What do we do with 160 GT ?

How Grassland Restoration Can Sequester Legacy Atmospheric Carbon While Mitigating Floods and Building Healthy Economies

Jim Laurie & Seth Itzkan

Stockholm Environmental Institute
Somerville, MA
March 18, 2009

Objectives

- New Perspectives on Climate Change
- To understand the role of soils, oceans, ecosystems, and human decisions in creating the future.
- Holistic Management – Making decisions by seeing the world as “wholes within wholes.”
- To motivate action and share tools for creating a future that we want.

Premise

Healthy ecosystems and especially grasslands sequester prodigious amounts of atmospheric carbon.

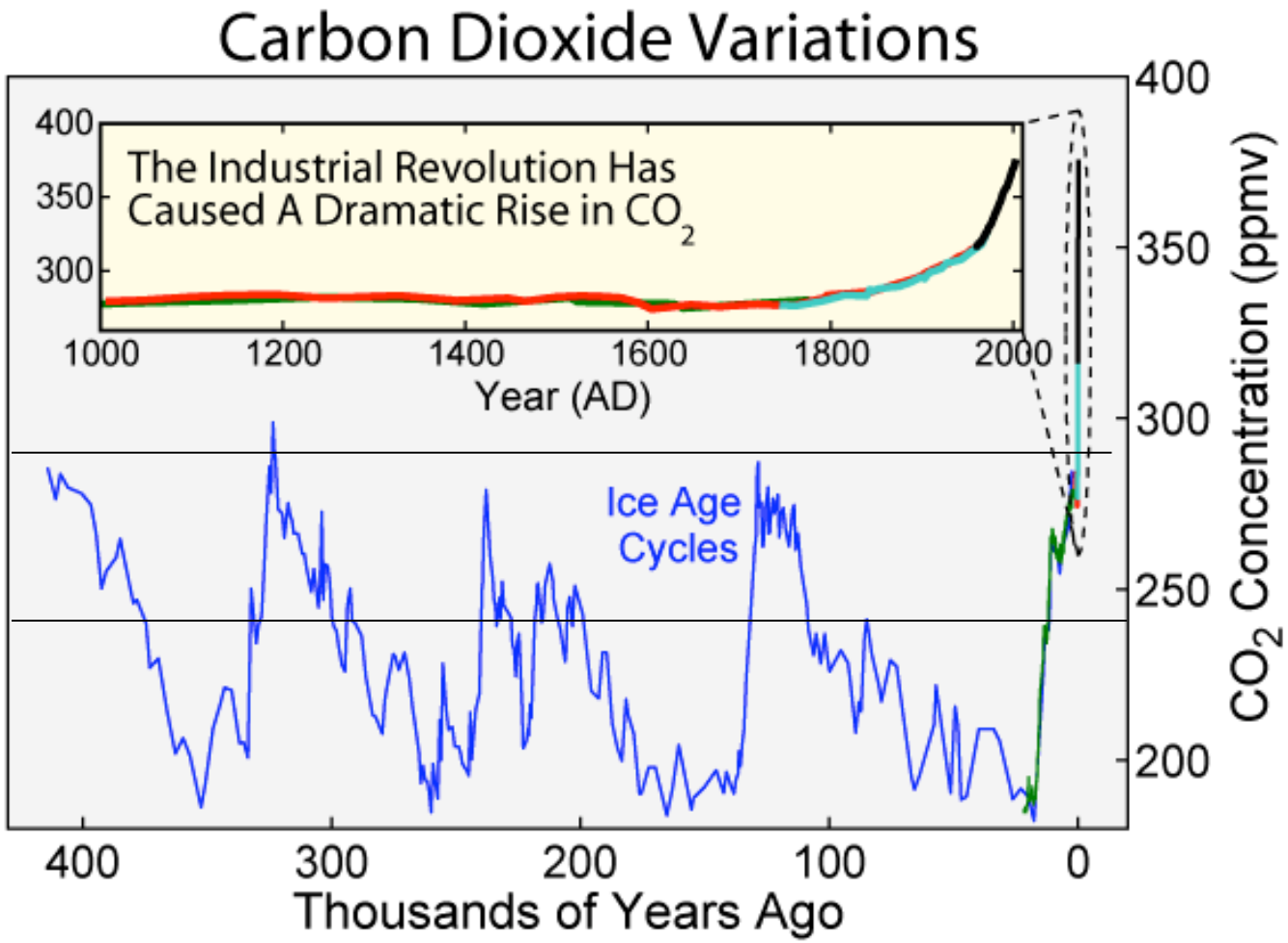
Restoration of depleted soils and fisheries will create economic opportunities for local residents while reversing climate change.

Greenhouse conditions and ocean “dead zones” are the predecessors of most extinction episodes. Anoxic oceans emit hydrogen sulfide gas which kills most life.

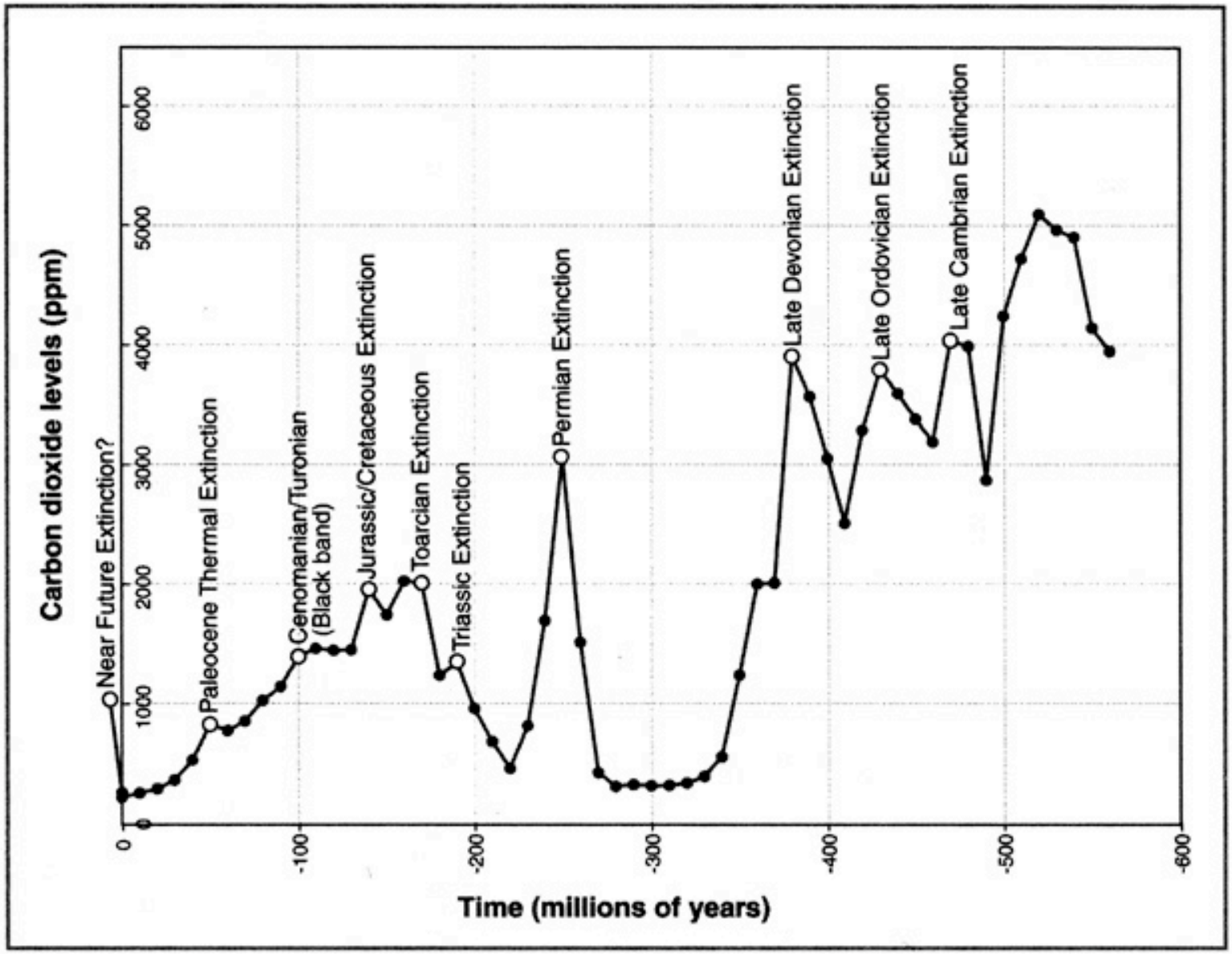
Restoring soils can reverse the spread of ocean dead zones and bring back polar ice allowing the ocean to breath again.

400,000 Year CO2 Variations

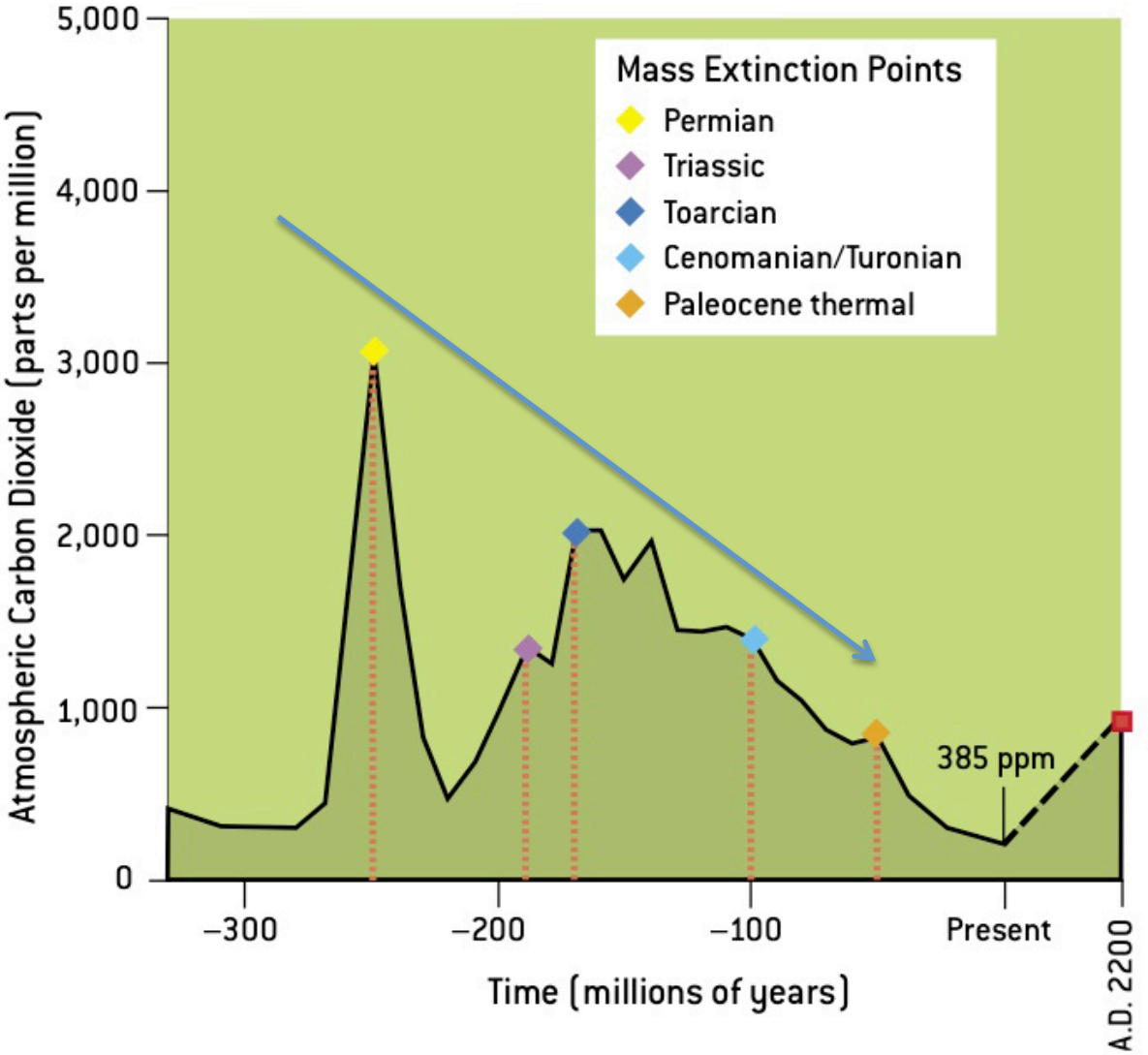
Historic High? Historic Low?



CO2 & Extinction Episodes



Heading for Another Extinction?

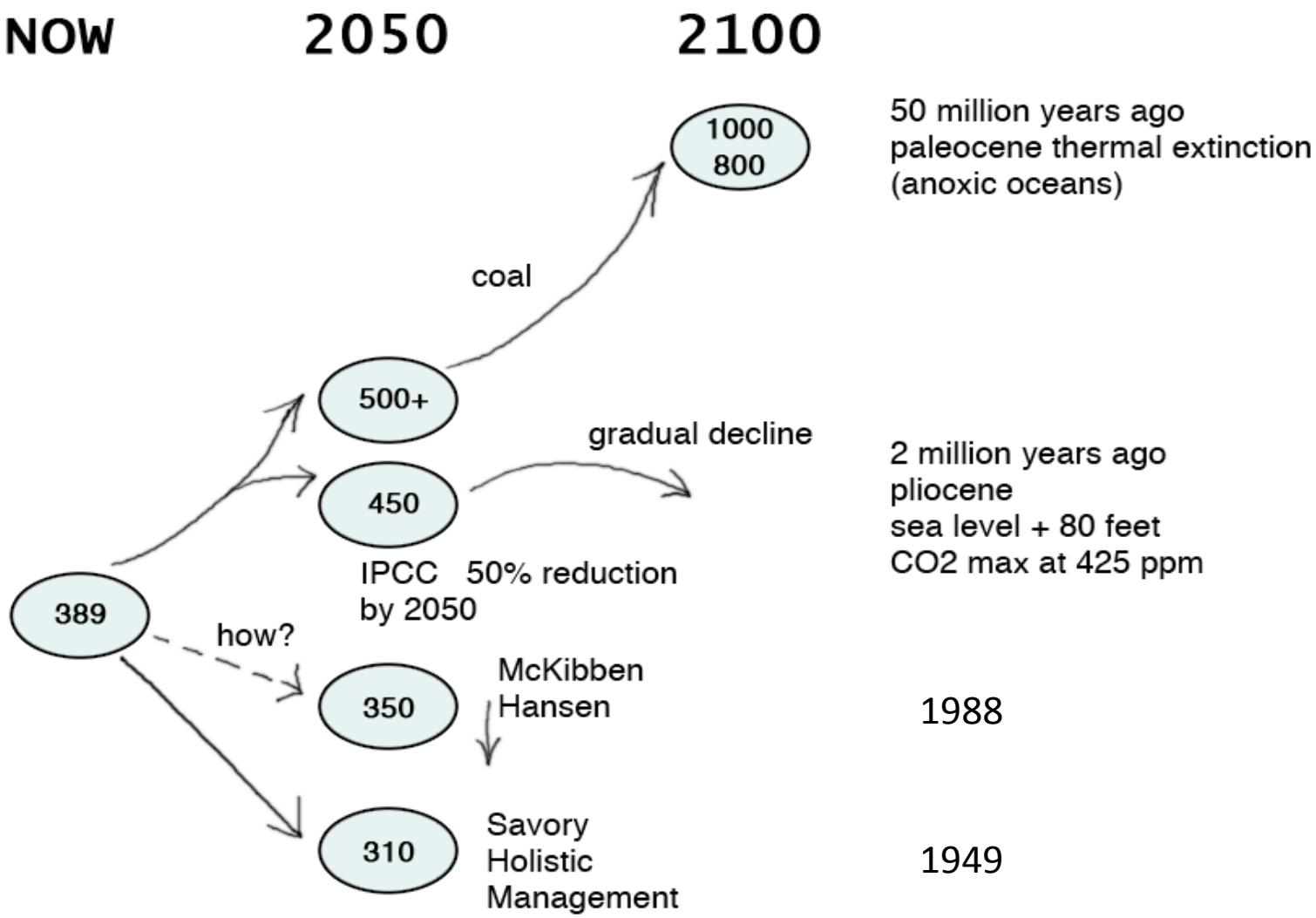


Lovelock Line

Jim Lovelock developed "Daisy World" In 1983 to demonstrate how nature could regulate climate even as the sun grows warmer.

CO2 levels are diminishing over time

What Do We Want?



DC Coal Protests – March 2, 2009

See anyone you know?

Bill McKibben – "…. 350 is the most important number in the world!"

Jim Hansen - "…. 350 or far beyond…. 325 or 300."

160 GigaTons Carbon ?

There are about 780 billion tons of carbon in the atmosphere, almost all of it in CO2 molecules. (780 GT C)

The concentration of atmospheric CO2 is now ~ 389 ppm.
(The factor is very close to 2.)

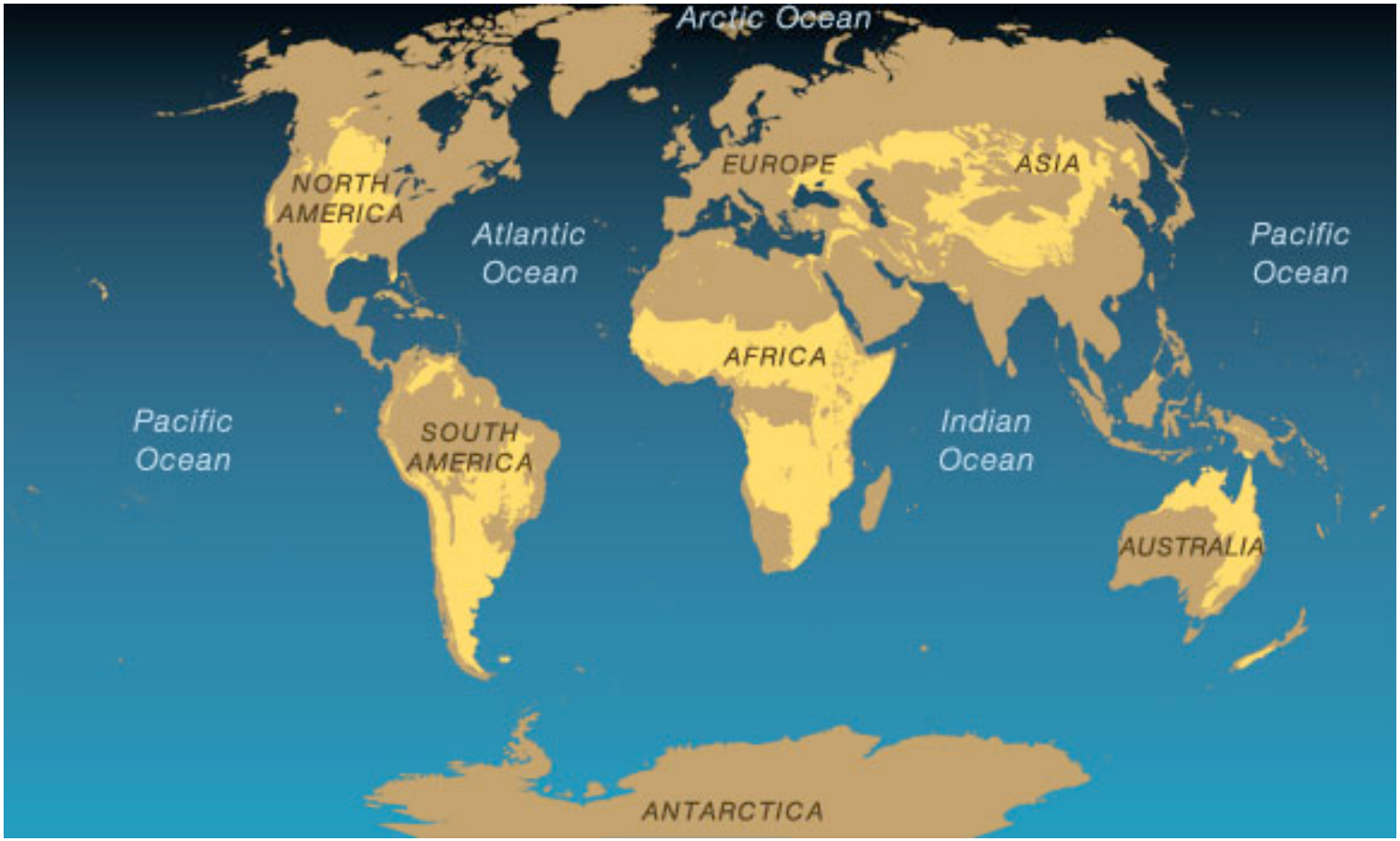
We want to remove enough "Legacy Carbon" to reach 310 ppm by 2050. How much carbon is this?

Reduction is: 390 ppm – 310 ppm = 80 ppm CO2

X 2 GT C per ppm CO2

Where can it go? 160 GigaTons Carbon

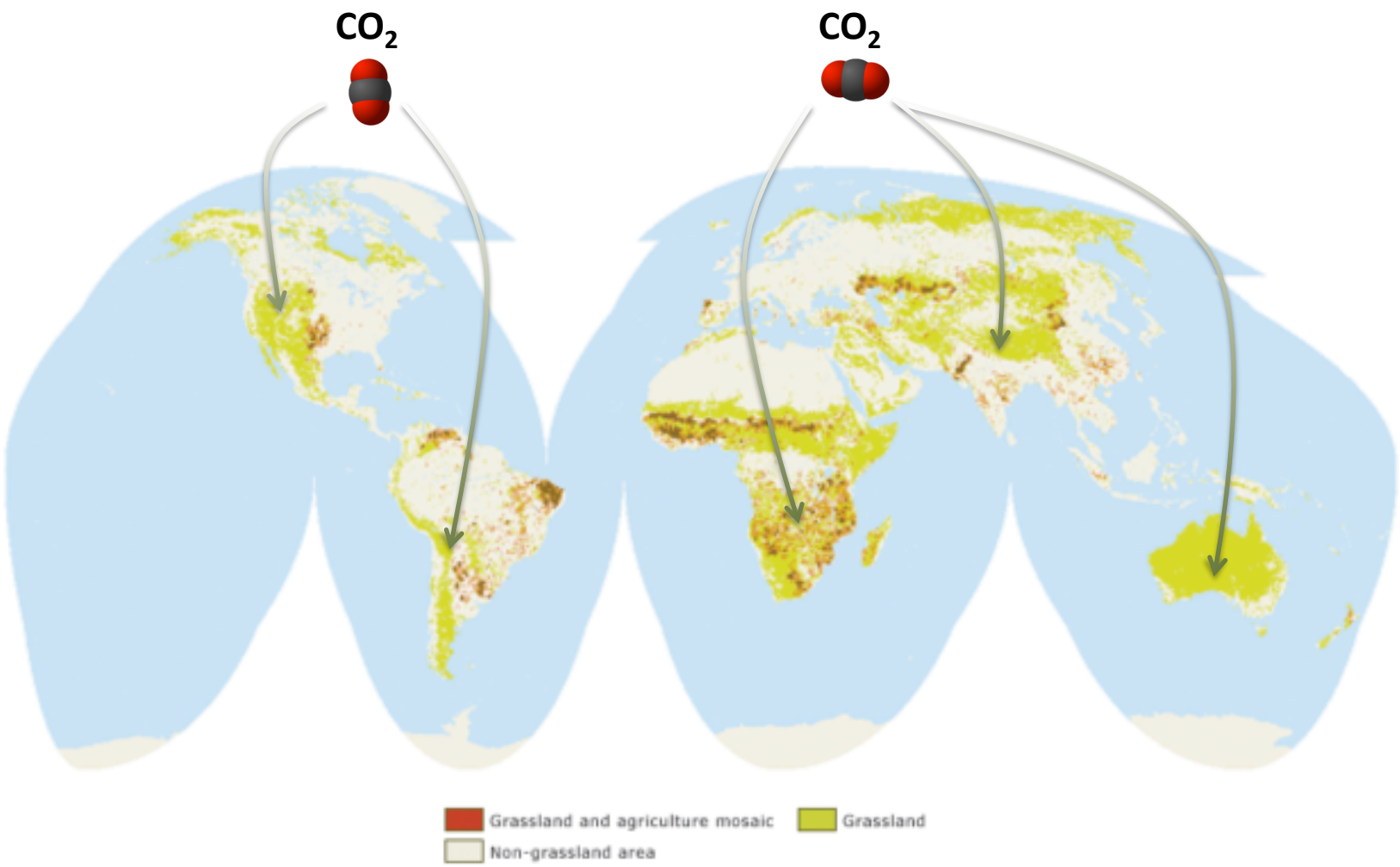
World Grasslands



Is this all of them?

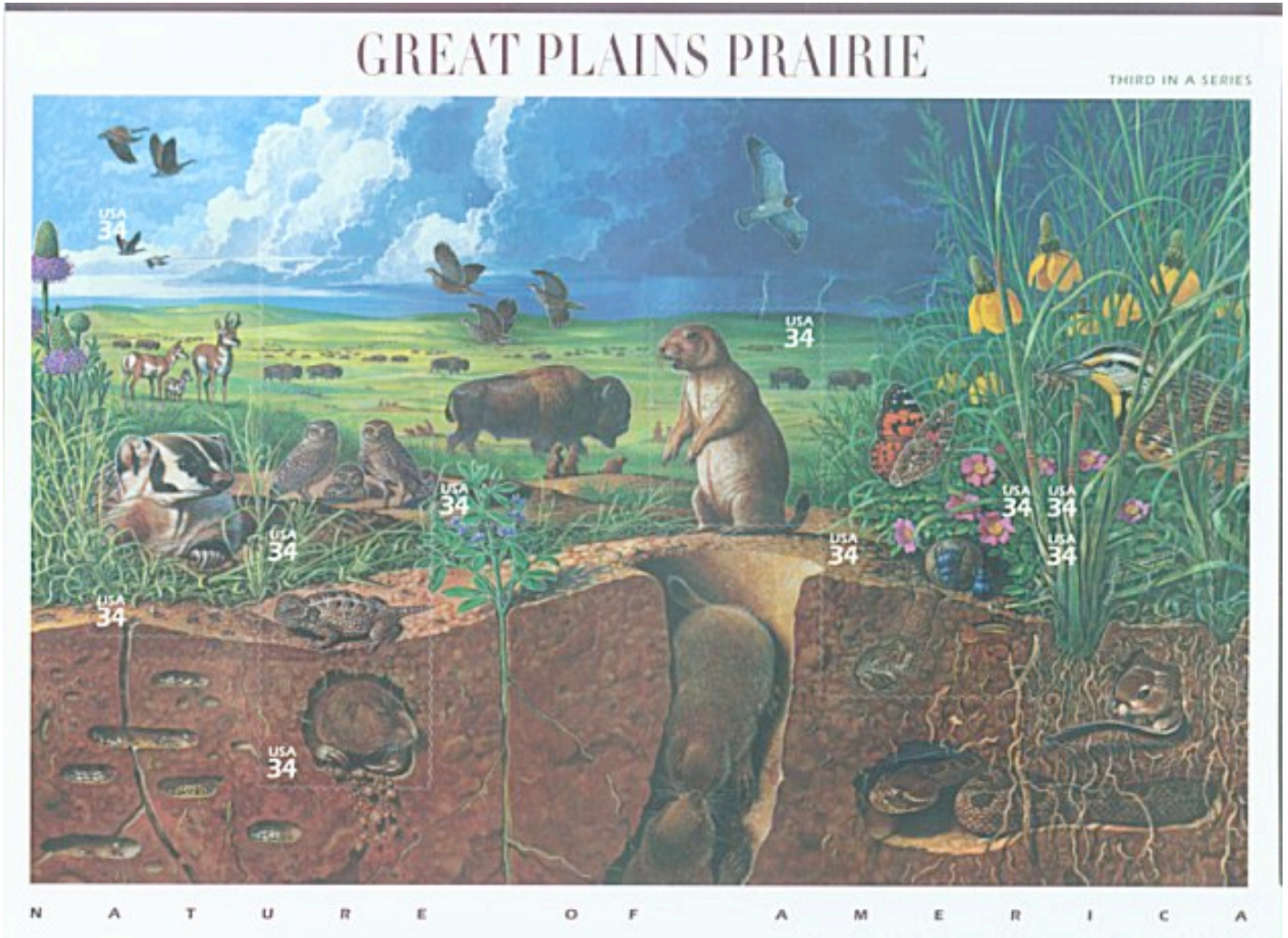
12 GT/year ?

1 ton per acre / year on 12 billion acres



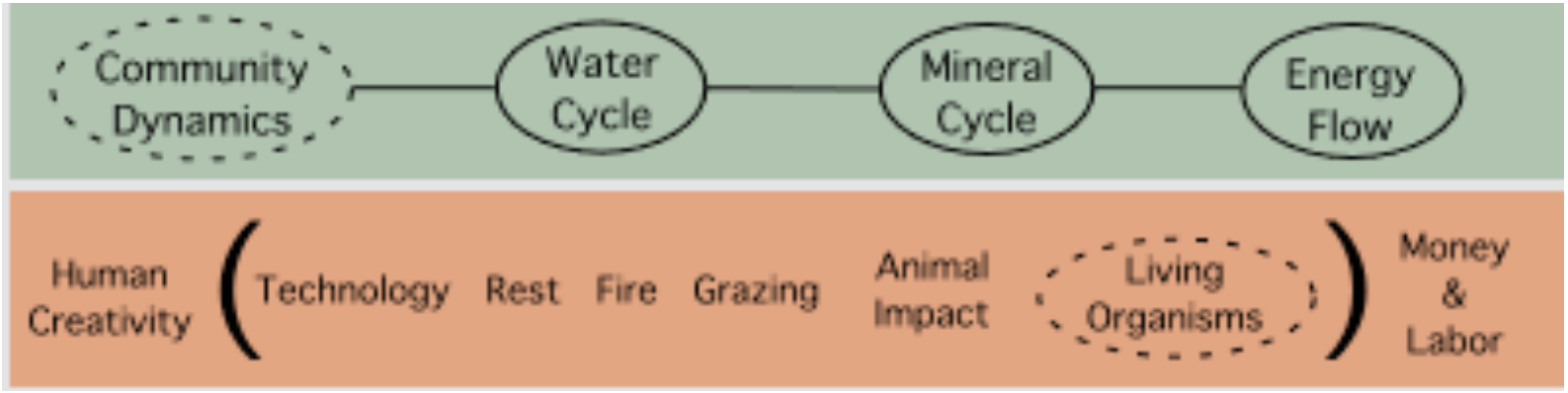
Jim Laurie & Seth Itzkan, www.planet-tech.com

Understanding Soil



Ecosystem Processes & Tools

Holistic Management Model



Technology: All Human Artifacts

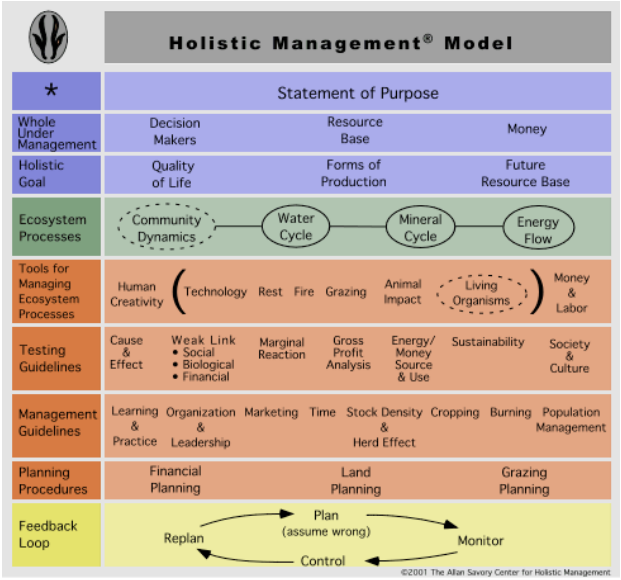
Rest: Leave Land Alone (Brittleness Scale)

Fire: Frequency

Grazing: Intensity and Timing

Animal Impact: Dung, Urine, Hoof Action

Living Organisms: Biodiversity



Fire & Technology

Dragging and Burning Mesquite

Seed, fertilizer, and irrigation to grow grass for hay or grazing

Grazing is often continuous and at much lower stocking rates than at West Ranch.

Note Bare Ground Here

Mesquite is not a problem and can be a resource!

What is the impact of using Fire and Technology?

- Climate Change ?
- Ranch Budget ?

Grazing and Animal Impact

2002 – 68% Bare Ground
No animal impact for 15 years.

2007 – 31% Bare Ground

Many new species of Perennial Grasses

Running 3 times standard stock density

No Fire or Chemicals

No irrigation

Wildlife are Welcome !

West Ranch near Ozona, Texas – (Joe & Peggy Maddox)

Photo by Jim Laurie - January, 2009

Brittle Environments – Grazing is Timing

West Ranch

25 Paddocks

Move herd 1 time each week.

6 month recovery time for grasses.

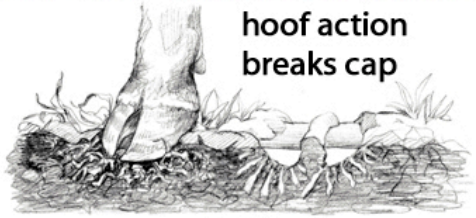
Mesquite , Juniper, Persimmon Trees are common. No effort to control mesquite.

Overgrazing is caused by timing not numbers.

Brittle Environments: 2/3 of all landscapes on the planet have seasonal rainfall.
They need Animal Impact and a Grazing Plan.
Animal Impact includes hoof action, dung, and urine.

CO2 Sequestration, Animal Impact

Mega Heard of Buffalo
or
well-timed pulsed
grazing of livestock



water infiltration

Animal Impact Enriches Soil

dung

urine

Carbon Farmers
in Vermont

Dung beetles
bury tons of
manure several
feet deep.

Humus
(carbon rich "bug poop")

Prairie Dogs in the Janos Grasslands

Prairie dogs are vital to restoring the dwindling grasslands of the Chihuahuan desert. Scientists, in fact, refer to prairie dogs as the architects of North America's grasslands. Prairie dogs gnaw through woody shrubs such as mesquite that would otherwise takeover the grassland habitat. And as burrowing animals, they excavate tons of hard-baked desert soils, increasing the grounds' fertility and improving foraging for cattle.

http://www.nature.org/wherewework/northamerica/states/newmexico/preserves/art15134.html

Who will pray for the rain?

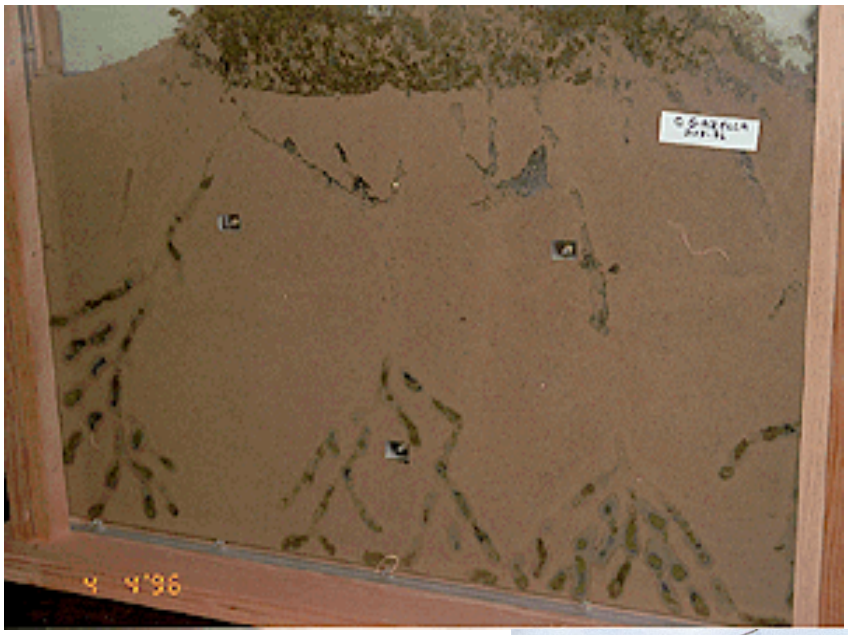
Human beings build communities, and so do prairie dogs; vibrant communities upon which many species, including our own, are dependent.

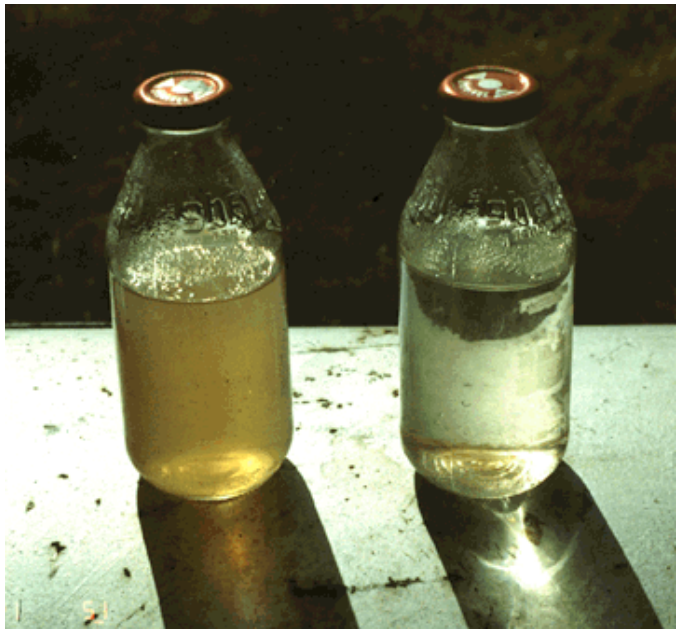
She told, for instance, of a government proposition to the Navajo Nation to irradicate prairie dogs on a part of their land. But who will pray for the rain? The Navajo elders asked. The government agents chuckled at the question but went on with their project, eliminating prairie dogs from that area.

The result: without the constant churning of the soil and engineering prowess of the prairie dog infrastructure, the ground in that area turned to hardpan, resulting in nightmarish problems with runoff and erosion.

From “Mosaic: Finding Beauty in a Broken World“
Published 2008
by Terry Tempest Williams

1st Maddox Ranch - West Texas 1995





Big Bluestem re-appears in West Texas !!!

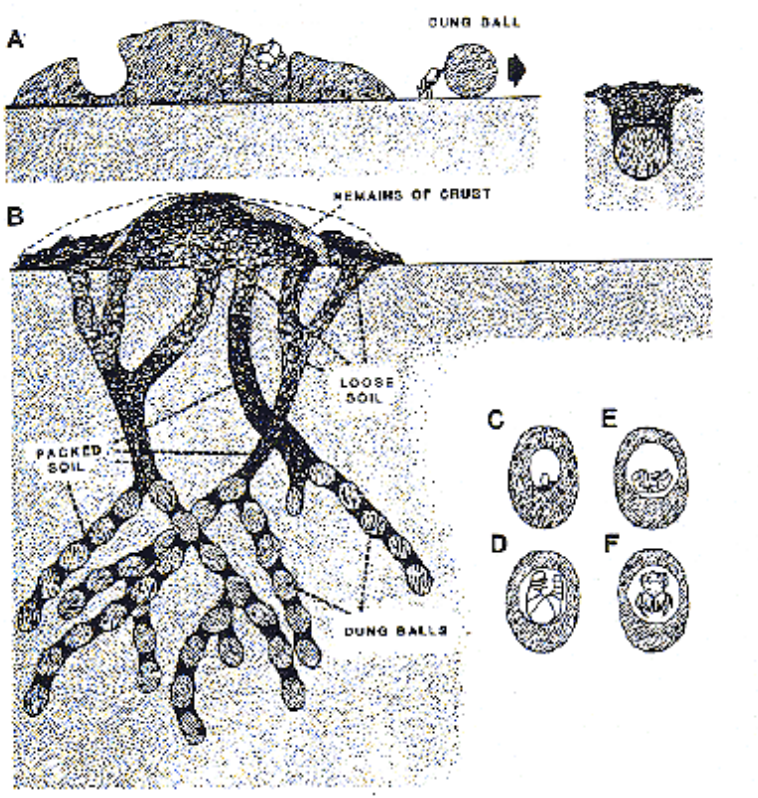
How deep do Dung Beetles go?

Left - Upstream from Ranch
Right - Running Through the Ranch

Dr. Dick Richardson - University of Texas 1996

http://www.utexas.edu/depts/grg/eworks/proceedings/engeo/richardson/richardson.html

Dung Beetles



http://attra.ncat.org/attra-pub/dungbeetle.html

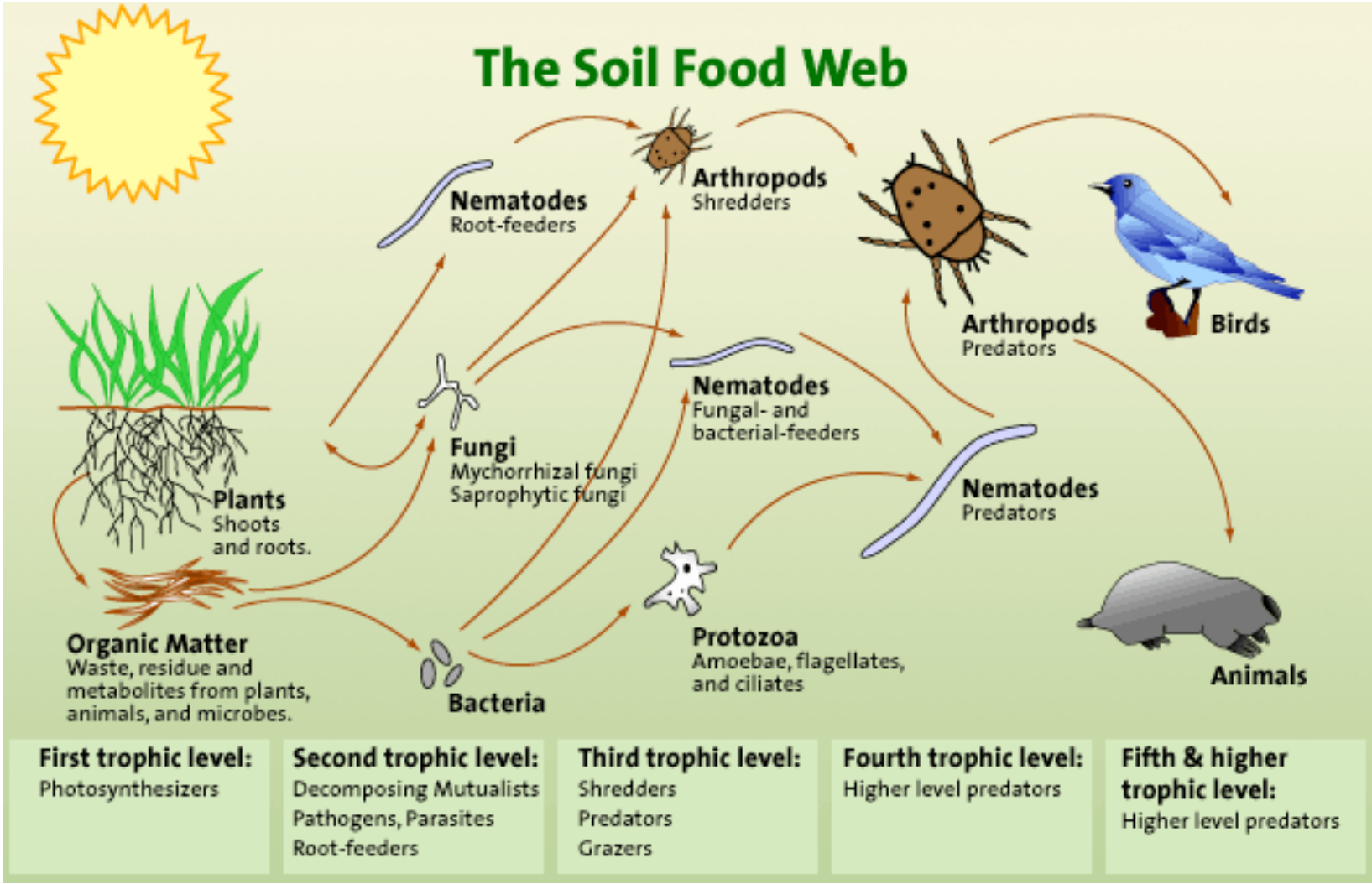
"the beetles bury a ton of wet manure per acre per day" "I counted 206 dung beetles exiting in 6 minutes.I could *hear the activity in that cow pad"*

Dr. Patricia Richardson U of Texas

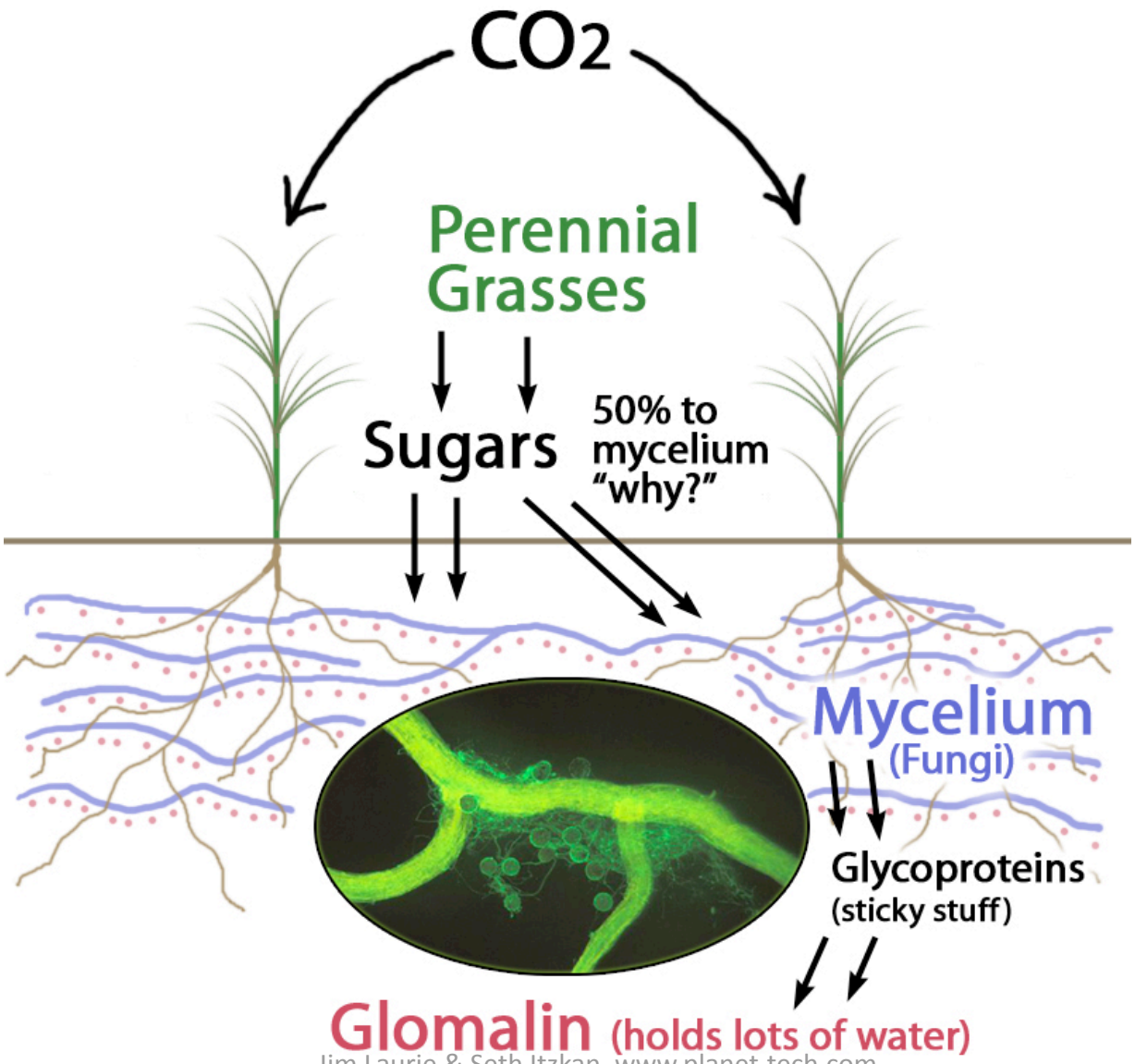
http://managingwholes.com/dung-beetles.htm

13 hour impact – O. gazella

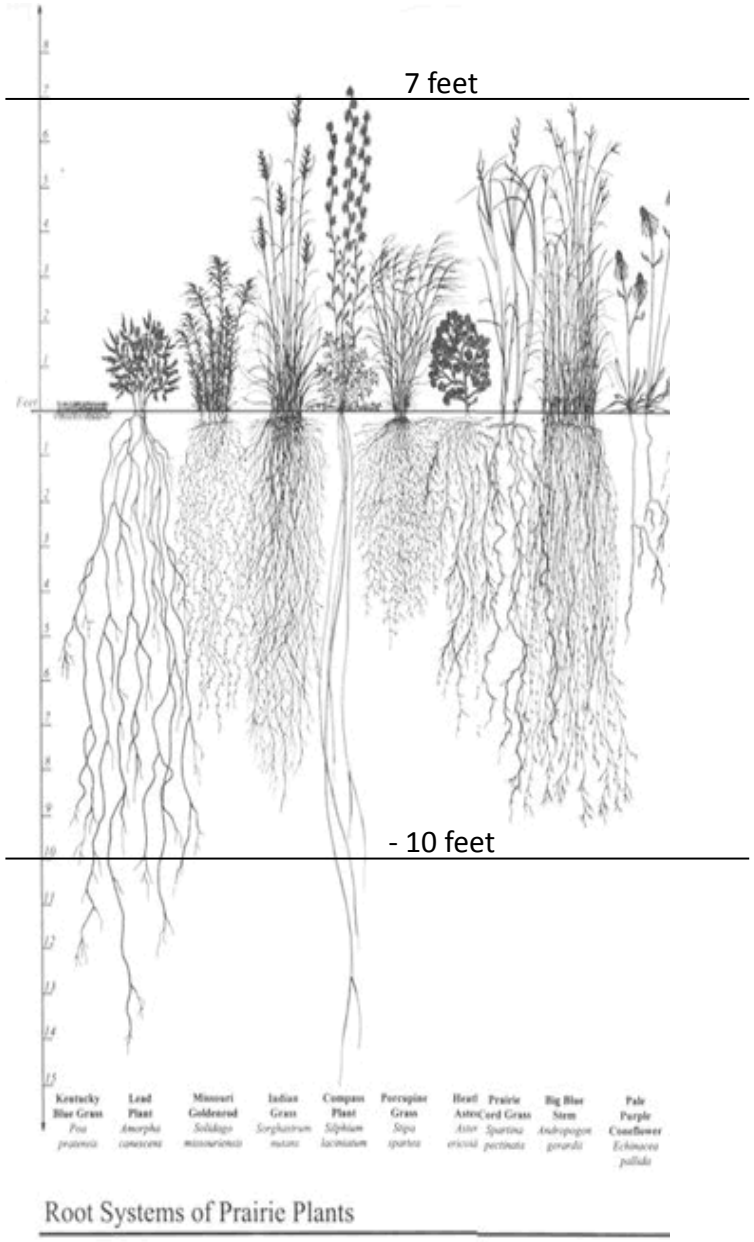
Making Humus (Bug Poop)



CO2 Sequestration, Plant – Fungi



Jim Laurie & Seth Itzkan, www.planet-tech.com

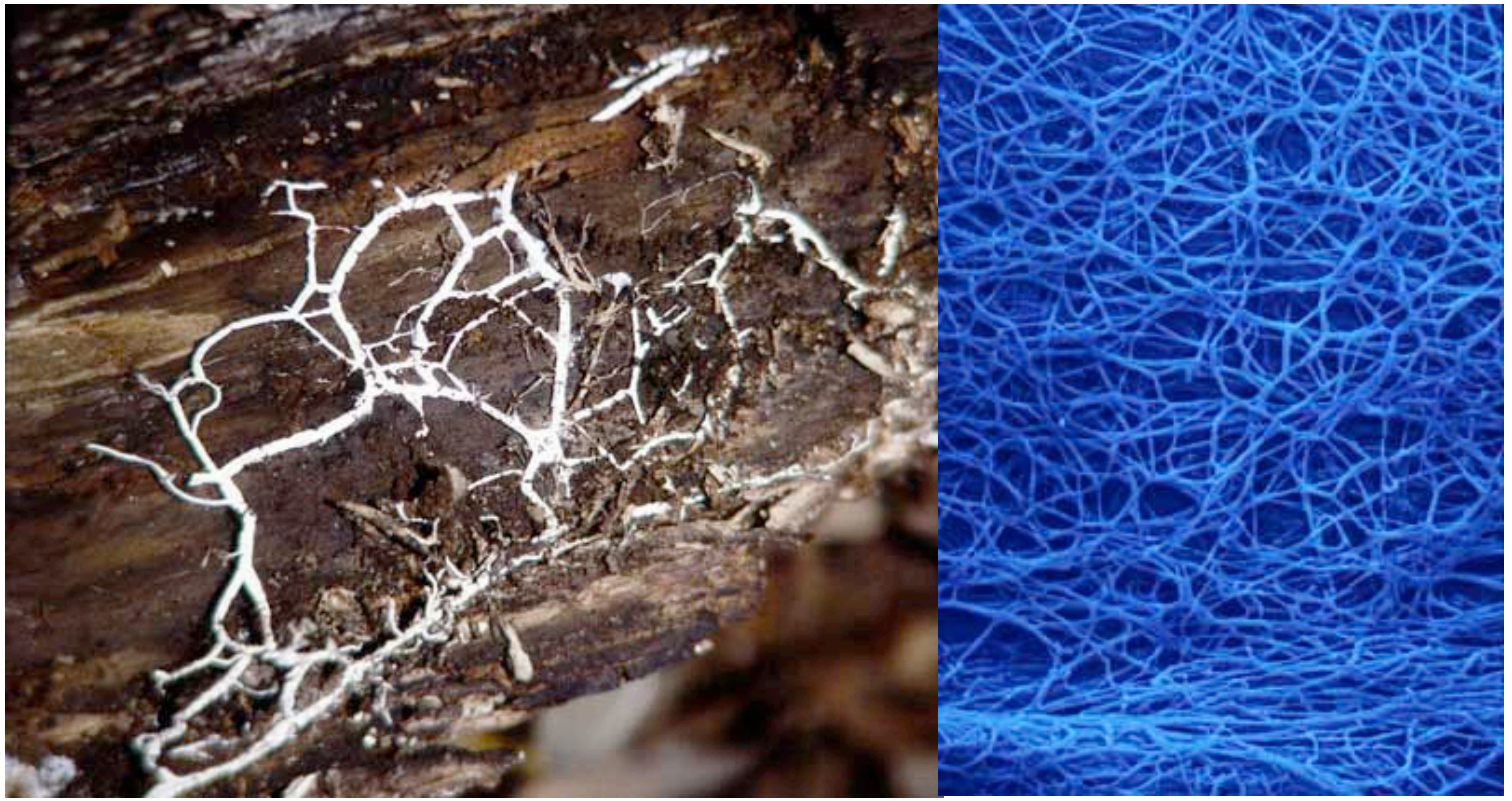


Root Systems of Prairie Plants

Prairie Grasses

1. Take Carbon from Atmosphere
2. Sugar Factories
3. 50%+ Sugars to Fungi - Why ????
4. Mycelium Networks
5. What is Glomalin ???

Fungi Mycelium Networks
“Soil Brain Tissue”



Paul Stamets “Mycelium Running” fungi.com

Mycelium and Glomalin

Photo by Sara Wright (USDA) http://www.sciencedaily.com/releases/2008/06/080629075404.htm

Austin, Nevada - Restoration

Steep clay dam in central Nevada has lost most of its topsoil in 1989.

Tony and Jerrie Tipton were looking for a tough demonstration site to demonstrate Holistic Management.

HM is a decision making process inspired by the work of Allan Savory.

www.holisticmanagement.com

Jerrie Tipton spreading hay bales on dam.

Cattle spent 4 days on dam: grazing, stomping, leaving dung and urine.

Cattle left area for a year.

Perennial grasses had time to take hold.

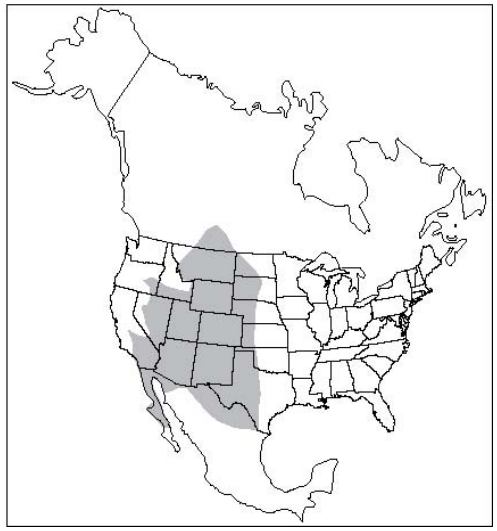
Tony & Jerrie Tipton - Restoration

November 1989 - 32 tons hay on 10 acres

Spring 1990 with < 6 inches of winter rain

Fall 1990 - Tony Tipton viewing thigh-high grass.

Pronghorn, Buffalo, Prairie Dogs



1800 - At the time of Lewis and Clark

100 million Pronghorn

All in Brittle Environments.
Wolves are very important to healthy antelope herds.

60 to 80 million Buffalo

5 billion Prairie Dogs

400 million in one Texas town

Where the Buffalo Roamed

Buffalo Nation:

53 Native Tribes now have buffalo. Some are protecting prairie dogs.

Where could MegaHerds return complete with predators?

Return of the Wolf to Yellowstone in 1995 led to return of the beaver and a huge improvement in the soil's ability to hold water. Fires are down and biodiversity is up.

Springbokfontien - Karoo, South Africa

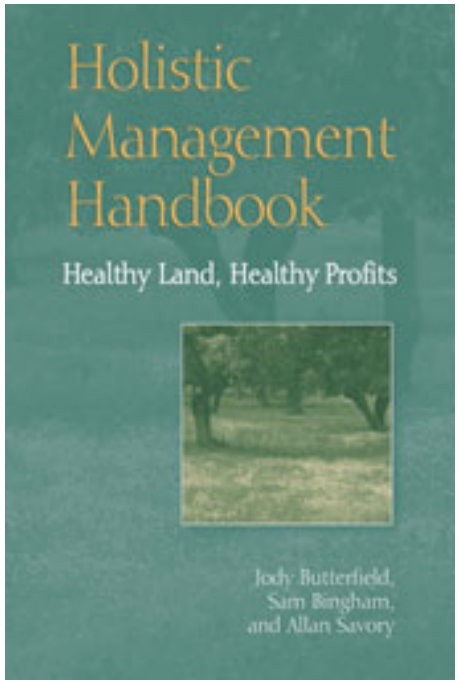
Once a “fountain” now a desert !

The year 1896 saw the last of the great migrations. As Mr Gert Van der Merwe describes it:
“The cloud of dust was dense and enormous, and the front rank of the springbok, running faster than galloping horses could be seen. They were in such numbers that I found the sight frightening. I could see a front line of buck at least three miles long but could not estimate the depth. All night long the buck passed.”

What a sight this must have been! Writers emphasize the landscape "destruction" that took place with the passing of the great herds. Yet that very destruction maintained the grass. Millions of hooves broke capped surfaces, allowing dormant grass seeds to germinate. Millions of dung pats provided fertilizer. And the grass came back, year after year.

By Norman Neave
http://managingwholes.com/klipdrift.htm

Allan Savory - Zimbabwe to New Mexico



Allan Savory was a Game Manager in Zimbabwe for many years before moving to New Mexico. He developed the Holistic Management decision making process with ranchers and land managers on four continents.
Allan and his wife Jody Butterfield co-wrote the Holistic Management Handbook.

Carbon Farming In America

What if we paid landowners $100 per ton of Carbon they put in the soil? (30¢/ a gallon)

Jim Laurie & Seth Itzkan, www.planet-tech.com

Carbon Farmers of America

We use Keyline and Holistic Management. Techniques include grazing tall and ultra high stocking rates.

New Topsoil

Abe insists that he can capture several tons of carbon per acre per year.

He is trying to fund a study by Cornell to quantify sequestration.

Thank you to Abe Collins of Swanton Vermont.
See carbonfarmersofamerica.com

Africa & Australia

Australia – Political Pressure to Reverse GW

- Christine Jones
- Yeomans
- Measuring Carbon

Zimbabwe & Sudan & Benin

- Sam Bingham – Tech picture
- HM in Zimbabwe
- Songhai in Benin

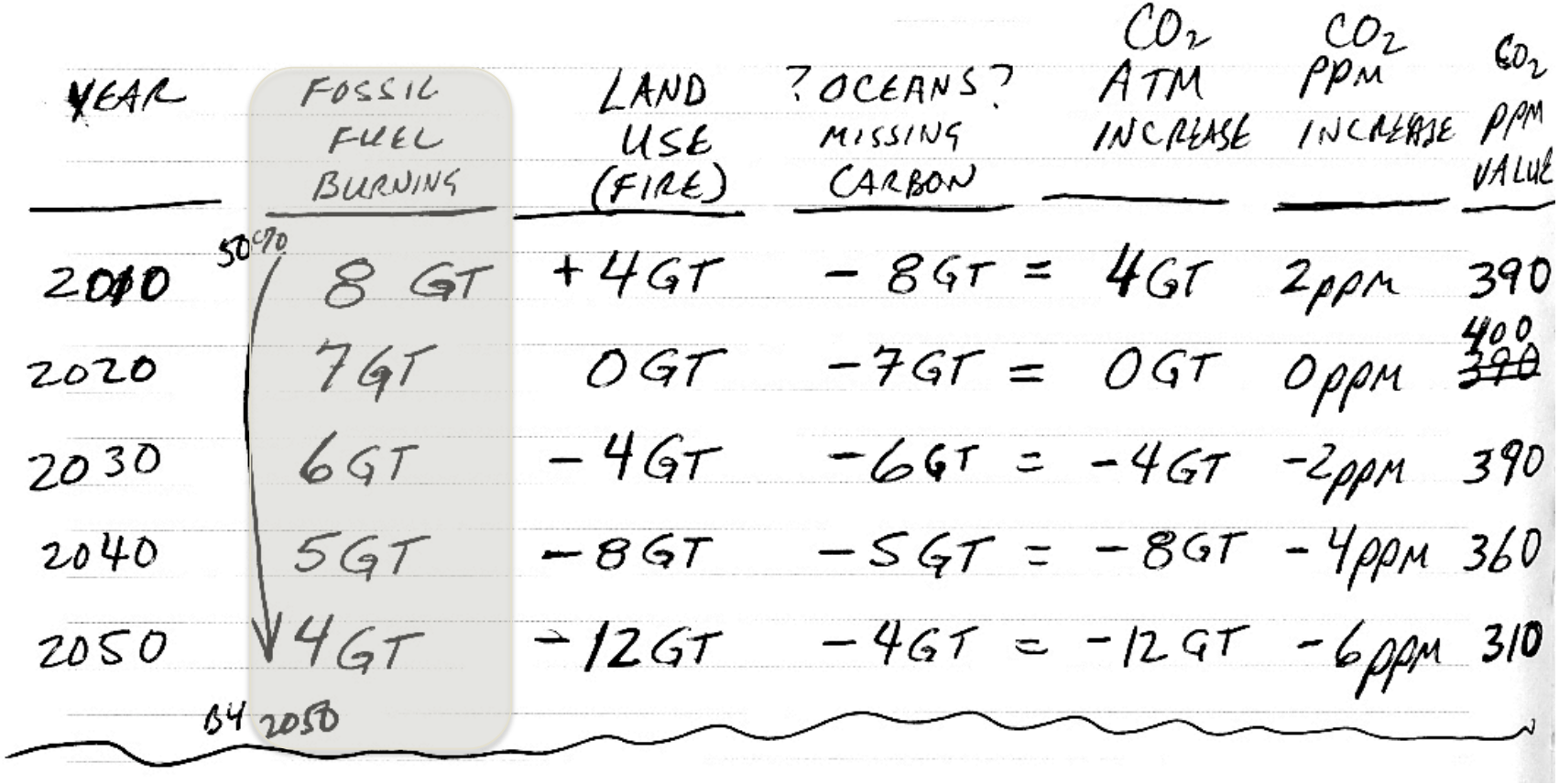
Land Use Possibilities

Fire Reduction, Rodale, Holistic Management, MegaHerds with Predators

HOW?	FIRE	NON-BRITTLE LAND RODALE KEYLINE POLYFACE	BRITTLE RANGE MANGT. HOLISTIC MADDOK	MEGA-HERDS W/PREDATORS WRANGLERS YELLOWSTONE AFRICAN REMNANT	ATM C ↑
2010	4GT	0.01GA	0.1GA	0.2GA	3.69GT
2020	3GT	1GA	1GA	1GA	0GT
2030	2GT	2GA	2GA	2GA	−4GT
2040	1GT	3GA	3GA	3GA	−8GT
2050	0GT	4GA	4GA	4GA	−12GT

310 by 2050

Holistic Management, Fire Reduction, Technology Enhancements



How to Destroy Soil Food Web

1. Poison Prairie Dog Towns
2. Chemical Fertilizer – Mycelium are consumed by bacteria.
3. Pesticides – Dung Beetles and other insects die off.
4. Eliminate grazing herds – Perennial grasses disappear.

Soil Carbon Resources

Holistic Management International
http://www.holisticmanagement.org/

Carbon Farmers of America
http://carbonfarmersofamerica.com/

Managing Wholes
http://managingwholes.com/

Soil Carbon Coalition
http://soilcarboncoalition.org/

Eco-Results!
http://www.ecoresults.org/

The Carbon Coalition
http://www.carboncoalition.com.au/

Soil and Carbon Credits
http://
www.soilcarboncredits.blogspot.com/

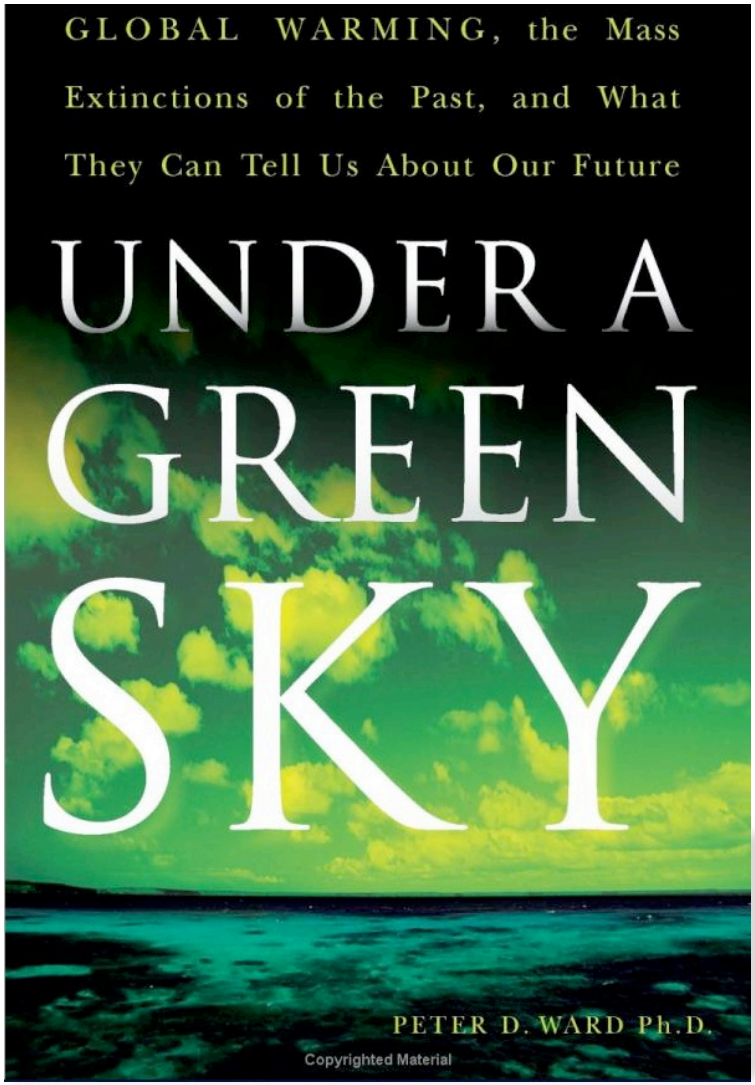
Amazing Carbon
http://www.amazingcarbon.com/

What Causes Extinctions?

Everyone knows they're caused by asteroids.

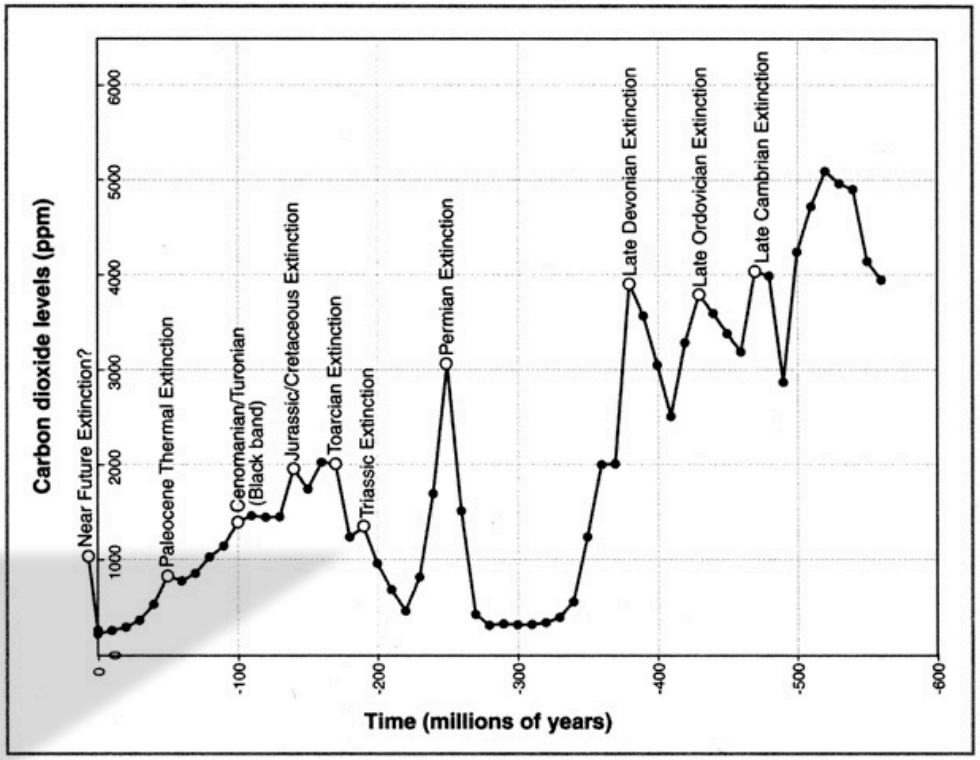
Right?

Wrong, “Under a Green Sky"



CO2 is the driver of extinction episodes.

Anoxic oceans. Hydrogen sulfidic Atmosphere.



A new climate regime

Two Papers to Change Them All

Summons, Roger E.; Grice, Kliti et al (2005). **Photic Zone Euxinia During the Permian-Triassic Superanoxic Event**. *Science* 4 February 2005: Vol. 307. no. 5710, pp. 706 – 709.

Kump, Lee R., et al (2005). **Massive release of hydrogen sulfide to the surface ocean and atmosphere during intervals of oceanic anoxia**. *Geology*, Volume 33, Issue 5 (May 2005). pp. 397–400.

According to Peter Ward, these two papers changed the conversation on extinction episodes.

“Photic Zone Euxina”

A planet covered in green and purple sulfur bacteria - Shallow anoxic seas

“The data show that PZE (photic zone euxinia) conditions occurred during the P–T (Permian–Triassic) superanoxic event….

we propose that sulfide toxicity in the ocean and emission of hydrogen sulfide to the atmosphere were important drivers of the largest mass extinction in the past 500 million years and may have also been a factor in the protracted recovery.” (Summons et al 2005)

Hydrogen Sulfide, Anoxic Oceans

"kill mechanism", "impeded evolution of eukaryotic life on land"

Global Circulation Models indicate that anoxic paleo-oceans would produce enough H2S to increase atmospheric levels 2000 fold.

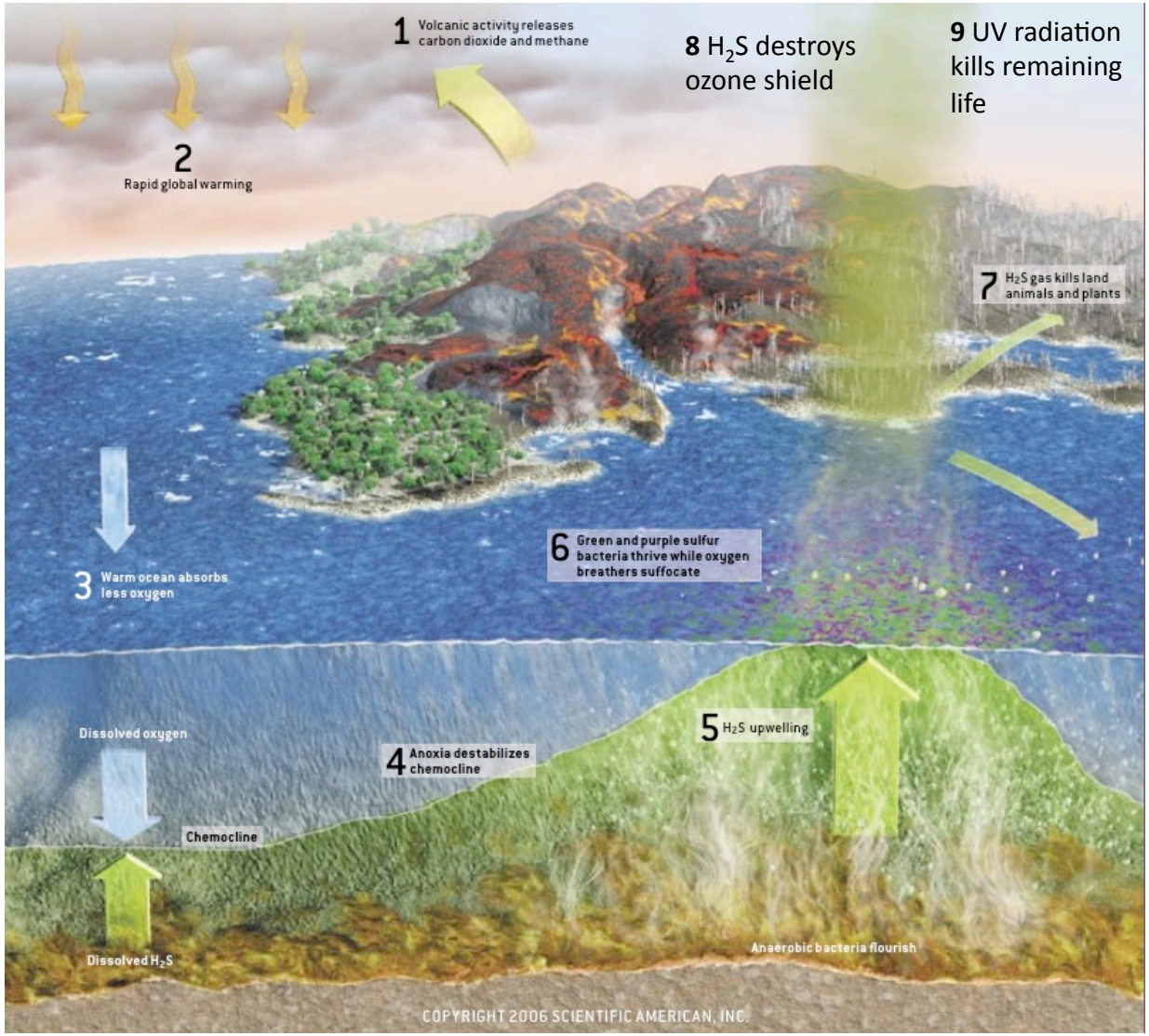
Deep-water H2S (hydrogen sulfide) could have risen abruptly to the ocean surface (a chemocline upward excursion).

Resulting fluxes of H2S to the atmosphere (>2000 times normal) would likely have led to toxic levels of H2S in the atmosphere.

"We thus propose (1) chemocline upward excursion as a kill mechanism during the end-Permian, Late Devonian, and Cenomanian–Turonian extinctions, and (2) persistently high atmospheric H2S levels as a factor that impeded evolution of eukaryotic life on land during the Proterozoic."

(Kump et al 2005)

9 Steps to Extinction



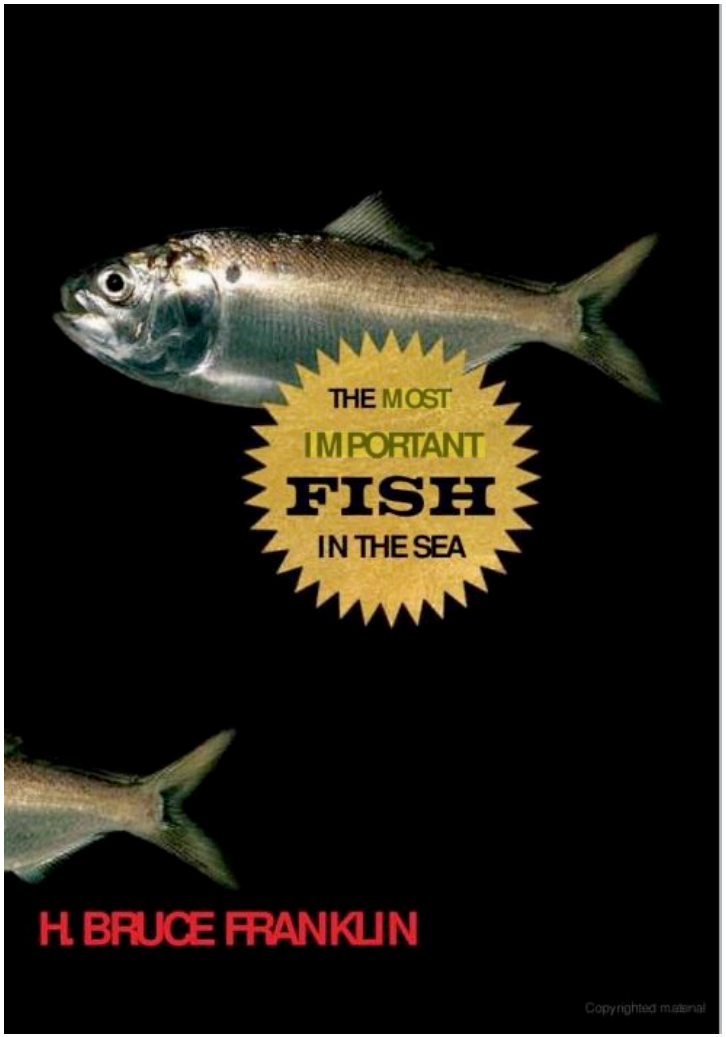
Jim Laurie & Seth Itzkan, www.planet-tech.com

A new climate regime

Alternating supremacy between aerobic and anaerobic life. During Greenhouse regimes, the oceans can't breath, and anaerobic life gains the upper hand.

Will it again?

The Most Important Fish in the Sea



- Far and away the largest fishery
- Oily, non-eatable by people.
- Industrial and agricultural uses, oils, feedstocks, fertilizer - was the original fertilizer
- Rarely discussed, yet essential to marine ecology
- Essential food source for larger marine animals
- Algae-eater, keeps estuaries clean - prevents algal blooms

Prodigious Algae-Eater

“colossal submarine vacuum cleaner”

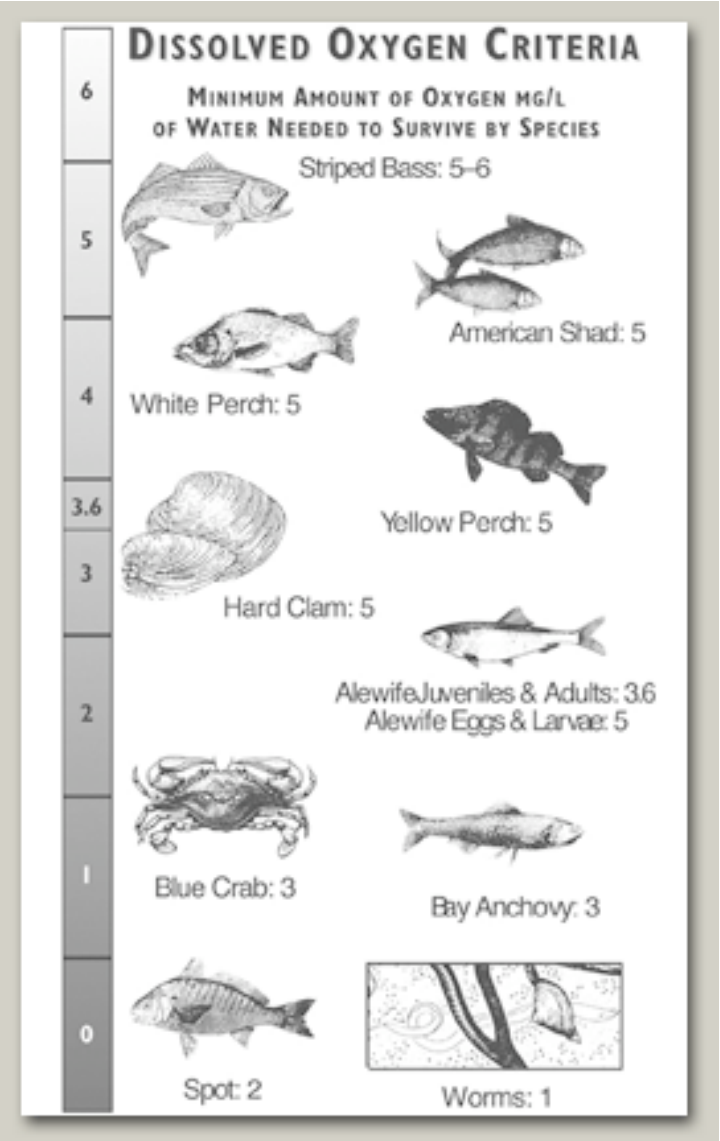
Each filters 4 gallons of water a minute

as wide as a city block and as deep as a train tunnel...

“Dense schools of menhaden…pour through these waters, toothless mouths agape, slurping up plankton, cellulose, and just plain detritus like a colossal submarine vacuum cleaner as wide as a city block and as deep as a train tunnel...this filter feeding clarifies the water, allowing sunlight to penetrate.”

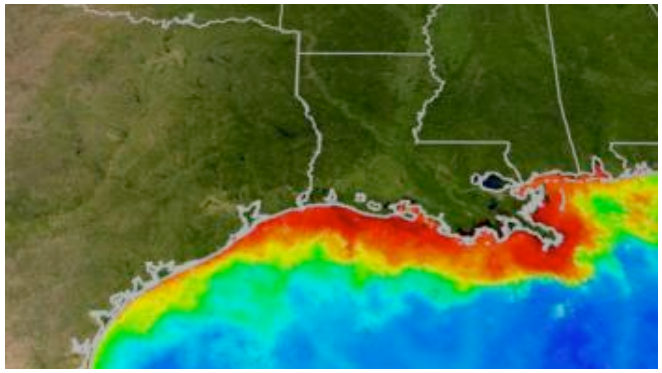
Dissolved Oxygen, Hypoxia, Fish

Minimum Levels



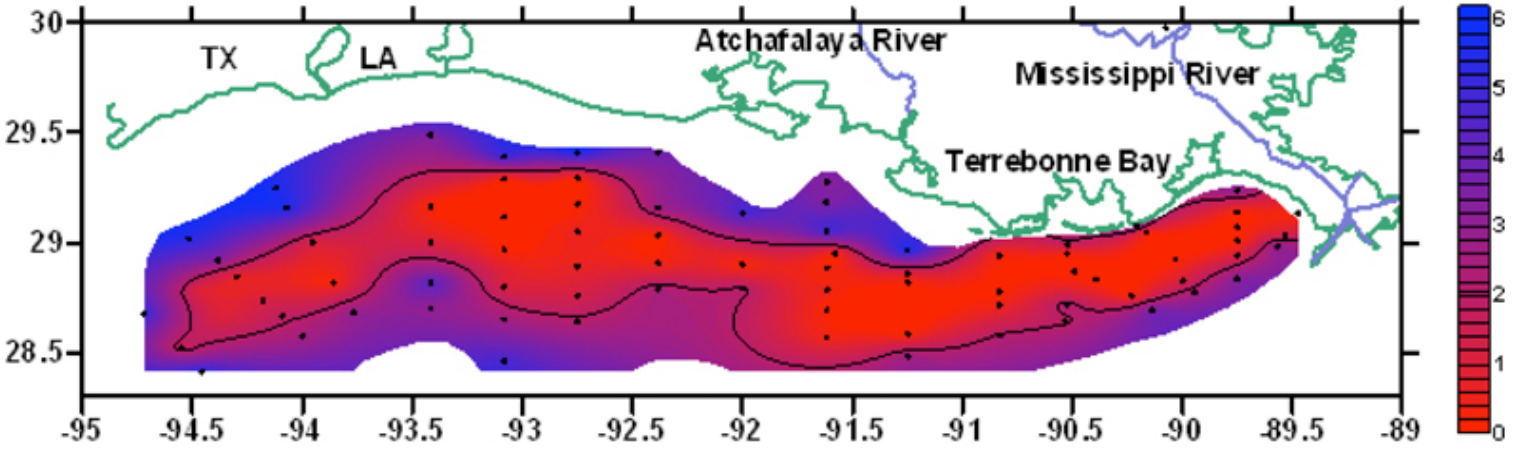
- Bass: 5-6
- Shad: 5
- Perch: 5
- Clams: 5
- Alewife Juveniles & Adults: 3.6
- Alewife Larvae: 5
- Crab: 3
- Anchovy: 3
- Spot: 2
- Worms: 1

Gulf of Mexico Dead Zone



2008 Dead Zone: 7,988 square miles - The size of Massachusetts

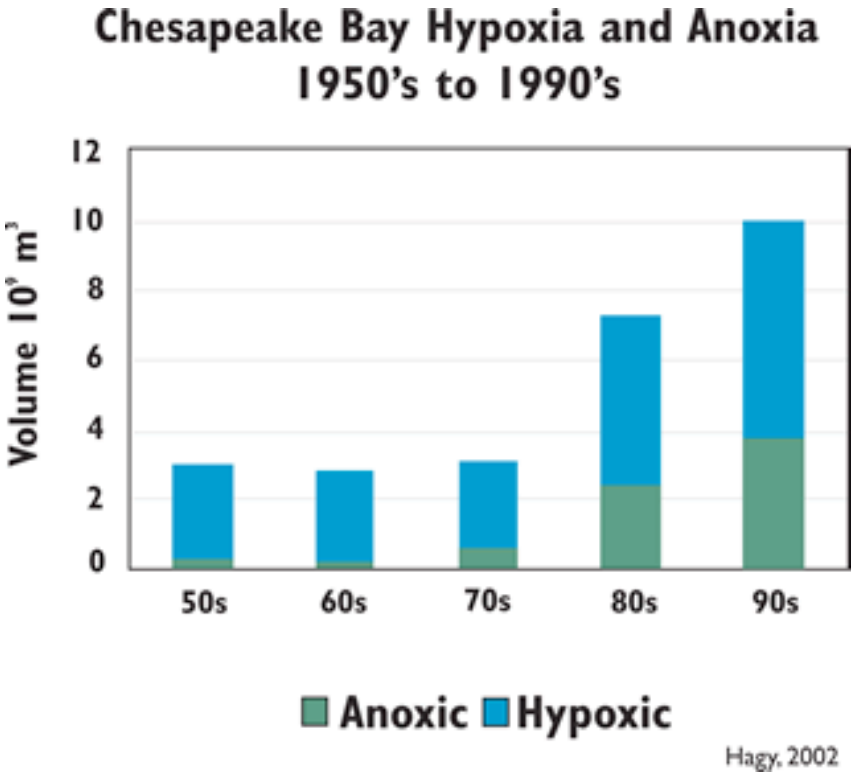
2nd Largest Recorded



Map of bottom water oxygen levels in mg/L (or ppm). Black line is less than 2 = Hypoxia. Data source: N. Rabalais, Louisiana Universities Marine Consortium, map by B. Babin.

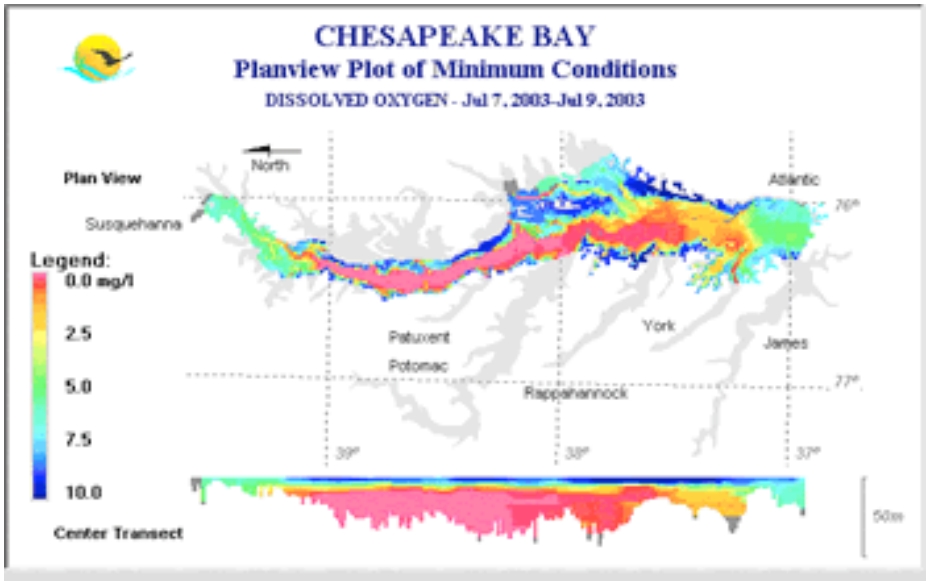
Chesapeake Bay Hypoxia

Hagy Study



Affected area:

- 100 miles
- 40% of the Bay's mainstem



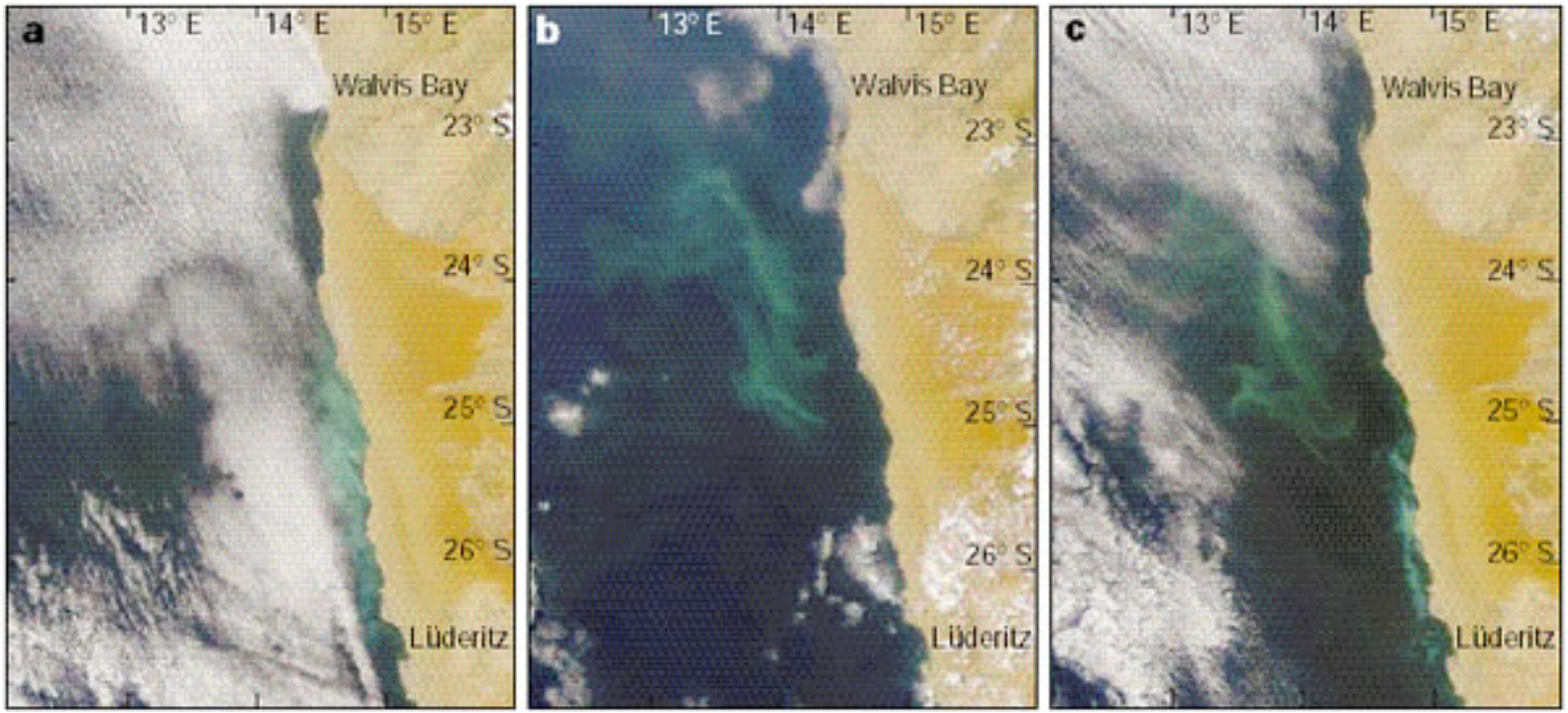
Namibia Story

Coastal Hydrogen Sulfide Plumes

National Geographic. Strange Days on Planet Earth
http://www.pbs.org/strangedays/

Jim Laurie & Seth Itzkan, www.planet-tech.com

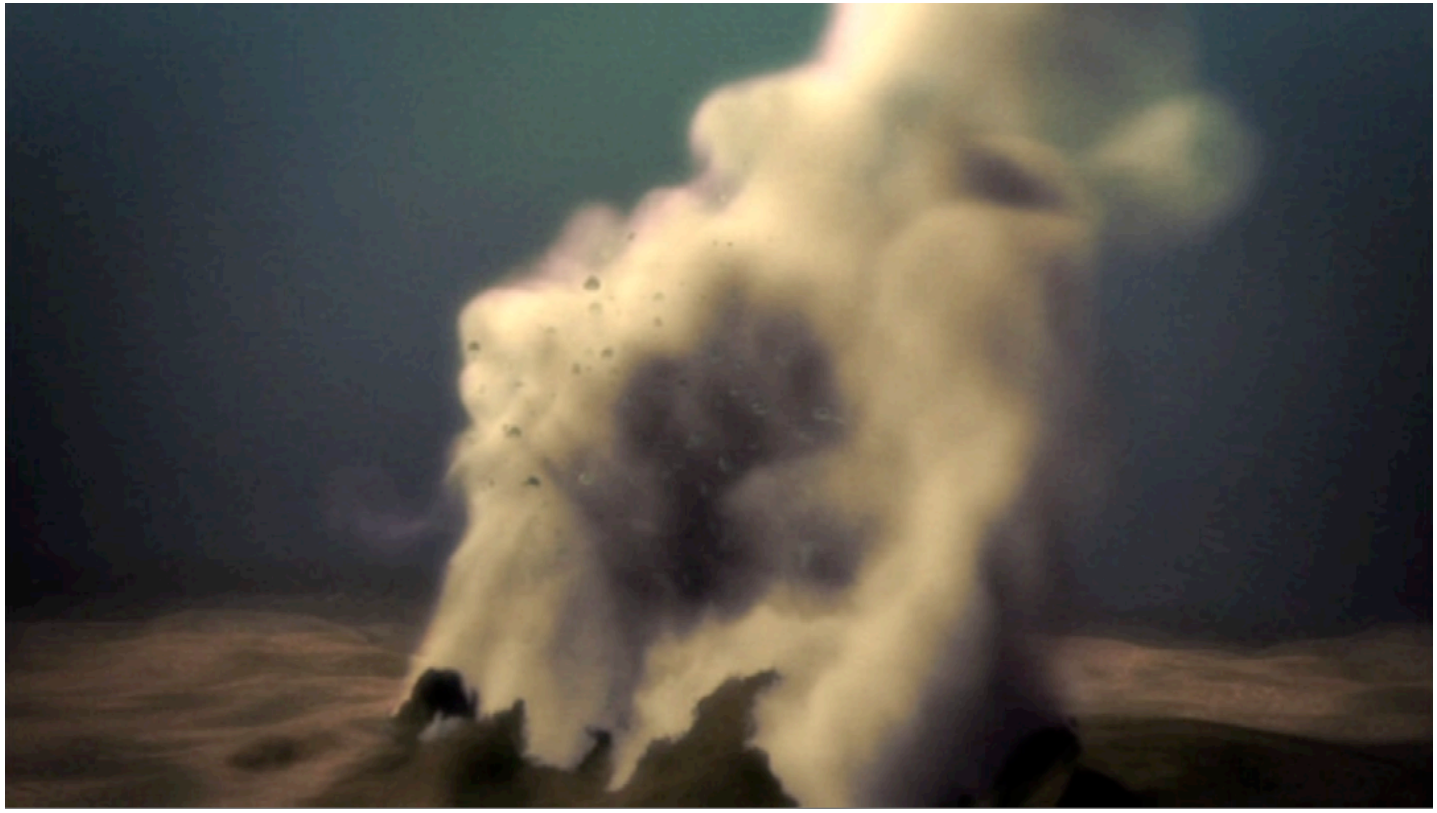
Namibia, H2S Zones, Satellite Images



National Geographic. Strange Days on Planet Earth
http://www.pbs.org/strangedays/
Jim Laurie & Seth Itzkan, www.planet-tech.com

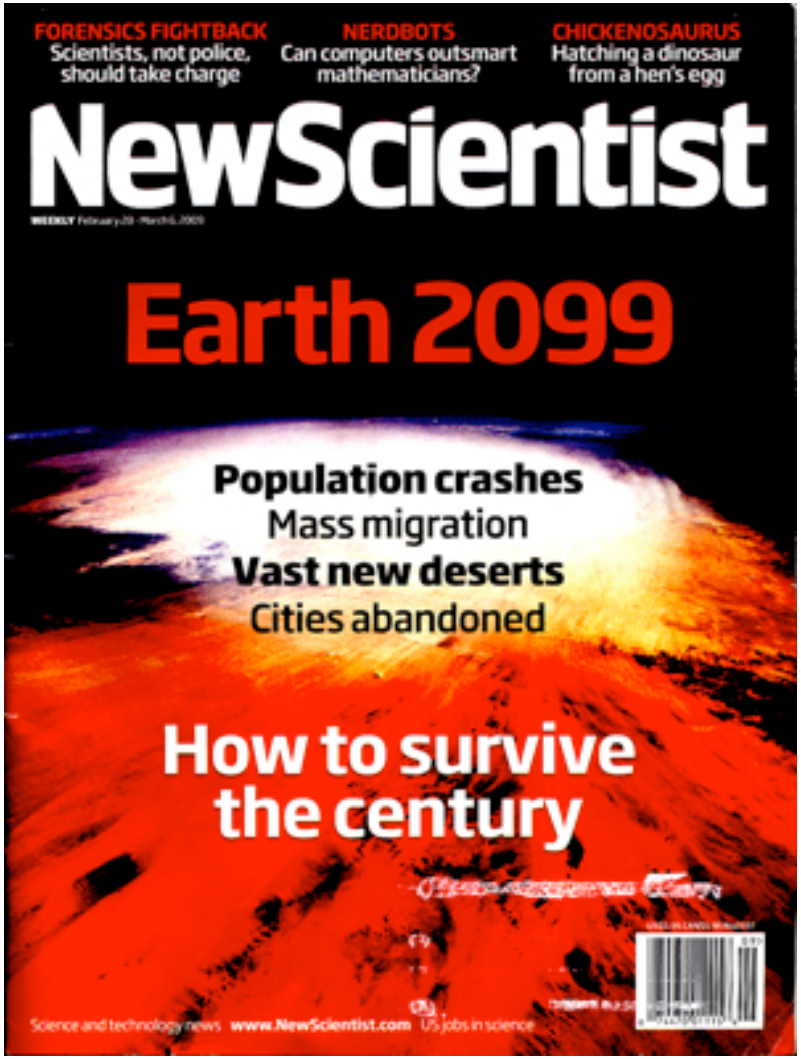
Hydrogen Sulfide Plum

Chain reaction: The plums lower the water pressure, which causes release of more sub surface gas.



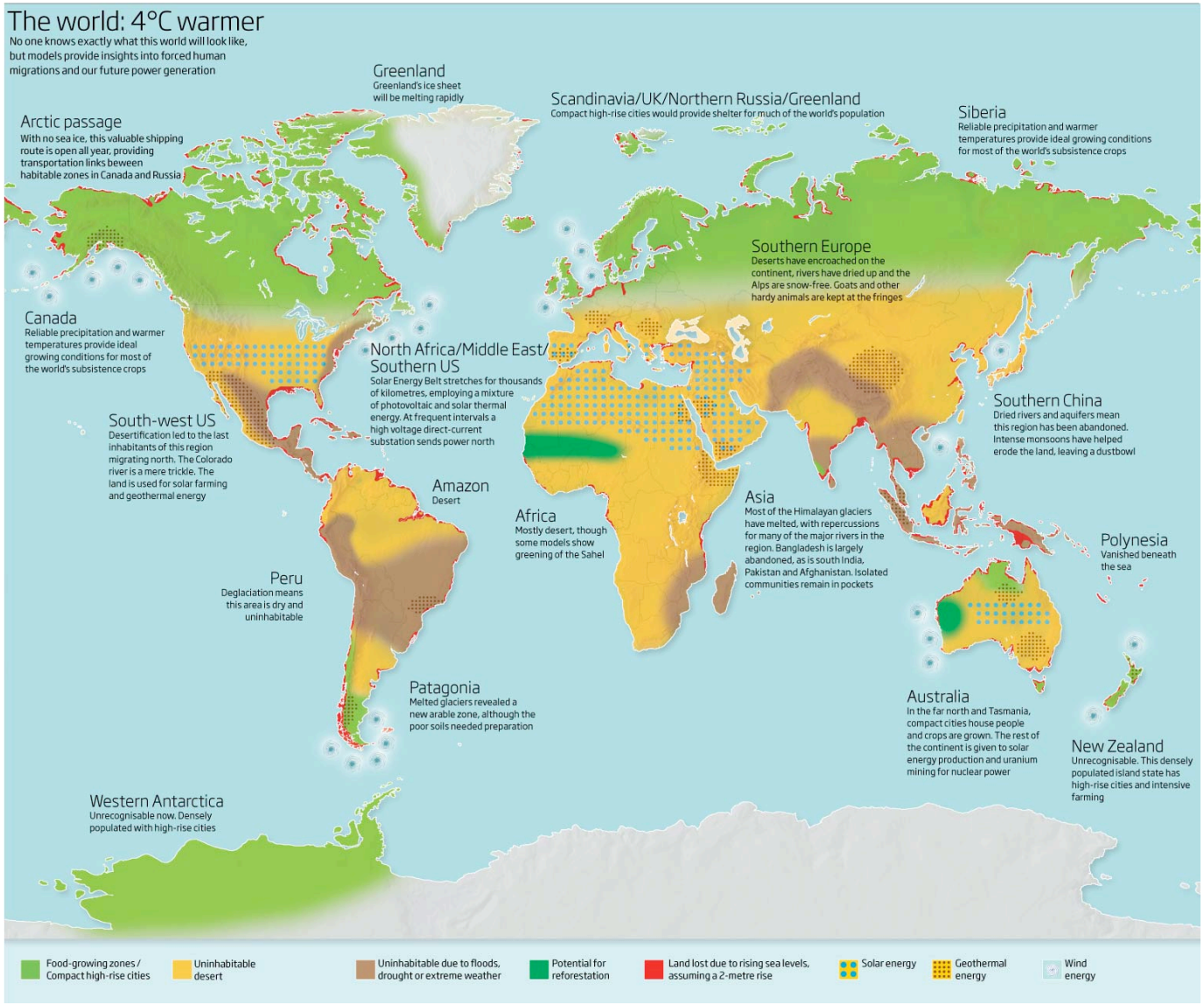
National Geographic. Strange Days on Planet Earth
http://www.pbs.org/strangedays/

How we think about the future



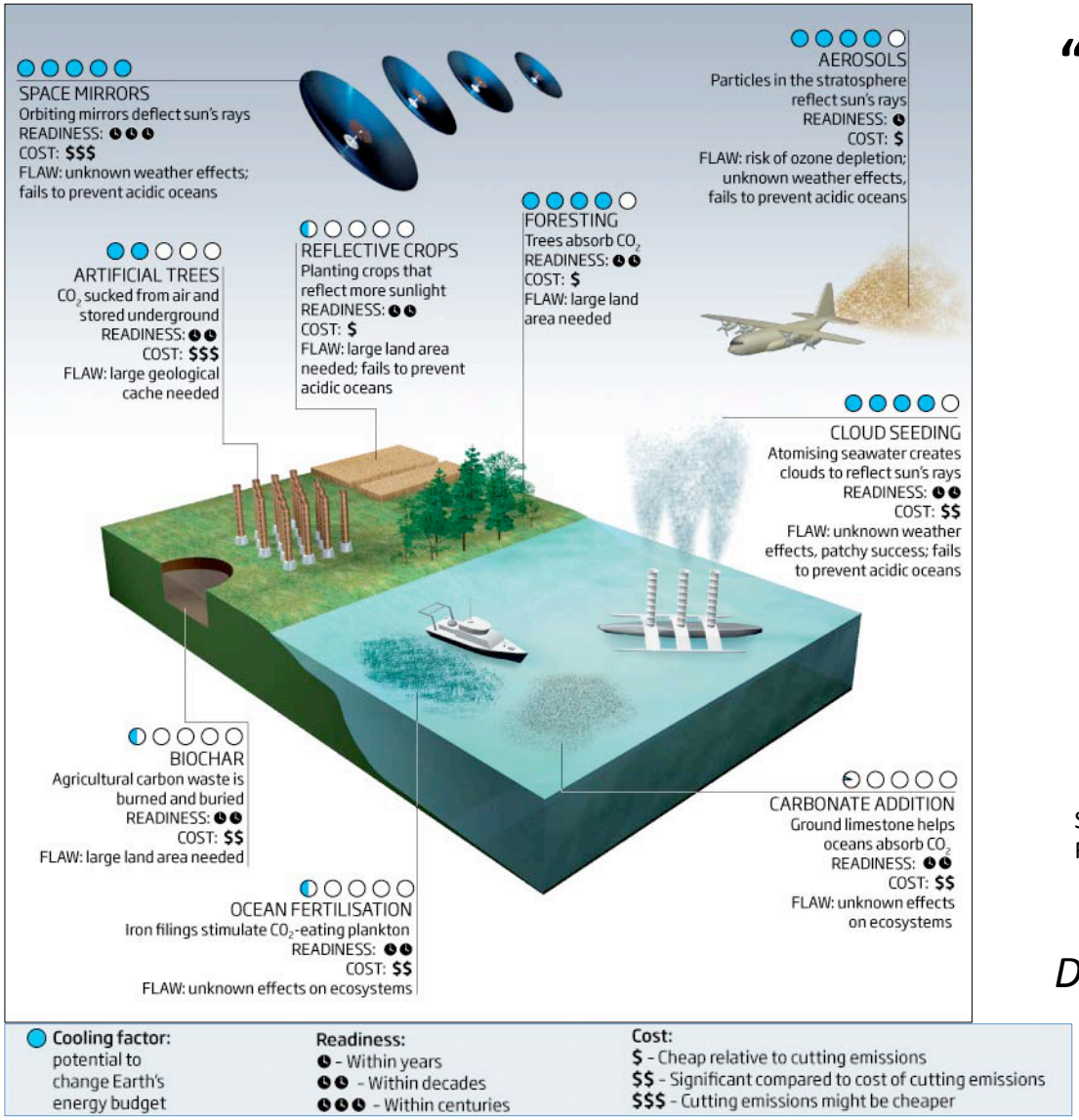
- Population crashes
- Mass migrations
- Vast new deserts
- Cities abandoned

4°C Warmer World



Jim Laurie & Seth Itzkan, www.planet-tech.com

Geo-engineering to the Rescue!



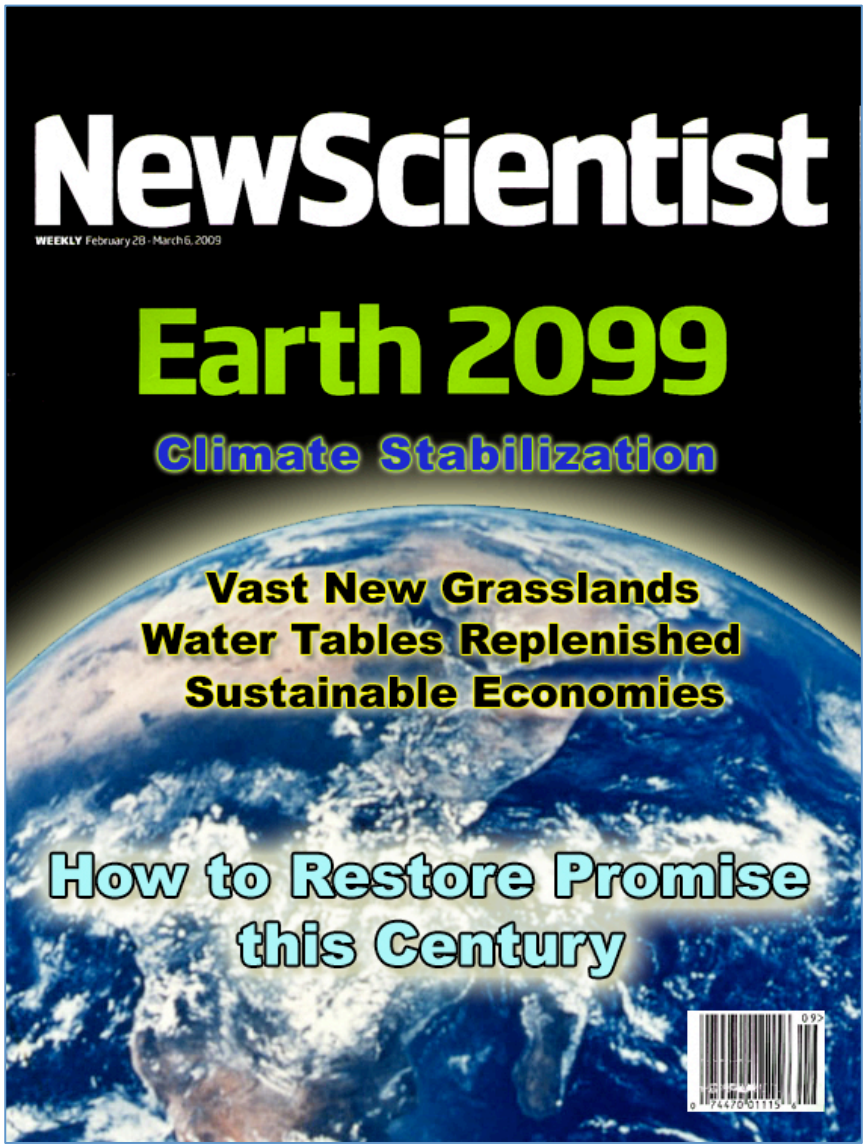
"Earth's Plan B"

- Space Mirrors
- Artificial Trees
- Reflective Crops
- Biochar
- Ocean Fertilization
- Foresting
- Aerosols
- Cloud Seeding
- Carbonate Addition

Source: Earth's Plan B, *New Scientist*, 28 Feb. 2009, p8

Do you feel better now?

How we *could* think about the future



- Climate Stabilization
- Vast new grasslands
- Water tables replenished
- Sustainable economies

Myths

425 ppm is acceptable

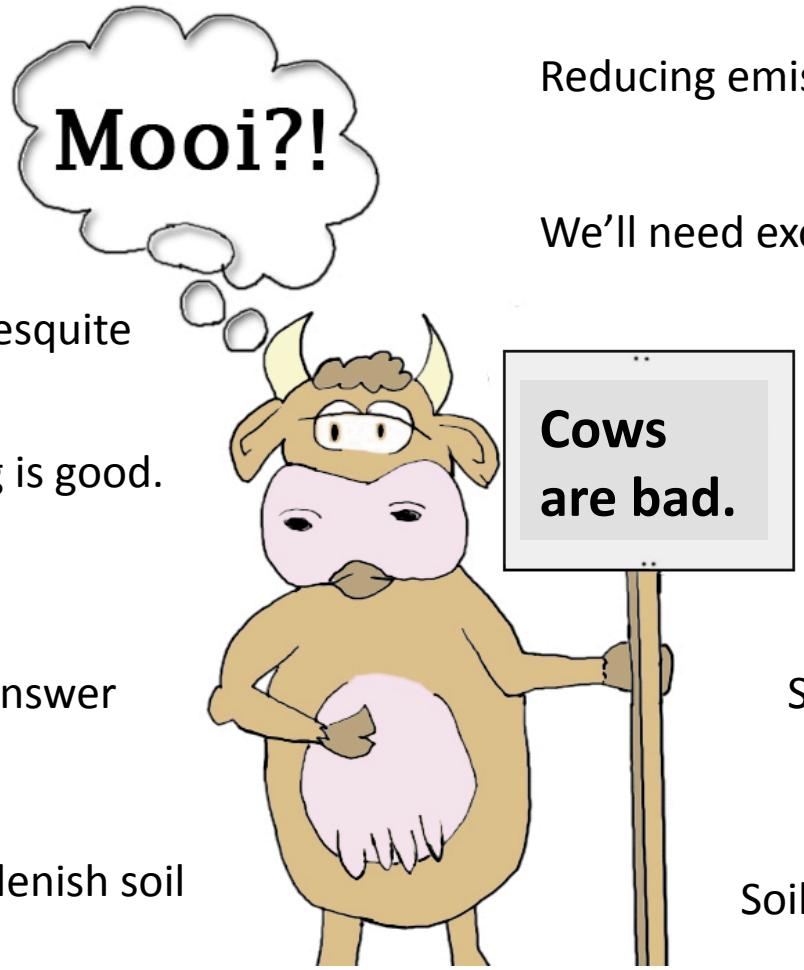
Cows are the problem

Meteors cause extinctions

Reducing emissions is sufficient

We'll need exotic solutions

We need to kill mesquite



Low stock grazing is good.

Forests will save us

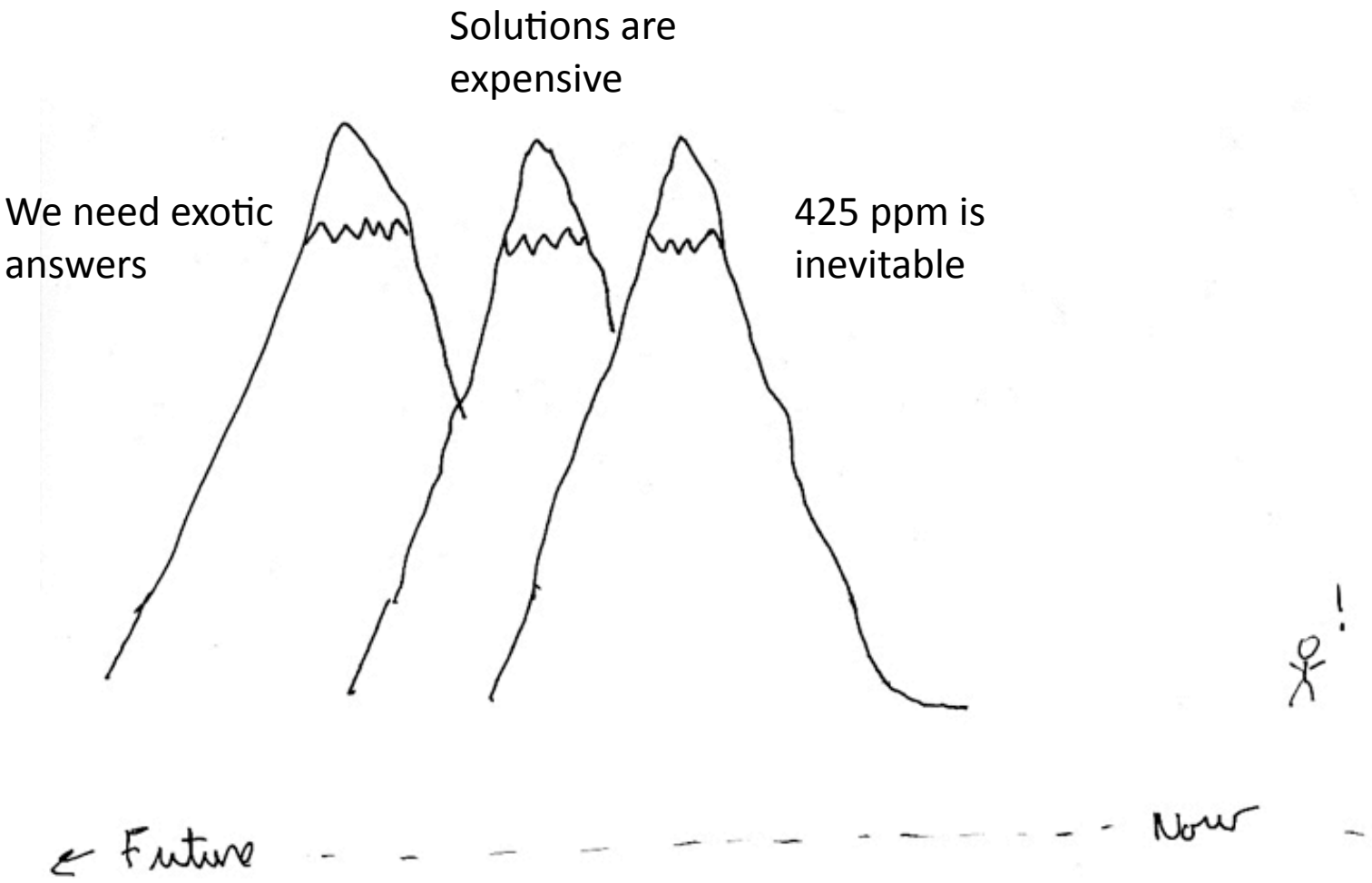
Technology is the answer

Solutions are expensive

We need fire to replenish soil

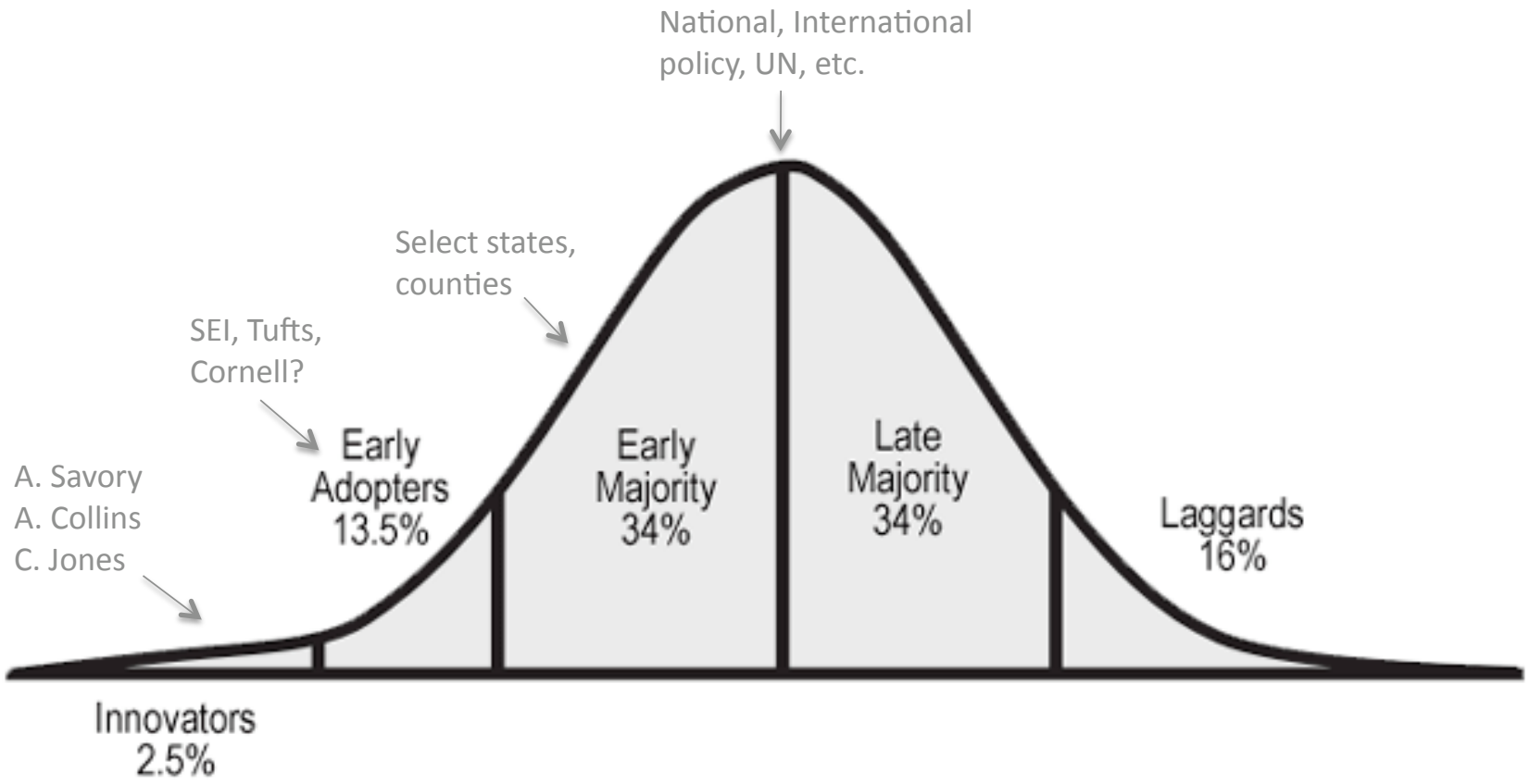
Soil takes centuries to replenish

Paradigm Mountains



Diffusion of Innovations

Application to Grassland Restoration as Climate Change Policy



*From E.M. Rogers, *Diffusion of Innovations*, 4th edition (New York: The Free Press, 1995)

Projects

Measurement – Improve soil carbon measuring science.

Documentation – Who, what, where, how much. Web database of projects, achievements, worldwide.

Contest – Blazing vs Grazing: Three year carbon sequestering contest; one county blazes, another grazes.

Soil Carbon Credits – Pay farmers for the carbon they sequester. Soil carbon credits should be *many* times the value of an offset credit.

Strategic Planning – What can the future look like. What are the benchmarks? What's the plan?

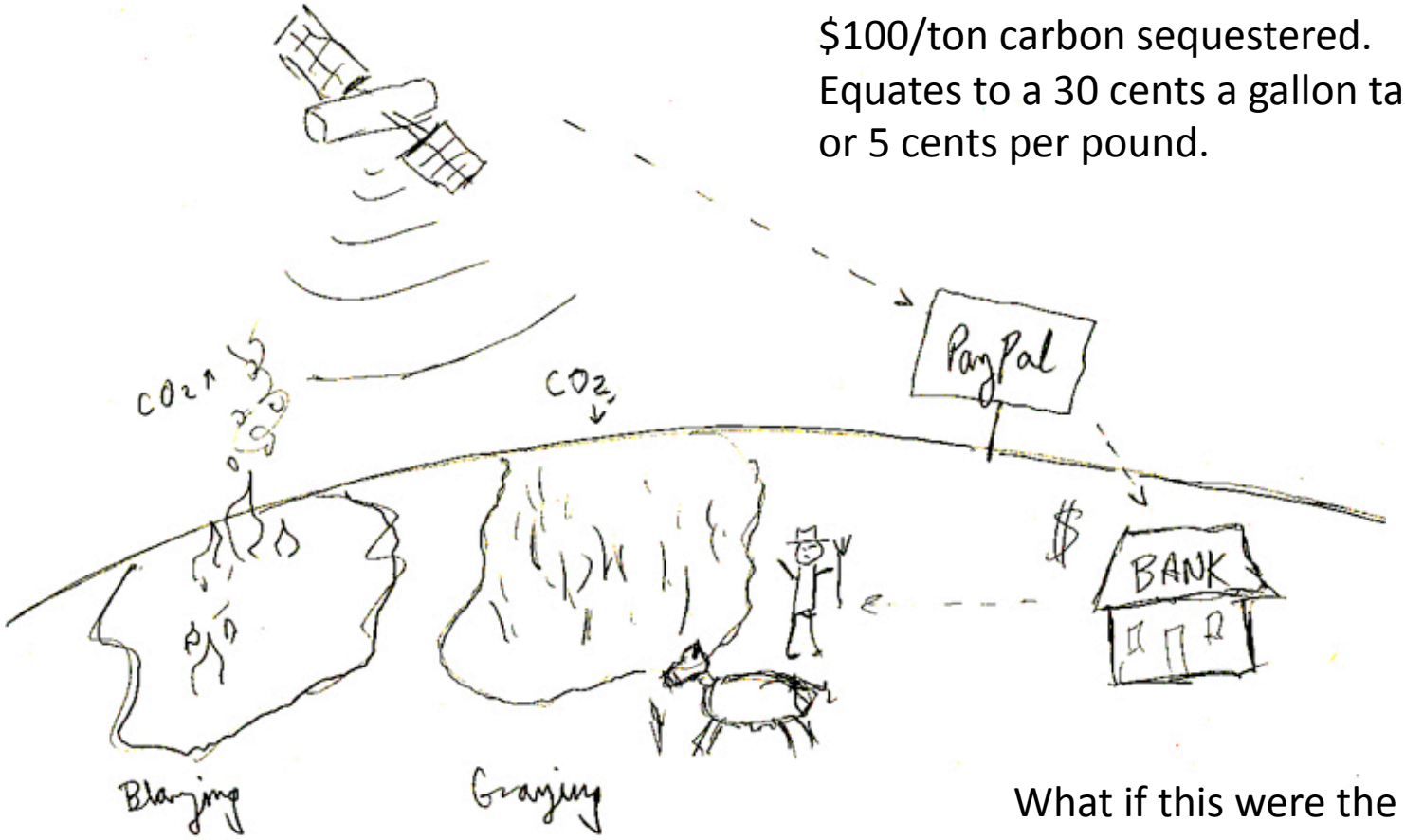
Communications – Ranchers and policy people need to know there are options.

Satellite Verification & Auto Payment

A Vision for 2020

Blazing versus Grazing – Farmers are automatically rewarded for the carbon they sequester. Satellites measure soil carbon via plant sugar signatures.

$100/ton carbon sequestered.
Equates to a 30 cents a gallon tax
or 5 cents per pound.



What if this were the goal?

What do we want?