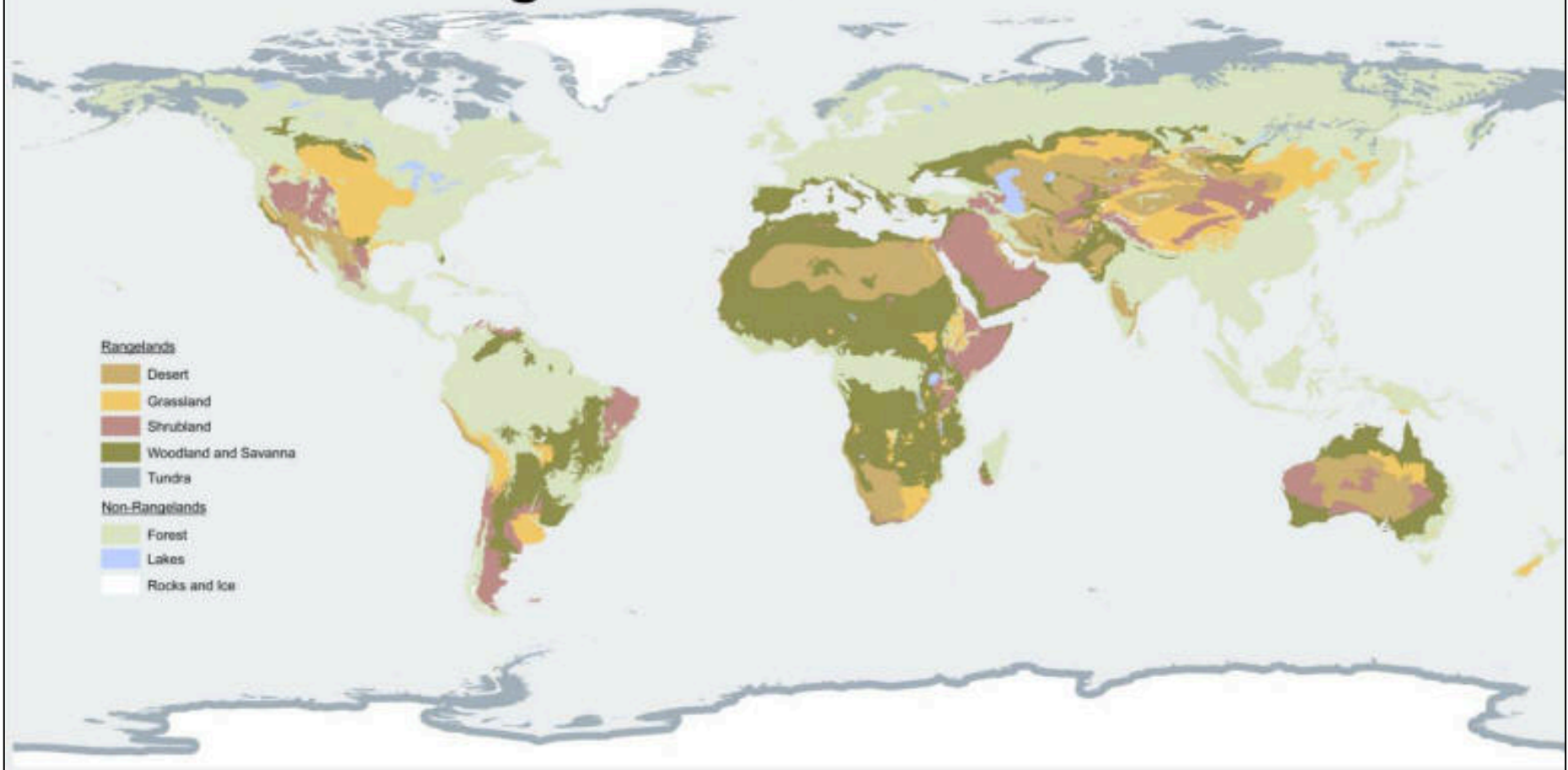


Chapter 10

Sustaining Terrestrial Biodiversity: The Ecosystem Approach

Managing and Sustaining Grasslands and Rangelands

Rangelands of the World



Managing and Sustaining Grasslands and Rangelands

Rangelands

- Unfenced grassland in temperate and tropical climates. Cattle, sheep and goats
- Many ecosystem services: soil formation, erosion control, nutrient cycling, food, carbon dioxide sequestration in biomass, habitat and biodiversity



Kenya



California

Managing and Sustaining Grasslands and Rangelands

Overgrazing of Rangelands

- Grass grows from the tip not from the base. Grass will grow back as long as not overgrazed (i.e. eaten down to the roots).
- Thus, overgrazing reduces grass cover and leads to erosion of soil by water and wind.
- Overgrazing from too many animals for too long a period of time causes desertification (grassland → desert).
- Soil becomes compacted by trampling from grazing ungulates (i.e. hooved animals; cows) → *Result: difficult for plants to establish; soil can't hold water.*
- Enhances/facilitates invasion of plant species that cattle won't eat



Managing and Sustaining Grasslands and Rangelands

Managing Rangelands

- Control number of animals allowed to graze and implement Rotational grazing
- Protect Riparian Buffer Zones: thin strip of lush vegetation along river and stream banks.



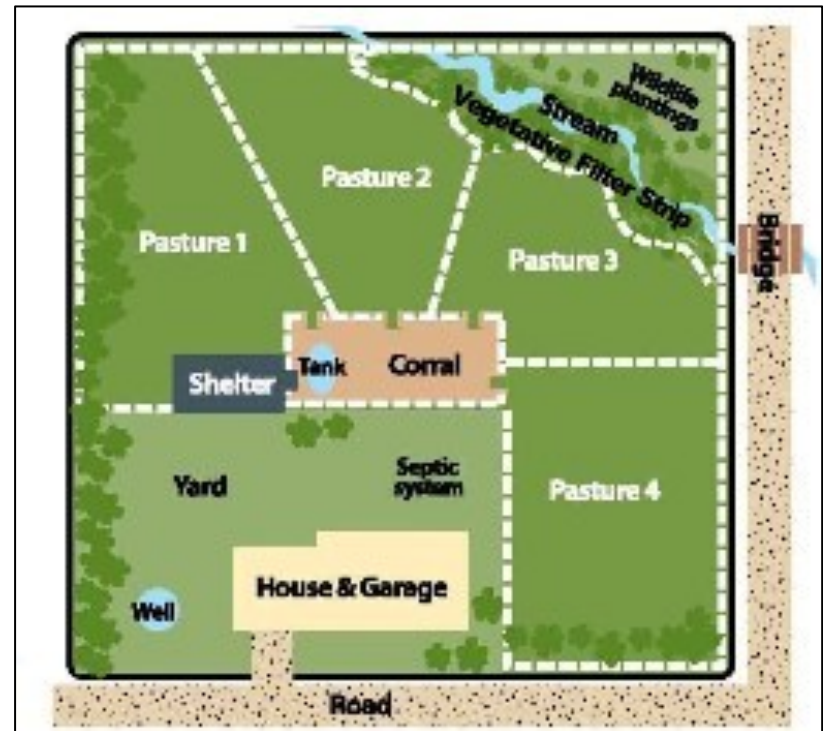
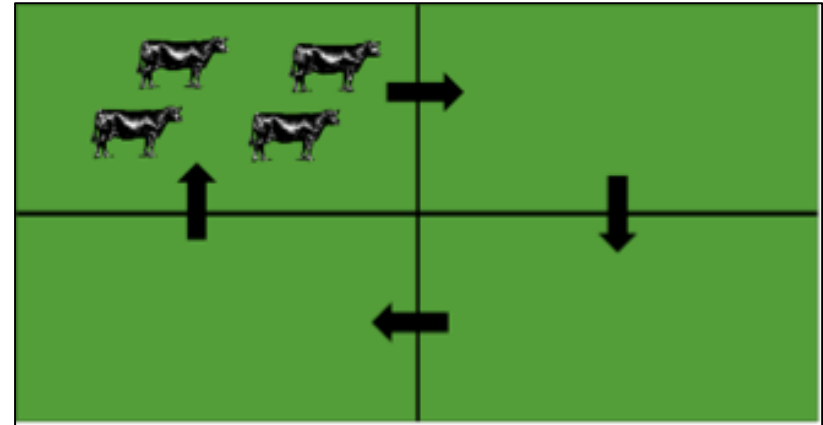
Above: Wyoming rangeland;
Left: well-managed Right: managed conventionally
Taken on same day

← Fenceline contrast from overgrazing Red Rock
River Centennial Valley Montana

Managing and Sustaining Grasslands and Rangelands

Managing Rangelands

- Rotational grazing

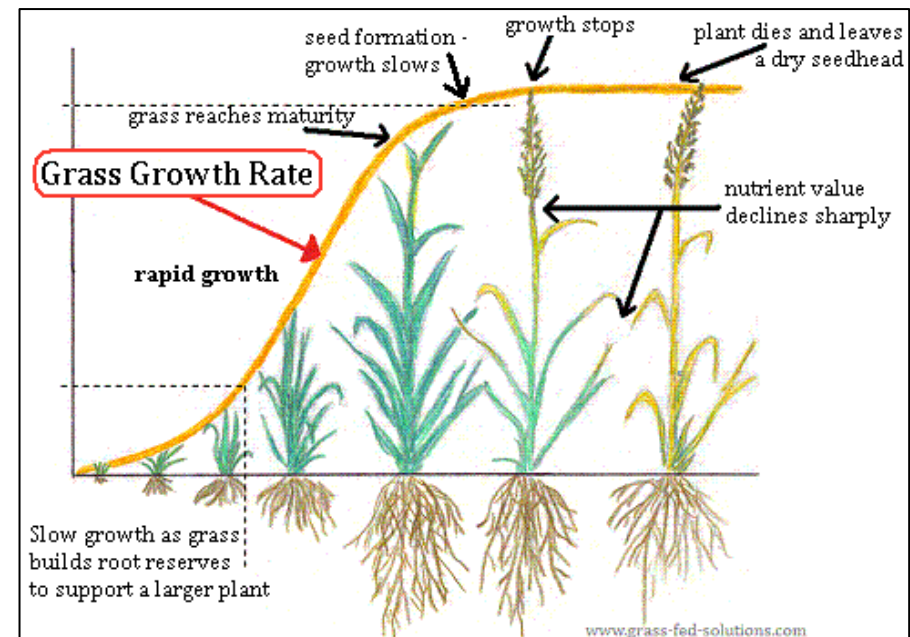
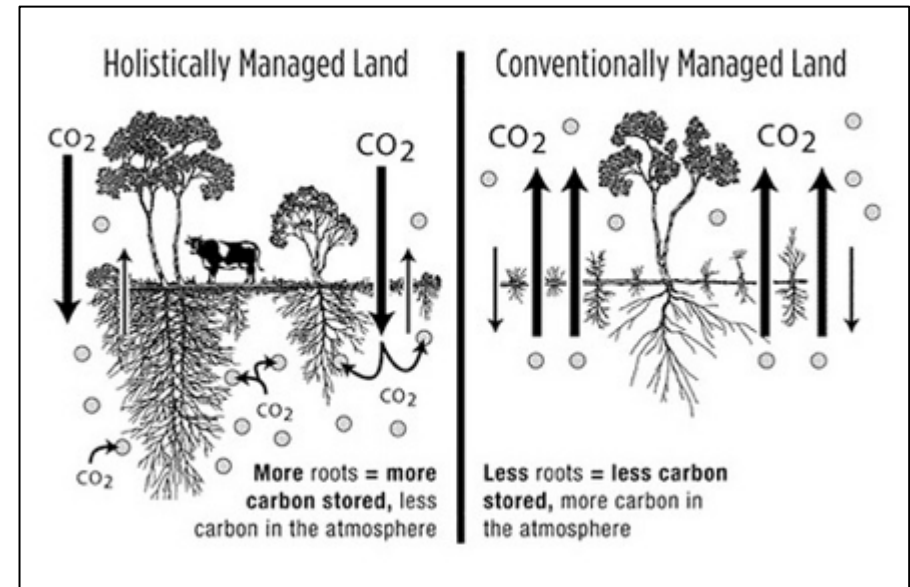
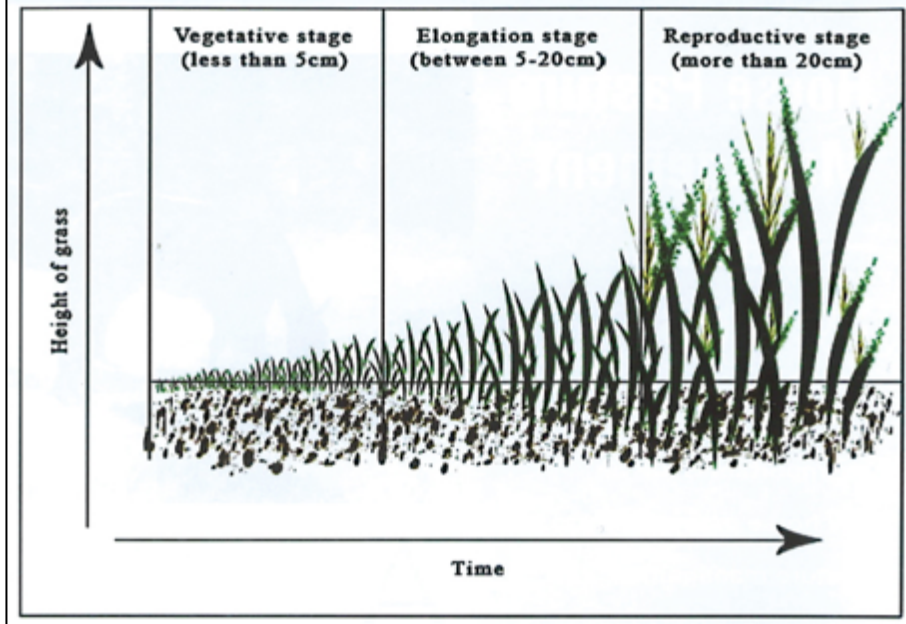


Managing and Sustaining Grasslands and Rangelands

Managing Rangelands

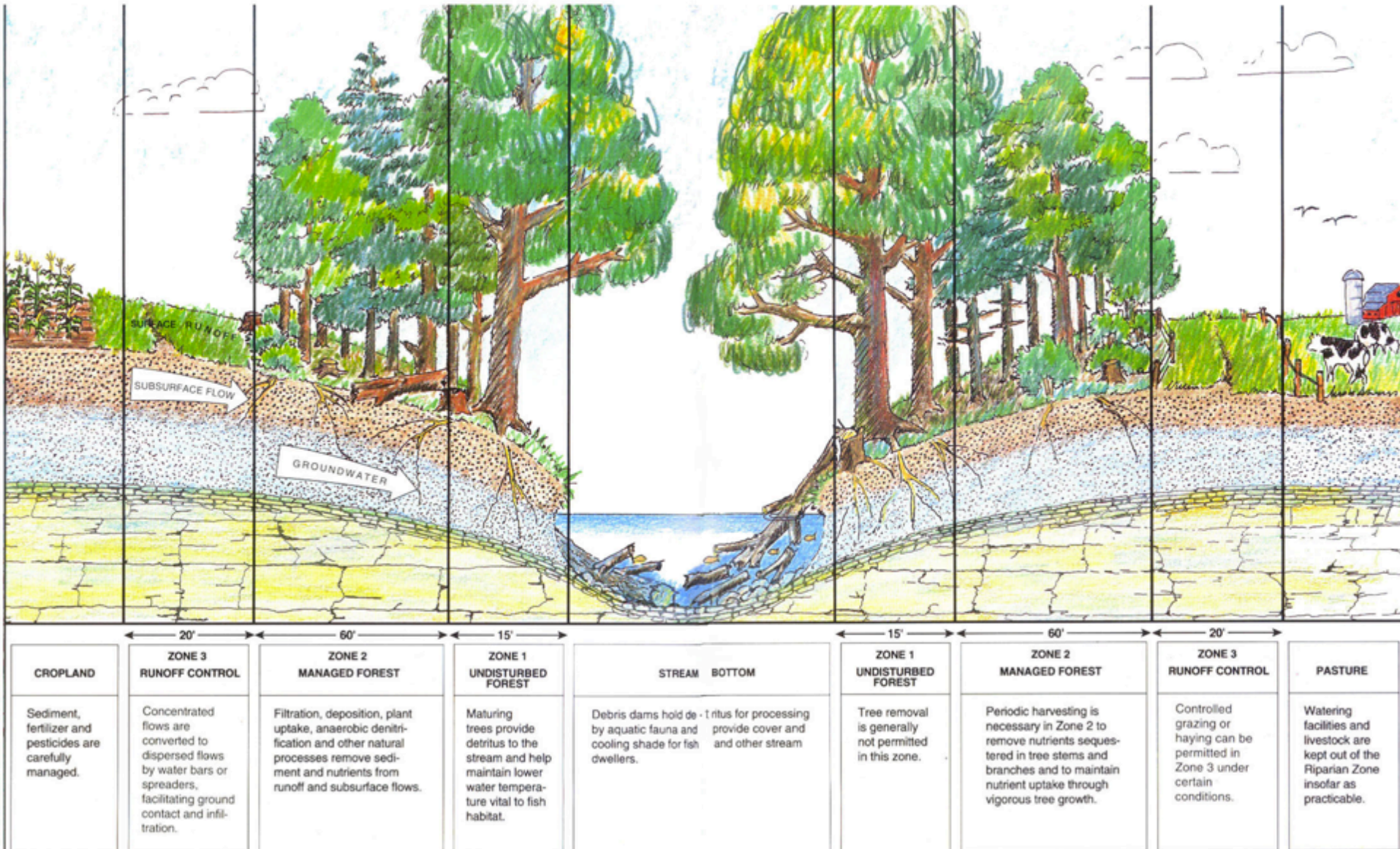
- Rotational grazing

Being aware of the three stages of grass growth will help you to manage your pasture more efficiently.



Managing and Sustaining Grasslands and Rangelands

Managing Rangelands → Riparian Buffer Zones



Managing and Sustaining Grasslands and Rangelands

Managing Rangelands → Riparian Buffer Zones



Managing and Sustaining Grasslands and Rangelands

Managing Rangelands

- Suppress growth of invasive species
 - Herbicides
 - Mechanical removal
 - Controlled burning
 - Controlled short-term trampling
- Replant barren areas
- Apply fertilizer
- Reduce soil erosion



Photo courtesy of Lisa Michl

Removal of Scotch Broom from Point Reyes National Seashore This invasive plant has been in the park for over 35 years and threatens native habitats, including several rare plants and threatened and endangered wildlife. The species also changes soil chemistry, which alters plants that can grow nearby. By removing this plant, we open up room for native species to repopulate.

Maasai community on Kuku Group Ranch, decided to develop and implement an integrated grazing and rangeland restoration management plan.

Natural Capital Degradation: Overgrazed and Lightly Grazed Rangeland

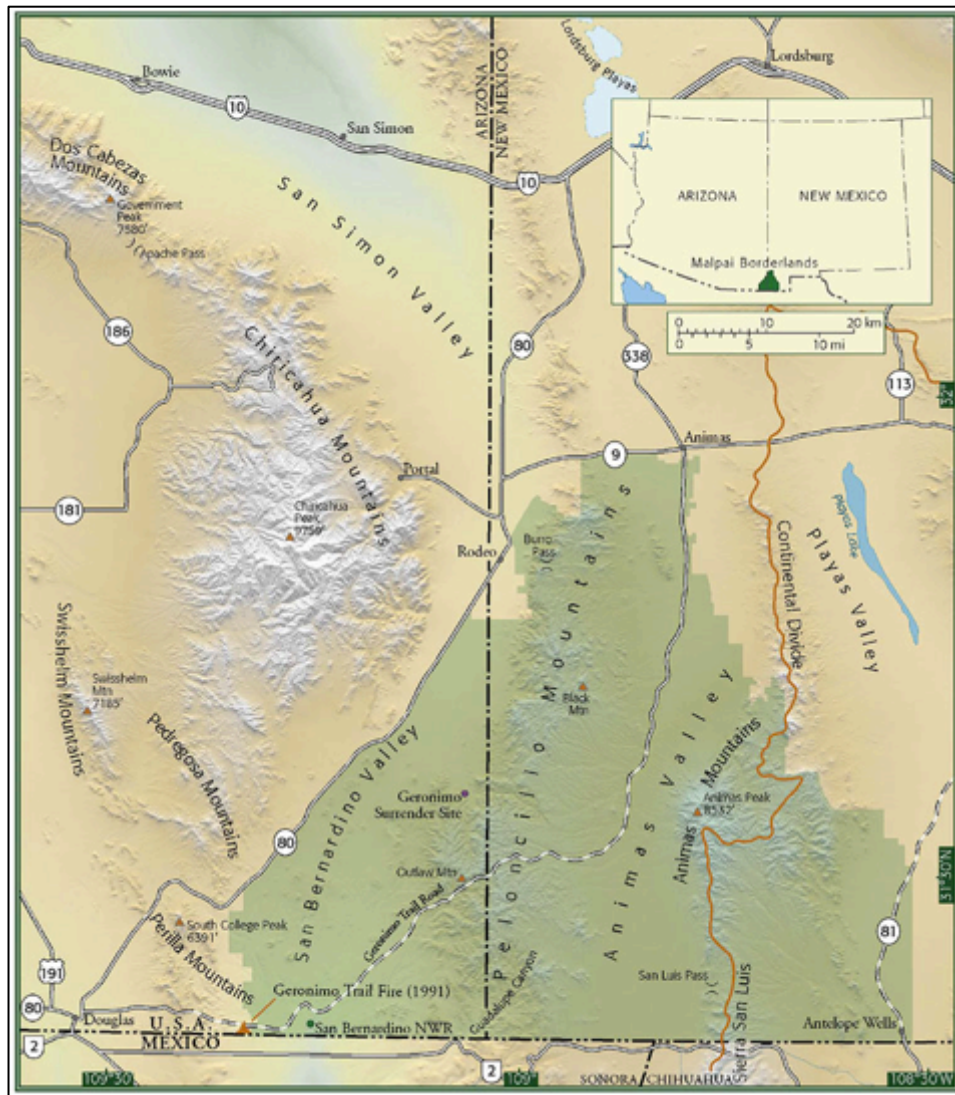


Restoration of San Pedro River in Arizona

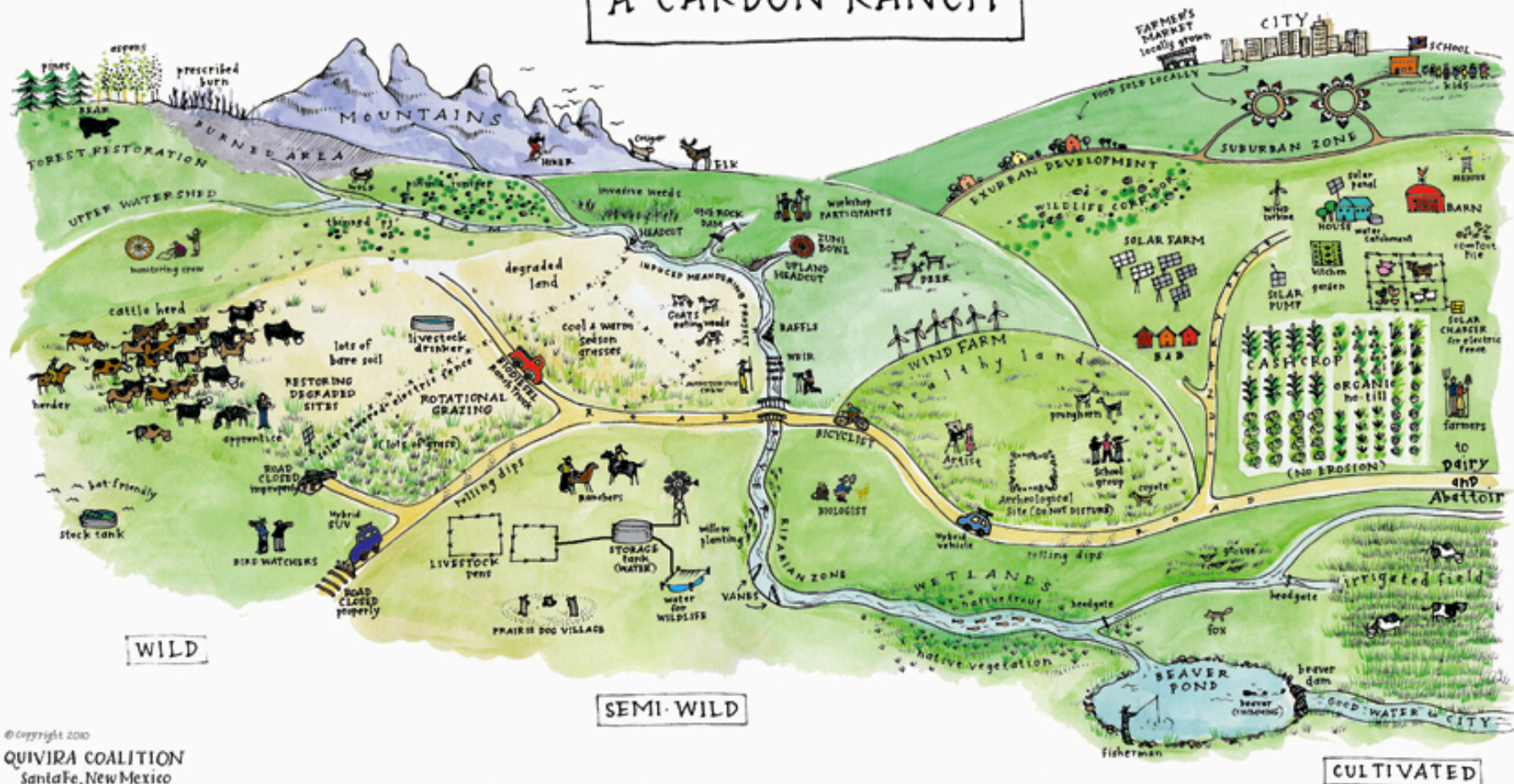


Restoration of Malpai Borderlands

- Arizona-New Mexico border
- Management success story



A CARBON RANCH



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QUIVIRA COALITION
Santa Fe, New Mexico
www.quiviracoalition.org

concept by Courtney White Illustration by Jone Hallmark

Write, Pair, Share

Rangelands

Quietly & Independently

What ecosystem services do rangelands provide?

What is overgrazing and what are its harmful effects?

How can rangelands be managed to reduce the effects of overgrazing?

Turn & Talk

Turn to you neighbor and discuss your answers with each other.

Public Land Management in the United States

Management of public lands in the U.S. is administered by the four main land agencies. They are managed for many purposes, primarily related to preservation, conservation, recreation, and development of natural resources.

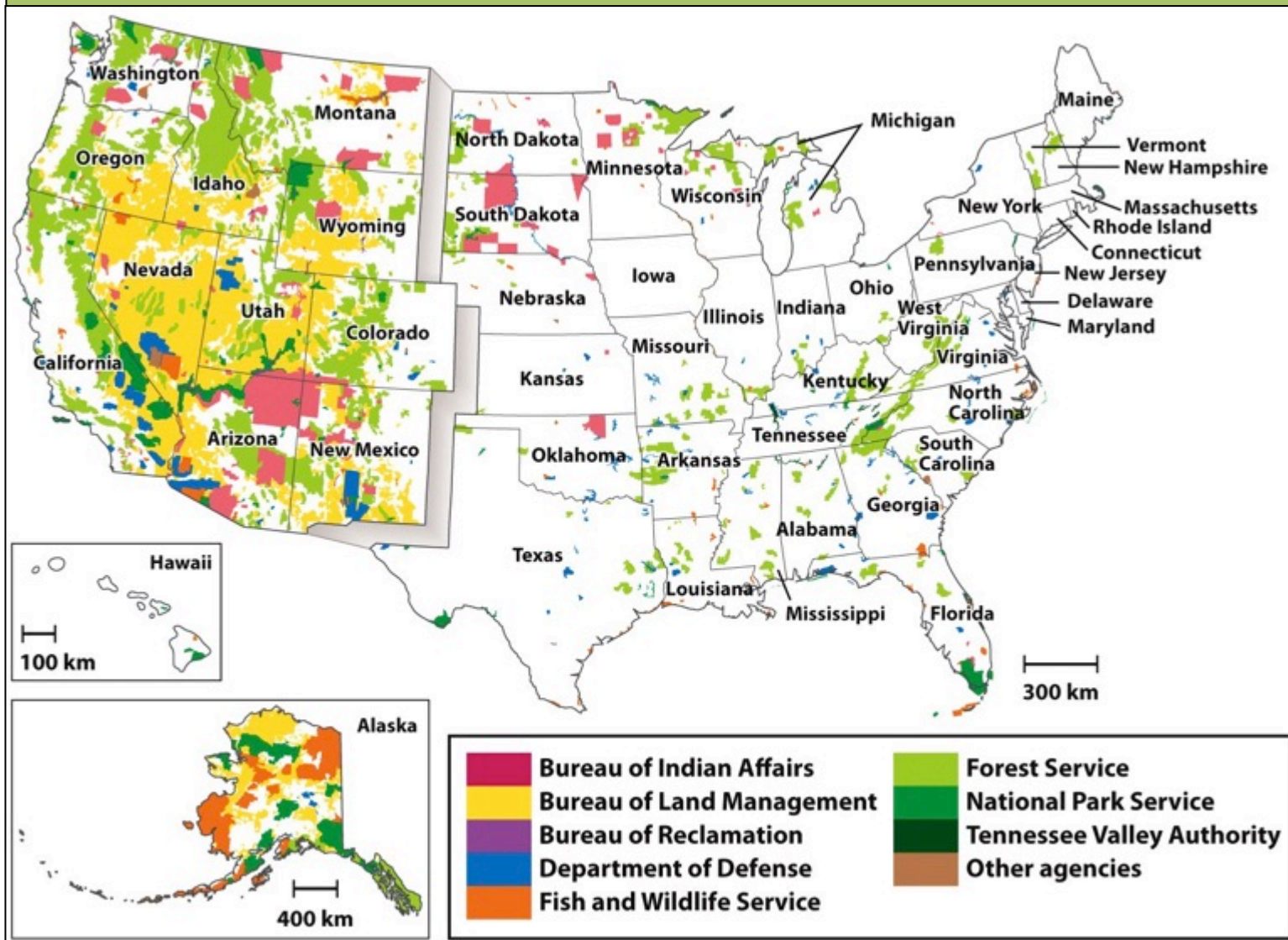
The greatest good for the greatest number of people.

- ✧ **National Park Service (NPS)**
- ✧ **Forest Service (FS)**
- ✧ **Bureau of Land Management (BLM)**
- ✧ **Fish and Wildlife Service (FWS)**

42% of land in U.S. is publicly held; includes rangelands, national forests, national parks, national wildlife refuges and wilderness areas.

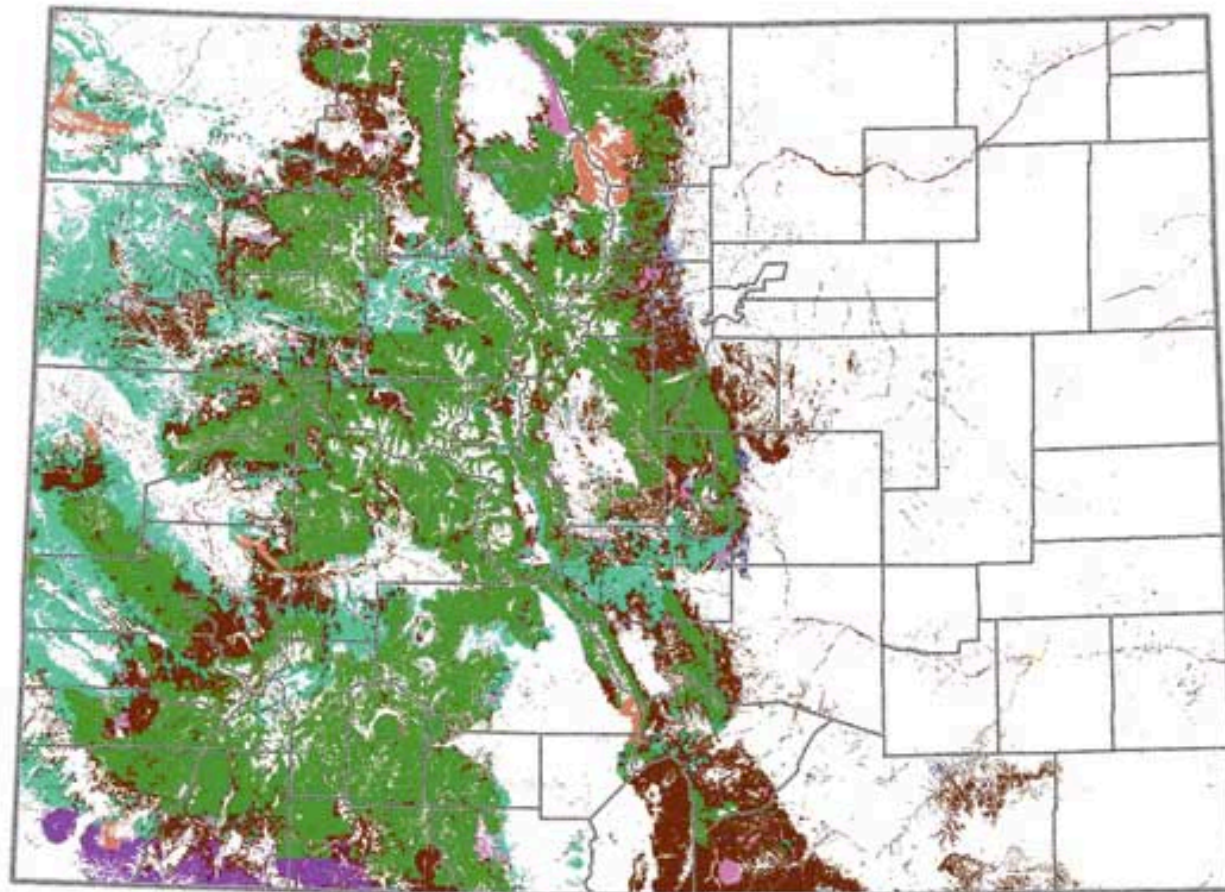


Public Land Management in the United States



Public Land Management in the United States

Colorado



USFS	NPS	DOD	State	Local gov't
BLM	USFWS	Federal-Other	Tribe	Private



Public Land Management in the United States

National Park Service

58 Major national parks in the U.S.

Conserve lands and resources and make them available for public use. Activities that harvest or remove resources generally are prohibited.

Stresses on National Parks

Biggest problem may be popularity: *“Are we loving our national parks to death?”*

- Noise
- Congestion
- Pollution
- Damage or destruction to vegetation and wildlife



Public Land Management in the United States

National Park Service- Threats

Damage from nonnative species

- Great Smokey Mountain N.P.
 - European wild boars threaten vegetation
- Olympic N.P.
 - mountain goats trample and destroy roots; accelerate erosion
- Non-native species; i.e. introduced plants, insects, worms
- Native species sometimes killed or removed
- Threatened islands of biodiversity
 - Air pollution
- Need billions in trail and infrastructure repairs



Public Land Management in the United States

Joshua Tree National Park

Threatened by Climate Change & Invasive Species

- 20-year biological study, found few or no young Joshua trees in roughly 30% of their range.
- **Adaptation** to desert climate: Joshua trees have a shallow network of roots, that spread out 5-6 meters around each plant and suck up large volumes of rainwater; therefore, they can go long periods of time without rain.
- Seedlings lack this root network and depend on regular rain events to survive.



Public Land Management in the United States

Joshua Tree National Park

Threatened by Climate Change & Invasive Species

- Increasing frequency and duration of droughts; new Joshua trees are not replacing old ones.
- A Mojave Desert weather station recorded mean temperature has increased 2 °F over 40 years.
- But the real change came in the nighttime lows, which are nearly 8 °F above average.
- Desert plant adaptation: open stomata at night to take in CO₂; closed during day to hold in water i.e. reduce evaporative water loss.
- This means that even if precipitation is about the same, the evaporation rate is higher (because it is so much warmer at night) which means less water is available to the plants.



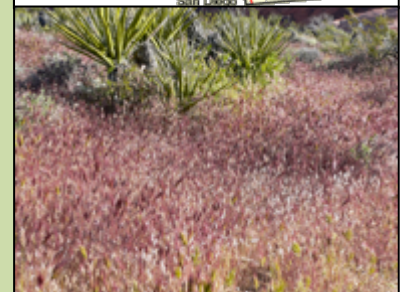
Public Land Management in the United States

Joshua Tree National Park

Threatened by Climate Change & Invasive Species

Invasive Grasses & Nitrogen

- The spread of the invasive grass, red brome (native to the Mediterranean)
- Fuels intensely hot wildfires that can incinerate even the largest Joshua trees.
- Fires are becoming larger, more frequent, and more destructive since 1945 (park records).
- Atmospheric nitrogen deposition from SoCal auto exhaust is driving (fertilizing) spread of the grass.
- Fertilizes desert soil facilitating rapid spread of red brome.
- Outcompeting native plants, changing species composition, and making fires more likely which is detrimental to young Joshua trees.



Public Land Management in the United States

Rocky Mountain National Park Ecosystems Threatened by Invasive Species

Cheat Grass

- Aggressive invasive exotic species
- Introduced from Europe; invaded Rocky Mountain ecosystem
- Very specialized grass: a high-volume seed producer, opportunistic & can outcompete native plants and establish dominance
- Invasion can convert intermountain sagebrush scrubland to Cheat grass monocultures
- This reduces abundance and genetic diversity of native plants, leading to an overall reduction in biological diversity



Public Land Management in the United States

Rocky Mountain National Park Ecosystems Threatened by Invasive Species

Cheat Grass

- Outcompete native plants because it depletes the soil of water, altering soil ecology and biogeochemical cycles
- Highly flammable and increases potential and frequency of wildfires
- Changes plant communities; therefore it affects wildlife habitat
- Such changes reduce the availability of appropriate habitat for several species of birds, including: Brewer's sparrow, sage sparrow, and sage-grouse

Solution? IPM: Herbicide & Mechanical Removal

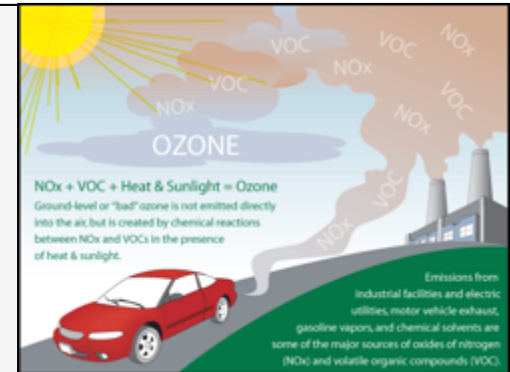


Public Land Management in the United States

Rocky Mountain National Park Ecosystems Threatened by Air Pollution

Ozone

- Ozone is produced by the interaction of nitrous oxides, sunlight and heat.
- RMNP is prone to high ozone levels on warm, summer afternoons and evenings.
- Car exhaust from Front Range communities is a main source of nitrous oxides.
- There are 11 different plant species in the park that are known to be susceptible to injury from high ozone levels. A five-year study from 2006-2010 documented ongoing leaf injury from ozone in the park.



Cutleaf
coneflowers are
affected by high
ozone levels.

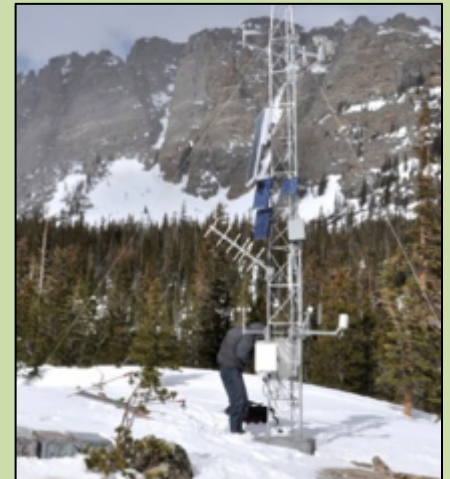
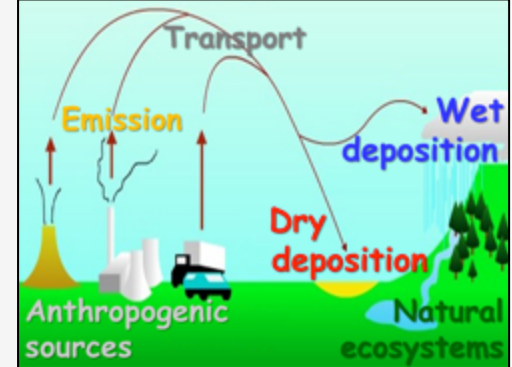
Public Land Management in the United States

Rocky Mountain National Park Ecosystems Threatened by Air Pollution

Nitrogen Deposition

Nitrogen is transported by wind combined with moisture in the air, and then deposited in the park by rain or snow.

- Pollutant concentrations: may begin causing unnatural ecosystem changes.
- Excess nitrogen may promote non-native plants, increase acidification of aquatic systems, & reduce forest health.
- Sources of human made or excess atmospheric nitrogen include power plants, vehicle exhaust



Public Land Management in the United States

Solutions

National Parks

- Integrate plans for managing parks and nearby federal lands
- Add new parkland near threatened parks
- Buy private land inside parks
- Locate visitor parking outside parks and provide shuttle buses for people touring heavily used parks
- Increase federal funds for park maintenance and repairs
- Raise entry fees for visitors and use resulting funds for park management and maintenance
- Seek private donations for park maintenance and repairs
- Limit the number of visitors in crowded park areas
- Increase the number of park rangers and their pay
- Encourage volunteers to give visitor lectures and tours



Public Land Management in the United States

National Park Service

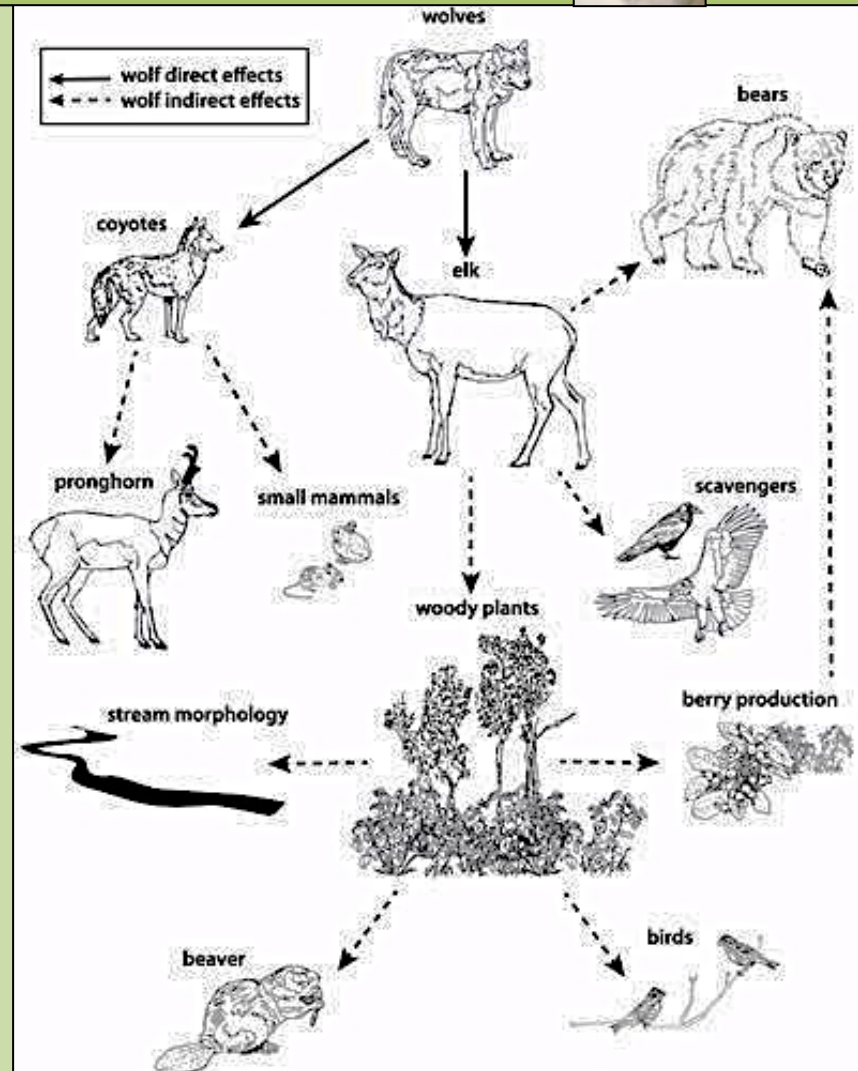
Reintroducing the Gray Wolf to Yellowstone National Park



- Wolves are **keystone species**
- 1995: reintroduced; 2009: 116 wolves in park

Trophic Cascade: wolves prey on elk suppressing elk population growth and pushing them to a higher elevation (away from riparian zone)

- Allows for regrowth of aspen, cottonwoods, and willows
- This creates food and shelter for beaver which build more beaver dams = more wetlands
- More aspens = more bird habitat
- More trees=less erosion into streams = healthier streams = more fish; etc.



Public Land Management in the United States

National Park Service

Yellowstone Trophic Cascade- How Wolves Change Rivers



Public Land Management in the United States

Forest Service

Manages for multiple uses and sustained yields of various products and services, including:

- timber harvesting
- recreation
- grazing
- watershed protection
- fish and wildlife habitats

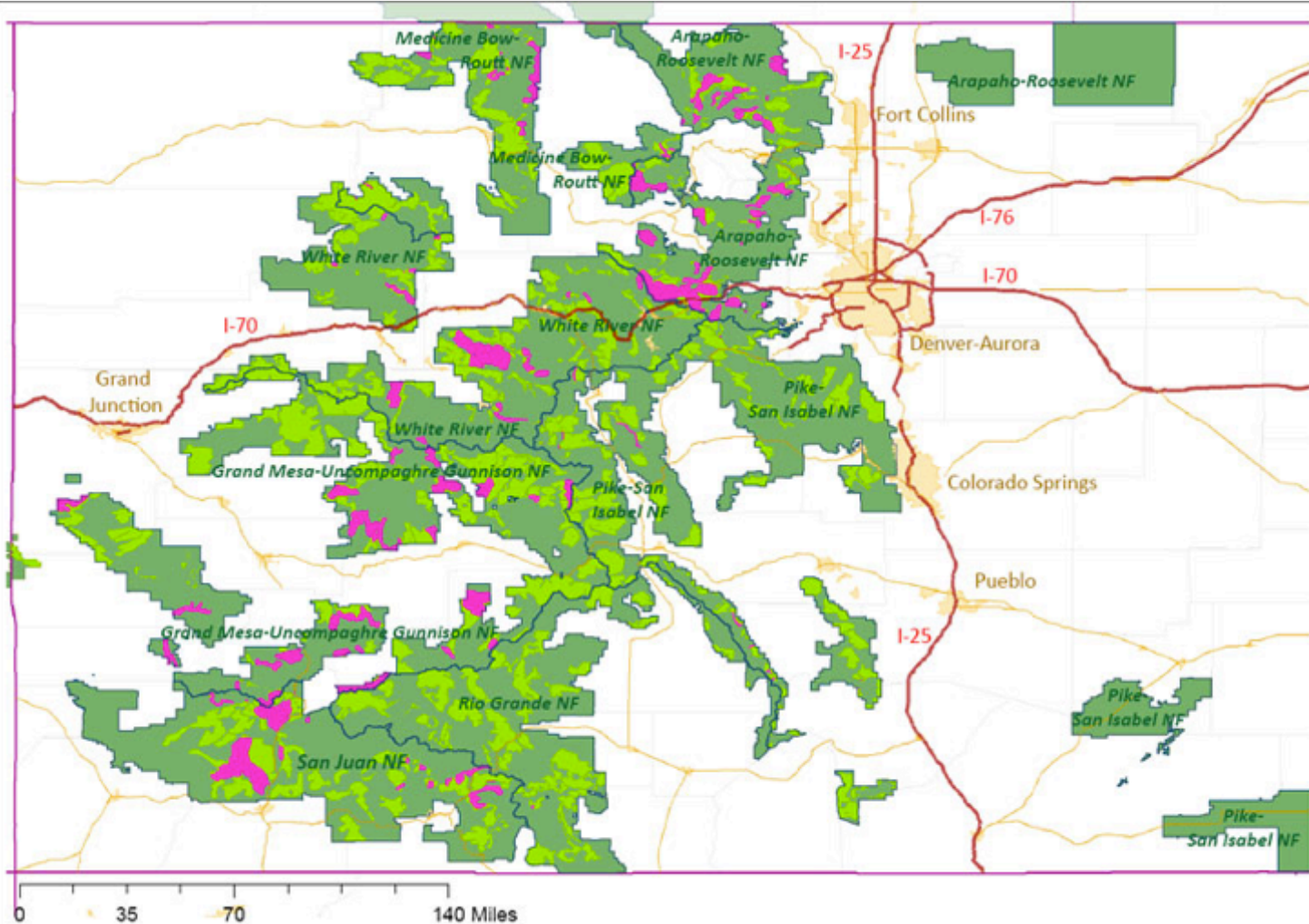
Most of the Forest Service lands are designated national forests.

Wildfire protection is increasingly important.



Public Land Management in the United States

Forest Service



Public Land Management in the United States

Forest Service



U. S. Forest Service Resiliency Project by Beulah Designed to Slow Wildfire Growth- In April 2015, district crews began utilizing an AmeriCorps National Civilian Community Corps crew to help drastically thin the forest by cutting small diameter trees known as “ladder fuels” in order to minimize the possibilities of catastrophic wildfires.



Public Land Management in the United States

Bureau of Land Management

BLM manages public land and administers multiple-use, sustained-yield mandate that supports a variety of uses and programs:

- mineral extraction (mining)
- energy development
- recreation
- rangelands: livestock grazing, wild horses, burros etc.
- conservation

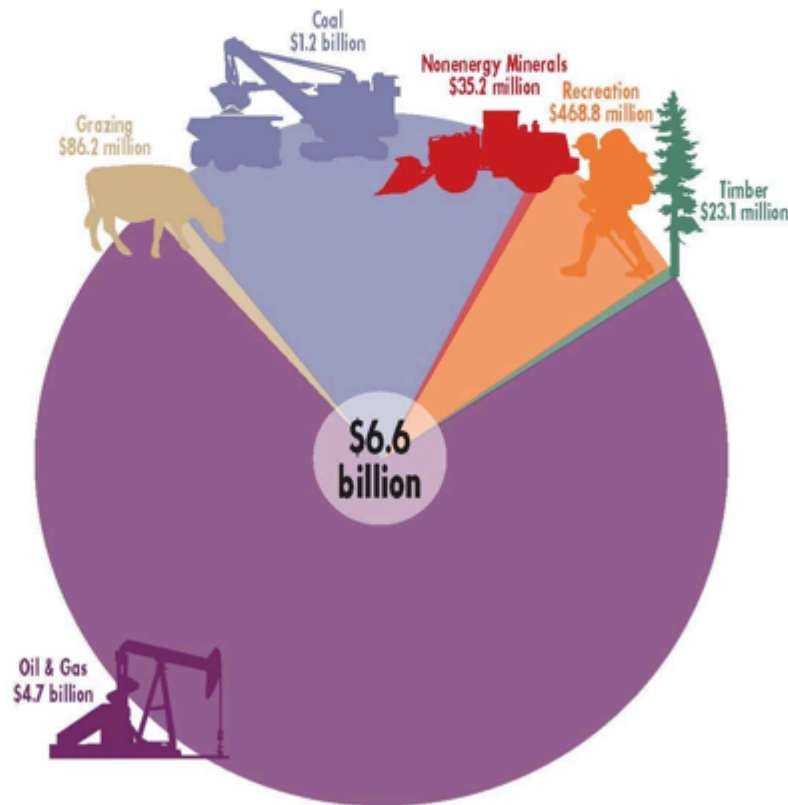


Public Land Management in the United States



BLM Colorado

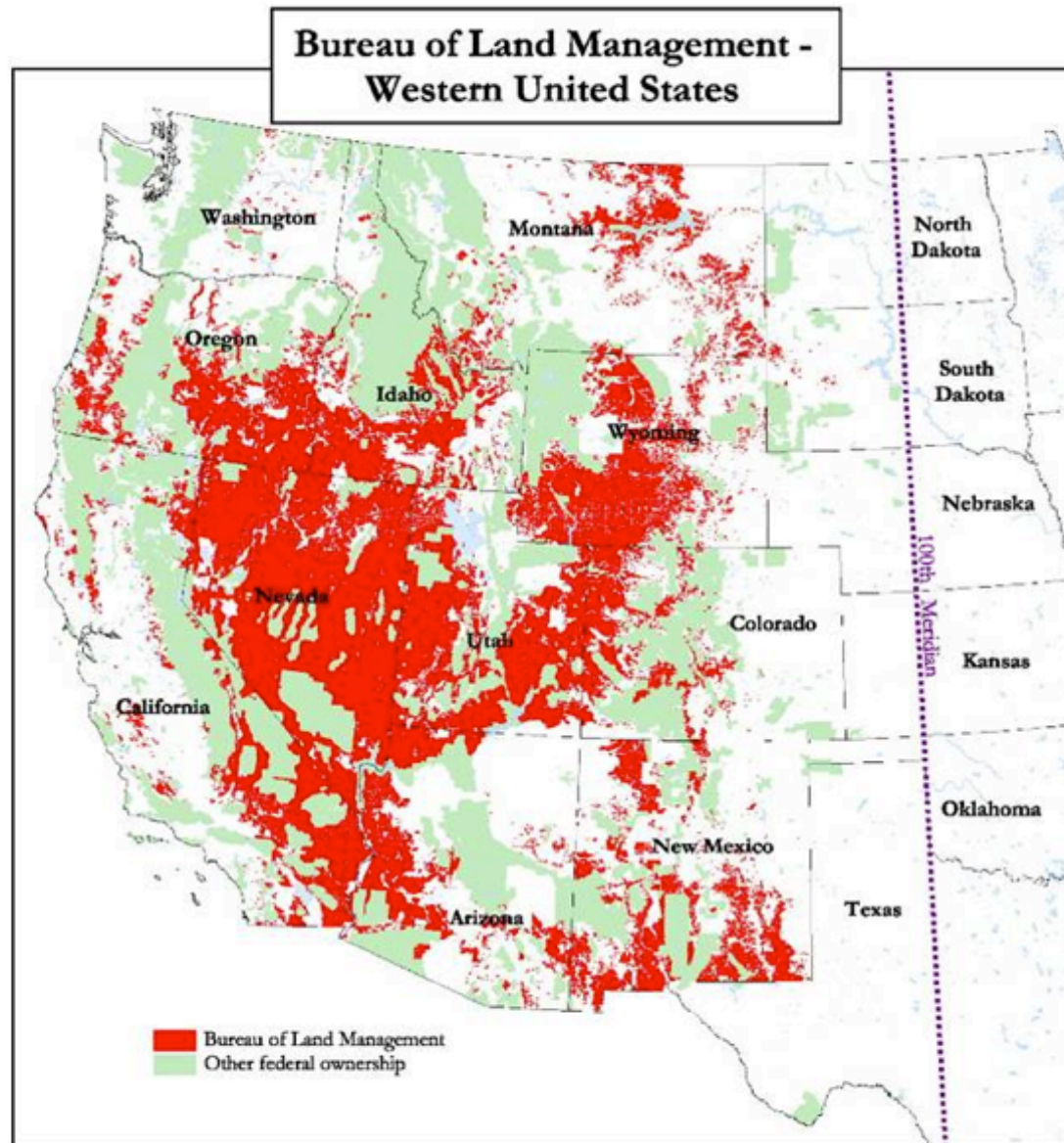
Economic Contributions from BLM-Managed Lands



Public Land Management in the United States



Public Land Management in the United States



Public Land Management in the United States

Fish and Wildlife Service

The FWS manages public land primarily to conserve and protect animals and plants.

National Wildlife Refuge System

FWS manages National Wildlife Refuge System; network of lands and waters that are managed for **conservation** and often **restoration** of the fish, wildlife, and plant resources and their habitats.

Endangered Species Act (ESA; 1973)

FWS is responsible for administering the Endangered Species Act (ESA; 1973). The goal of the Endangered Species Act is the recovery of listed species to levels where protection under the Act is no longer necessary.

- listing endangered and threatened species
- listing critical habitat
- Developing and administering habitat conservation plans



FWS- National Wildlife Refuge System

Rocky Mountain Arsenal National Wildlife Refuge

EPA Superfund Program: ROCKY MOUNTAIN ARSENAL (USARMY), ADAMS COUNTY, CO

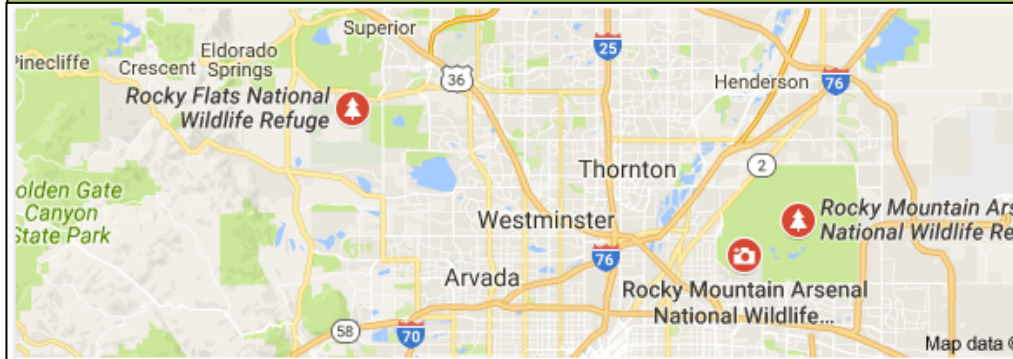
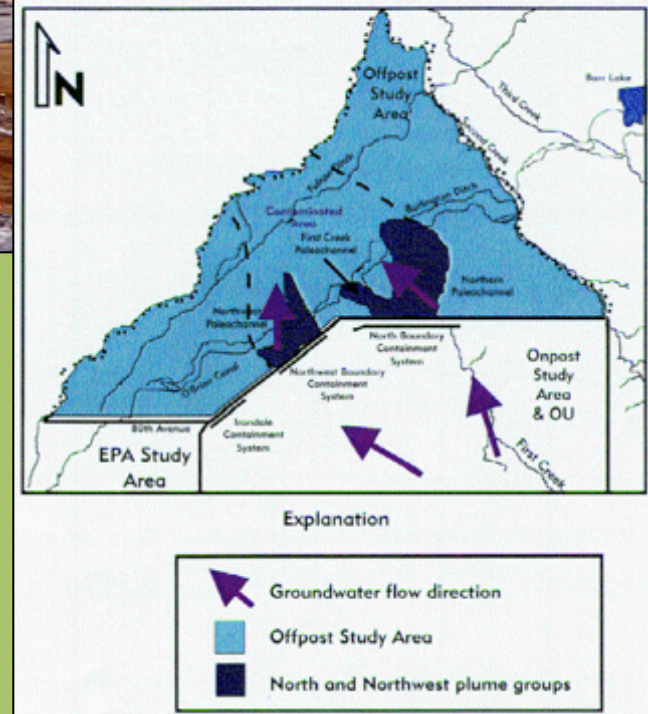


Figure 5 - The generalized extent of groundwater contamination plumes in the Offpost Study Area, Rocky Mountain Arsenal. (After HLA, 1993, Fig. 5.1)



1942-1992 Weapons manufactured at RMA included both conventional and chemical munitions, including white phosphorus (M34 grenade), napalm, mustard gas, lewisite, and chlorine gas. RMA is also one of the few sites that had a stockpile of Sarin gas (aka nerve agent GB), an organophosphorus compound.

Public Land Management in the United States

Protecting Wilderness to Preserve Biodiversity

Wilderness Act (1964): Created the National Wilderness Preservation System; Wilderness are wild or primitive portions of national forests, national parks, wildlife refuges where timbering, most commercial activity, motor vehicles, and human made structures are prohibited.

- Encompasses variety of ecosystems: swamps Southeast U.S., tundra in Alaska, snowcapped peaks in Rocky Mountains, hardwood forests in Northeast U.S., and deserts in Southwest U.S.
- ***Managed by NPS, FWS, BLM, and Forest Service***

Wild and Scenic Rivers Act (1968): Established a system of areas distinct from traditional park concept to ensure protection of river environments; maintains free-flowing condition. Preserves rivers with distinct scenic, recreational, geologic, cultural or historic values.



Public Land Management in the United States

Wilderness Areas-

Collegiate Peaks Wilderness San Isabel National Forest

South of Buena Vista, CO



Public Land Management in the United States

Wilderness Areas- The Brainard Lake Recreation Area is set in a glacially-carved valley and the high peaks of the Indian Peaks Wilderness Area (Within Arapaho & Roosevelt National Forests) North of Boulder, CO



Nature Reserves

Land Trust Groups

Private, nonprofit organizations that actively work to conserve land by undertaking or assisting in stewardship of the land, purchasing the land, or assisting in the acquisition of conservation easements.



Conservation Easements

- Conservation easements protect land for future generations.
- A conservation easement is a restriction placed on a piece of property to protect its associated resources.
- Prevents future development of the land
 - e.g. logging, ranching, mining etc.
- A conservation easement is legally binding, whether the property is sold or passed on to heirs (permanently written into the deed).
- Economic benefit: landowners are eligible for tax breaks.

Nature Reserves

Silver Creek Nature Conservancy Preserve near Sun Valley, Idaho



Global Land Use & Management

Globally, National Parks Face Many Environmental Threats

Worldwide: 1100 major national parks

Parks in developing countries have the greatest biodiversity of all parks globally, but only 1% of these parks are protected.

Threats to these parks include:

- Illegal animal poaching (illegal hunting)
- Illegal logging and mining

Nature Reserves Occupy Only a Small Part of the Earth's Land

- Currently less than 13% is protected
- Conservationists goal: protect 20%
- Cooperation between government, private groups and individuals

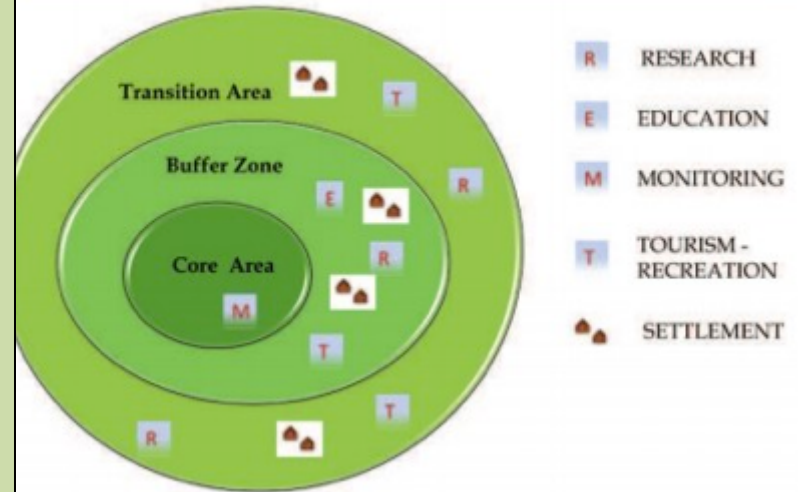
The Buffer Zone Concept

United Nations: 669 biosphere reserves in 120 countries

Biosphere reserves have three zones:

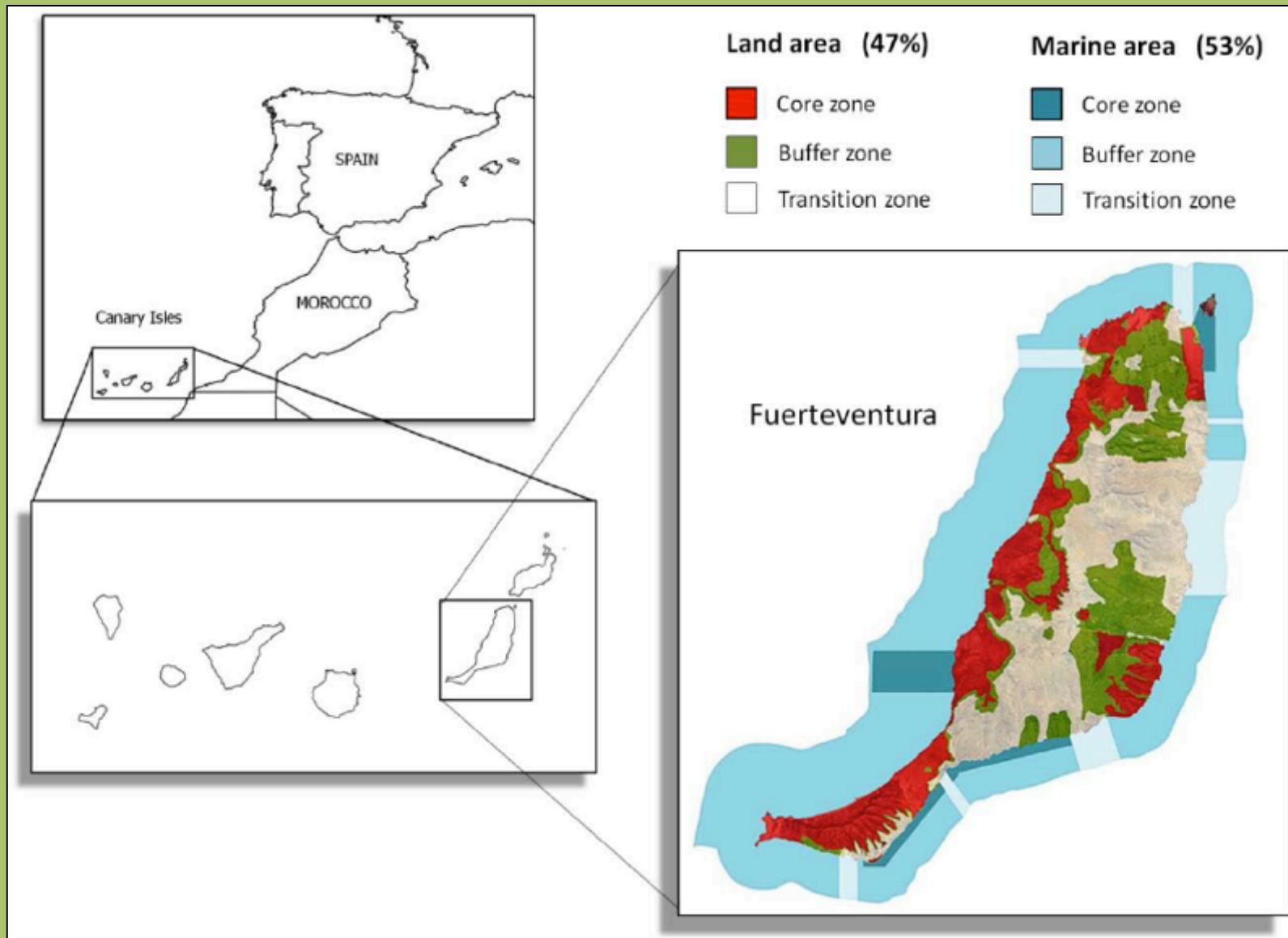
1. **Core area:** a strictly protected ecosystem; conservation of landscapes, ecosystems, species and genetic variation.
2. **Buffer zone:** surrounds core areas; activities compatible with sound ecological practices that can reinforce scientific research, monitoring, training and education.
3. **Transition area:** part of the reserve where the greatest activity is allowed; economic and human development that is socio-culturally and ecologically sustainable.

BIOSPHERE RESERVE ZONING



The Buffer Zone Concept

United Nations Biosphere Reserves: The Canary Islands

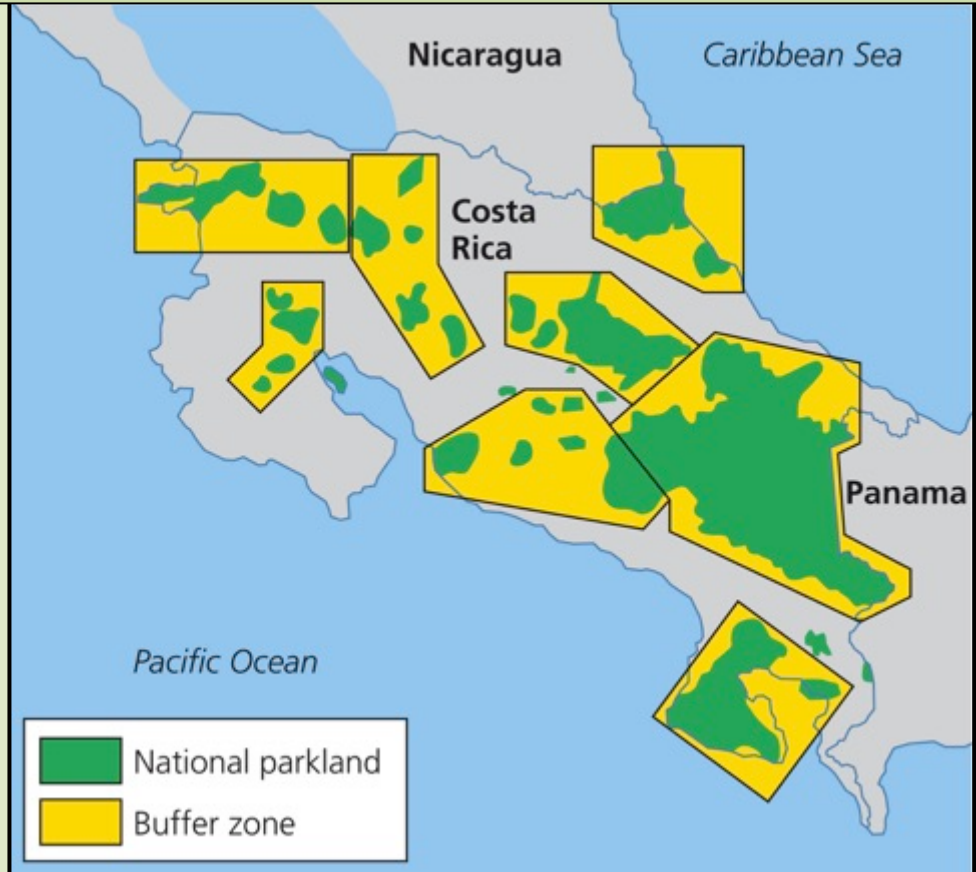


Global Land Use & Management

Costa Rica- Tropical Rain Forest Conservation

A Global Conservation Leader

- 1963–1983: cleared much of the forest; cattle ranching
 - 1986–2006: forests grew from 26% to 51%
 - $\frac{1}{4}$ of land in nature reserves and natural parks Estimated 500,000 plant and animal species
 - Earns \$1 billion per year in tourism → **Ecotourism**
 - Parks & Reserves
 - 8-Mega-reserves
- Gov't eliminated logging subsidies; now pays landowners to manage forest.



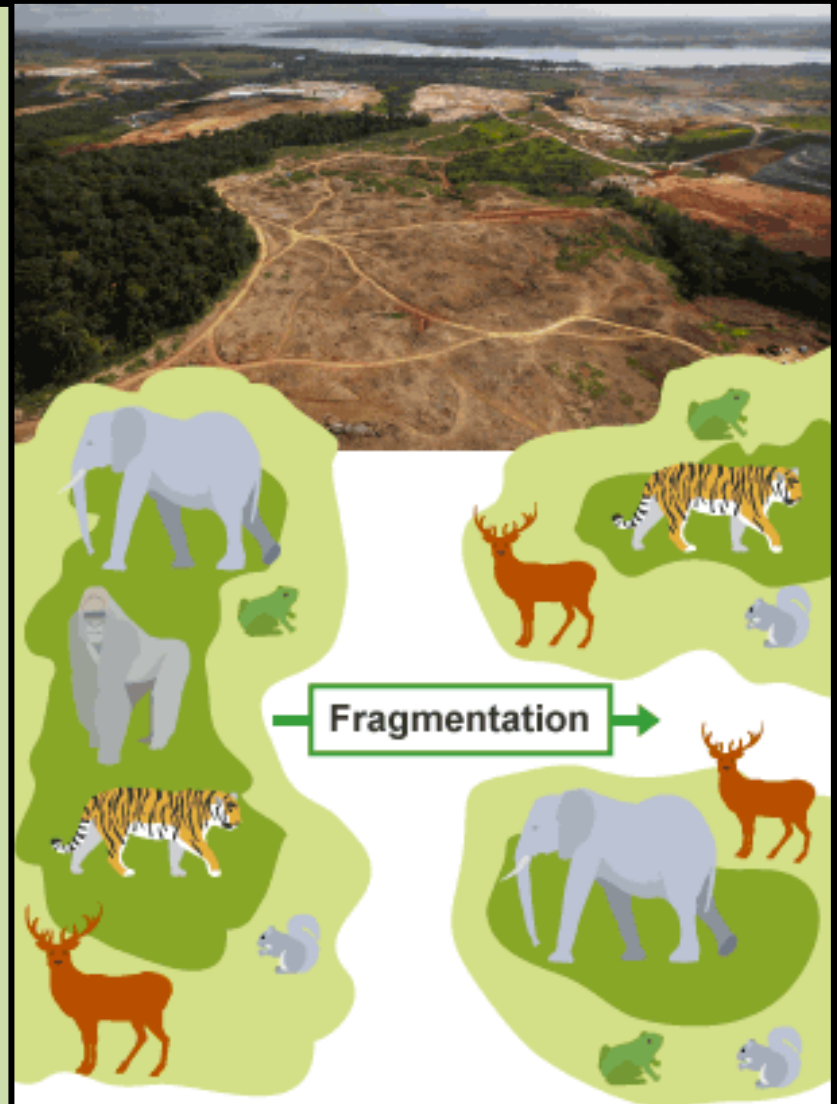
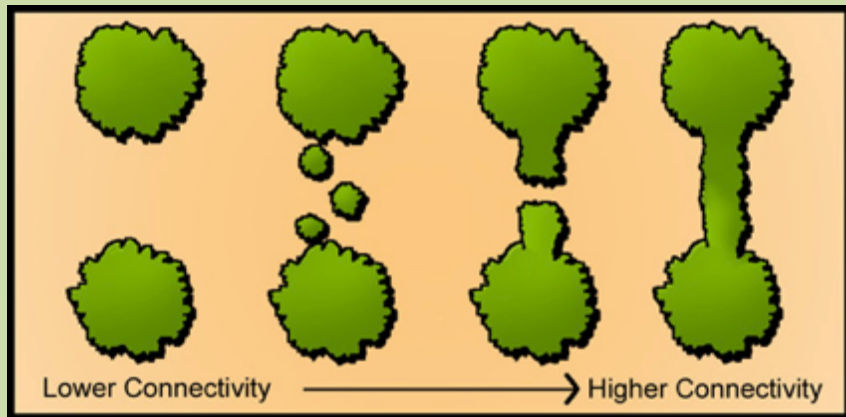
Buffer Zones: used for sustainable logging, crop farming, cattle grazing

Global Land Use & Management

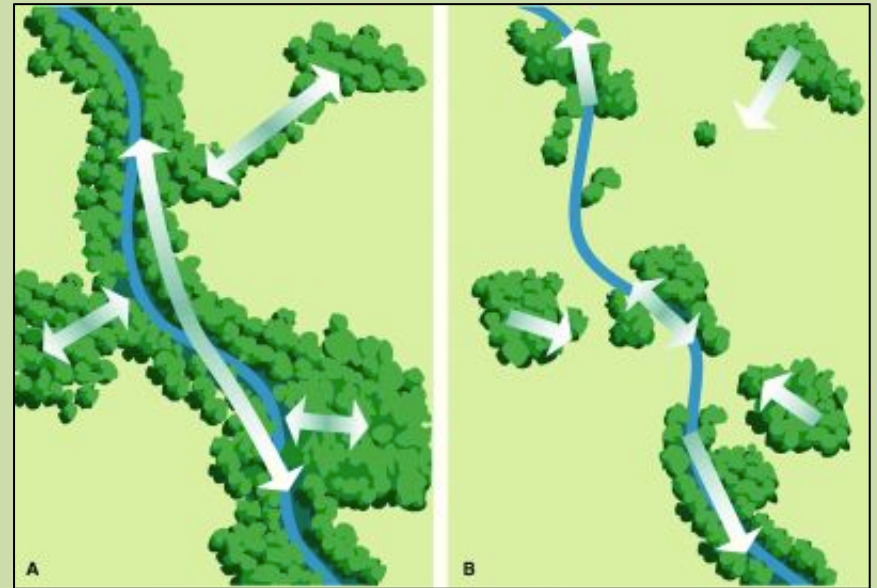
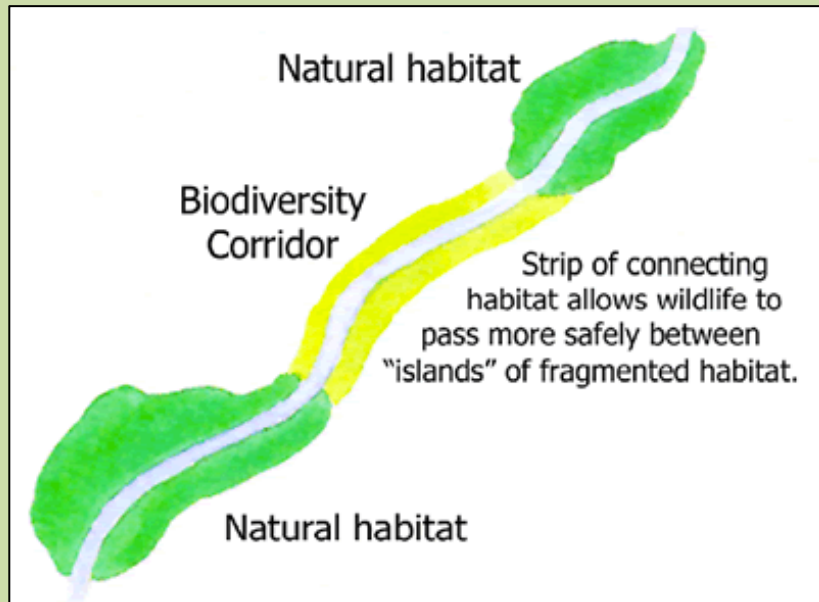
Designing and Connecting Nature Reserves

Habitat Corridors

- Provides connectivity between habitat fragments
- Increase genetic diversity through gene flow
- Decreases human wildlife conflict
- Help support more species and allows for migration



Habitat Corridors



Habitat Corridors



Western Wildway Network

**Connecting and Restoring the
Spine of the Continent**

**Western Wildway Conservation
Planning Boundaries**

-  Yukon North Slope
-  Brooks - Richardson Ranges
-  Taku River
-  Yellowstone to Yukon
-  Greater Crown of the Continent
-  Heart of the West
-  Southern Rockies
-  Colorado Plateau
-  Grand Canyon
-  New Mexico Highlands
-  Sky Islands
-  Sierra Madre

Western Wildway



Habitat Corridors



Habitat Corridors



Biodiversity Hotspots

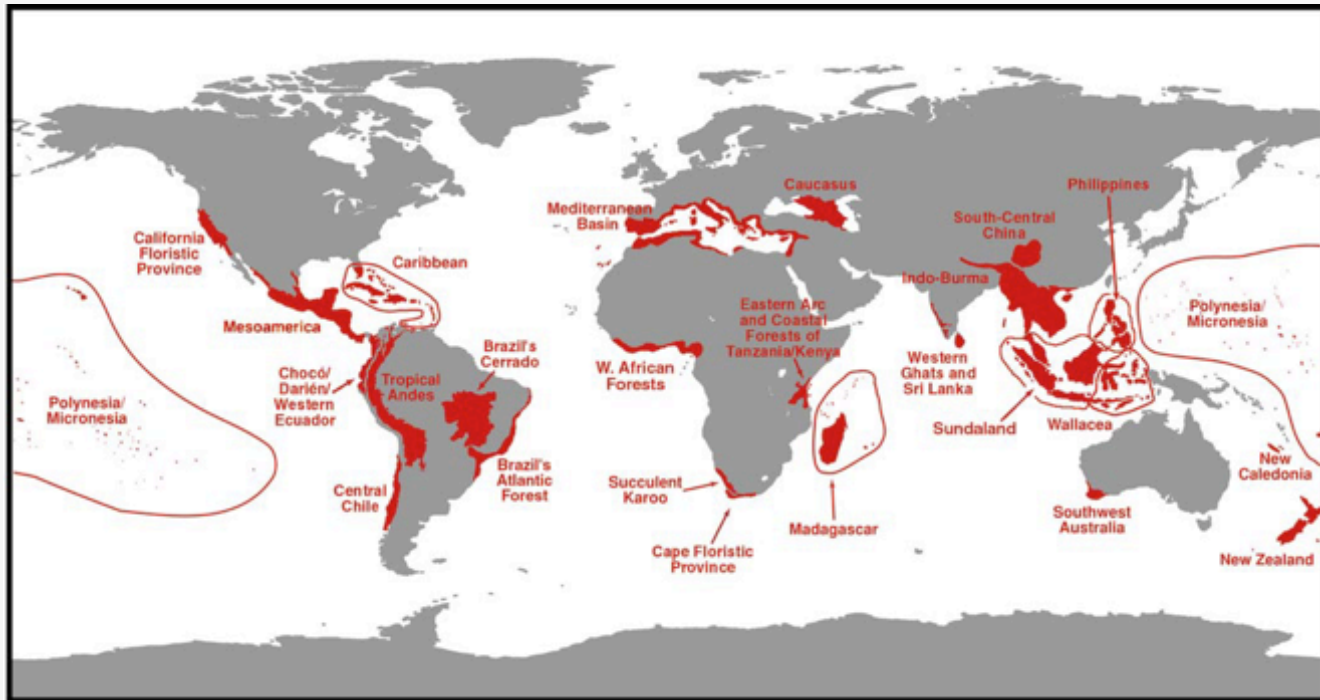
How can we support the most species at the least cost?

One way is to identify areas where exceptional concentrations of endemic species are undergoing exceptional loss of habitat.

36 biodiversity hotspots

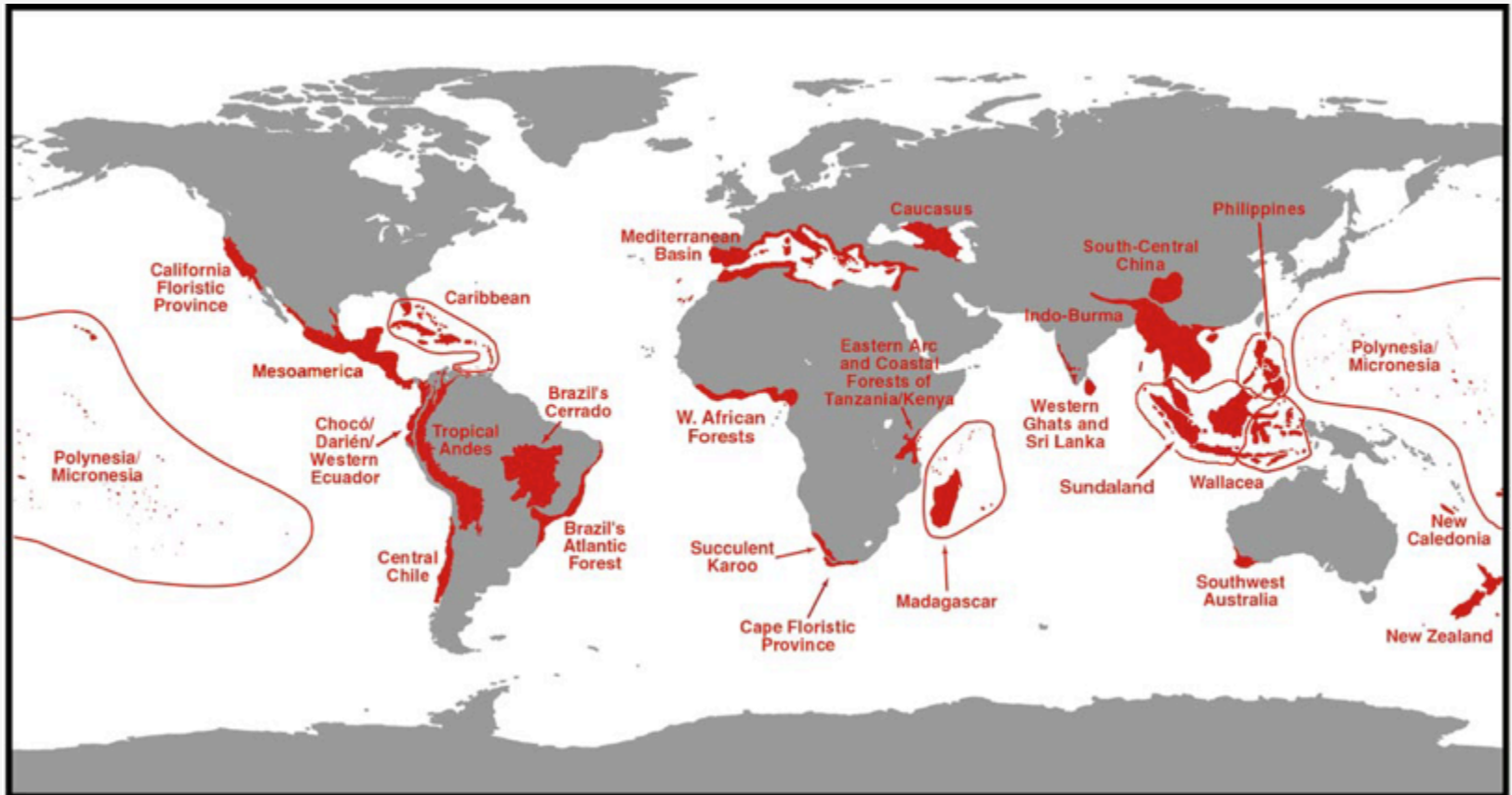
What are the criteria for classification?

- 1) 1,500 endemic vascular plant species, i.e. found nowhere else;
- 2) 30% or less of its original natural vegetation, i.e. must be threatened.



Biodiversity Hotspots

They represent just 2.3% of Earth's land surface, but they support more than half of the world's plant species as endemics — i.e., species found no place else — and nearly 43% of bird, mammal, reptile and amphibian species as endemics. 1.2 billion people live in these fragile places and depend on their ecosystem services.



Protecting Ecosystem Services

U.N. Millennium Ecosystem Assessment: 2005

4-year study; 1,360 scientists; 95 countries; \$7 million

Assessed conditions and trends in the world's ecosystems and the services they provide (such as clean water, food, forest products, flood control, and natural resources) and the options to restore, conserve or enhance the sustainable use of ecosystems.

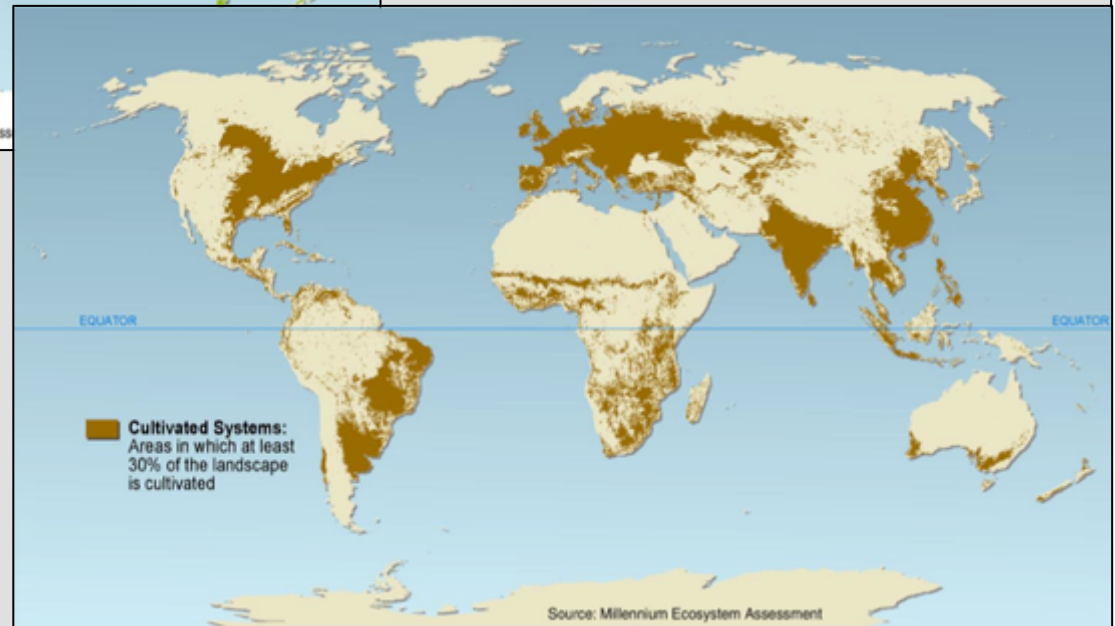
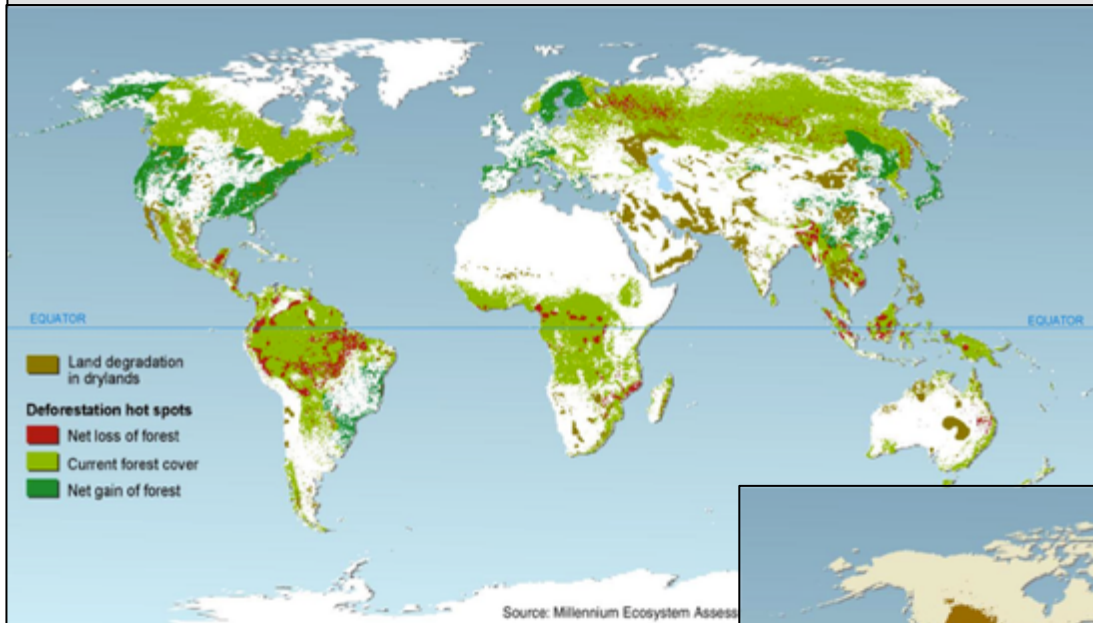
Over the past 50 years humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history, largely to meet rapidly growing demands for food, fresh water, timber, fiber and fuel. This has resulted in a substantial and largely irreversible loss in the diversity of life on Earth.

Human activities have degraded or overused 60% of the earth's natural services.

Solution: Foster cooperation among residents (often high poverty levels), government and scientists to protect people and biodiversity.

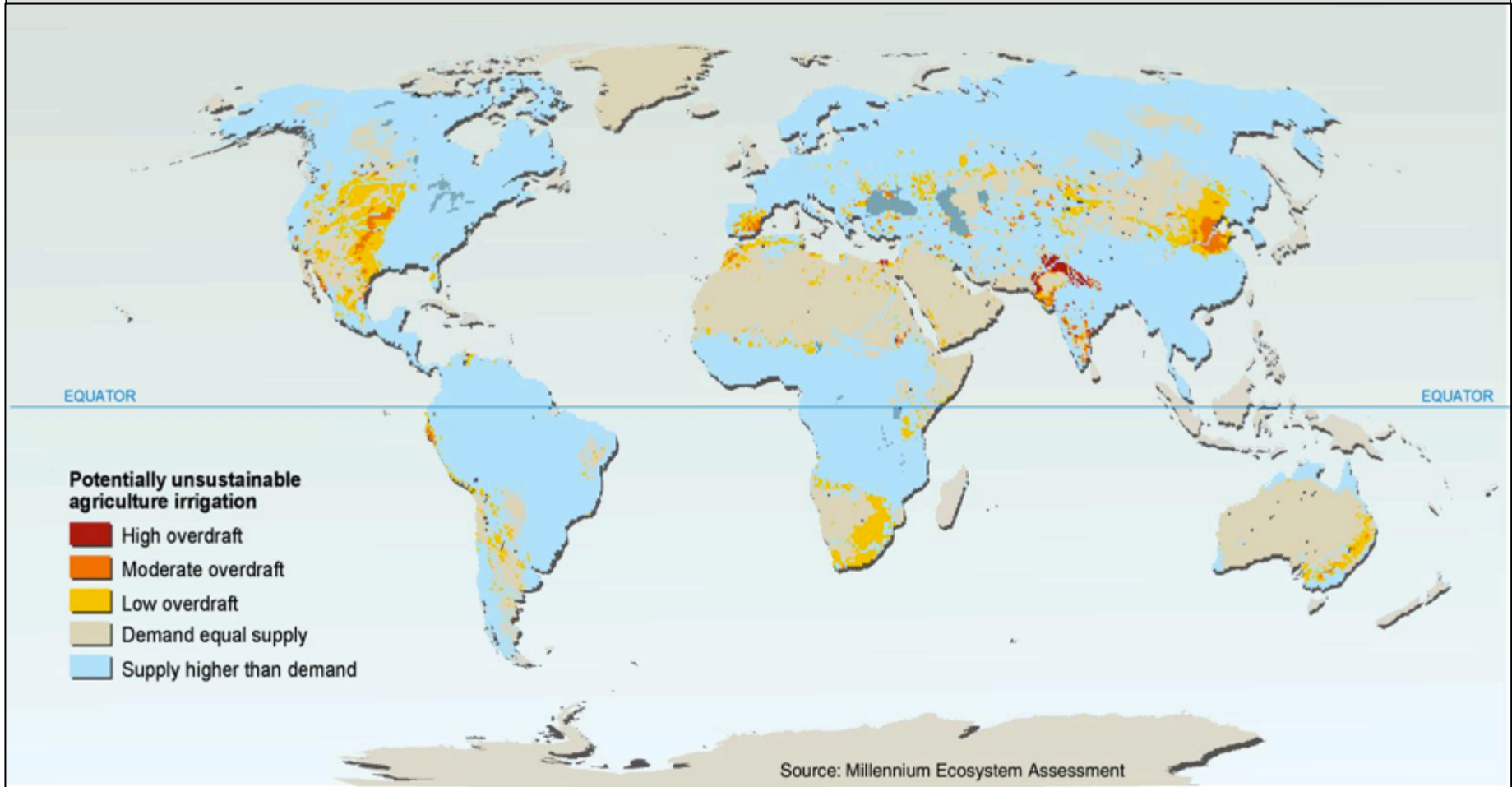
Protecting Ecosystem Services

U.N. Millennium Ecosystem Assessment: 2005



Protecting Ecosystem Services

U.N. Millennium Ecosystem Assessment: 2005



Managing Ecosystems & Repairing Damaged Ecosystems

Conservation

Controlled Use", "Scientific Management" of natural resources. "Greatest good for the greatest number of people."

Preservation

Remaining wilderness areas on public lands should be left untouched

Restoration

Repair of areas damaged by humans; returning degraded habitat or ecosystem to a condition as similar as possible to its natural state.

Replant forest or grassland, restore wetland, stream-bank improvement

Remediation

Most often used with cleanup of chemical contaminants in a polluted area.

Rehabilitation

Turning a degraded ecosystem into a functional or useful ecosystem without trying to restore it to its original condition; e.g. Removing pollutants and replanting to reduce soil erosion in abandoned mining sites, landfills, and clear-cut forests

Managing Ecosystems & Repairing Damaged Ecosystems

Mitigation

Repairing/Rehabilitating a damaged ecosystem or compensation for damage, Most often by providing a substitute or replacement area; frequently involves wetland ecosystems.

Reclamation

Typically used to describe chemical or physical manipulations carried out in severely degraded sites, such as open-pit mines or large-scale construction

Replacement

Replacing a degraded ecosystem with another type of ecosystem; e.g. A degraded forest could be replaced by a productive pasture or tree plantation

Artificial Ecosystems

e.g. Creating artificial wetlands to reduce flooding or treat sewage

Reclamation & Remediation



Reconciliation Ecology

Reconciliation Ecology: is the science of inventing, establishing and maintaining new habitats to conserve species diversity in places where people live, work or play; e.g. ***community based conservation***.

Community-based conservation

- Belize and the black howler monkeys; farmers agreed to set aside strips of land for monkey habitat
- Protect vital insect pollinators; communities establish pollinator pathways that are pesticide free and provide pollinator friendly flowering plants
- Wangari Maathari 's Green Belt Movement; Kenya-1977
50,000 members (mostly women; empowerment; planted 40 million trees; women were paid for each tree that survives; slows soil erosion; create shade; mitigate global warming
✧ 2004 Nobel Peace Prize

The Blackfoot Challenge—Reconciliation Ecology in Action

1970s: Blackfoot River Valley in Montana threatened by

- Poor mining, logging, and grazing practices
- Water and air pollution
- Unsustainable commercial and residential development



Community meetings led to

- Weed-pulling parties
- Nesting structures for waterfowl
- Developed sustainable grazing systems
- Landowners committed to legal conservation easement to preserve their land for future generations
- Created habitat corridors between large tracts of undeveloped land

Successfully restored and enhanced large areas of wetlands, streams, and native grasslands.