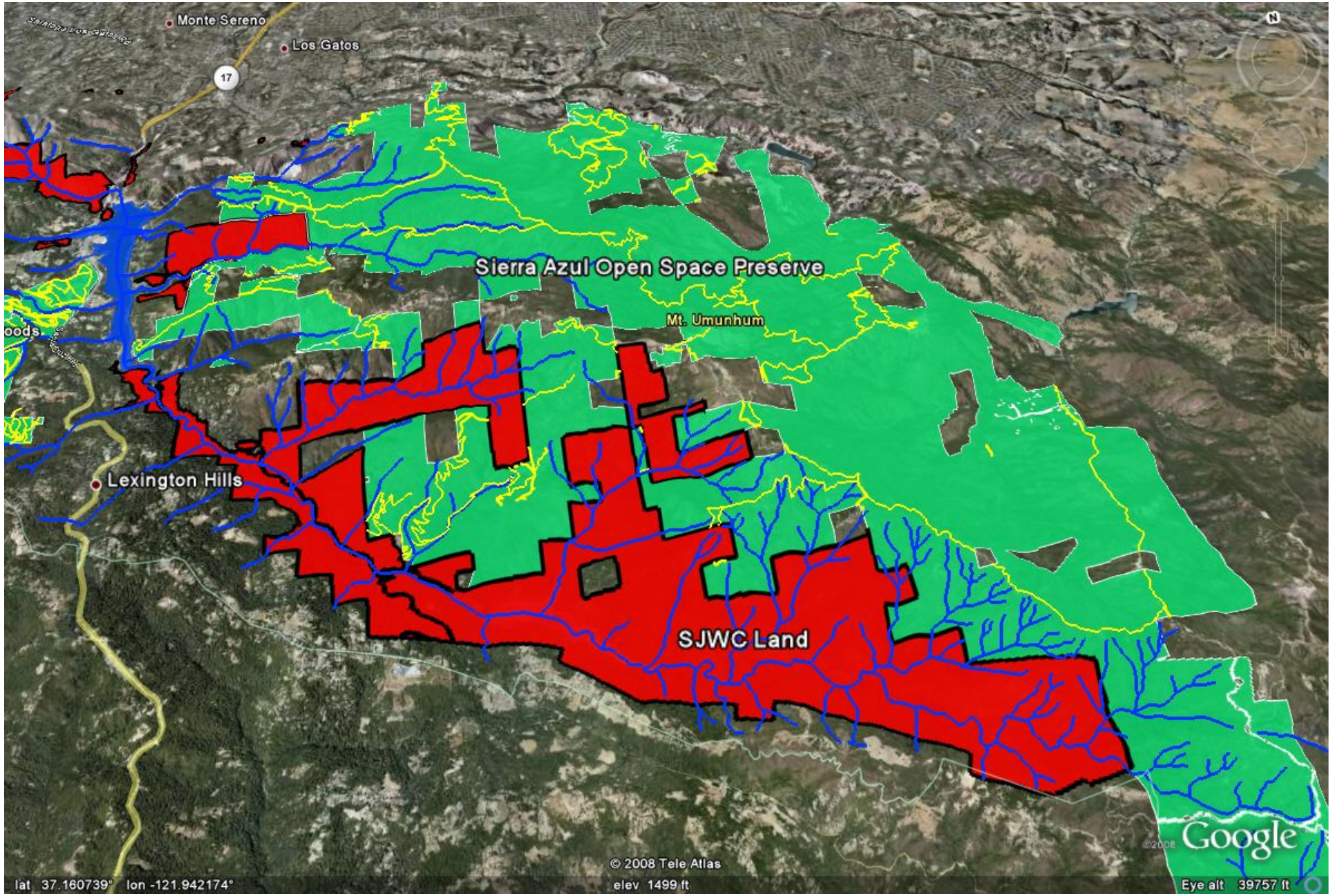
2010 Road and Trail Visitor Map
Paved Road (Restrictions May Apply)
Unpaved Road (bicycles and horses permitted - no private vehicle access)
Hiking and Equestrian Trail
Hiking Trail Only
2.2 Distance Between Major Intersections (in miles)
MMWD Watershed Boundary
Marin County Open Space District
Headquarters
Parking Area
Parking Fee
Picnic Area
National Park Service
California Dept of Parks and Recreation
Audubon Society
WATERSHED RULES AND REGULATIONS
Open for Public Use Sunrise to Sunset
Pets on Leash Only
No Camping
No Fires or Smoking
No Swimming or Boating
No Firearms or Weapons
San Anselmo
Fairfax
Ross
Kentfield
Woodacre
San Geronimo
Forest Knolls
Lagunitas
Phoenix Lake
Bon Tempe Lake
Lake Lagunitas
Alpine Lake
Kent Lake
Golden Gate National Recreation Area
Audubon Canyon Ranch
Mount Tamalpais State Park
Muir Woods National Monument
0 0.5 1 2 Miles

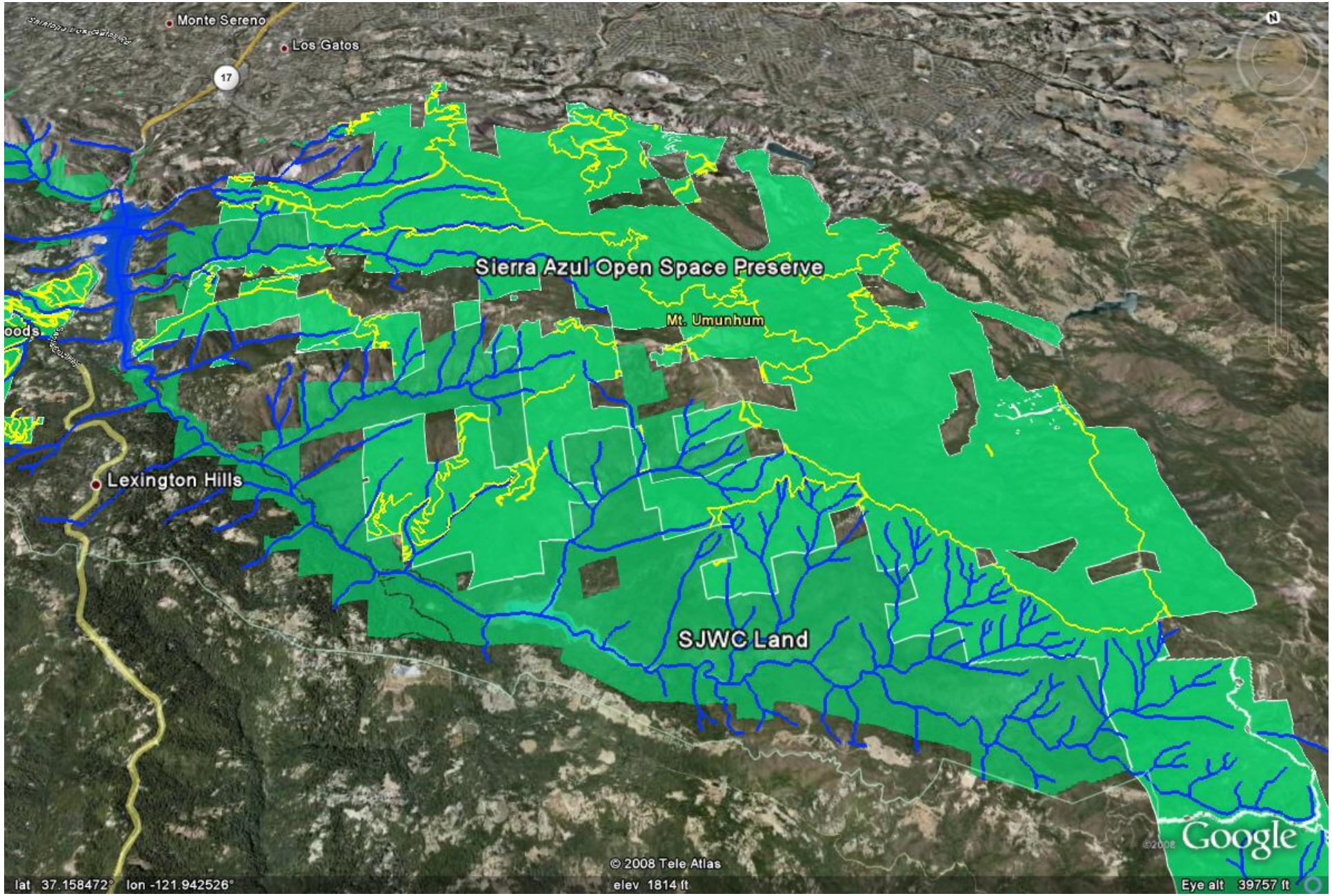
Redwood Watch

http://www.savetheredwoods.org/our-work/study/understanding-climate-change/citizen-science/

Redwoods and Climate Change High School Program


Redwood
Watch
FIND and TRACK
FUTURE FORESTS
Redwood Watch Observations
Coast Redwood
Giant Sequoia
Historic Range of Redwoods
0
25
50
100 Miles


Monte Sereno
Los Gatos
17
Sierra Azul Open Space Preserve
Mt. Umunhum
Lexington Hills
SJWC Land
© 2008 Tele Atlas
Google
lat 37.160739° lon -121.942174°
elev 1499 ft
Eye alt 39757 ft


Monte Sereno
Los Gatos
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Sierra Azul Open Space Preserve
Mt. Umunhum
Lexington Hills
SJWC Land
© 2008 Tele Atlas
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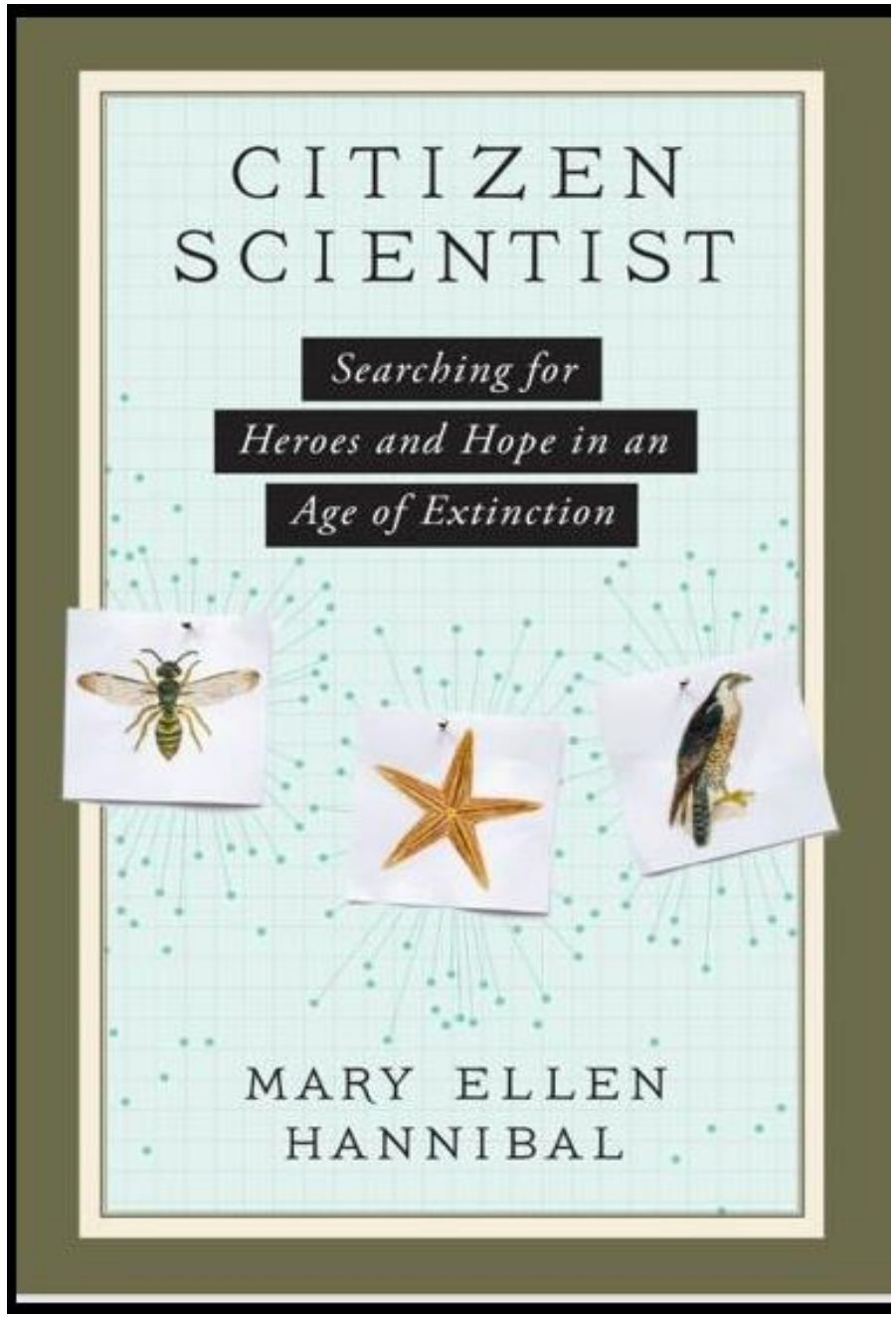
lat 37.158472° lon -121.942526°
elev 1814 ft
Eye alt 39757 ft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