

## APES Ch. 10 Notes: Wild Species and Biodiversity

### 10.1 Notes

- I. The Value of Wild Species
  - A. Biological wealth
    - 1) background info
      - a) *natural capital = natural resources*
      - b) basis of ecosystems = **biota** (natural species of plants, microbes, animals) with their **genetic bank**
      - c) to maintain *sustainability*, their *resilience* and *biodiversity* must be preserved
      - d) those who agree on protection of wild species often disagree on how to do it
      - e) ~1.75 million species have been discovered and classified; 13-14 million more are estimated yet to be found or classified
      - f) **biodiversity**—the variety of living organisms on the planet
      - g) **biological wealth**—the biota and the ecosystems they inhabit
    - 2) our 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
    - a) agriculture, forestry, aquaculture, and animal husbandry
    - b) medicine
    - c) recreational
    - d) scientific
  - 2) *intrinsic value*—valuable for its own sake (subjective decision)

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- C. Sources for agriculture, forestry, aquaculture, and animal husbandry
    - 1) Agriculture
      - a) plant breeding

From <http://www.davidson.edu/>

“Artificial plant breeding has been done for thousands of years. Since the beginning of farming, farmers have selectively chosen the plants they wish to continue to grow. *The farmers planted seeds harvested from the plants that were the biggest, healthiest, or tastiest.* This reproduces plants similar to the desired phenotype, although the farmers hundreds of years ago

did not know their chances of success or understand the process of passing traits through generations. *Initial variation to a plant can be induced by changing conditions where the plant is grown. This will eventually force the plant to adapt to more extreme conditions.* For example, continuously growing seeds from a plant in colder conditions will slowly make that plant more likely to survive in a colder climate. Though it began with haphazard planting of seeds, plant breeding has become a specific science to manipulate the characteristics of plants. *Plant breeding is defined as the controlled pollination of plants.*"

- b) International Code of Nomenclature for Cultivated Plants
  - International Society for Horticultural Science <http://www.ishs.org/>
  - **cultivar**— *cultivated variety of plant*

## 2) Forestry – **silviculture**

- a) FAO forestry page <http://www.fao.org/forestry/en/>
- b) EPA forestry page <https://www.epa.gov/agriculture/agriculture-forestry>

from Biodiv:

*"In the last 8000 years, about 45% of the Earth's original forest cover has disappeared, cleared mostly during the past century. According to the Food and Agriculture Organization of the United Nations (FAO), the present area of the world's forests... is the equivalent to North, Central and South America combined.*

*Forest biodiversity is being lost due to the rapid deforestation, fragmentation, and degradation of all forest types. ...The most important factors associated with forest and biological diversity decline are human-induced causes: conversion to agricultural land, overgrazing, unmitigated shifting cultivation, unsustainable forest management, introduction of invasive alien plant and animal species, infrastructure development (road building, hydro-electrical development urban sprawl), mining and oil exploitation, forest fires caused by humans, pollution and climate change."*

## 3) Aquaculture issues

- a) Problems, from Virginia Tech
  - escaping of aquatic crops as an invasive species
  - the relationship between effluents, eutrophication or pollution of water bodies, and changes in the fauna of receiving waters
  - land use, in particular conversion of sensitive areas such as mangroves and wetlands
  - water use and water loss from surface water systems
  - overexploitation of stock over other resource uses, such as fish oil
  - predator control, such as the killing of birds near aquaculture facilities
  - genetic alteration of existing stocks from escaped hatchery products
  - antibiotic and hormone use, which may influence aquatics species near aquaculture facilities
- b) EPA's aquaculture threat list

<i>Exotic Species</i>	<i>Sedimentation</i>
<i>Human Bias</i>	<i>Climate Change</i>
<i>Habitat Loss and Degradation</i>	<i>Alterations to Hydrology</i>
<i>Overexploitation</i>	<i>Air Pollution</i>
<i>Aquaculture</i>	<i>Dredging</i>
<i>Pollution</i>	

United Nations Environment Program (UNEP) recommendations to minimize the adverse impacts of aquaculture on wild stocks:

- Closed culture: better containment to prevent escape of the organism
- Sterilization: easily induced way of avoiding direct genetic effects
- Localization: locating farms away from wild populations, and choosing locations for sea ranching that minimize straying so as to reduce gene flow to wild populations
- Coastal parks: providing totally protected areas for valuable wild populations
- Reduced or selective fishing: protecting native populations by reducing fishing pressure or by directing that pressure toward cultured fish
- Restrictions on transport: reducing the spread of exotic genes and diseases by restricting transport of live fish and eggs.
- Gene banks: counteracting extinction of local populations by the establishment of gene banks
- Minimal genetic differences from native populations: reducing effects of gene flow by minimizing the genetic differences between escaping or released fish and recipient wild populations
- Training of workers: basic training of aqua-culture workers (including non-specialists) to minimize the risk of accidental releases of organisms into aquatic ecosystems”

- 4) *Animal husbandry* (animal science)—the agricultural practice of breeding and raising livestock (can be cattle, hogs, sheep, horses, poultry, goats, yaks, alpacas, llamas...)

FAO <http://teca.fao.org/read/8378>

Roles of livestock:

- “Produce dung which is of great importance for soil fertility.
- Yield products such as milk or eggs for sale or own consumption continuously.
- Recycle by-products such as straw or kitchen waste.
- Serve as draught animals for tillage or transport.
- Produce meat, hides, feathers, horns etc.
- Serve as an investment or a bank.
- Help in pest control (e.g. digging) and weed management (e.g. grazing on barren fields).
- Have cultural or religious significance (prestige, ceremonies etc.).
- Produce young stock for breeding or sale.”

#### D. Sources for medicine

- 1) **ethnobotany**—the study of how people of a particular culture and region make of use of indigenous plants
- 2) ethnobotanists explore how plants are used for food, shelter, medicine, clothing, hunting, and religious ceremonies
- 3) examples

ALOE VERA  
ANISE

ARROWROOT  
BASIL

CAMPHOR  
CELERY

CHAMOMILE  
CHICORY  
CINNAMON  
CLOVE  
CORIANDER  
DANDELION  
DILL  
EUCALYPTUS  
FENNEL  
GARLIC  
GINGER  
GINKGO  
GINSENG  
JASMINE

JUNIPER  
LAUREL  
LAVENDER  
LEMON  
MARJORAM  
MYRTLE  
NETTLE  
OLIVE  
PARSLEY  
PATCHOULI  
PEPPERMINT  
PEPPER  
RADISH  
RHUBARB

ROSE  
SAGE  
SANDALWOOD  
SESAME  
ST. JOHN'S WORT  
TARRAGON  
TEA TREE  
THYME  
TURMERIC  
VALERIAN  
VERBENA  
YARROW  
YLANG-YLANG

**E. Recreational, aesthetic, scientific value**

Viewing scenery	Gathering herbs, berries, mushrooms, etc.	Backpacking
Swimming		Hiking
Boating	Mountain biking	Field research
Fishing	Camping	<b>Ecotourism</b>
Bird watching	Hunting	

**F. Value for their own sake**

- 1) Long-established existence merits a right for continued existence.
- 2) Religious views supporting respect for the environment
- 3) No “moral justification” for species decimation

## 10.2 Notes

**II. Saving Wild Species**

**A. U.S. Fish and Wildlife Service (FWS, USFWS)**

- 1) <http://www.fws.gov/>
- 2) FWS Law Digest: <https://www.fws.gov/laws/Lawsdigest.html>

**B. North American game animals**

1) common examples      B = big game; U = upland; W = waterfowl

Bear (B)  
Bighorn Sheep  
Buffalo  
Caribou  
Chukar (bird)  
Deer (B)  
Dove  
Duck (W)  
Elk (wapiti) (B)  
Goose (W)

Grouse (U)  
Hare  
Javelina/Peccary  
(like a pig)  
Moose (M)  
Mountain goat  
Muskrat  
Partridge  
Pigeon  
Pheasant (U)  
Pronghorn antelope (B)

Quail (U)  
Rabbit (U)  
Raccoon  
Sandhill Crane  
Squirrel (U)  
Swan  
Turkey  
Wild boar  
Woodcock(U)

- 2) main types of hunting: upland-game, waterfowl, big-game, and pest
- 3) pests: coyotes, crows, woodchucks, groundhogs

#### 4) Quotes from Sportsmans 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.*"

- B. Suburban animal migration
  - 1) increased roadkills 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

- C. Animal Damage Control ("Wildlife Services")
  - 1) a program of the United States Department of Agriculture, Animal and Plant Health Inspection Service
  - 2) spends millions of dollars to kill thousands of predators coyotes, wolves, bears, mountain lions, and many others as a subsidy for the livestock industry
  - 3) animals are shot, poisoned, gassed, snared, and caught in leghold traps

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- D. Acts protecting endangered species
    - 1) **Lacey Act** (of 1900, recent amendments – 1981)—*prohibits trade in wildlife, fish, and plants that have been illegally taken, possessed, transported or sold*
    - 2) Endangered Species Preservation Act of 1966—allowed listing of only native animal species as endangered and provided limited means for their protection
    - 3) Endangered Species Conservation Act of 1969—provided additional protection to species in danger of worldwide extinction
    - 4) **Endangered Species Act (ESA) of 1973** (amended many times since)
      - a) From the EPA

Species include birds, insects, fish, reptiles, mammals, crustaceans, flowers, grasses, and trees. Anyone can petition FWS to include a species on this list. *The law prohibits any action, administrative or real, that results in a "taking" of a listed species, or adversely affects habitat. Likewise, import, export, interstate, and foreign commerce of listed species are all prohibited.*

- b) More info on "take prohibitions" from NOAA  
<http://www.nmfs.noaa.gov/pr/listing/>

*" 'Take' of a threatened or endangered species means to 'harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.' Depending if the species is endangered or threatened, different take prohibitions may apply. When a species is listed as **endangered**, 'take' prohibitions are automatically extended to it (under ESA Section 9). When a species is listed as **threatened**, we must issue protective regulations in order to extend any 'take' prohibitions to the species (under ESA Section 4(d)."*

- c) From the NOAA (National Oceanic and Atmospheric Administration)  
<http://www.nmfs.noaa.gov/pr/laws/esa/>

“Approximately 2,270 species are listed as endangered or threatened under the ESA. Of these species, about 650 are foreign species, found only in areas outside of the U.S. and our waters.” (~1620 are domestic).

The NOAA has ”jurisdiction over 151 endangered and threatened marine species, including 57 foreign species. We work with U.S. Fish and Wildlife Service (USFWS) to manage ESA-listed species. Generally, we manage marine species, while USFWS manages land and freshwater species.”

“A ‘species’ is considered **endangered** if it is in danger of extinction throughout all or a significant portion of its range, and **threatened** if it is likely to become an endangered species within the foreseeable future.”

- d) general ESA provisions
- listing of endangered and threatened species
  - development and implementation of recovery plans
  - regular reviews of species’ status
- e) critical habitat info from NOAA <http://www.nmfs.noaa.gov/pr/listing/>

“When listing a species as threatened or endangered, we also designate critical habitat for the species. This designation occurs about one year after the final listing, as long as it is prudent to do so and critical habitat is determinable. Unlike the listing determination, economic impacts must be considered when designating critical habitat. Critical habitat is:

- *specific areas within the geographical area occupied by the species at the time of listing, if they contain physical or biological features essential to conservation, and those features may require special management considerations or protection*
- *specific areas outside the geographical area occupied by the species if we determine that the area itself is essential for conservation”*

- f) categories in the process
- petitioned species (awaiting 90-day findings)
  - candidate species (status review completed, action not warranted now)
  - proposed for ESA listing
  - listed
  - under review for delisting
  - delisted
- g) More details on the process <https://www.fws.gov/endangered/esa-library/pdf/listing.pdf>
- h) conflicting parties
- “property rights advocates” are ESA critics: developers, timber industry, mining industry, etc.
  - “recovery advocates” support reauthorization and enforcement of ESA
- i) FWS Endangered Species search  
<https://www.fws.gov/endangered/?ref=topbar>
- j) IUCN Red List of Threatened Species <http://www.iucnredlist.org/>

E. other related legislation

1) **Marine Mammal Protection Act (MMPA) of 1972**

From NOAA: <http://www.nmfs.noaa.gov/pr/laws/mmpa/>

- a) protects all marine mammals
- b) prohibits, with certain exceptions, the “take” of marine mammals in U.S. waters and by U.S. citizens on the high seas
- c) prohibits, with certain exceptions, the importation of marine mammals and marine mammal products into the U.S.
- d) NMFS (National Marine Fisheries Service) maintains marine mammals at or above optimum sustainable population levels
- e) regular assessment of marine mammal stocks
- f) amended since, major amendments in 1994

2) **Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973**

- <https://www.cites.org/>
- 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.”

- 183 member countries (Parties)
  - U.S. was the first country to ratify it
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**\*\*\* IMPORTANT NOTE: When you are reviewing past FRQs, be sure you know updated information about a species' status.. Some of the scoring rubric information online is outdated. \*\*\***

F. species information, quotes from <http://wdfw.wa.gov/>

(species can have a different designation nationally vs. state-wide)

1) **species of least concern (LC)**

- a) *the wildlife is abundant and is likely to survive in the wild*
- b) native wildlife may be prescribed as least concern wildlife even if
  - the population size or distribution of the wildlife has declined
  - there is insufficient information about the wildlife to conclude whether the wildlife is common or abundant or likely to survive in the wild
- c) examples: Eastern cottontail rabbit, brown bear, bald eagle, common bottlenose dolphin, brown pelican

2) *species of concern*

“include those species listed as State Endangered, State Threatened, State Sensitive, or State Candidate, as well as species listed or proposed for listing by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service.”

3) *monitor species* are not considered Species of Concern but are monitored for status and distribution

4) *candidate species*

“Include fish and wildlife species that the Department will review for possible listing as State Endangered, Threatened, or Sensitive. A species will be considered for designation as a State Candidate if sufficient evidence suggests that its status may meet the listing criteria...”

5) *sensitive species*

“Any wildlife species native (to the area) that is vulnerable or declining and is likely to become endangered or threatened throughout a significant portion of its range (within the area) without cooperative management or removal of threats.”

6) **near threatened / threatened species (NT or T)** *have populations in a rapid decline*

a) definition: “Any wildlife species native (to the area) that is likely to become an endangered species within the foreseeable future throughout a significant portion of its range (within the area) without cooperative management or removal of threats.”

b) examples: bee hummingbird, Albacore tuna, jaguar, Ivory coast wart frog

7) **vulnerable (VU)**

a) *faces a high risk of extinction in the medium-term*

b) examples: African elephant, Giant panda, polar bear, cheetah, Blue marlin, loggerhead turtle

8) **endangered species (EN)**

a) *have populations nearing the estimated critical number*

b) “seriously threatened with extinction throughout all or a significant portion of its range”

c) faces a very high risk of extinction in the near future

d) examples: bluefin tuna, blue whale, snow leopard, whooping crane

9) **critically endangered species (CR)**

a) *faces an extremely high risk of extinction in the immediate future*

b) examples: black rhino, Bengal tiger, orangutan, Florida panther, Chinese alligator

10) **extinct in the wild (EW)**

a) captive individuals survive, but there is no free-living, natural population

b) example: Alagoas curassow bird, splitfin butterfly

11) **extinct (EX)**

a) the last remaining member of the species had died, or is presumed beyond reasonable doubt to have died

b) examples: Dodo bird, passenger pigeon, wooly mammoth

ICBN listing progression:

NE (not evaluated)

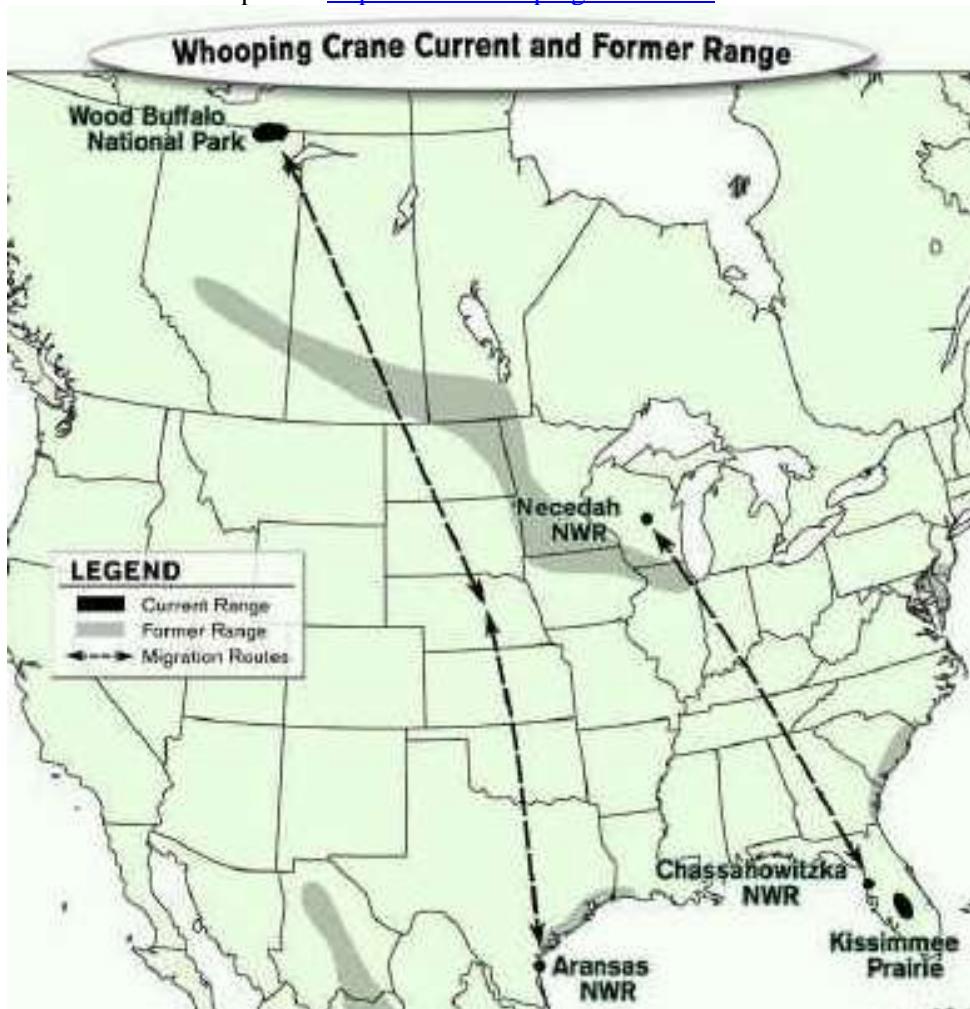
DD (data deficient)

LC → NT → VU → EN → CR → EW → EX

G. controversy

- 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
  - 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

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



### 10.3 Notes

#### III. Biodiversity and Its Decline

- A. As stated previously, ~1.75 million species have been discovered and classified; 13-14 million more are estimated yet to be found or classified

<http://www.nature.com/news/wildlife-in-decline-earth-s-vertebrates-fall-58-in-past-four-decades-1.20898>

“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).”

#### B. Reasons for the decline in biodiversity

general causes: deforestation, poaching, anthropogenic climate change, loss of habitat (logging, agriculture, etc.)

- 1) *physical alteration of habitats*
  - a) *conversion* to human-made uses: urbanization, deforestation, etc.
  - b) *fragmentation*—natural geographic ranges are “cut up” due to construction, farming, etc.
  - c) *simplification*—clearing and cleaning up land areas of natural debris; stream channelization, etc.
  - d) *intrusion*—interference with species: telecommunication lighted towers attracting migrating birds, causing collisions and entanglement in wires, etc.
- 2) *human population explosion* – increased demand for ecosystem goods and services
- 3) *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<sub>x</sub>, SO<sub>x</sub>, acid deposition; ozone depletion, GHG (Greenhouse gases)
  - c) freshwater ecosystems are impacted more than terrestrial ecosystems
- 4) *exotic (invasive, non-native, introduced, alien) species*
  - a) introduction can be accidental or deliberate (ornamentation, horticulture, aquaculture)
  - b) can take over an area, competing with native species for resources
  - c) FWS invasive species page <https://www.fws.gov/invasives/faq.html>
  - d) invasive plant examples from FWS

Purple loosestrife

Salt cedar

Brazilian pepper tree

Canada thistle

Melaleuca

Hoary cress (Whitetop)

Kudzu

Russian knapweed

Eurasian water milfoil

Leafy spurge

Cogon grass

Phragmites (reed)

Chinese tallow

Perennial pepperweed

e) invasive animal examples from FWS

Nutria (like beavers)

Round goby (fish)

Brown Tree Snake

Mediterranean Fruit Fly

(“medfly”)

Alewife (fish)

Gypsy moth

Feral pigs

Zebra mussel

Japanese shore crab

Ruffe (fish)

Rusty crayfish

Sea lamprey

Mitten crab

- 5) *overuse and overexploitation*
- deforestation
  - nonsustainable agricultural practices: overcultivation, etc.
  - overfishing
  - excessive hunting
  - illegal poaching
  - illegal exotic species trade
- 6) urbanization
- C. some consequences of declining biodiversity
- simplification of the ecosystem
  - possible loss of **keystone species**—*species which are vital to maintaining diversity of life* and whose extinction would consequently lead to the extinction of other forms of life
    - common examples: grizzly bear, sea otter, prairie dog
    - can be predators, mutualists, engineers who shape their environment
  - alteration of the balance and performance of ecosystems
  - diminished resistance to invasive species
  - decreased uncategorized organisms

#### 10.4 Notes

IV. Protecting Biodiversity  
 A. general info from Countdown2010 archives

- SEVEN STEPS TO SAVE BIODIVERSITY**
- “Species and ecosystems need space to develop and recover. *At least 10% of all ecosystem types should be under protection* to maintain nature and natural landscapes.
  - Without biodiversity there will be no agriculture. Farming practices should not jeopardize species survival: *improving farmland diversity and reducing the usage of pesticides and fertilizer* are key efforts to saving biodiversity. Organic agriculture practices can serve as an example in many areas.
  - 75% of all *fisheries* are fully exploited or over-fished. Species like cod, haddock and halibut are already threatened. If we do not move towards *sustainable use*, there will be no fish left for our grandchildren.
  - Roads, factories and housing destroy habitats for animals and plants.* If urban and rural development continues to ignore nature, our surroundings will be dominated by concrete and pollution.
  - Climate change is considered to be the greatest challenge for humanity. *With changing conditions, ecosystems and habitats will change as well.* It is an obligation to fight climate change and make sure that species can migrate or adapt to new surroundings.
  - If you *release a species outside its usual habitat*, it might simply die. In other cases, the so-called alien invasive species have thrived and destroyed local flora and fauna. *As you never know how things turn out, reducing these invasions is crucial.*

- 7) *Biodiversity is the foundation for sustainable development.* Its ecosystem services provide the basis for all economic activity. Biodiversity concerns need thus be integrated into all areas of policy-making. Measures include market incentives, development assistance, biodiversity-friendly trade and international governance processes.”

#### B. International developments

- 1) *IUCN: International Union for Conservation of Nature and Natural Resources (World Conservation Union)*
  - a) classifies species
  - b) publishes data in “red lists”
  - c) more info from <http://www.iucn.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.”

- 2) **Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973**
  - an international agreement to ensure that international trade in specimens of wild animals and plants does not threaten their survival
- 3) **Convention on Biological Diversity (CBD/UNCBD) / Biodiversity Treaty**
  - a) 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.”

- b) presently 168 member countries (Parties) ratified
- c) U.S. signed in 1993 but did not ratify

- 4) Critical Ecosystem Partnership Fund <http://www.cepf.net/xp/cepf/>

“The Critical Ecosystem Partnership Fund is a joint initiative of Conservation International, the Global Environment Facility, the government of Japan, the MacArthur Foundation, and the World Bank. The Critical Ecosystem Partnership Fund (CEPF) enables conservation action and builds capacity for sustainability in **biodiversity hotspots, the Earth’s biologically richest and most endangered regions.**”

#### C. Stewardship concerns – how we can help

- 1) revisit and reform policy
- 2) practice conservation in everyday life
- 3) fund more research on biodiversity
  - *biodiversity informatics*, from <http://www.cs.umd.edu/hcil/biodiversity/>

“We are building information retrieval and analysis interfaces for the rapidly expanding domain of biodiversity and ecological databases. Biodiversity databases contain organism-related information such as distribution, taxonomy, natural history, and conservation data. They are as complex as molecular and medical biology resources, yet serve a broad audience as do general-use digital libraries.”

- 4) responsible land use/landscape planning
- 5) protection of certain ecosystems, wherever they are
- 6) enforce geographically specified nature protection areas