

Chapter 7

Lecture Outline

Sustaining Biodiversity

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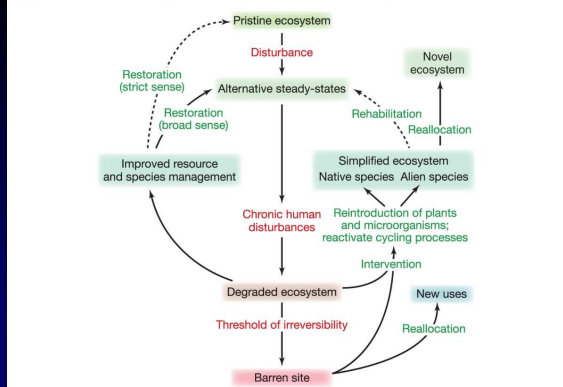
- ### Outline
- Helping Nature Heal
 - ✦ Ecological restoration
 - Restoration is Good for Human Economics and Cultures
 - Restoring Prairies
 - Restoring Wetlands and Streams
 - ✦ Everglades
 - ✦ Chesapeake Bay
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Helping Nature Heal

- **Ecological restoration** - to reverse degradation and restore native ecosystem
- Restoration to an original pristine condition is rarely possible. Often it involves compromise between ideal goals and pragmatic achievable goals.

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Terms Commonly Used in Restoration

- **Rehabilitation** - repairing ecosystem function, but not to original condition (may be similar to the original community or an entirely different community)
- **Reintroduction** - transplanting organisms from an external source to a site where they have been previously reduced/eliminated
- **Remediation** - using chemical, physical, or biological methods to remove pollution while causing as little disruption as possible
- **Reclamation** - employs stronger, more extreme techniques to clean up severe pollution or create a newly functioning ecosystem on a seriously degraded or barren site
- **Mitigation** - compensation for destroying a site by purchasing or creating one of more or less equal ecological value somewhere else

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An Interdisciplinary Approach

- Restoration draws on principles from ecology, hydrology, chemistry and soil science
- Should we attempt to restore what used to be or create a community compatible with future conditions?

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Restoration Projects Have Common Elements

- Removing physical stressors (i.e., the cause of degradation)
- Controlling invasive species
- Replanting
- Captive breeding and reestablishing fauna
 - ✦ Example: wolves returned to Yellowstone National Park
- Monitoring

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Early Conservationists

- Gifford Pinchot - First head of the U.S. Forest Service. Pioneer in resource management. Promoted science-based management of trees as a commercial resource for logging.
- Aldo Leopold - pioneer in restoration ecology with theories of game management, conservation, and land restoration. He wrote a land ethic stating that responsible land stewardship meant the land was capable of self renewal.

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Leopold's Shack

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Nature is Resilient

- Sometimes stopping the damage is all that is necessary and Nature can rebuild.
- For example the forests in Vermont today are interconnected biological communities
 - ❖ By 1840, early settlers had cleared the land and sheep farming dominated. Only 20% of forest remained.
 - ❖ Today 80% of the land is forested. Much of the forest resembles old growth forest and moose, bear, pine martens, and bobcats have become re-established.
 - ❖ Vermont law requires consulting a professional forester and developing a plan before cutting forested areas.

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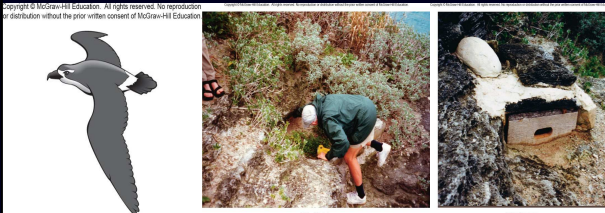
Native Species May Need Help to Reestablish

Today, the Bermuda cahow is Bermuda's national bird.

- ❖ This endemic bird was thought to be extinct by the mid 1600s due to human hunting and predation by hogs, cats, and rats.
- ❖ In 1951, 18 nesting pairs were discovered.
- ❖ Protection program began on Nonsuch Island, which involved removing invasive species, reintroducing native vegetation, creating nesting burrows, and protecting against predators.
- ❖ By 2002, there were 200 birds.

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The Bermuda Cahow



(a) Bermuda cahow (b) David Wingate examines a cahow nest © William P. Cunningham (c) Long-tail excluder at mouth of burrow © William P. Cunningham

Cahow

Nonsuch Island

Artificial burrow (to keep out tropic birds)

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Restoring Forests Has Benefits

- Logging companies reforest cut areas.
 - ❖ Creates a monoculture that does not have the complexity of natural forest
 - ❖ But does provide ground cover, habitat for some species, and lumber
- War-torn Rwanda began a country-wide forest restoration in 2001.
 - ❖ 85% of the population still subsists on farms on degraded land
 - ❖ Restoration of forest conserves the national wildlife, including the mountain gorilla.
 - ❖ Tourists visit these areas for wildlife viewing

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Trees Improve Our Quality of Life

- Trees improve air quality and provide shade for cooling.
- Trees provide wildlife habitat
- United Nations billion tree initiative was inspired by Wangari Maathai's Green Belt Movement in Kenya

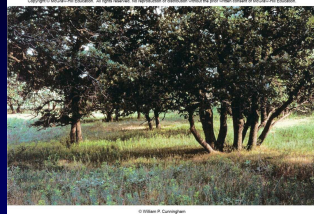


Everyone can participate. Have you planted a tree?

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Oak Savanna

- An oak savanna is a forest with scattered open grown trees where the canopy covers 10% to 50% of the area and the ground has grasses and flowering plants.
- Most common tree is the fire-adapted bur oak.



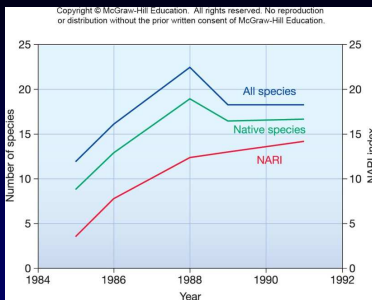
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Fire is an Essential Tool for Savanna Restoration

- Oak savanna once covered areas between Great Plains and the deciduous forest of the eastern U.S.
 - ❖ Wisconsin had 2 million ha; less than 0.01% is left.
 - ❖ Difficult to restore because it is maintained by fire
 - Somme Prairie Grove in Cook County, Illinois is being restored.

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Somme Prairie Grove Restoration



The results of the monitoring of the restoration show that native species are increasing. NARI stands for Natural Area Rating Index and it measures the frequency of native species associated with a high quality community.

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Recognizing the Role of Fire

- Land managers now recognize fire as a key factor in maintaining/restoring many forest types.
 - ✦ Can also allow natural fires to burn
 - ✦ Superior National Forest in Minnesota has started a program of prescribed fires to maintain complex forest structure
 - ✦ Periodic prescribed burns protect ancient sequoias in California

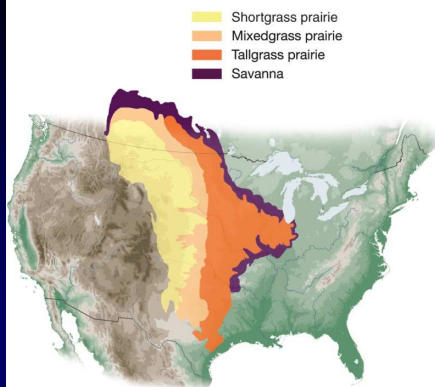
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Restoring Prairies

- Before European settlement, the eastern edge of the Great Plains was covered by tallgrass prairie, with grasses reaching a height of 2 m (6 ft).
 - ✦ Less than 2% remains
- The middle of the Great Plains contained a mixed prairie of bunch and sod-forming grasses.
- The western edge of the Great Plains, with less rainfall, was covered with shortgrass prairie containing bunch grasses 30 cm (1 ft) in height.
- These prairies were maintained by grazing and by fires.

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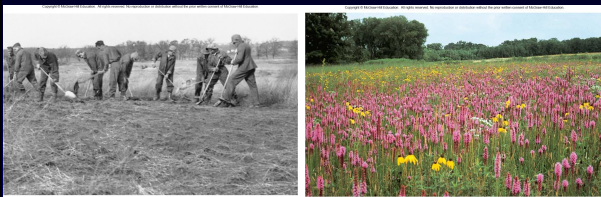
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Fire is also Crucial to Prairie Restoration

- In 1934, Aldo Leopold began to re-create tallgrass prairie on an abandoned farm in Madison, Wisconsin (now the Curtis Prairie).
 - ❖ Discovered that fire was essential. Kills weeds and removes soil nitrogen, which gives low-nitrogen native species an advantage.
- Nature Conservancy has tallgrass prairie northwest of Tulsa, Oklahoma
 - ❖ 1/3 of each pasture burned per year
 - ❖ Bison re-introduced

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The Curtis Prairie in Wisconsin



(a) Courtesy of Wisconsin-Madison Archives (b) Courtesy University of Wisconsin Arboretum

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Shortgrass Prairie Preserved

- The middle of the Great Plains has been fertile cropland due to irrigation by water from the Ogallala aquifer. This water is being depleted and it may be impossible to continue our current mode of farming there.
- Human population is leaving these areas.
- Some believe the best use of the land is to return it to **buffalo commons**, allowing buffalo to graze freely.

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Shortgrass Prairie Preserved

- Saving shortgrass prairie in Montana
 - ❖ Nature Conservancy bought the Matador ranch, but permits ranchers to use the land in exchange for agreements to protect prairie dogs and sage grouse, control weeds, and allow fire.
 - ❖ American Prairie Foundation is buying land, pulling out fences, eliminating buildings and returning the land to wilderness. Plans to restore elk, bison, wolves, and grizzly bears.
 - Locals resent the reintroduction of predators and of outside funding

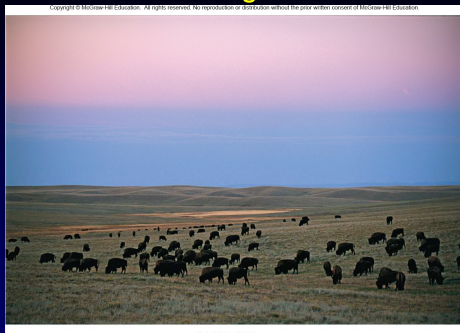
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Restoring Shortgrass Prairie in Montana



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Bison on Shortgrass Prairie



- They are adapted to harsh climate
- Their meat can be marketed.

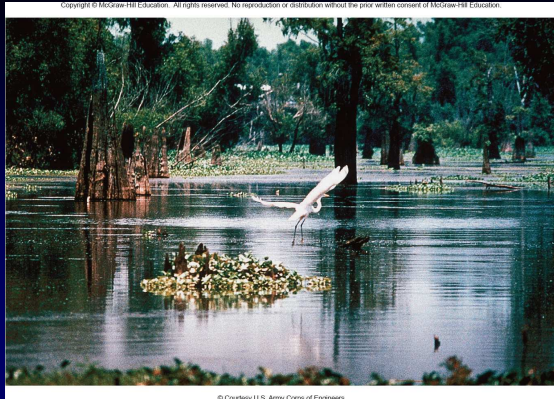
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Restoring Wetlands and Streams

- Wetlands and streams provide ecological services.
 - ❖ Hydrologic cycle
 - ❖ Food and habitat for a variety of species
 - ❖ Coastal wetlands absorb storm surge
- Wetlands occupy less than 5% of land, but 1/3 of endangered species spend at least part of their life cycle there.
- Up until the 1970s, government gave incentives to drain and destroy wetlands.

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A Wetland



Restoring Wetlands and Streams

- Clean Water Act (1972) began protecting streams and wetlands from pollution discharge.
- Farm Bill (1985) blocked agricultural subsidies to farmers who damaged wetlands.
- Many states now have a “no net loss” policy and wetlands are coming back.
- However, there is an imbalance as swamps are drained and replaced by small ponds. No net loss, but not the same ecosystems.

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Restoring Wetlands and Streams

- Restore water supplies that have been diverted elsewhere
 - ✦ Marshes in Iraq
 - ✦ Everglades
 - Ditching, draining and diverting water started a century ago in order to get cropland and prevent flooding of coastal cities. Rivers were straightened to shunt water to the sea.

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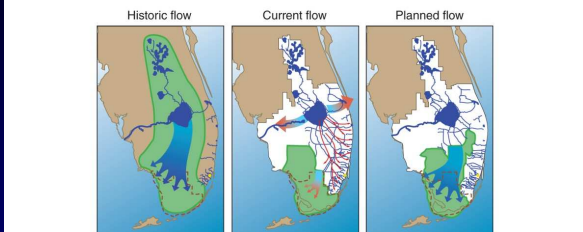
Everglades Restoration

- Draining the Everglades resulted in water shortages in the dry season.
- Everglades National Park has lost 90% of its wading birds. Its ecosystem may be collapsing.
- Plans to remove levees, restore natural course of rivers, and save water in underground aquifers for later use (while still controlling flooding)
- Plan announced in 2000 is over budget and behind schedule

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Plans for the Everglades

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Chesapeake Bay

- America's largest and richest estuary.
- 2,700 species spend all or part of their lives in/near the bay.
- It suffers from pollution and degraded water quality.
- Important species of fish and shellfish have declined dramatically.
- Eelgrass, a keystone species, was smothered by sediment. It served as a nursery for marine animals.
- Damage is due to
 - overfishing
 - sewage discharge
 - silt from erosion
 - heavy metals and toxic chemicals
 - heat from industry
 - pesticides and herbicides
 - oil spills

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Restoring Dune Grass at Chesapeake Bay

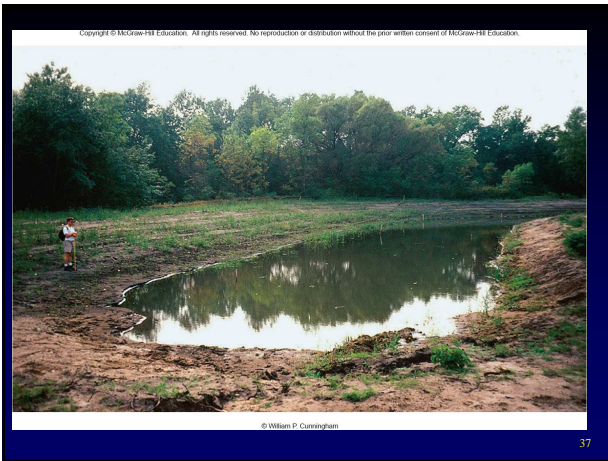


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Wetland Restoration

- Prairie potholes in Great Plains re-created
- Passage of the Migratory Bird Hunting Stamp Act (Duck Stamp Act) in 1934. Money from hunting used to acquire wetland habitat.
- Artificial wetlands can be used to treat sewage and collect storm runoff.
- **Wetland mitigation** is required when development destroys a natural wetland, but it often does not replace native species and ecological functions.
 - ✦ In building a housing project in Minnesota, the developer destroyed a complex native wetland containing rare orchids. The mitigation is just a hole filled with rainwater. It quickly became re-vegetated with invasive species.

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Streams Need Rebuilding

- Streams threatened by pollution, toxins, invasive organisms, erosion, and other insults
- 44% of streams suffer degradation, mostly due to sedimentation and excess nutrients.
- Streams have been turned into cement channels and buried underground in urban areas. Little resemblance to natural state.
 - ✦ Rebuilding involves returning to a natural stream bed.

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Streams Need Rebuilding

- Reduce sediment entering streams by providing ground cover
- Redirect water with
 - ✦ earth-moving equipment
 - ✦ barriers to deflect current
- Provide fish habitat with logs, roots, artificial "lunkers"
- Stabilize banks by having slope of no more than 45 degrees

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Polluted Sites Can Be Remediated

- **Bioremediation** – using living organisms to remove toxins
 - ❖ Some plants can selectively eliminate toxins from soil.
 - ❖ Bacteria can remove toxins from water if they are provided with oxygen and nutrients.
- If the area is small, contaminated dirt can be hauled away and clean soil brought in.
- Decontaminated urban fields (“brown fields”) can become valuable real estate.

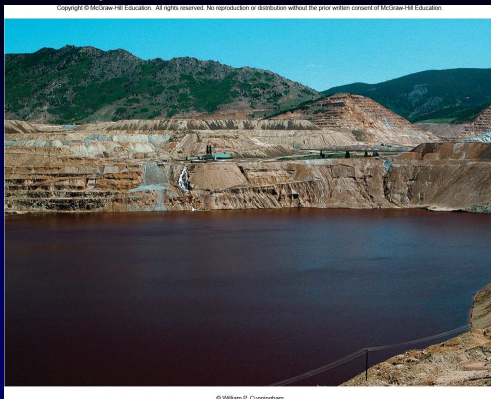
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Reclamation of Severely Degraded Sites

- Reclamation means the repairing of human-damaged lands.
- The Surface Mining Control and Reclamation Act requires mine operators to restore the shape of the land to its original contour and re-vegetate it to minimize impacts on local surface and groundwater
- More than 8000 square kilometers of former strip mines have been reclaimed.
- Some of the largest strip mines like the Berkely mine pit in Butte, Montana will never be fully reclaimed.

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Berkely Mine Pit, in Butte, Montana



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