

APES CHAPTER 18 NOTES (MRS. BAUCK): CONSERVATION OF BIODIVERSITY

MODULE 59: The Sixth Mass Extinction

- I. Decline in Genetic Diversity of Wild Species (some natural, some anthropogenic)
 - A. U.S. Fish and Wildlife Service (FWS, USFWS) <http://www.fws.gov/>
FWS Law Digest: <https://www.fws.gov/laws/Lawsdigest.html>
 - B. example causes through population dynamics (review Ch. 5)
 - 1) population bottlenecks
 - 2) geographic isolation
 - 3) inbreeding
 - 4) invasive species
 - 5) exotic wildlife diseases
 - C. example causes through habitat destruction
 - 1) damming/disruption of waterways
 - 2) deforestation
 - 3) wetland destruction
 - 4) fragmentation
 - 5) ocean acidification
 - 6) natural disasters
 - 7) pollution
 - 8) illegal poaching
 - 9) urbanization
 - 10) climate change impact
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- II. Decline in Genetic Diversity of Domesticated Species
 - A. livestock
 - 1) animals: buffalo, cattle, donkeys, goats, horses, sheep, pigs
 - 2) birds: chickens, ducks, geese, turkeys
 - B. examples causes
 - 1) overgrazing
 - 2) nonsustainable aquaculture (overfishing fish farms)
 - 3) nonsustainable farming practices
 - 4) pesticide overuse
 - 5) pollution
 - 6) nonsustainable hunting practices
 - 7) selective breeding for specific traits in plants and animals
 - C. Svalbard seed storage facility (genetic bank) in Norway
<https://www.seedvault.no/>
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- III. Global Biodiversity in Decline (review Ch. 5, Module 17)
 - A. **IUCN Red List search** <https://www.iucnredlist.org/>
 - 1) IUCN codes: NE (not evaluated); DD (data deficient)
 - 2) IUCN listing progression: LC → NT → VU → EN → CR → EW → EX
 - B. **least concern species (LC)**—*the wildlife is abundant and widespread*
 - C. **near-threatened species (NT)**—*species very likely to be threatened in the near future*
 - D. **threatened species (T)**—*species that have high risk of extinction in the future*
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IV. Ecosystem values (review Ch. 1, module 2)

A. biological wealth

1) background info

- 1) *natural capital = natural resources*
- 2) basis of ecosystems = *biota* (natural species of plants, microbes, animals) with their *genetic bank*
- 3) to maintain *sustainability*, their *resilience* and *biodiversity* must be preserved
- 4) those who agree on protection of wild species often disagree on how to do it
- 5) **biodiversity**—*the variety of living organisms on the planet*
- 6) *biological wealth*—the biota and the ecosystems they inhabit

2) human dependence on biological wealth

from wri.org

“The world’s biological diversity has co-evolved with human culture. Humanity has applied growing knowledge and skills to order and manipulate nature to meet changing human needs. In this process, people have *hunted, fished, and gathered species for food, fuel, fiber and shelter*. They have *eliminated competing or threatening species, domesticated plants and animals, cut forests, used fire to alter habitats, and recently even significantly changed hydrological and geochemical cycles*. As a result, the landscape and, to a lesser extent, the sea, today reflect human culture.

At a time when humanity’s needs for productive biological resources are greater than ever before, we are witnessing the irreplaceable loss of the world’s fundamental capital stock—its species and genes—and the deterioration of ecosystems’ ability to meet human needs. As species disappear, humanity loses today’s foods, medicines, and industrial products, as well as tomorrow’s. As genetic diversity erodes, our capacity to maintain and enhance agricultural, forest, and livestock productivity decreases. And with the degradation of ecosystems, we lose the valuable services that natural and semi-natural systems provide.”

B. types of value of species

1) **instrumental value (anthropocentric)**—*beneficial to humans in some way*

- 1) agriculture, forestry, aquaculture, and animal husbandry
- 2) medicine
- 3) recreational
- 4) scientific

2) **intrinsic value**—*valuable for its own sake (subjective decision)*

- a) long-established existence merits a right for continued existence
- b) religious views supporting respect for the environment
- c) There is no “moral justification” for species decimation!

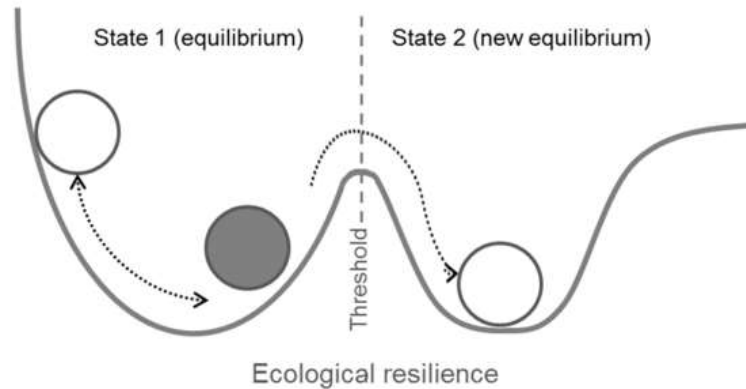
3) *provisions*

- a) goods produced by ecosystems that humans can use
- b) examples: food crops, lumber, fur, rubber, fiber, genetic resources, fresh water

4) *regulating services*

- a) benefits obtained from regulation of ecosystem processes
- b) examples: climate regulation, disease control, flood control, detoxification

- 5) *support system services*
 - a) naturally generated services that are necessary for the production of all other ecosystem services
 - b) examples: soil formation, nutrient cycling, pollination, primary production, O₂ production, provision of habitats
- 6) *ecosystem resilience* – depends on biodiversity



- 7) *cultural services*—recreational, aesthetic, scientific value

Viewing scenery Swimming Boating Fishing Bird watching	Gathering herbs, berries, etc. Mountain biking Camping Hunting Backpacking	Hiking Field research Ecotourism
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C. Monetary Value of Ecosystem Services (review Ch. 1, module 2)

In order of importance:

- Soil formation (6x higher than the next one)
- Recreation
- Nutrient cycling
- Water regulation and supply
- Climate regulation
- Habitat
- Flood and storm protection
- Food and raw materials production
- Genetic resources
- Atmospheric gas balance
- Pollination

V. Hunting and other animal issues

- A. North American game animal examples: antelope, bear, caribou, deer, duck, elk, goose, moose, rabbit, quail, turkey, wild boar
- B. main types of hunting: upland-game, waterfowl, big-game, and pest
- C. pests: coyotes, crows, woodchucks, groundhogs

Sportsman's Choice archive:

CONS: "Critics of game hunting refer to it as a blood sport that causes needless suffering and death to harmless animals in order to satisfy primitive desires in those who do not need to hunt to live. They also point out that the tons of *lead from shotgun cartridges and bullets deposited in the environment each year have caused a steady rise in toxic lead poisoning in animals*, including endangered species who ingest it.

PROS: Proponents of game hunting point out that *killing animals quickly is often more humane than letting them starve slowly in regions where the animal population may be too large to be supported by the limited food available in the habitat.*"

D. Suburban animal migration

- 1) increased road kills of wild animals
- 2) increased incidence of rabies
- 3) attacks of cougars, alligators, bears, coyotes etc. on humans and/or small pets
- 4) Canada geese flocks in parks

E. Animal Damage Control— Wildlife Services

https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/sa_program_overview

- 1) a program of the United States Department of Agriculture (USDA)
- 2) elimination of thousands of predators (coyotes, wolves, bears, mountain lions, etc.) to assist the livestock industry

MODULE 60: Causes of Declining Biodiversity

I. Habitat Loss (see this chapter, module 59)

A. development reduces natural habitat

B. terrestrial ecosystems' main cause of declining biodiversity = *deforestation*

- 1) large-scale deforestation or smaller-scale tree/vegetation removal
- 2) human reforestation efforts have a lower species diversity vs. the natural habitat

C. aquatic ecosystems: some causes of declining biodiversity

- 1) ocean acidification
- 2) water pollution
- 3) overfishing
- 4) coral harvesting

D. reduction of critical habitat, not elimination of it, may be enough to push species into decline

"The populations of Earth's wild mammals, birds, amphibians, fish and other vertebrates declined by more than half between 1970 and 2012, according to a report from environmental charity WWF and the Zoological Society of London (ZSL)."

E. *physical alteration of habitats*

- 1) *conversion* to human-made uses: urbanization, deforestation, etc.
 - 2) *fragmentation*—natural geographic ranges are "cut up" due to construction, farming, etc.
 - 3) *simplification*—clearing and cleaning up land areas of natural debris; stream channelization, etc.
 - 4) *intrusion*—interference with species: telecommunication lighted towers attracting migrating birds, causing collisions and entanglement in wires, etc.
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II. Exotic, Introduced, Non-native, Alien, Invasive Species

- A. **native species**—*species that live in their normal geographic range*
- B. **exotic species**—*species living outside their historical geographic range*
- C. **invasive species**

- 1) introduction can be accidental or deliberate (ornamentation, horticulture, aquaculture)
- 2) can take over an area, competing with native species for resources
- 3) FWS invasive species page <https://www.fws.gov/invasives/faq.html>
- 4) invasive plant examples from FWS

<i>Purple loosestrife</i> Salt cedar <i>Brazilian pepper tree</i> Canada thistle Melaleuca
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Hoary cress (Whitetop) <i>Kudzu</i> Russian knapweed Eurasian water milfoil Leafy spurge Cogon grass

Phragmites (reed) Chinese tallow Perennial pepperweed

- 5) invasive animal examples from FWS

Nutria (like beavers) Round goby (fish) Brown tree snake
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Mediterranean Fruit Fly ("medfly") Alewife (fish) Gypsy moth

Feral pigs Zebra mussel Japanese shore crab Ruffe (fish)

III. Overharvesting (hunting, fishing)

- A. *overharvesting*—individuals are removed from the population faster than the replacement rate replenishes the population
- B. specific hunting and fishing season times can be assigned
- C. acceptable sizes of individuals that can be legally harvested
- D. illegal poaching can occur all over the world

from libretexts.org

Overharvesting, also called overexploitation, refers to harvesting a renewable resource to the point of diminishing returns. Ecologists use the term to describe populations that are harvested at a rate that is unsustainable, given their natural rates of mortality and capacities for reproduction. The term applies to natural resources such as <i>wild medicinal plants, grazing pastures, game animals, fish stocks, forests, and water aquifers</i> . Sustained overharvesting can lead to the destruction of the resource, and is one of the five main activities – along with pollution, introduced species, habitat fragmentation, and habitat destruction – that threaten global biodiversity today.
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IV. Pollution

- A. land and water pollution: pesticides, toxic waste, oil spills, eutrophication of water, pathogens from human waste
- B. air pollution and related issues: NO_x, SO_x, acid deposition; ozone depletion, GHG
- C. freshwater ecosystems are impacted more than terrestrial ecosystems

- V. Climate Change (review Ch. 19)
Climate change and biodiversity, from **Convention on Biological Diversity**:
<https://www.cbd.int/climate/intro.shtml>

“There is ample evidence that climate change affects biodiversity. According to the Millennium Ecosystem Assessment, climate change is likely to become one of the most significant drivers of biodiversity loss by the end of the century. *Climate change is already forcing biodiversity to adapt either through shifting habitat, changing life cycles, or the development of new physical traits...*

Biodiversity can support efforts to reduce the negative effects of climate change. Conserved or restored habitats can remove carbon dioxide from the atmosphere, thus helping to address climate change by storing carbon (for example, reducing emissions from deforestation and forest degradation). Moreover, conserving intact ecosystems, such as mangroves, can help reduce the disastrous impacts of climate change such as flooding and storm surges.”

MODULE 61: The Conservation of Biodiversity

- I. Legislation
- A. **Lacey Act of 1900** *prohibits trade in wildlife, fish, and plants that have been illegally taken, possessed, transported or sold* (review Ch. 10, module 30)
<https://www.fws.gov/international/laws-treaties-agreements/us-conservation-laws/lacey-act.html>
- B. **Endangered Species Act (ESA) of 1973**—*prohibits any action that results in a “taking” of a listed species, or adversely affecting the habitat... import, export, interstate, and foreign commerce of listed species are all prohibited* (review Ch. 10, module 30)
<https://www.fws.gov/endangered/laws-policies/>
- C. **Marine Mammal Protection Act (MMPA) of 1972** (amended since)
<https://catalog.data.gov/dataset/marine-mammal-protection-act>
- 1) protects all marine mammals
 - 2) prohibits, with certain exceptions, the “take” of marine mammals in U.S. waters and by U.S. citizens on the high seas
 - 3) prohibits, with certain exceptions, the importation of marine mammals and marine mammal products into the U.S.
 - 4) NMFS (National Marine Fisheries Service) maintains marine mammals at or above optimum sustainable population levels
 - 5) regular assessment of marine mammal stocks
- D. **Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973** <https://www.cites.org/>
- 1) an international agreement to ensure that international trade in specimens of wild animals and plants does not threaten their survival

“CITES works by subjecting international trade in specimens of selected species to certain controls. All import, export, re-export and introduction from the sea of species covered by the Convention has to be authorized through a licensing system. Each Party to the Convention must designate one or more Management Authorities in charge of administering that licensing system and one or more Scientific Authorities to advise them on the effects of trade on the status of the species.”

- 2) 183 member countries (Parties)
- 3) U.S. was the first country to ratify it

II. Ecosystem Protection

A. IUCN: International Union for Conservation of Nature and Natural Resources (World Conservation Union) (review Ch. 5, module 17)

- 1) publishes data in the **IUCN red list** of threatened species worldwide
- 2) more info from <http://www.iucnredlist.org/>

“The World Conservation Union is the world’s largest and most important conservation network. The Union brings together 82 States, 111 government agencies, more than 800 non-governmental organizations (NGOs), and some 10,000 scientists and experts from 181 countries in a unique worldwide partnership.

The Union’s mission is to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable.

The World Conservation Union is a multicultural, multilingual organization with 1000 staff located in 62 countries. Its headquarters are in Gland, Switzerland.”

B. Convention on Biological Diversity (CBD/UNCBD) / Biodiversity Treaty

- 1) background info from <https://www.cbd.int/>

“Signed by 150 government leaders at the 1992 Rio Earth Summit, the Convention on Biological Diversity is dedicated to promoting sustainable development... the Convention recognizes that *biological diversity is about more than plants, animals, microorganisms and their ecosystems— it is about people and our need for food security, medicines, fresh air and water, shelter, and a clean and healthy environment in which to live.*”

- 2) presently, 168 member countries (“Parties”) ratified it
- 3) U.S. signed in 1993 but did not ratify it
- 4) major findings (2002-2010) – mostly continuing today
 - a) ecological footprint of humans has increased
 - b) the intensity of the causes of biodiversity loss have stayed the same or increased
 - c) ecosystem function loss is widespread

“*Ecosystem function* is the capacity of natural processes and components to provide goods and services that satisfy human needs, either directly or indirectly.” (de Groot et al 2002)

- d) genetic diversity of livestock and crops is declining
- e) fragmentation of natural habitats into smaller areas has increased
- f) overall, species at risk for extinction have moved closer to extinction
- g) ¼ of all plant species are moving toward extinction

C. Protection of Whole Ecosystems

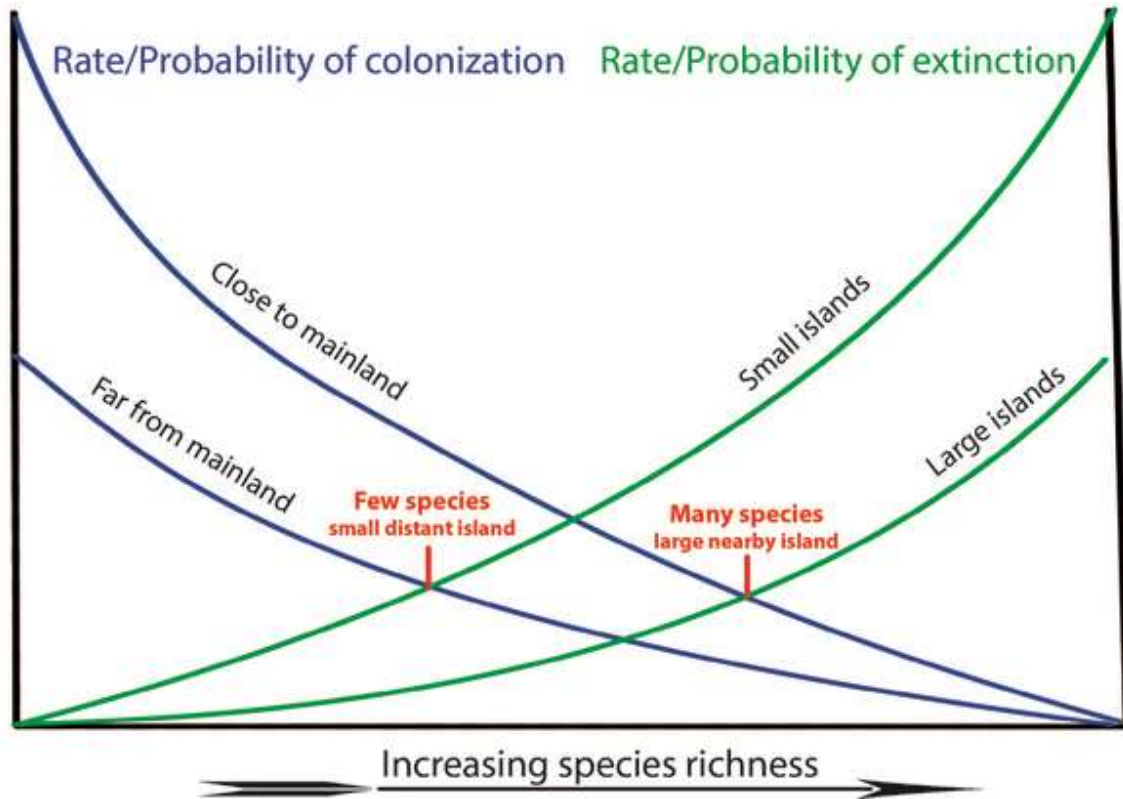
- 1) SLOSS = “single large or several small” areas
 - a) large connected protected area, far from other areas
 - b) protected areas that are close to one another, with habitat corridors
- 2) **Theory of Island Biogeography** can be modified and applied to human activity

(From reference*) “*The theory of island biogeography states that the number of species found on a particular, undisturbed island is determined solely by the number of species immigrating to the island and by extinction rates. The theory also states that isolated species may follow evolutionary routes that are different than species on land masses that are not isolated.*”

There are *five variables* to consider whenever thinking about the island biogeography theory. These include the *immigration rates of new species, the emigration rates, the extinction rates, the size of the island, and the distance the island is to another land mass.* The land mass could be a mainland or another island. The theory states that all of these variables will play a part in how the species thrive,

survive and evolve on the island. *Other influencing factors that contribute to the island's biodiversity include the degree of isolation, the length of isolation, the size of the island, the climate, ocean currents, and human activity.* Ideally, the theory of island biogeography refers to an undisturbed island that has no human contact or activity. However, *it is modifiable to include human activity but the biodiversity and the species' distribution and evolution will be different from that of an isolated island.*”

THE ECOLOGICAL MODEL OF ISLAND BIOGEOGRAPHY www.islandbiogeography.org



3) **edge habitat**—an abrupt transition between two habitat types

From <https://www.dnr.illinois.gov/education/Pages/CDHabitatEdge.aspx>

“Edge habitat is found where one habitat type meets another. For example, where the tree line of a forest meets a farm field is edge habitat. Roadsides, thickets, barnyards, old fields, ditches, fence rows, building ledges and rooftops, vacant lots, urban areas, power line corridors, borders of streams, rivers, ponds, swamps and lakes and many other areas qualify as edge. Edge habitat is very widespread and is used by many species of wildlife for food and/or shelter. Migrating species also use these areas for food, shelter and to rest. In some areas... edge habitat may be the most commonly found wildlife habitat.”

4) **biosphere reserves**

From <http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/biosphere-reserves>

“Biosphere reserves are areas comprising terrestrial, marine and coastal ecosystems. Each reserve promotes solutions reconciling the conservation of biodiversity with its sustainable use. *Biosphere reserves are ‘Science for Sustainability support sites’— special places for testing interdisciplinary approaches to understanding and managing changes and interactions between social and ecological systems, including conflict prevention and management of biodiversity.*”

Biosphere reserves are nominated by national governments and remain under the sovereign jurisdiction of the states where they are located. Their status is internationally recognized.”

Biosphere reserves have three interrelated zones that aim to fulfil three complementary and mutually reinforcing functions:

-- The **core area(s)** comprises a strictly protected ecosystem that contributes to the conservation of landscapes, ecosystems, species and genetic variation.

-- The **buffer zone** surrounds or adjoins the core areas, and is used for activities compatible with sound ecological practices that can reinforce scientific research, monitoring, training and education.

-- The **transition area** is the part of the reserve where the greatest activity is allowed, fostering economic and human development that is socio-culturally and ecologically sustainable.

D. Controversies

- 1) peregrine falcon
 - a) DDT affected egg shells, causing fewer viable offspring
 - b) U.S. Fish and Wildlife Service and other organizations: release of captive-bred birds
 - c) the species, once endangered, is now least concern
- 2) whooping crane flocks (see map, p. 10)
 - a) non-migratory Florida flock
 - b) Texas/Canada migratory flock
 - c) Florida/Wisconsin migratory flock
- 3) northern spotted owl vs. Pacific Northwest timber industry, settled by the Northwest Forest Plan
- 4) Klamath river salmon—diverting water flow, affecting other species

E. Restoration ecology

- 1) **restoration ecology**—deliberate repair of a damaged ecosystem that can no longer restore itself
- 2) example: Florida everglades (see map, p. 11)
 - a) **CERP: Comprehensive Everglades Restoration Plan (2000)**



<https://www.evergladesrestoration.gov/>

“...The Florida Everglades was once a vibrant, free-flowing river of grass that provided clean water from Lake Okeechobee to Florida Bay... To restore and preserve this American treasure, enhance water supplies, and maintain flood protection, the U.S. Army Corps of Engineers in partnership with the South Florida Water Management District and numerous other federal, state, local and tribal partners, has developed a plan to save the Everglades.

*The Comprehensive Everglades Restoration Plan (CERP) provides a framework and guide to restore, protect and preserve the water resources of central and southern Florida, including the Everglades. It covers 16 counties over an 18,000-square-mile area and centers on an update of the Central & Southern Florida (C&SF) Project also known as the Restudy. The Plan was approved in the Water Resources Development Act (WRDA) of 2000.** It includes more than 60 elements, will take more than 30 years to construct and will cost an estimated \$7.8 billion.*

...The goal of CERP is to capture fresh water that now flows unused to the ocean and the gulf and redirect it to areas that need it most. The majority of the water will be devoted to environmental restoration, reviving a dying ecosystem. The remaining water will benefit cities and farmers by enhancing water supplies for the south Florida economy.

** *Water Resources Development Act (WRDA)*

Provided the U.S. Army Corps of Engineers with the authority to re-evaluate the C&SF Project and to recommend improvements and modifications to the project in order to restore the ecosystem.

... In 2016, the Central Everglades Planning Project (CEPP) was authorized. CEPP combines several CERP components extending from Lake Okeechobee down to Everglades National Park into a comprehensive project that includes water storage, water quality treatment, conveyance, and decartmentalization (the removal of levees and canals) in the heart of the Everglades.”

- b) initial human impact
 - canals, levees, dams to control water flow
 - cropland (sugar industry)
 - urban and suburban development
 - water diverted from its original pathway for irrigation and municipal use
- c) Everglades: water status
 - too little in the winter and too much in the summer
 - increased eutrophication
 - increase in invasive species

Diagrams, next two pages...

map from <http://www.whoopingcrane.com/>



FLORIDA EVERGLADES

