



COLLEGE OF NATURAL SCIENCES
DEPARTMENT OF BIOLOGY



**CONSERVATION & MANAGEMENT OF NATURAL
RESOURCES (BIOL 2053)**

Biol. REGULAR 2nd YEAR, Sem. II

Instructors:

Habtam G. (MSc) and Ayalew T. (PhD)

MARCH 2020

Course outline

Module Title	Ecology & Environmental Biology	Module Code	Biol-M2051
Course Title	Conservation & management of NR	Course code	Biol2053
Credit hours	2	ECTS	3
Mode of delivery	Block II	Target group	2nd year students
Course status	Compulsory	Semester	II
Instructors contact information			
Office No	Biol. DEp	Consul hrs	Needs prearrangement
Phone number	09120723 60	E-mail	getaneh.habtam@gmail.com/ ayalewtalema@yahoo.com

Course description

This course is designed to provide an introduction to the area of conservation biology. It will include an examination of the historical and ethical background underpinning the current conservation movement; the types of natural resources. The course will focus on the values of biodiversity and ecosystem services, and threats on biodiversity due to human impacts.

Furthermore, ecological concepts that are utilized in conservation management practices and conservation status in Ethiopia will be examined. The role of international conventions, national policy and institutions in implementing conservations and the future directions of conservation biology will also be discussed.

2. Course Objectives

After attending this course, each student will be able to:

- ✓ describe the basic concepts of conservation biology**
- ✓ discuss the history of conservation biology**
- ✓ enumerate the types of natural resources**
- ✓ discuss global biodiversity and its importance**
- ✓ identify the threats to biodiversity and natural resources and seek solutions to the problem**
- ✓ describe methods for the conservation and management of natural resources**
- ✓ discuss the role of governments and other institutions in conservation endeavors**

Course outline and tentative Schedule

Week 1: Introduction

**Concepts and definition; The need to conserve natural resources;
Types of natural resources; Renewable, Non-renewable**

Week 2: Biodiversity

**Definition; Scope of biodiversity; Threats of biodiversity/
Biodiversity at risk; Human impact on biodiversity;
Maintaining biodiversity; Patterns and processes (predicting
biodiversity patterns and species distribution modeling); Values
and services of ecosystem
Threat to biodiversity: Habitat degradation and loss; Habitat
fragmentation; Overexploitation**

Tentative Course Schedule

Week 3: Species extinction; Invasive species.

Conservation biology: Definition and history of conservation biology; Conservation ethics and rationale; Conservation planning in theory and practice; conservation priority setting

Week 4: conservation approaches: In-situ conservation, Ex-situ conservation; Habitat restoration; Restoration of degraded ecosystem; Combating desertification; Saline habitat reclamation; Future direction in conservation biology

Week 5: Field trip

Week 6: The status of conservation in Ethiopia:

Soil and water conservation; Wildlife conservation; Forest conservation

Week 7: The role of governments and other institution in conservation:

International conventions; National laws and policies

Week 8: final exam

Teaching Learning Methods/Strategies:

- Lectures with the help of LCD projector and boards, group discussions, field work, visiting national parks, individual or group project work, independent reading of handouts, assignments.

Student Study hours

Students' activity	Hour
Lecture	32
Filed work	20
Independent reading	29
Total	81

Mode of Assessment criteria:

- Quizzes & Tests 30 %
- Assignments and presentation..... 10%
- Field report and presentation..... 10%
- Final exam 50%
- Total100%

References:

1. Cox, G.W. (1997). *Conservation Biology, Second Edition*. McGraw- Hill Companies, Inc. Boston.
2. Ewusie, J. Y. (1980). *Elements of Tropical Ecology*. Heinmann, London.
3. Meffe and Carroll (1997). *Principles of Conservation Biology by. 2nd Edit*. Sinauer Associates.
4. Johnson, J. B. (2000). *The Living World, 2nd Edition*. McGraw-Hill, Boston.
5. Juneja, K. (2002). *Ecology*. Anmol Publications Pvt Ltd, New Delhi.
6. Kormondy, E. J. (1996). *Concepts of Ecology, 4th Edition*. Prentice Hall of India Pvt Ltd, New Delhi.
7. Miller, G. T. (2000). *Sustaining the Earth: An Integrated approach, 4th Edition*. Brooks/Cole Publishing Company, Pacific Grove.
8. Postlethwait, J.H. and Hopson, J.L. (1995). *The nature of Life. 3rd Edition*. McGraw-Hill, Inc. New York.
9. Reaka-Kudla, M. L., Wilso, D. E. and Wilson, E.O. (Eds.) (1997). *Biodiversity II.: Understanding and protecting our biological Resources*. Joseph Henry Press, Washington, D.C.
10. Meffe and Carroll (1997). *Principles of Conservation Biology by. 2nd Edit*. Sinauer Associates.

Chapter one:

Introduction

Chapter one: Introduction

- Refers to the management of natural resources such as land, water, soil, plants and animals, with a particular focus on **how management affects the quality of life for both present and future generations.**
- Deals with managing the way in which people and natural landscapes interact.
- It brings together land use planning, water management, biodiversity conservation, and the future sustainability of industries like agriculture, mining, fishing, etc.

Natural resource management...

- Is also congruent with the concept of sustainable development.
- Natural resource management specifically focuses on a **scientific and technical understanding** of resources and ecology and the **life-supporting capacity** of those resources.
- Environmental management is also similar to natural resource management.

Chapter one: Introduction

- **The** satisfaction of needs, depends on various resources from which we are able:
 - ✓ To **satisfy our basic needs for survival;** such as food, housing, clothes and health
 - ✓ To derive a **great variety of amenities;** buildings, forms of transport, household equipment,

Conservation of Natural Resources (CNS)

- **Came into use in the late 19th century**
- **Referred to an ethic of resource use, allocation, and protection, mainly for economic reasons, (as timber, fish, game, topsoil, pastureland, and minerals).**
- **In addition it referred to the preservation of forests, wildlife, parkland, wilderness, and watersheds.**

Focus of CNS

1. **Maintaining the health** of the natural world, its fisheries, habitats, and biological diversity.
 2. **Materials and energy** conservation, which are seen as important to protect the natural world.
- Those who follow the conservation ethic and, especially, those who advocate or work toward conservation goals are termed **conservationists**.

Conserving Natural Resources...

- There are many ways that one can conserve natural resources.
- Conservation can include **small-scale clean-up projects along roadways** or building fences to prevent dune erosion to **large-scale beach renourishment**.
- **Planting trees** is another way to support conservation as trees are too often removed without being replanted.

Conserving Natural Resources...

- For conservation of natural resources like natural gas, use of **another energy source** for instance **hydro**, **solar** or **wind power**....
 - ✓ are all healthy and great alternatives to conserving natural resources.
 - ✓ these energy sources are **clean and healthy** for environment.
 - ✓ **do not emit** or produce **harmful gases** or toxin into our environment like that of the burning fossil fuels
 - ✓ are renewable
 - ✓ are not easy to deplete.

The need for conservation

- **The conservation of nature is considered important for three reasons:**
 1. **nature's intrinsic values;**
 2. **instrumental or economic values; and**
 3. **emotional, spiritual, and psychological values.**
- **These values are not mutually exclusive, but different people may hold different values, which must be taken into account to achieve conservation.**

Chapter two:

Types of Natural Resources

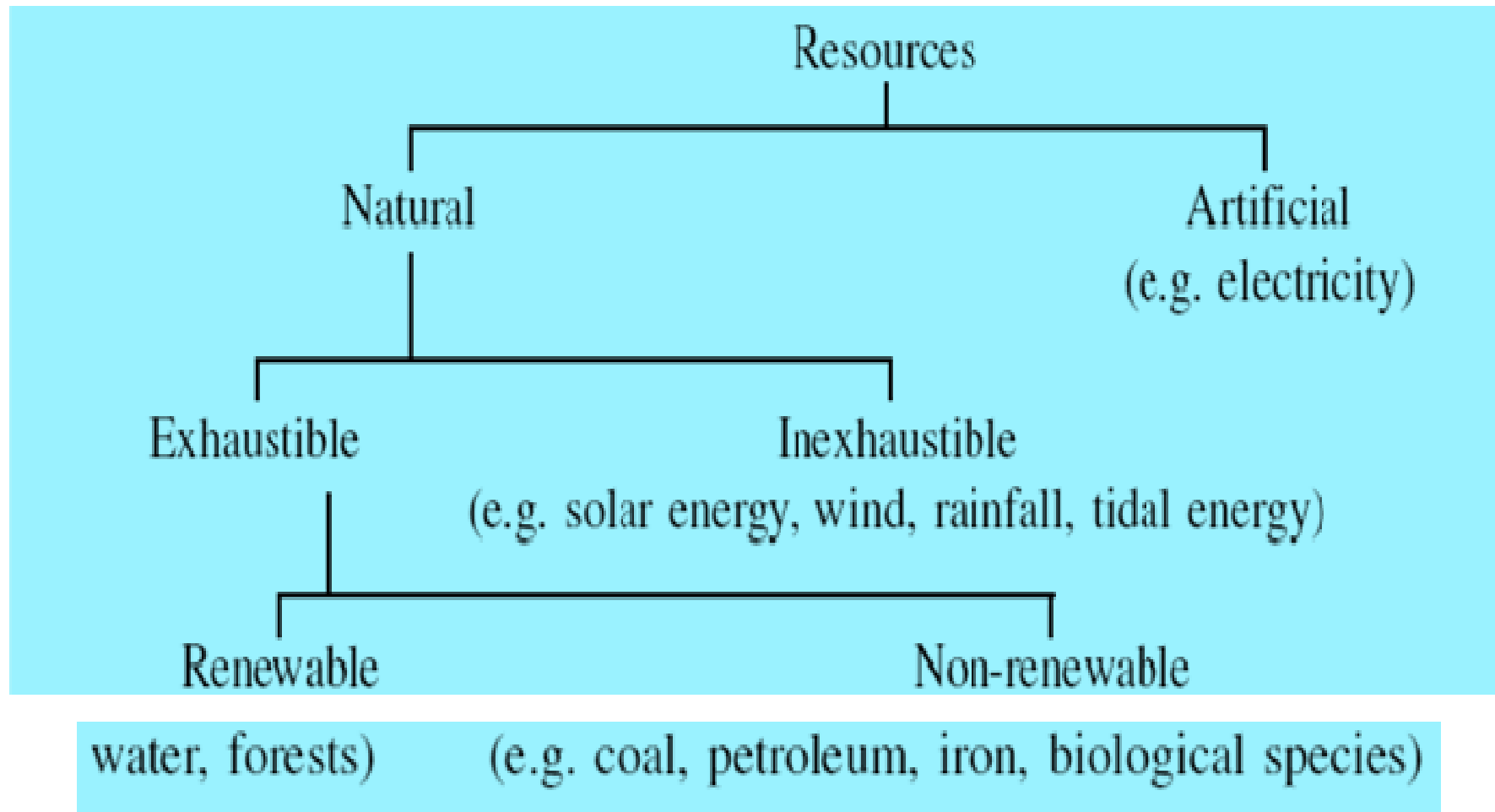
Types of Natural Resources

- The term “**resource**” means anything that we use from our environment to **achieve our objective**.
- For example, we require bricks, cement, iron, wood etc. to construct a building.
- All these items are called the resources for construction of building.
- A resource can be defined as ‘**any natural or artificial substance, energy or organism, which is used by human being for its welfare**’.

Types of resources

- There are two types of resources:
 - a) Natural resources
 - b) Artificial resources
- ❑ Natural resources: provided by nature
 - ✓ soil, air, water, minerals, coal, sunshine (sunlight), animals and plants, etc
- ❑ Artificial resources: developed by human being during the growth of civilization
 - ✓ biogas, thermal electricity, plastics, etc

Classification of Natural Resources



Classification of NR...

1. Inexhaustible (renewable) Resources

- ✓ cannot be exhausted by human consumption and other uses,
- ✓ E.g. solar radiation, wind power, water power (flowing streams) and tidal power, and substances like sand, clay, air, water in oceans, etc.

2. Exhaustible (non-renewable) Resources

- resources which are available in limited quantities and are going to be exhausted as a result of continues use.
- For example, the stock of coal,Petroleum

Renewable Resources

- Exhaustible resources are naturally regenerated after consumption
- A natural resource which can replenish itself with the passage of time, either through biological reproduction or other naturally recurring processes.
- If the consumption of these resources exceeds the rate of regeneration they may also get totally exhausted.
- The maximum rate at which a renewable natural resource can be used without damaging or impairing its ability to be renewed is called maximum sustained yield.
- Fresh water, fertile soil, forest (yielding wood and other products), vegetation, wildlife,

Characteristics of Renewable Natural Resources

- ➡ **Regeneration**
 - ➡ **Multiplicity of species interaction & dependence**
 - ➡ **Naturally determined growth rate**
 - ➡ **Possibility of Man-made Improvement**
 - ➡ **Biological Resources as Ecosystem**
 - ➡ **Common Property Effect**
- ☐ **The characteristics of non-renewable natural resources are the opposite of these views except the common properties effect which is applicable to both.**

Non-renewable Resources

- Resources that can be **exhausted or not replaced naturally** if highly exploited
 - ✓ Minerals, fossil fuels, wildlife species (rare plants and animals)
- They are exhaustible and are extracted faster than the rate at which they formed.
- They may also be Recycled and Non recycled

CHAPTER THREE

BIODIVERSITY

Biodiversity

Biological diversity

- is the **variety of all life forms**: the different plants, animals and microorganisms, the genes they contain and the ecosystems of which they form a part.
- It is a broad unifying concept, encompassing all forms, levels and combinations of natural variation, at all levels of biological organization.

Biodiversity...

- It is not static, but constantly changing
 - ✓ it is increased by genetic change and evolutionary processes and
 - ✓ reduced by processes such as habitat degradation, population decline and extinction.
- emphasizes the interrelatedness of the biological world;
- it covers the terrestrial, marine and other aquatic environments.
- **Solar energy** & **water availability** are the most important factors for biodiversity.
- This is why tropical forest has the most species diversity.

Types of biodiversity

1. Genetic diversity: variety in the genetic makeup among individuals within a species
 - ✓ refers to the variation at the level of individual genes and provides a mechanism for populations to adapt to their ever-changing environment.

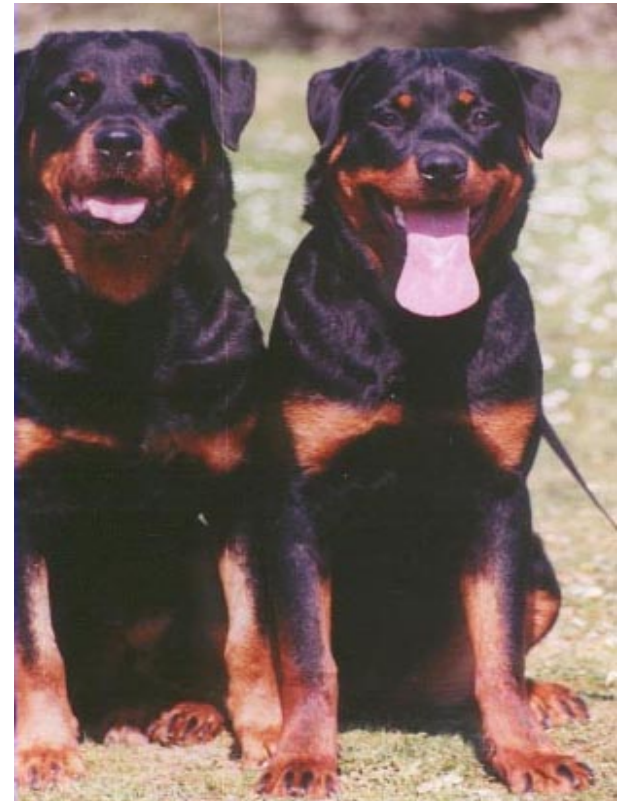




Chihuahua



Beagle



Rottweilers

Types of biodiversity...

2. **Species diversity: variety among the species or distinct types of living organisms found in different habitats of the planet**
 - is a measure of the diversity **within an ecological community** that incorporates both species richness (the number of species in a community) and the evenness of species' abundance
 - Species diversity is influenced by species richness.
 - All else being equal, communities with more species are considered to be more diverse.
 - is also influenced by the relative abundance of individuals in the species found in a community.

Community A	
Species	Abundance
1	20
2	20
3	20
4	20
5	20

Community B	
Species	Abundance
1	96
2	1
3	1
4	1
5	1

All five species in Community A have the same abundance, whereas there is great variation in abundance across the five species in Community B. For this reason, we would consider Community A to be more even. All else being equal, communities with greater equalness or evenness are considered to be more species diverse or have a greater species diversity. Even though the species richness of the two communities is equal, i.e. because each community has 5 different species, community B is less diverse

than community A because most of the individuals in community B are of 1 specific species.

Community A

Species	Abundance
---------	-----------

1	20
---	----

20

2

20

3

20

4

20

5

20

Community B

Species	Abundance
---------	-----------

1

96

2

1

3

1

4

1

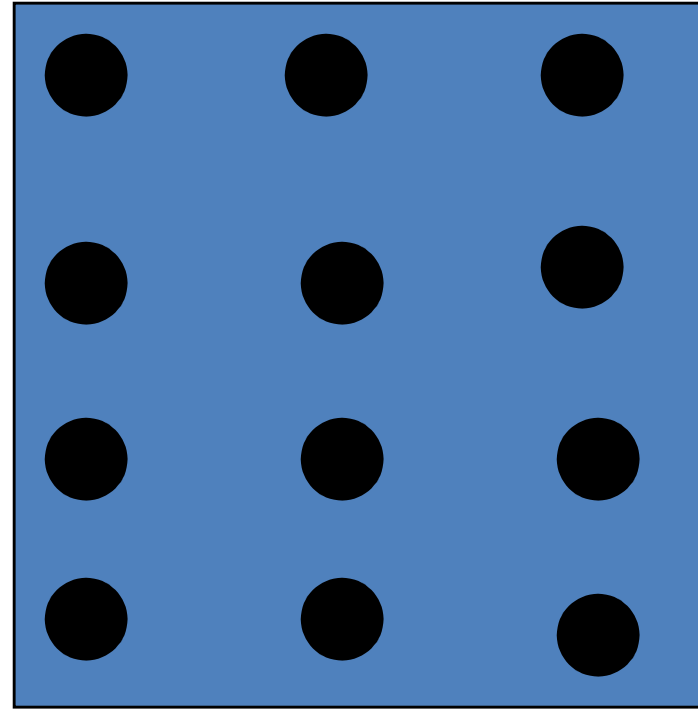
5

1

Which is more diverse?

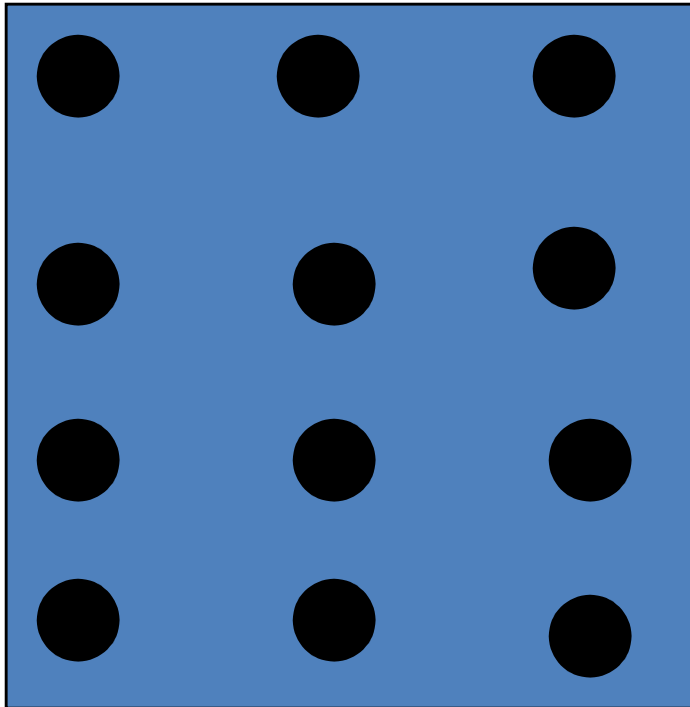


A

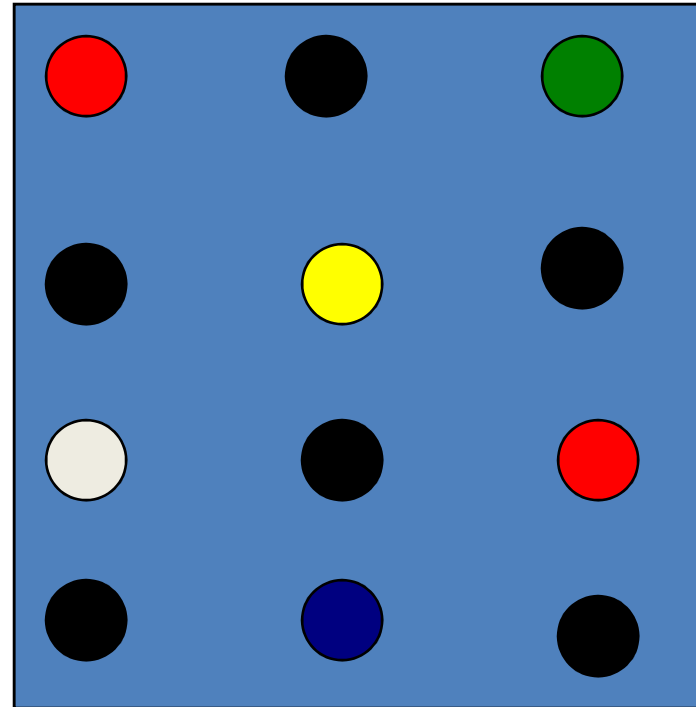


B

Which is more diverse?

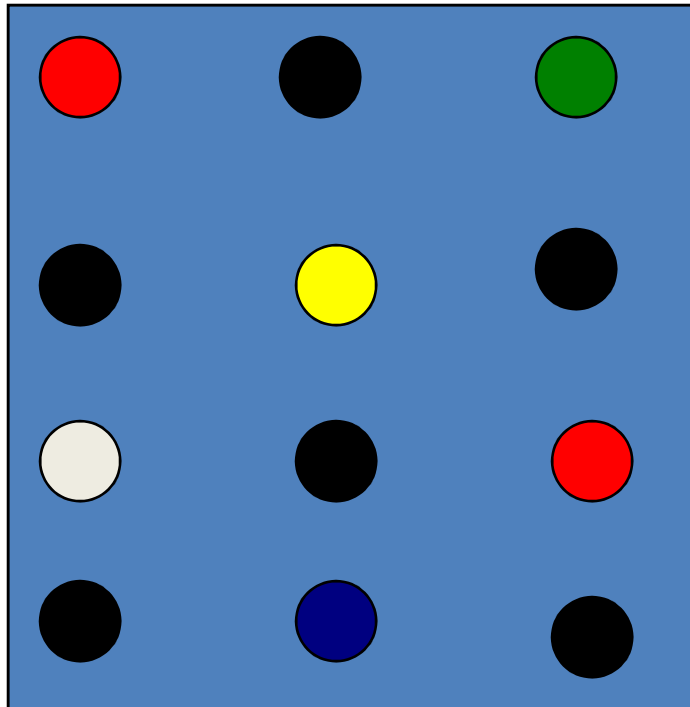


A

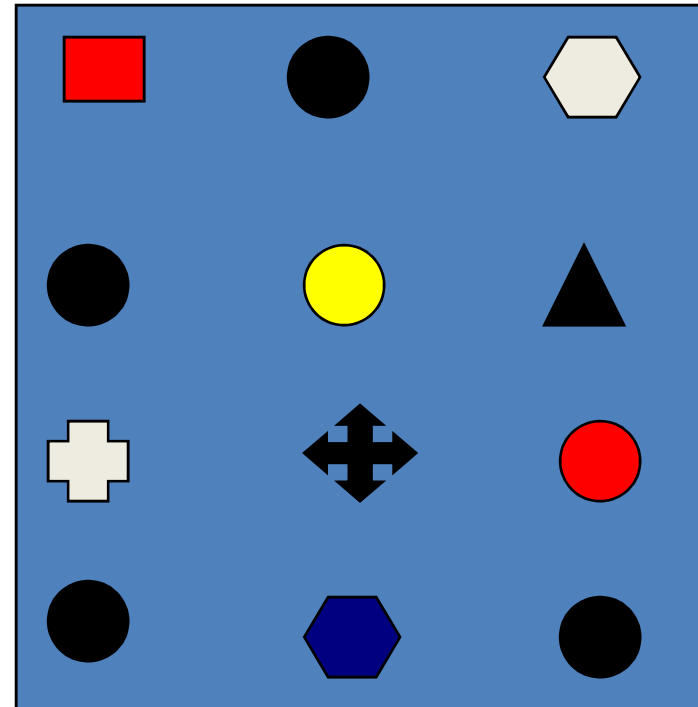


B

Which is more diverse?

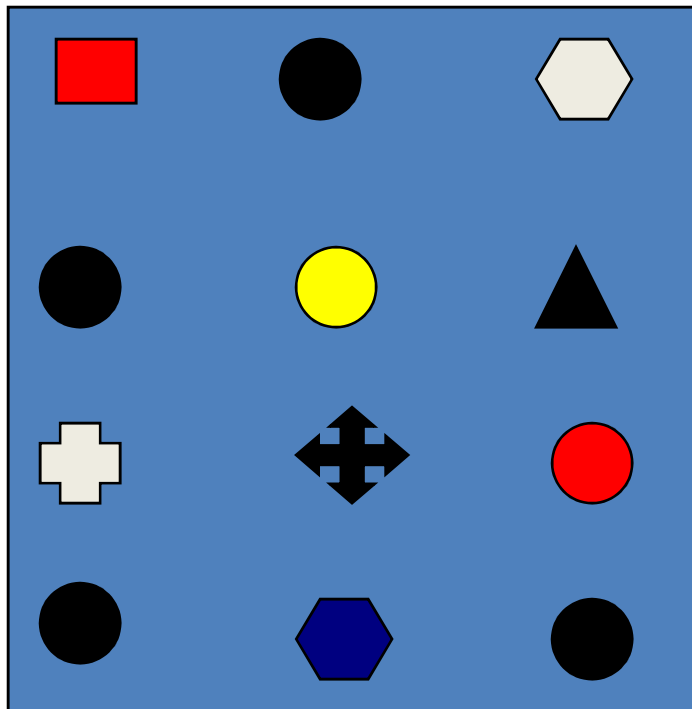


A

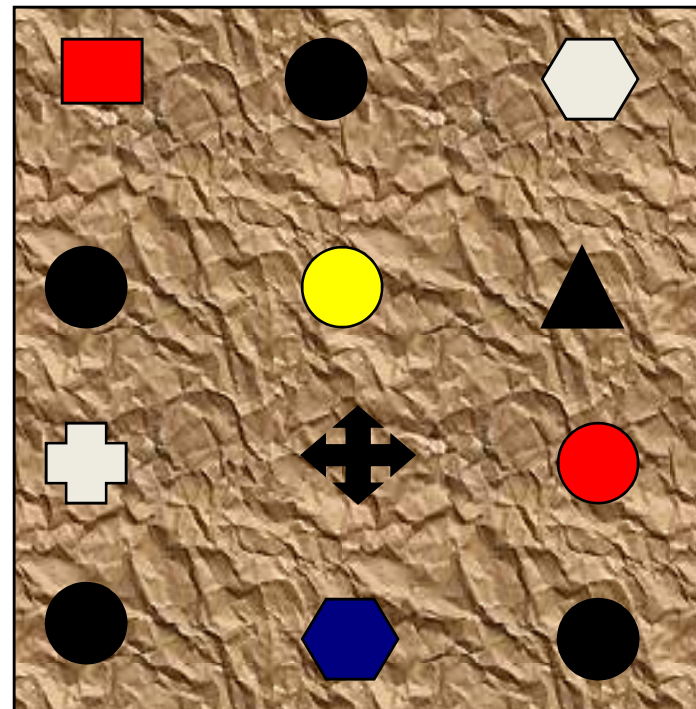


B

Which is more diverse?

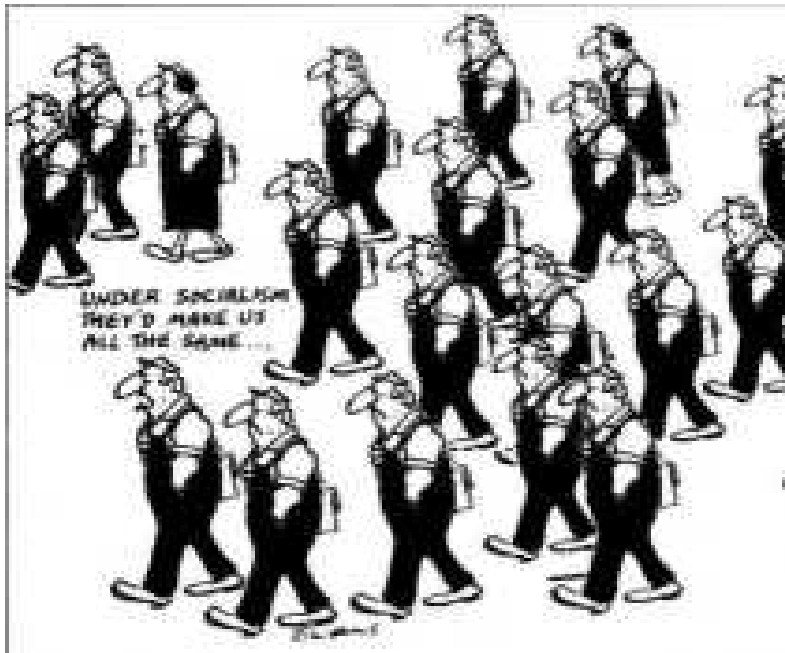


A



B

Which has more cultural diversity?



A



B

Which has more biodiversity?



A



B

Which has more biodiversity?



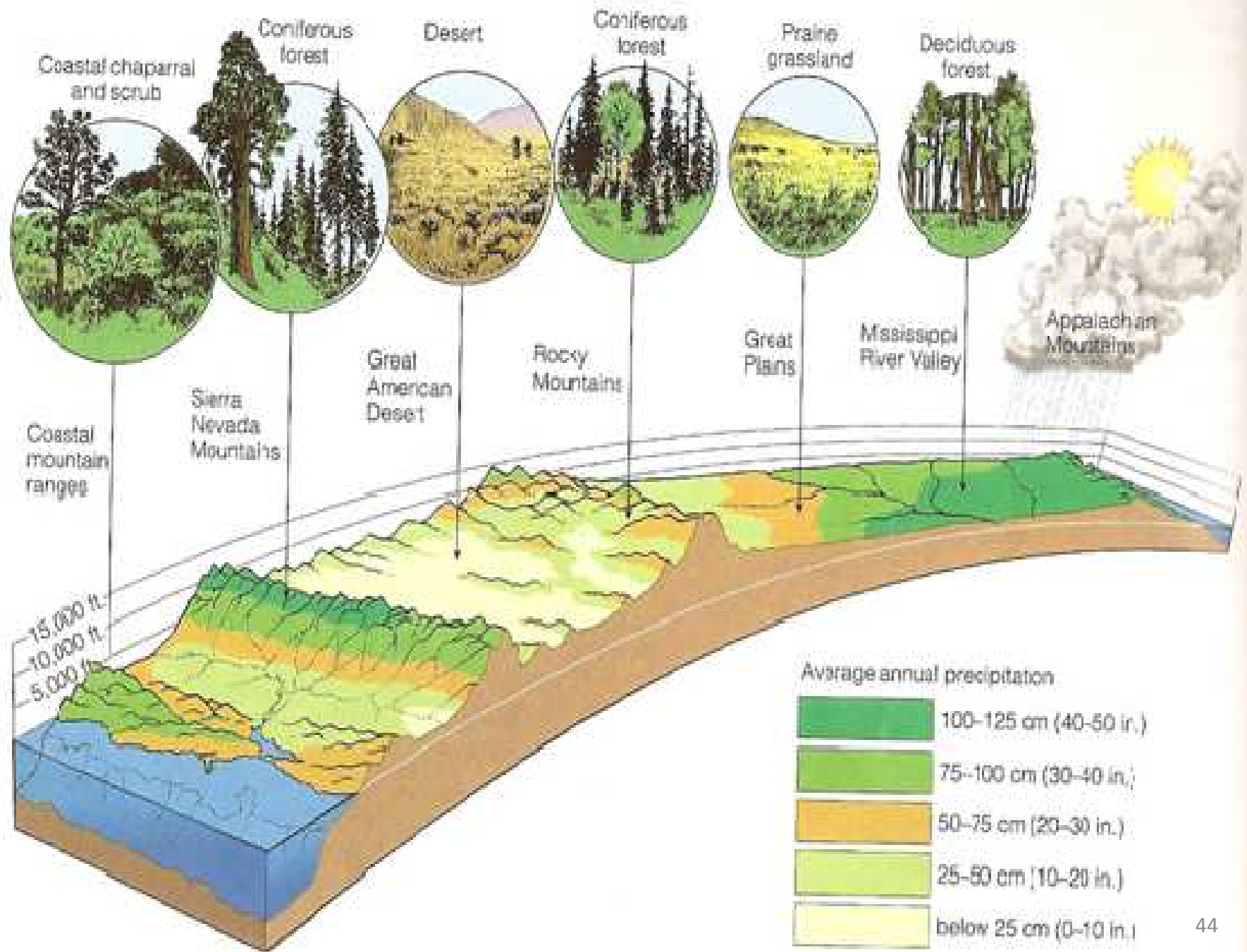
A



B

Types of biodiversity...

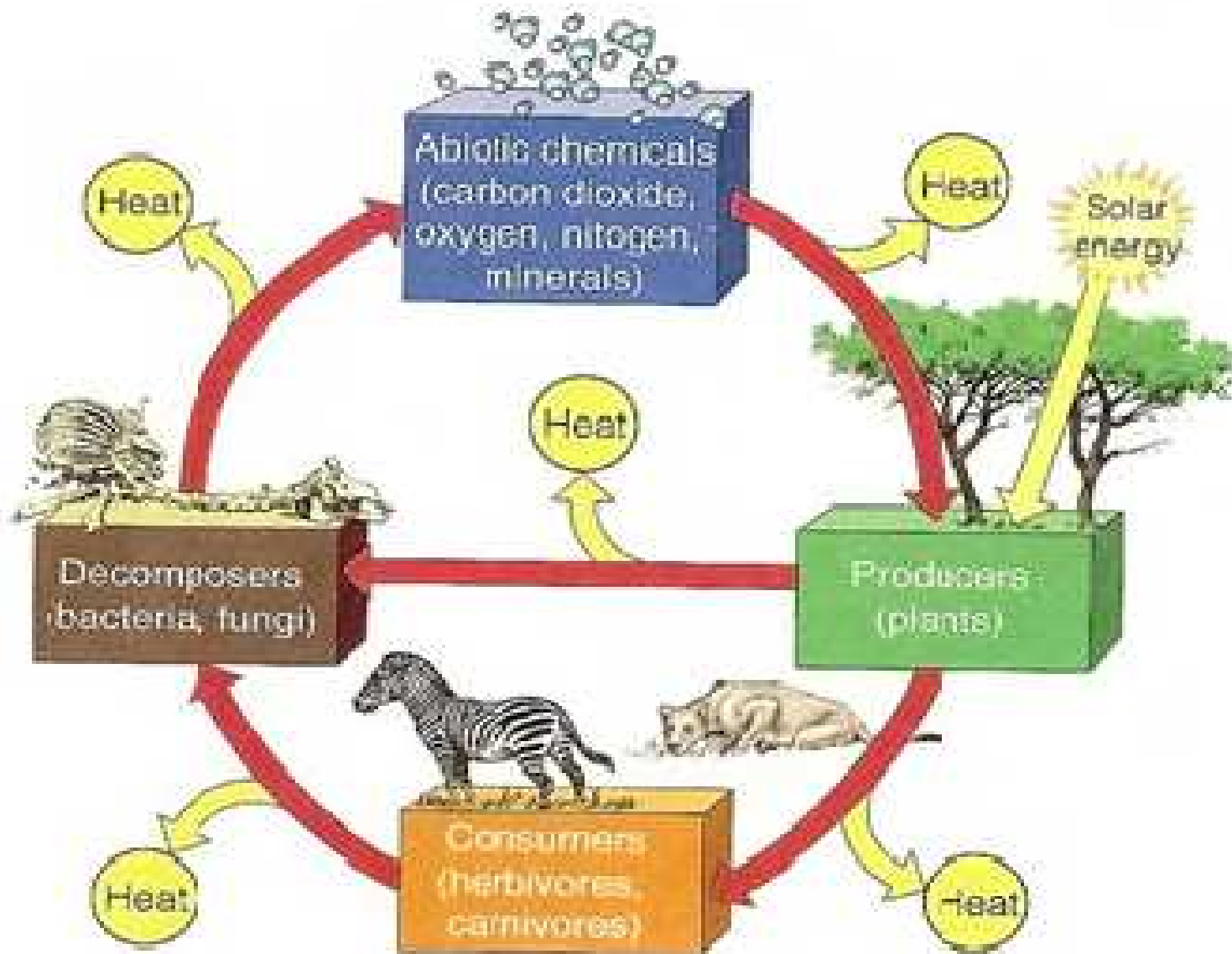
3. **Ecosystem or ecological diversity:** is the variety of biological communities, such as forests, deserts, grasslands and streams that interact with one another and with their physical and chemical (nonliving) environments.
- ✓ A biological community is defined by the species that occupy a particular locality or interaction between those species.
- ✓ A biological community together with its associated physical environment is known as an ecosystem



4. Functional diversity:

- ✓ Refers to the diversity of ecological processes that maintain and are dependent upon the other components of diversity.
- ✓ Functional diversity includes the many ecological interactions among species e.g. competition, predation, parasitism, mutualism, etc. as well as ecological processes such as nutrient retention and recycling.
- ✓ It also includes the varying tempos and intensities of natural disturbances that many species and communities require if they are to persist.

4. Functional diversity:



Scope of biodiversity

- biodiversity of a given ecosystem consists of three components: composition, structure, and function
- The composition includes the groups of organisms, species and the various organic and inorganic substances that are **inputs and residues** of the organisms.
- two primary types of structures:
 - ✓ **architectural structure**, consisting of spatial organization and patterns; and
 - ✓ **social structure**, which includes the interdependence and relationships among the parts.

Scope of biodiversity...

- **Organisms, materials, and energy of the ecosystem function in relation to one another.**
- **They might interact to influence processes in the ecosystem or the structure of the ecosystem.**

Human impact on biodiversity

- Human activities are responsible for most of the loss in biodiversity
- With an **increasing population**, we are **consuming** more and more natural resources.
- using **more energy** in our homes, and **buying** many more products than we need.
- Many people work very hard to make changes to their lifestyles that lessen their impact on the environment, which also helps preserve biodiversity.

Human impact...

- Humans have been responsible for causing more **extinction** within a given period of time than ever before.

☐ Driving forces

- **Deforestation,**
- **pollution,**
- **anthropogenic climate change** and
- **human settlements**
- **extinction rate**  **a sixth mass extinction event**

Importance of Biodiversity

- **helps to balance the nature**
- **is a measure of sustainable development**
- **is essential provider of natural services**

Maintaining biodiversity

Our resource economy depends largely on our efforts to control natural forces

- **The more plants, animals, and microbes that exist, the better the chances of finding treatments for a wide range of diseases and conditions.**
- **Is managing human uses of the Earth's resources in a way that allows for the preservation of ecosystem, species and genetic diversity**

How can we maintain biodiversity?

- Biodiversity as a whole includes soil fertility, water quality, and air pollution levels in addition to species diversity.
- Preserving these is central to the stability of an ecosystem.
- The best way is to preserve habitats, prevent pollution, manage invasive species and address the looming problem of global warming.

Patterns and processes

- The patterns of **species diversity** in an area or at any one time are set by the combination of three factors:
 - chance,
 - history
 - Necessity
- Chance: random processes of birth, death and migration
- for example, lizard might arrive unpredictably on a remote island, because the log it was on happened to float in the right direction.

Cont...

- History: correlation through time as a function of reproduction.
- In other words, if a species was abundant in the **near past**, chances are that it will be abundant **today**.
- Also, progeny tend to cluster near the parents, therefore, we tend to find organisms in "pockets" rather than evenly distributed in space.

Cont...

- Necessity: The laws of growth, competition and interaction.
- The number of species that can coexist will depend on **how complex the environment is** and on **how strongly they compete with one another**
- The overall diversity of a particular region will depend on
 - its capacity to support life - its size and productivity
 - on the variety of habitats that it includes.
- Speciation can occur gradually via **geographic speciation (allopatric)** or **competitive speciation (sympatric)** or abruptly through mechanisms such as **polyploidy (sympatric)**.

Natural processes that regulate species diversity

- occur independently of any differences among species, as though the species were genetically identical.
- affect diversity regardless of the ecological characteristics of a region.
- ❖ **Immigration**-- importance of immigration increases as the size of the area decreases.
- ❖ **Extinction**
 - a) Accidents
 - b) Population interactions
- ❖ **Area**: the bigger the area sampled, the more species found.
- ❖ **Productivity**: is the capacity of an area to support growth → more productive areas support more species.

Patterns of Species Biodiversity

- **Patterns in space**
 - **Latitudinal Gradients:** species diversity declines with increasing distance from the Equator
 - **Habitat Variety:** The more variable the habitat, the greater the species diversity within it
- **Patterns in time**
 - **Seasonal patterns:** Diversity of species can vary during different seasons of the year

Patterns of Species Biodiversity...

- **Succession patterns**

- For plants, diversity increases with succession until woody species
- For animals, diversity generally increases with succession (for birds and insects).

- **Evolutionary patterns**

Values and services of ecosystem

CBD of the UN considers the values of the biological diversity and its components as

- ✓ intrinsic,
- ✓ ecological,
- ✓ genetic,
- ✓ social,
- ✓ economic,
- ✓ cultural,
- ✓ recreational and
- ✓ aesthetic values.

Values and services...

- **Ecosystem services**
 - ✓ **Protection of water resources**
 - ✓ **Soil protection**
 - ✓ **Nutrient storage and cycling**
 - ✓ **Pollution reduction**
 - ✓ **Maintenance of ecological processes**

Values and services...

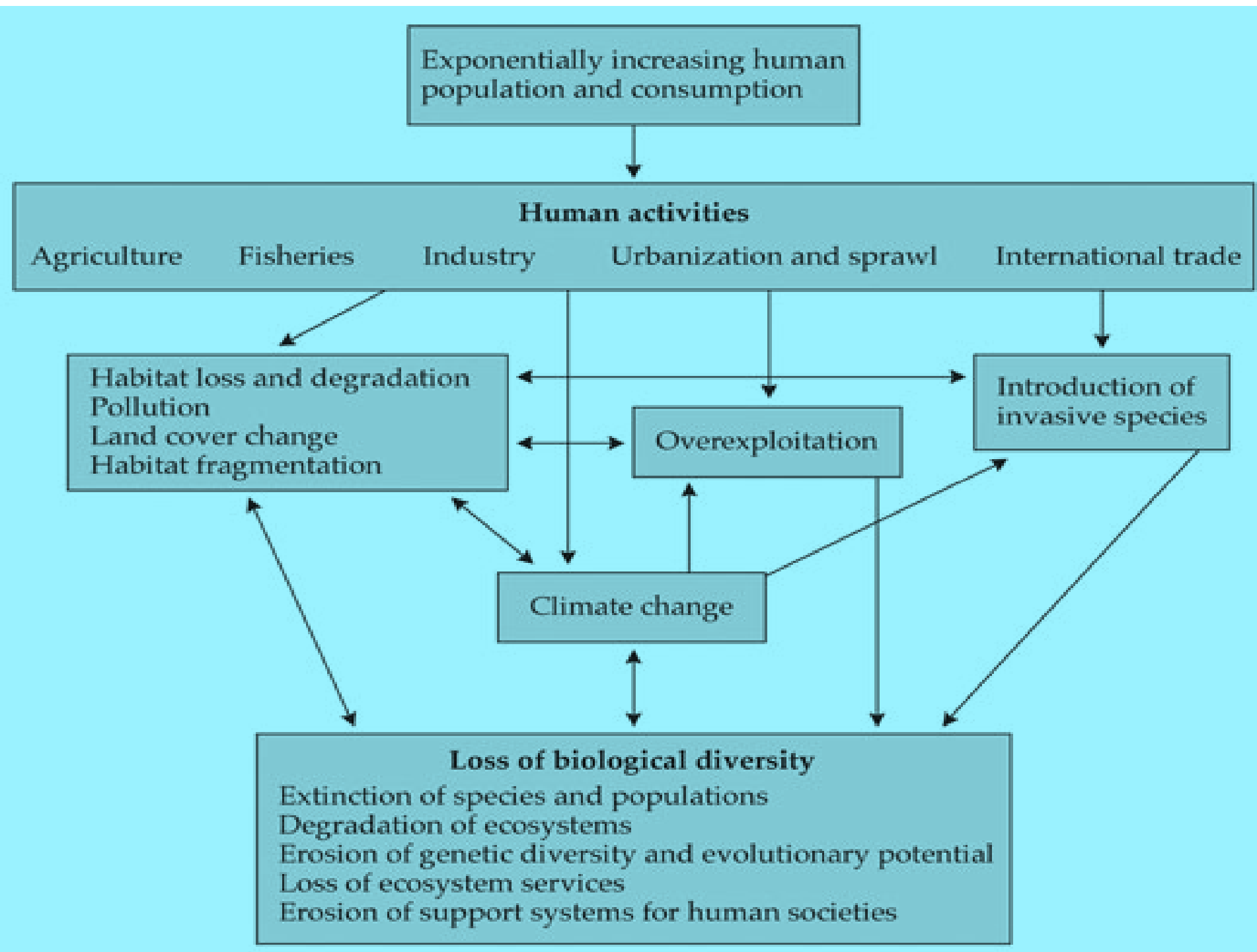
- **Biological resources of economic importance**
 - ✓ Food, fibre, medicines, fuel wood and ornamental plants
 - ✓ Breeding material for crop improvement
 - ✓ Future resources
- **Social benefits**
 - Recreation
 - Cultural values
 - Research, Education and Monitoring

CHAPTER FOUR

THREATS OF BIODIVERSITY

THREATS OF BIODIVERSITY

- Global biodiversity is in jeopardy today, because it is under threat, mainly by human induced activities.
- almost all threats facing ecosystems today are the result of human and industrial activities.
- The major categories of threat on biodiversity are caused by
 - ✓ **habitat loss,**
 - ✓ habitat fragmentation,
 - ✓ Invasive species,
 - ✓ **Overexploitation,**
 - ✓ species extinction and
 - ✓ the interactions of these factors.
- ❖ An ecosystem, once altered, can take years to return to a state of equilibrium after a disturbance.



THREATS OF BIODIVERSITY...

- threat to survival or loss may be caused in the following three ways:
 - **Direct ways:** Deforestation, hunting, poaching, commercial exploitation.
 - **Indirect ways:** Loss or modification of the natural habitats, introduction of exotic species, pollution, etc.
 - **Natural causes:** Climate change.

i. Habitat degradation and loss

- The major types of habitat losses that have significant impact and threat on biodiversity are deforestation, wetland destruction, coral reefs loss, and mangrove loss.

a. Deforestation

- the global deforestation rates is about 2% on average every year. The loss is equal to the area of a football field every second.
- Tropical forest occurs in 73 countries and once covered 11,610,350 km². Of that total, 75% occurs in only 10 countries (in South America, Asia, and Africa).
- Of that total, just over 30% occurs only in Brazil.

- The primary causes of deforestation are (in approximate order of importance):
 - Conversion to subsistence farming
 - Conversion to large-scale ranching
 - And other types of economic development (dams, roads, mining, etc.)
- ❖ The consequences of deforestation include direct effects of forest loss, edge effects, and additional effects of fragmentation.
- Direct effects of forest loss include loss of 'ecosystem services'
- deforestation typically results in
 - (a) loss of nutrients and nutrient retention and
 - (b) change in the hydrological regime.

Reducing tree cover:

- ✓ reduces the amount of water returned to the atmosphere via transpiration – which, in turn, reduces rainfall
- ✓ decreases the water-retaining capacity of the soil, causing an increase in surface runoff and flooding. So the total effect is, ironically, an increase in severity of both floods and droughts!
- ✓ results in loss of species, especially endemics with limited ranges.

- The edge effects results from changes in the abiotic conditions along the edge of clear cuts and other disturbances.
- The edge of a clear cut has different abiotic conditions than are found in forest interiors; regardless of forest type, edges of clear cuts typically are exposed to increased solar radiation, and wind, and consequently tend to be sunnier, warmer, and drier than interiors.
- Because of abiotic differences, edges are typically more susceptible to specific kinds of disturbance, including fire, disease, and tree fall.
- The structure and function of vegetation also differs along edges-edges typically are dominated by early succession “weedy” species, and typically “shrubbier” and more densely vegetated.
- Changes in plant community along edges, in turn, change the abundance and distribution of animal species.



Deforestation...

- Deforestation has additional consequences resulting from fragmentation:
- large-scale deforestation often has the effect of simplifying the landscape elements,
- Insularization (patches act as habitat islands) – patches may lose species richness because patch size and increased isolation from other patches
- Competitive replacement by exotics–
fragmentation often results in “corridors” of disturbed habitat that allow dispersal of exotics (including pests and pathogens) into patches, where they may outcompete “natives”.

- **Specific results of deforestation will vary among forest types and regions, so predicting specific outcomes is very difficult, because of:**
 - (a) variation expected due to differences in climate, forest type, surrounding habitat matrix;**
 - (b) variation resulting from differences in type of logging and post-logging practice and**
 - (c) lack of detailed information, especially in tropics and other remote areas.**

b. Coral reefs loss

- the most complex and biodiverse of marine ecosystems
- Found throughout shallow coastal waters of the warm tropics, coral reefs lie near many coastal cities and other settlements.
- Disturbances in coral reefs can be caused by natural or human-induced reasons.
- naturally subjected destructive forces:
 - ✓ powerful hurricanes that may physically destroy large parts of a reef,
 - ✓ extreme high tides that expose the corals to air,
 - ✓ several types of diseases.
 - ✓ Coral bleaching, in which the cnidarians coral animals expel their algal symbionts and frequently die, may also occur naturally, due to extreme high temperatures and possibly high levels of solar radiation

Coral reefs loss...

- Although these natural disturbances may be severe, they are typically infrequent and short-term, and reefs generally recover.
- The constant cycle of disturbance and recovery, however, leaves coral reefs vulnerable to additional anthropogenic disturbances.
- Factors associated with coastal development and tourism are another major threat to coral reefs and have already caused considerable damage.
- **Physical damage** may be caused by dredging activities, increased ship traffic, and tourists, while sedimentation, in which reefs can be buried, choked or shaded out, can be caused by construction projects, erosion, or dredging.



Coral reefs loss...

human-induced reasons of Coral reefs loss

- ✓ **coastal development and tourism**
- ✓ **Agricultural and industrial pollution**
- ✓ **collection of corals for use as building materials or souvenirs**
- ✓ **excavation of sand and lime from reef areas**



C. Mangrove loss

- mangrove forests are being destroyed at a rapid rate throughout the world.
- In many parts of the world, mangrove forests have already been substantially reduced and degraded.
- Like tropical rainforests, mangroves are threatened by a variety of factors **linked to population growth and urban expansion.**
- Although not often used for pasture land, mangrove stands are **cut for conversion to wet-field agriculture** such as rice cultivation, for firewood used by local peoples, and **for local and commercial charcoal production.**

- Mangrove **wood-chips** are also harvested commercially for the production of rayon.
- The locations of mangrove forests are also ideal for salt-condensation ponds, whose construction contributes to habitat loss.
- **Urbanization**, dredging, industrial expansion and pollution, and construction of ports and harbors all contribute to the decline of mangrove ecosystems.
- **Agricultural pollution** threatens mangrove ecosystems especially in the developed world.

- **The impact of shrimp farming and other causes of mangrove loss vary from region to region, but the fact remains that mangrove forests throughout the world are threatened.**
- **Without considerable conservation attention, the destruction and degradation of mangrove ecosystems will imperil both the terrestrial and marine species they support.**



d. Wetland loss

- **Wetlands are lands transitional between terrestrial and aquatic system where the water table is usually or near the water surface and land is covered by shallow water.**
- **are life support systems for people living around**
- **effective in flood control, waste water treatment, reducing sediment, recharging of aquifers and also winter resort for variety of birds for shelter and breeding and provide a suitable habitat for fish and other flora and fauna.**

- **They also act as buffer against the devastating effect of hurricanes and cyclones, stabilize the shore-line and act as bulwark against the encroachment by the sea and check soil erosion.**
- **Throughout the world, agriculture and development increasingly threaten freshwater ecosystems. Agricultural conversion has posed the greatest danger to wetlands.**



- **Wetlands have also commonly been drained for mosquito control, especially for the suppression of malaria, and for forestry.**
- **Pollution has also taken a significant toll on nearly all types of wetlands**
- **Human alterations to waterways and water flows have also destroyed many natural wetlands; dams, channels, canals, levees, roads, and other structures all change the flow of water and sediment that maintains wetlands.**

- **Dredging and channelization for boat navigation especially affect estuaries and marshes**
- **Mining and extraction of groundwater and petrochemicals also present a substantial threat to many wetlands.**
- **Wetlands are also lost to natural processes such as subsidence, sea-level rise, drought, storms and hurricanes, erosion, and eutrophication and succession**

The halting and reversal of wetlands destruction worldwide is a daunting task and the subject of an international treaty, the Ramsar Convention.



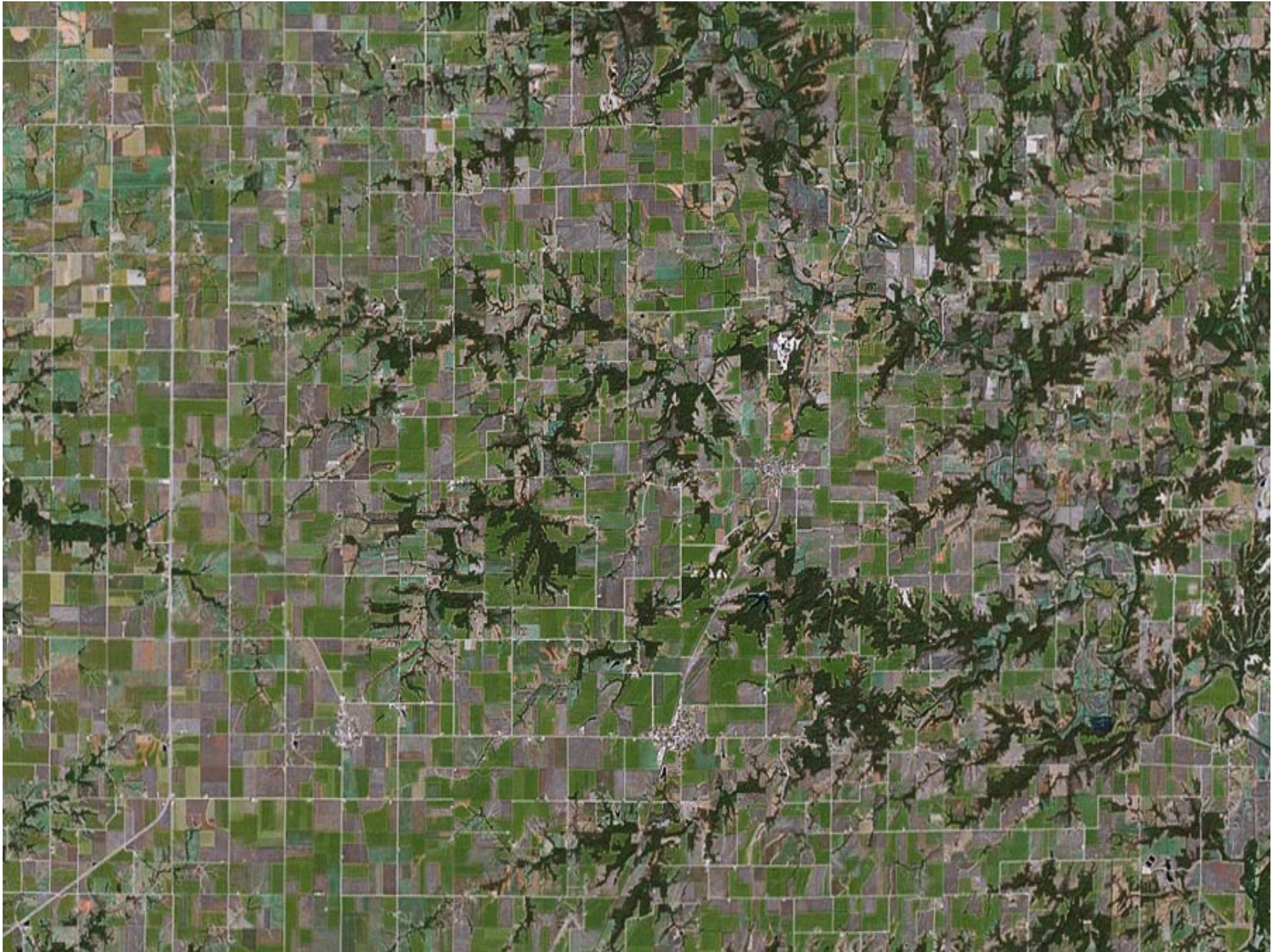
ii. Habitat fragmentation

- The process by which a natural landscape is **broken up into small parcels** of natural ecosystems, isolated from one another in a matrix of lands dominated by human activities
- can be caused by
 - ✓ geological processes: slowly alter the layout of the physical environment (suspected of being one of the major causes of speciation),
 - ✓ by human activity such as land conversion, which can alter the environment much faster and **causes extinctions** of many species.



Habitat fragmentation

- habitat fragmentation includes five discrete phenomena:
 - **Reduction** in the total area of the habitat
 - Decrease of the **interior : edge** ratio
 - **Isolation** of one habitat fragment from other areas of habitat
 - **Breaking** up of one patch of habitat into several smaller patches
 - **Decrease in the average size** of each patch of habitat



Habitat fragmentation

Natural causes

- ✓ Volcanism
- ✓ fire
- ✓ climate change

Human causes

- ✓ Agriculture
- ✓ rural development
- ✓ urbanization
- ✓ creation of hydroelectric reservoirs

Habitat fragmentation effects

- Small fragments are **unfavourable** for species which require interior habitat.
- cause for species to become **threatened or endangered**.

Solution to the problem of habitat fragmentation

- **link the fragments by preserving or planting corridors of native vegetation (important to mitigate the problem of isolation but not the loss of interior habitat.**
- **enlargement of small remnants in order to increase the amount of interior habitat**

iii. Overexploitation

- **After habitat loss, overharvesting has had the greatest effect on biodiversity**
- **overharvesting and habitat loss often occur simultaneously**
- **Overexploitation occurs when a resource is consumed at an unsustainable rate**
- **occurs on land in the form of overhunting, excessive logging, poor soil conservation in agriculture and the illegal wildlife trade**

Types of Exploitation

- 1. Commercial Exploitation-** money “makes the world go round” and is the driving force behind most exploitation of wild life.
✓ food, fiber, fuel, medicine, building materials,
- 2. Subsistence Exploitation-** to meet personal needs for food, clothing, fuel, and shelter.
- 3. Recreational Exploitation**
- 4. Incidental Exploitation-** common in fishing (unintentional mortality)
- 5. Indirect Exploitation-** roads, fences, antennas, and so forth

Consequences of Overexploitation

a. Population Effects

- ✓ not all the individuals in a population are equally susceptible to exploitation;
- ✓ their vulnerability may be influenced by their size, age, sex, phenotype, where they are, and when they are there.
- ✓ changing the structure of a population, particularly its age, sex, and genetic composition,

b. Ecosystem Effects- dominant species or a keystone species

- ✓ Overexploitation occurs when the harvest rate of any given population exceeds its natural replacement rate

iv. Invasive species

- more than just plants (plants, animals, microbes , viruses)

Terminologies

- **Native or Indigenous**= Originated where they now occur without the help of humans.
- **Introduced, Exotic or Non-native**= non-native species occurring by human agency in an area where it is not native
 - Other names include alien, foreign, non-indigenous
- **Invasive Species**= Often non-native (or alien) to the ecosystem
 - ✓ Whose introduction causes or is likely to cause economic or environmental harm or harm to human health.
 - ✓ Not all non-natives are invasive
- **Weed** =Troublesome pest that affects the health and productivity of native landscapes

Characteristics of Invasive species

-  Abundant seed producers
-  Rapid population establishment
-  Long-term survival of seeds
-  Occupy disturbed sites
-  Competitive
-  Lack of natural enemies



Invasive species...

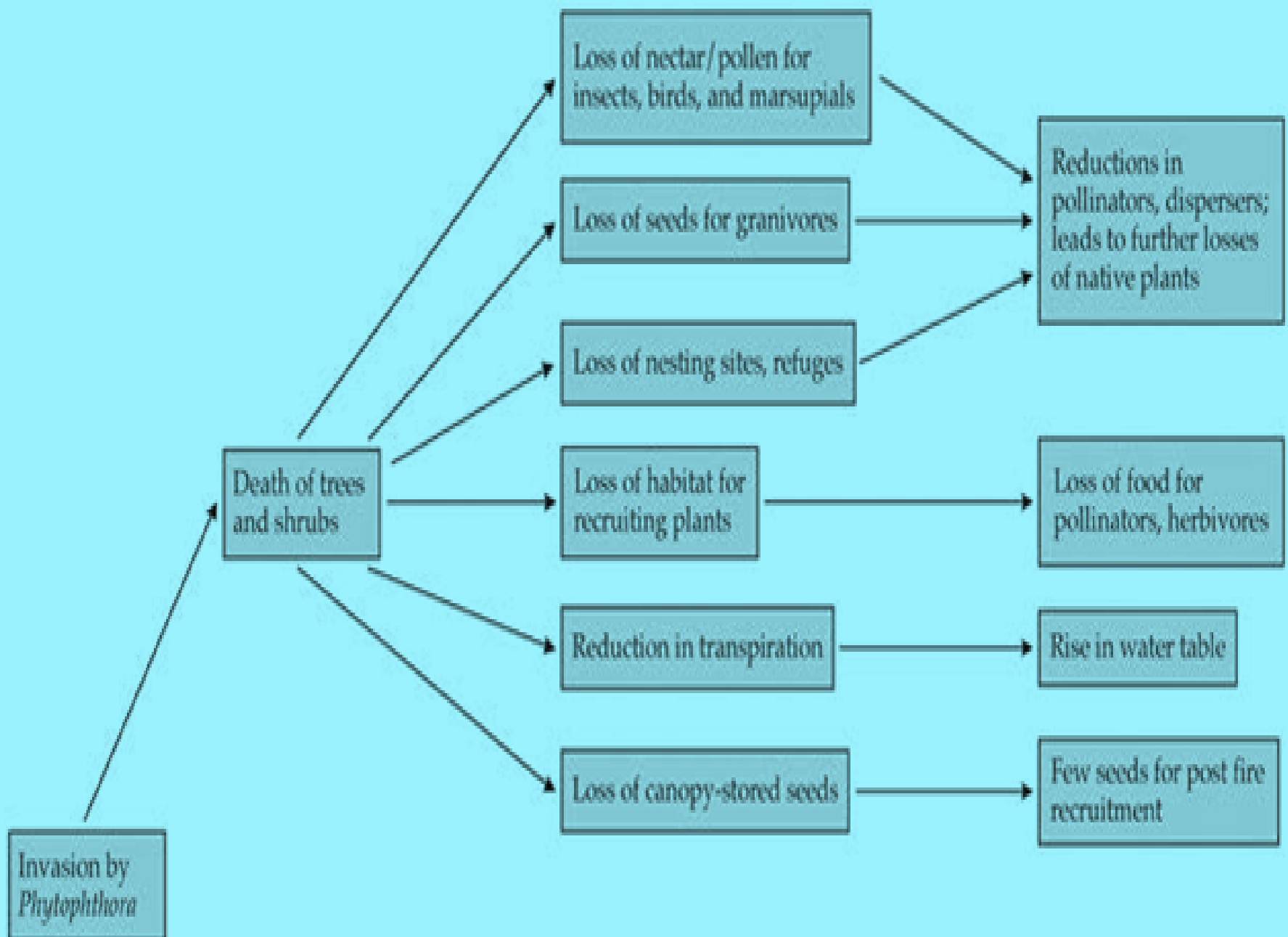
- are one of the main conservation threats today and have caused many species extinctions.
- can be spread either accidentally or intentionally
- The ability of a non-native species to establish itself is influenced both by
 - ✓ its own characteristics (e.g., reproductive biology) and
 - ✓ the condition of the natural community into which it is being introduced
 - ecologically healthy communities tend to be less vulnerable to invasion).

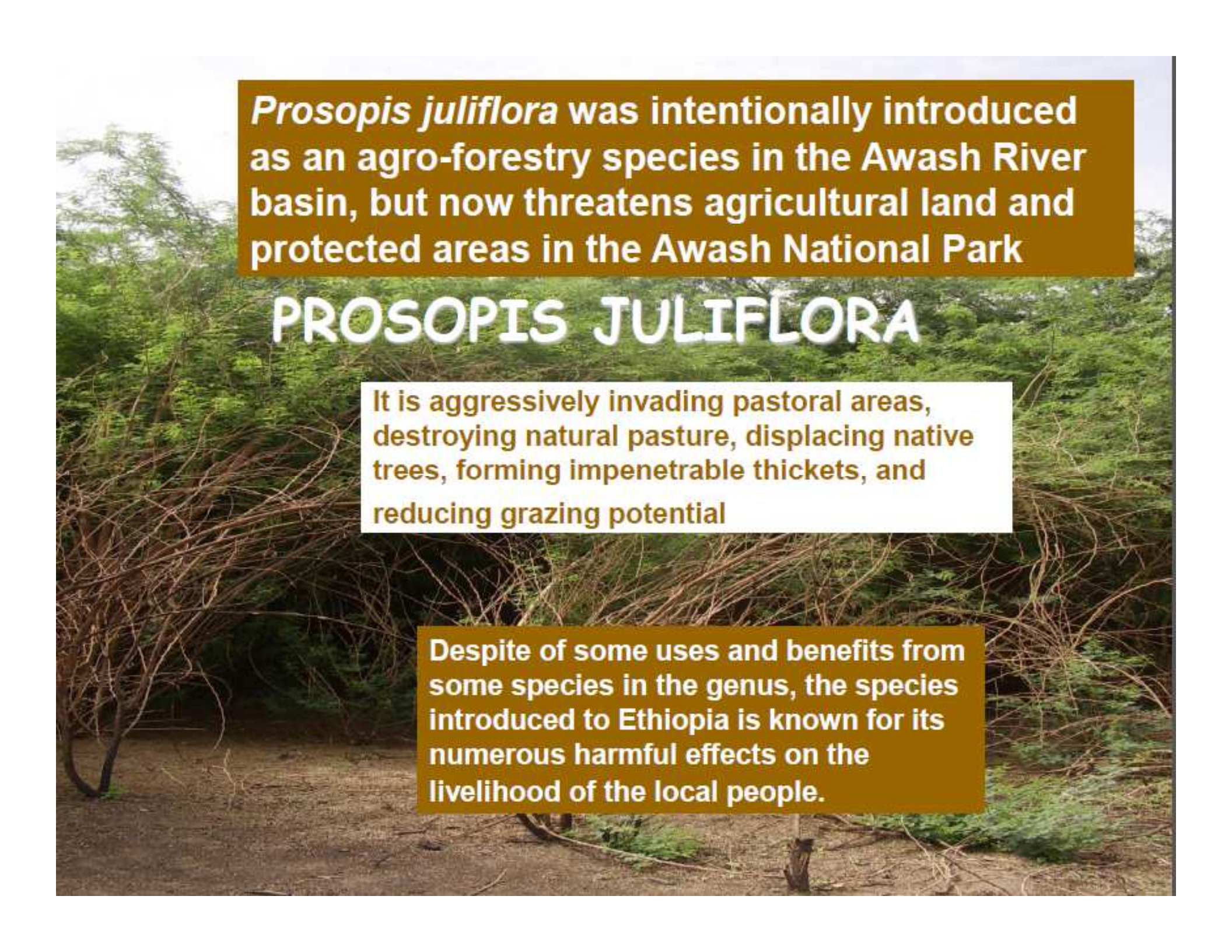
Invasive species...

threat of invasive species to natural habitats

- **Habitat alteration**
 - ✓ **Predation**
 - ✓ **Competition**
 - ✓ **Hybridization**
 - ✓ **Disease and parasites**
- **Homogenization of ecosystems**
- **Cascade Effects-**
 - ✓ **One factor can create a trophic cascading domino-like effect within an ecosystem that leads to secondary losses of other species**







***Prosopis juliflora* was intentionally introduced as an agro-forestry species in the Awash River basin, but now threatens agricultural land and protected areas in the Awash National Park**

PROSOPIS JULIFLORA

It is aggressively invading pastoral areas, destroying natural pasture, displacing native trees, forming impenetrable thickets, and reducing grazing potential

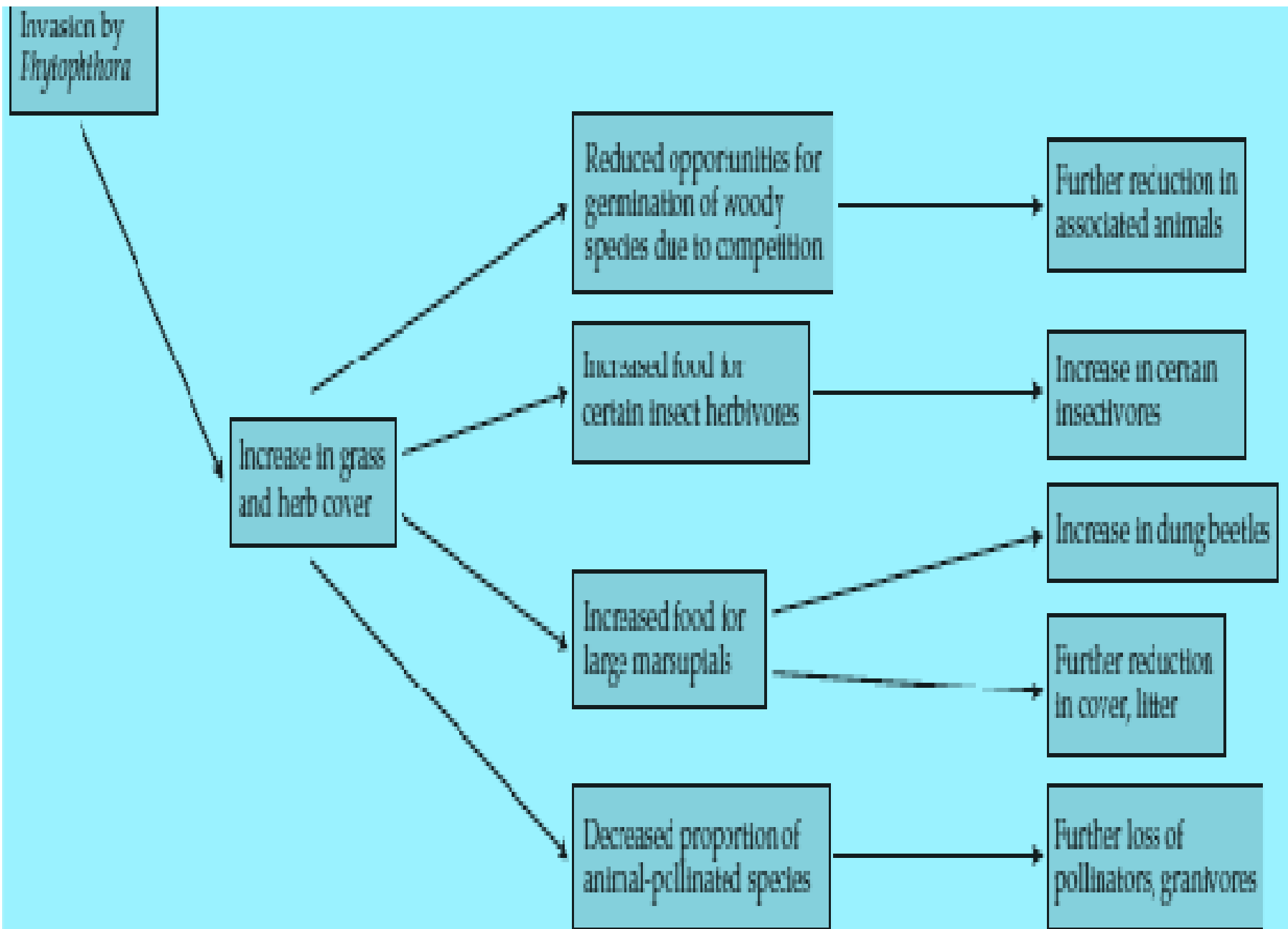
Despite of some uses and benefits from some species in the genus, the species introduced to Ethiopia is known for its numerous harmful effects on the livelihood of the local people.

Lantana has usually been deliberately introduced into various localities in Ethiopia (particularly urban settings) as an ornamental shrub, and has been quickly spread by birds and animals that eat its fruits but cannot digest the woody seeds



Water hyacinth





Argemone ochroleuca

Opuntia spp



Monitoring and eradication

- ✓ Sufficient resources must be available
- ✓ Clear lines of authority must exist
- ✓ The biology of the target organism must be studied well enough that a weak point in its life cycle is identified.
- ✓ Should the eradication succeed, there must be a reasonable prospect that reinvasion will not occur fairly quickly.
- If eradication is not an option, many available technologies may limit populations of invasive species so that damage is minimized.
 - mechanical or physical control
 - chemical control, and
 - biological control

v. Species extinction

- **Extinction is part of nature.**
- **Extinction, or the complete elimination of an entire species, is the harshest reality of nature.**
- **There have been at least five mass extinctions in the past, and humans are likely causing a sixth.**
- **Extinctions occur when species fail to adapt to changing ecological conditions.**
- **Extinction has consequences.**
- **Some species are more prone to extinction than others.**

Cont...

- **Extinction cannot be undone—extinction is forever.**
- **Species disappear when they fail to adapt to changing ecological conditions**
- **Species disappear when deaths exceed births over a long enough period**
- **Humans cause extinction through habitat destruction and modification, overexploitation, and introduction of non-native species.**

Extinction drivers

- any phenomena that can cause mortality rates to exceed reproductive replacement over a sustained period can cause a species to become extinct.
- **Overexploitation-** is a major threat to at least one-third of threatened birds and amphibians
- **Human-mediated climate change-** Climate warming can affect species in five principal ways
 1. alterations of species densities (including altered community composition and structure);

- 1. range shifts, either poleward or upward in elevation;**
- 2. behavioral changes, such as the phenology (seasonal timing of life cycle events) of migration, breeding, and flowering;**
- 3. changes in morphology, such as body size; and**
- 4. reduction in genetic diversity that leads to inbreeding depression**

Extinction vulnerability

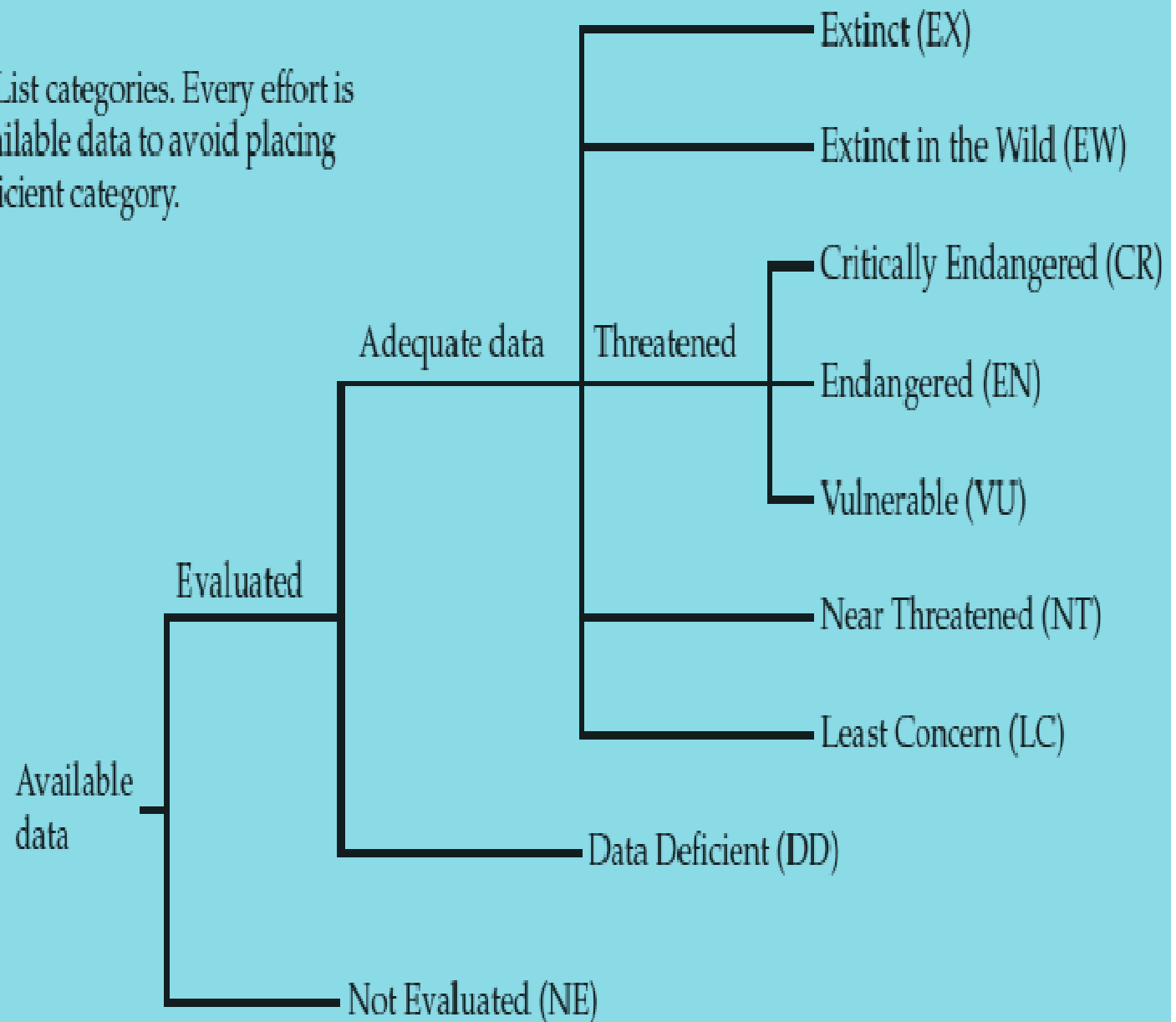
- **Certain life-history, behavioral, morphological, and physiological characteristics appear to make some species more susceptible than others to the extinction drivers**
 - ✓ **size of a species' range**
 - ✓ **reduced dispersal capacity, and the ensuing lower population viability**
 - ✓ **Larger-bodied animals**

- ✓ **Seasonal Migrants**
- ✓ **Species with Specialized Niche Requirements**
- ✓ **Species found in relatively stable environments**
- ✓ **Species that form permanent or temporary aggregations**
- ✓ **“Native” species with no prior contact with humans**
- ✓ **Species closely related to other extinct or near extinct/threatened species.**

IUCN Red List System:

- **(International Union for the Conservation of Nature and Natural Resources)**
- **Created in 1963**
- **System to classify threats to individual species**
- **Classifies all species into 9 Status Categories**
 - ✓ **Not evaluated,**
 - ✓ **Data Deficient,**
 - ✓ **3 Threatened Categories (Vulnerable, Endangered, Critically Endangered),**
 - ✓ **2 Extinct Categories (Extinct in the Wild, Extinct),**
 - ✓ **Near Threatened, and**
 - ✓ **Least Concerned**

IUCN Red List categories. Every effort is made to employ all available data to avoid placing species in the Data Deficient category.



Cont...

- **General Evaluation Criteria by which Classification Decisions are made:**
 - ✓ **population size and trends**
 - ✓ **geographic range**
 - ✓ **quantitative predictive models**

CHAPTER FIVE

CONSERVATION BIOLOGY

CONSERVATION BIOLOGY

- is the applied science of maintaining the earth's biological diversity.
- is the planned management of natural resources, to retain the balance in nature and retain the diversity.
- includes wise use of natural resources in such a way that the needs of present generation are met and at the same time leaving enough for the future generations.

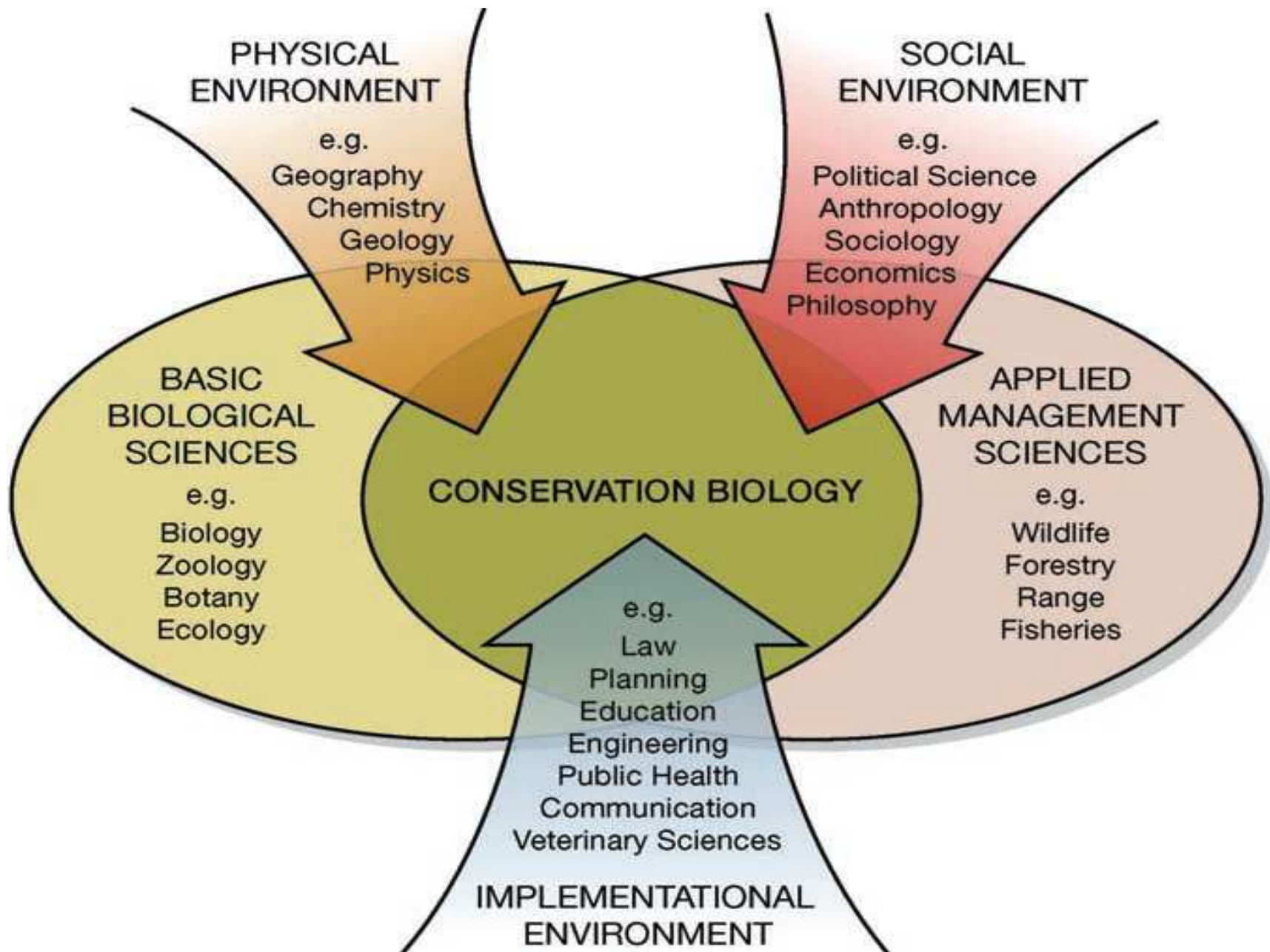
Cont...

- **Conservation of biodiversity is important to:-**
 - ✓ **prevent the loss of genetic diversity of a species,**
 - ✓ **save a species from becoming extinct, and**
 - ✓ **Protect ecosystems damage and degradation**
- **It is a cross-disciplinary subject lying between basic biologic sciences and natural resource sciences**

Cont...

- It is different from **traditional natural resource** sciences because it places relatively greater **emphasis on all forms of life and their intrinsic value**, compared with other natural resource sciences, which usually focus on a few economically valuable species.
- Like natural resource sciences, conservation biology is **influenced by the physical sciences** because it addresses issues with strong ecological and environmental linkages.

- Similarly, it is **influenced by social sciences**, law, education, and other disciplines because it operates in the world of human socio-economic-political institutions and seeks to change those institutions to **allow people to coexist** with the rest of the world's species.



Conservation ethics and rationale

- can be placed into three:

i. The Romantic-Transcendental Preservation Ethic-

- ✓ JohnMuir (1838–1914)
- ✓ believed that close association with nature brings people closer to God (thereby providing a “transcendent” experience)
- ✓ In other words, nature is a temple that is sullied by the economic activities of people

ii. The Resource Conservation Ethic-

- ✓ **Formulated by Gifford Pinchot (1865–1946)**
- ✓ **nature consisted solely of natural resources and should be used to provide the greatest good for the greatest number of people for the longest time**
- ✓ **a call to use it in a way that distributes benefits fairly and efficiently among many people**
- ✓ **believed that natural resources should be owned or regulated by the governments**

iii. The Evolutionary-Ecological Land Ethic

- Aldo Leopold (1886–1948) – founder of wildlife conservation as a professional discipline
- Leopold was saying that because nature is a complex system rather than a random set of species with positive, negative, and neutral values, each species is important as a component of the whole. In other words, species have instrumental value because of their utility in an ecosystem.
- gave people the right to use and manage nature *and* the responsibility of doing so in a manner that recognized the intrinsic value of other species and whole ecosystems.

Chapter 6

Conservation Planning in Theory and Practice

6. Conservation Planning in Theory and Practice

- Global conservation priority strategies are effective at **raising money** because they offer easily identifiable targets that attract the support of large donors
- At recent **prioritization** has become one of the principal pillars of conservation science.

Conservation priority setting

- A first step in conserving biodiversity is to **appreciate a spatial scale perspective of diversity**
- if the goal is to maximize local diversity at a single site (alpha diversity),

choose a site with high species richness

- But what if the management objective is to maximize biodiversity at a regional level (beta diversity)?
- At regional levels, the key is not to select the sites with highest richness, but to select sites in which species compositions are **most dissimilar** to one another.
- ❖ protecting areas of less biologic similarity enhances
 - ✓ protection of regional endemic species
 - ✓ ecological specialist species
 - ✓ contributes most to biodiversity at regional levels.

Priority setting...

- Although accurate inventories of diversity are important, **biodiversity is neither maintained nor managed simply by counting biological “things.”**
- Because the distribution of global biodiversity is complex, mapping and protecting key areas requires:
 - ✓ taxon specific approaches,
 - ✓ careful conceptual methods
 - ✓ sophisticated technologies for spatial problem solving.

- By examining biodiversity at different spatial scales, ecosystems and species can be defined at four different levels: **local, intermediate, coarse, and regional.**

Priority setting...

- Using technique such as GIS and GAP analysis, conservation biologists and land use planners can determine:
 - ✓ What proportion of an area's biodiversity is protected in an existing distribution of nature preserves and under existing land use practices?
 - ✓ Whether such protection can be expected to permit the persistence of endangered or endemic species
 - ✓ the best location and arrangement of new nature preserves or the best areas to attempt to change current land use patterns.

- Today there are identifiably nine major **global biodiversity conservation strategies**, or, more precisely, templates for identifying and selecting land areas to conserve for biodiversity.
 1. The Crisis Ecoregion (CE) strategy, prioritizes conservation of ecosystems facing the highest threats of destruction and degradation.
 2. Biodiversity Hotspots (BH), selects landscapes with the highest species diversity per unit area.
 3. Endemic Bird Areas (EBA), prioritizes areas with the highest densities of endemic bird species.
 4. Centers of Plant Diversity (CPD), targets areas with exceptional plant diversity per unit area.

5. **Megadiversity Countries (MC)**, identifies nations with the highest levels of biodiversity, and designs conservation plans sensitive to national interests and boundaries.
6. **Global 200 Ecoregions (G200)**, a science-based global ranking of the Earth's most biologically outstanding terrestrial, freshwater and marine habitats.
7. **High Biodiversity Wilderness Areas (HBWA)**, a strategy that identifies areas that combine high levels of biodiversity, relatively low human population density, and high landscape connectivity.

8. **Frontier Forests (FF)**, a strategy targeting the world's remaining large intact natural forest ecosystems.
9. **Last of the Wild (LW)**, a strategy that places conservation priority on areas representing the largest and relatively “wildest” (lowest human population and environmental impact) places in each of their biomes.

- Each of these strategies uses a somewhat different approach to biodiversity conservation, with unique, and, sometimes, complementary strengths and weaknesses.
- two criteria:
 1. such templates can be classed as proactive versus reactive, and,
 2. they emphasize either irreplaceability, which focuses on rarity and uniqueness, or vulnerability, which focuses on threat.
- For example, CE is a highly reactive strategy, prioritizing conservation areas according to immediate threat, while HBWA is highly proactive, attempting to conserve areas that are still relatively unaffected by negative human influences.

- Some strategies, such as those that focus on **endemic species**, such as EBA, or **biodiversity alone**, consider only irreplaceability, not vulnerability as the guiding criteria to prioritize conservation areas.
- What is important to note is that templates that prioritize the same thing, such as **high vulnerability**, tend to place priority of conservation effort on **many of the same areas**,
- while those that prioritize different things (for example, **irreplaceability versus vulnerability**) have much less overlap in their selection of priority conservation areas.

Priority setting...

- **There are four types of vulnerability measures:**
 - ✓ **environmental and spatial variables,**
 - ✓ **land tenure,**
 - ✓ **threatened species, and**
 - ✓ **expert opinion.**
- **79% of all land on Earth is prioritized in at least one of these systems, but the different templates require different kinds of conservation approaches.**

Selection of priority areas for biodiversity conservation

- the most important identifiable areas for biodiversity are those ecosystems and habitats that
 - ✓ contain many species
 - ✓ contain species that occur nowhere else (ie. Endemic species),
 - ✓ are taken to be representative samples of major or rare ecosystems,
 - ✓ which contain large numbers of genetic lineages of economic value.

Selection of priority areas...

- Three of the major criteria for selecting sites for investment should be:
 - ✓ Representativeness= is intended to ensure that adequate samples of distinct ecosystems are selected for management, and is uniquely relevant to making global choices
 - ✓ Complementarities=is concerned with ensuring that samples of all distinct ecosystems within a country are included within its national system of protected areas
 - ✓ Insurance or redundancy= the need for some duplication in the coverage of such systems

global distribution of biodiversity, and priority areas for conserving

A) Endemic bird areas

- only one consistent and comprehensive global assessment of animal biodiversity at the level of ecoregions, restricted-range bird species, which are those with historical breeding range of 50,000 square kilometers or less
- 221 endemic bird areas (EBAs)
- ☐ There are four EBAs in Ethiopia, namely:
 - ✓ the Central Ethiopian Highlands,
 - ✓ Jubba and Shabeelle valleys,
 - ✓ Southern Ethiopian Highlands and
 - ✓ Northern Ethiopia.

B) Centres of plant diversity

- The only worldwide study of plant biodiversity at an ecoregional level
- 250 centres of plant diversity (CPDs)
- areas which are known to be rich in species and endemics
- presence of an important **gene pool** of plants of value to people
- a diverse concentration of habitat types, a high proportion of species adapted to local soil conditions, and some degree of threat to the ecological integrity of the area.
- located in all continents (except Antarctica) and range in size from under one hundred hectares to over one hundred million hectares

C) Biodiversity Hotspots

- designate areas in which there is a disproportionate number of endemic species (species that are found nowhere else) and which **are losing habitat at a high rate**
- identified 25 “hotspots” that together comprise only 1.4 percent of the Earth’s surface yet contain 44 percent of all species of higher plants and 35 percent of all land vertebrate species.
- Hotspots are defined according to their plant vegetation
- a hotspot has to contain at least 0.5 percent of the world’s 300,000 plant species as endemics.

Biodiversity Hotspots



1. Tropical Andes, 2. Mesoamerica, 3. Caribbean, 4. Brazil's Atlantic Forests, 5. Choco/Darien/Western Ecuador, 6. Brazil's Cerrado, 7. Central Chile, 8. California Floristic Province, 9. Madagascar, 10. Eastern Arc & Coastal Forests of Tanzania/Kenya, 11. West African Forests, 12. Cape Floristic Province, 13. Succulent Karoo, 14. Mediterranean Basin, 15. Caucasus, 16. Sundland, 17. Wallacea, 18. Philippines, 19. Indo-Burma, 20. South-Central China, 21. Western Ghats/Sri Lanka, 22. Southwest Australia, 23. New Caledonia, 24. New Zealand, 25. Polynesia/Micronesia

D) Mega diversity countries

- countries with high species richness and endemism in different groups of organisms, i.e., mammals, birds, amphibians, reptiles, swallowtail butterflies and angiosperms
- 50 countries or territories can be divided into two groups
- **Group 1 (the 25 most biodiverse countries):** Argentina, Australia, Bolivia, Brazil, Cameroon, China, Colombia, Costa Rica, Ecuador, **Ethiopia**, India, Indonesia, Madagascar, Malaysia, Mexico, Papua New Guinea, Peru, the Philippines, South Africa, Tanzania, the USA, [ex USSR], Venezuela, Viet Nam and Zaire; and

- **Group 2 (the 25 next most biodiverse countries):**
- **Angola, Botswana, Cambodia, Central African Republic, Chile, Congo, Cote d'Ivoire, Cuba, Gabon, Ghana, Guatemala, Guyana, Iran, Kenya, Laos, Myanmar, Nigeria, Panama, Paraguay, Sudan, Suriname, Thailand, Turkey, Uganda and Zambia.**

Biodiversity conservation approaches

- two major approaches

1. **Ex situ-conservation**

- ✓ it is a technique of conservation of biological diversity outside its natural habitats, targeting all levels of biodiversity
- ✓ Outside of the protected areas (e.g. botanical gardens, zoological gardens, captive breeding, aquarium, gene banks)
- ✓ may be used on some or all of the population, when *in-situ* conservation is too difficult, or impossible
- ✓ It is used as valuable tools in studying and conserving biological resources

conservation approaches...

2. In situ-conservation

- ✓ emphasizes on the conservation work within the natural habitat of the species (e.g. national parks, biosphere reserves, forest priority areas).
- ✓ It is the process of protecting an endangered plant or animal species in its natural habitat,
 - either by protecting or cleaning up the habitat itself, or
 - by defending the species from predators.

- ✓ **It is applied to conservation of agricultural biodiversity in agro ecosystems by farmers**
- ✓ **maintains recovering populations in the surrounding where they have developed their distinctive properties.**
- ✓ **helps ensure the ongoing processes of evolution and adaptation within their environments.**

Habitat restoration

- **The term restoration, which in the most formal sense is returning an ecosystem to its original pre-disturbance state,**
- **refer to all types of habitat manipulations including enhancement, improvement, mitigation, habitat creation, and other situations**
- **The term habitat improvement means restoring, enhancing, or establishing physiographic, hydrological, or disturbance conditions necessary to establish or maintain native plant and animal communities**

Habitat restoration

- Habitat restoration/management involves a combination of practices such as:
 - ✓ tree/shrub planting, grass planting,
 - ✓ grassland management,
 - ✓ forestry/ woodland management,
 - ✓ wetland restoration,
 - ✓ livestock exclusion/access control, invasive species management, controlled burning.

Major types of Habitat restoration

□ Road rehabilitation=

- resurfacing roads, reducing traffic, increasing the number of stream crossings, stabilizing cut and fill slopes, and replacing stream crossings to improve the natural transport of sediment and biota
- complete road removal or abandonment of roads, is also a common method to reduce road impacts.

☐ **Riparian rehabilitation**

1) Silviculture treatments- through replanting of trees and other vegetation, typically with protection from further harvest or vegetation removal

2) Fencing and grazing reduction (passive restoration)

☐ **Floodplain rehabilitation**

☐ **Lake Habitat enhancement**

❑ **Nutrient enrichment**

diversion of nutrient rich agricultural runoff, addition of inorganic nutrients, and addition of manure or other solid organic material.

Restoration of degraded ecosystem

- Ecosystem Restoration is the “process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed”.
- Commission on Ecosystem Management (CEM) has identified it as one of its 19 priority thematic areas.
- Rehabilitation of a degraded ecosystem means shifting it back toward a greater value or higher use than it is serving currently, not necessarily all the way to its original state.

The Six Basic Steps for Restoring an Ecosystem

1. Set a goal= It is important to be realistic, especially because ecosystem restoration can be quite expensive.
 - ✓ requires answering both ethical (what do we want?) and technical (exactly what does that look like?) questions.
2. Determine a strategy and methods
3. Remove the source of degradation= This step is obvious and critical: you cannot recover from a knife wound until you have removed the knife.
4. Restore the physical environment
5. Restore the biota
6. Be patient

Combating desertification

- Desertification is "land degradation in arid, semi-arid and dry sub humid areas resulting from various factors, including climatic variations and human activities".



Combating desertification...

- "The sum of the geological, climatic, biological and human factors which lead to the degradation of the physical, chemical and biological potential of lands in arid and semi-arid zones, and endanger biodiversity and the survival of human communities."
- Climate has a major influence through three factors rainfall, solar radiation and wind

- **Human activities are the main factors triggering desertification processes on vulnerable land**
- **These activities are many and vary by country, society, land use strategies and the technologies applied.**
- **The impact of human society does not depend solely on its density.**

Some of the human activities that can cause desertification are:

- ✓ **Cultivation of soils**
- ✓ **Reduction in the fallow period of soils, and lack of organic or mineral fertilizers**
- ✓ **Overgrazing**
- ✓ **Overexploitation of woody resources**
- ✓ **Uncontrolled use of fire for different use**
- ✓ **Agricultural practices that destroy the soil structure**
- ✓ **Agricultural practices that result in the net export of soil nutrients**
- ✓ **Diversion of rivers to create irrigation schemes**
- **All these activities derive from two root causes.**
 - **The first five are typical of poverty and underdevelopment,**
 - **while the rest result from "modern" development that disregards the impact of the technologies used on land sustainability.**

- **The consequences of desertification - the phenomenon of land degradation - depend on four factors that vary by region, country and year**
 - ✓ **The seriousness and extent of land degradation**
 - ✓ **The severity of climatic conditions at the time**
 - ✓ **The number and diversity of affected populations**
 - ✓ **And the level of development of the country involved**
- **The poorer the peoples and the less developed the countries involved, the more profound will be the future effects of desertification, and the greater the potential for tragedy when natural conditions, especially climatic, become difficult.**

Combating desertification...

- The fight against desertification is a fight for survival.
- It is an integral part of the socio-economic development programmes of land resources and the inhabitants of concerned areas

❖ **Five main principles.**

1. The principle of integration- integrating the immediate, medium- and long-term needs of the population.
2. The consultation principle
3. The principle of planned spatial approach
4. The principle of decentralization of decision-making and modalities of action
5. The principle of duration and flexibility of assistance to activities

CHAPTER SEVEN

THE STATUS OF CONSERVATION IN ETHIOPIA

CONSERVATION IN ETHIOPIA

- Ethiopia is one of the world's rich biodiversity countries and it deserves attention regionally and globally.
- is one of the twelve known ancient countries for crop plant diversities in the world and has valuable reserves of crop genetic diversity,
- of which **11 cultivated crops** have their centre of diversity in the country
- The flora of Ethiopia is very diverse with an estimated number between 6,500 and 7,000 species of higher plants, of which about 12% are endemic.
- It has been said that Ethiopia is the fifth largest floral country in tropical Africa.

- also rich in its faunistic diversity.
- About 288 species of mammals, 862 species of birds, 201 reptile species, 145 species of freshwater fish, of which over 87 species are from Baro River and 16 from Lake Abaya, 324 butterflies and 64 species of amphibians are known from Ethiopia.
- A total of 31 species of endemic mammals
- Among these five are larger mammals Walia Ibex (*Capra walie*), Gelada Baboon (*Theropithecus gelada*), Starck's Hare (*Lepus starcki*), Mountain Nyala (*Tragelaphus buxtoni*) and Ethiopian Wolf (*Canis simensis*)



Cont...

- However the alarming increase of human population is causing environmental degradation throughout the country and an accelerated rate of **habitat loss**.
- Ethiopia desperately requires solutions to conserve its remaining biodiversity and ecosystem services, whilst striving to ensure sustainable livelihoods and reducing the vulnerability of resource-dependent communities.

Soil Conservation

- **Soil resources**

- ✓ total a land area of about 113,000,000 hectares
- ✓ highlands above 1500 m constitute around 45% of the total land area
- ✓ The highland areas are more densely populated, inhabited by four fifths of the population
- ✓ more densely populated, inhabited by four fifths of the population
 - Here the volcanic soils are relatively fertile and deep
 - provide a big range of environments suitable for the growth of a wide range of tropical, subtropical and temperate crops
- ✓ An equally wide range of farming and land use systems has thus developed

Soil conservation problems

- highlands of Ethiopia are facing soil degradation due to soil erosion and deterioration of soil quality
- Annually, about 1.9 billion tones of soil are eroded from the highlands.
- In 2010, about 38000 km² of land disappears and some 60000 km² have <10 cm soil depth.
- This can lead to reduction of about 2% in food production annually.
- For a country which depends heavily on agriculture like ours, soil erosion can be considered as one of the major problems and should be given priority.

Soil conservation practices

- **both traditional/indigenous and modern soil conservation practices are used**
- **traditional terraces in Konso and North Shoa areas**
- **modern soil conservation practices were massively carried out on the highlands of Ethiopia during the Military Government (Dergue),**
- **includes tree planting on hilly/degraded sloppy areas, terraces on farmlands, soil bunds, and combinations of soil bunds with grasses (physical structures and biological conservation measures)**
- **However, most of the efforts were not successful since they were done without convincing the farmers.**





Water Conservation

Water resources of Ethiopia

- includes surface water, lakes and ground water.

i. Surface water

- Ethiopia is the “water tower” of Northeastern Africa.
- Except for the Awash and the Omo, all the large rivers originating in Ethiopia flow into neighboring countries.
- The western part of the country drains into the Mediterranean Sea and the eastern part into the Indian Ocean.
- The total annual runoff is estimated at about 110 billion cubic meters.
- About 74 percent of the annual runoff goes into the rivers that flow into the Sudan, Egypt, Somalia and Kenya.

ii. Lakes:

- There are about 20 major natural and artificial lakes, covering over 80000 km².
- Seven of the eight major natural lakes are found in the Rift Valley.
- Most Ethiopian lakes except Ziway, Tana, Langano, Abaya and Chamo are terminal lakes.
- Lakes Shala and Abyata have concentrations of chemicals for the production of soda ash.

iii. Ground water:

- because of insufficiency of hydrogeological data, the groundwater potential of the country is not known with certainty
- A preliminary water resources master plan study of the various basins estimates it to be 2.9 billion cubic meters.
- So far, only a small fraction of this resource is in use, mainly for local water supply purposes.

Water use/conservation problems

- **major problems are natural factors like uneven distribution of rainfall and climate changes, and**
- **human factors like growing human population and increasing demand for domestic use, large-intervention in water-cycle (environmental degradation, deforestation, etc) and perceptions, or economic values that people put on water.**

Water conservation measures

- **water conservation activities are at infant stages in Ethiopia**
- **recent development projects on small-scale water-harvesting techniques and micro-dams. These projects were not well planned and are total failures.**
- **strategies in the future should focus on such issues like:**
 - (1) Improving perception of the value of water**
 - (2) Reducing population growth and individual demand**
 - (3) Using advances in technology for improved management**
 - (4) Integrating indigenous and innovative knowledge**
 - (5) Improving overall planning**
 - (6) And management and improving knowledge, monitoring and trainings**

Wildlife Conservation

Wildlife resources of Ethiopia

- Ethiopia is very rich in wildlife, with this great variety reflecting the diversity in climate, vegetation, and terrain.
- Some 288 terrestrial mammal species are found in the country of which 31 are believed to be endemic
- Some 862 bird species have been recorded from Ethiopia of which 16 are endemic Ethiopia

Conservation problems/ threats

- The major threats to the wildlife resources in Ethiopia are:
 - (1) Insufficient areas are protected, especially forest, and the arid thorn scrub in the Ogaden
 - (2) Protective measures in several areas have suffered because of the civil war-in several parts of the country, poaching, in particular of elephants, is out of control
 - (3) Habitat clearance for agriculture
 - (4)

Overgrazing by livestock

- (5) And Disease: Rinderpest is endemic in southern Ethiopia and presents a threat to all susceptible ungulates.
- The Globally threatened mammal species recorded from Ethiopia are: Black Rhinoceros (*Diceros bicornis*), Grevy's Zebra (*Equus grevyi*), African Wild Ass (*Equus africanus*), Walia Ibex (*Capra walle*) and Ethiopian Wolf (*Canis simensis*).

i. Endangered species

- *Canis simensis*- Ethiopian wolf (*C.s. simensis* & *C. s. citernii*)
- *Capra walie*-Walia ibex

ii. Rare species

- *Tauraco ruspolii*-Prince Ruspoli's turaco
- *Hirundo meganesis*- White-tailed swallow
- *Serinus ankoberensis*:-Ankober serin.
- *Zavattarirnis stresemanni*-Ethiopia bush-crow

iii. Indeterminate species

- *Miraфра degodiensis*:-Degodi lark
- *Heteromraфра sidamoensis*- Sidamo long-clawed lark
- *Serinus flavigula*- Yellow-throated serin

Conservation measures

- **The Ethiopian Wildlife & Natural History Society (EWNHS) is an active organization working on conservation of biodiversity and environmental education in the country.**
- **conservation and wise use of Ethiopia's natural resources**
- **the protection of the environment through the dissemination of information to create awareness,**
- **through conducting and supporting research concerning Ethiopia's flora and fauna.**
- **protected areas consist of national parks, sanctuaries, wildlife reserves, and controlled hunting areas.**
- **Most of the protected areas are merely on papers; only Awash and Siemen national parks are gazette**

Forest conservation

Forest resources of Ethiopia

- **Natural forests-** Today, the remaining forest areas are not more than 3% the land area of the country.
- **Most of the remaining forest areas are found in Oromiya, SNNP and Gambella states.**
- **Plantation forests:** the first human-made forest plantation was established around Addis Ababa at the turn of the century.

Forest conservation problems

- **clearing for agriculture**
- **overgrazing, settlement**
- **investment in plantations and logging for timber**

Conservation measures

- no major protected forest area except the Menagesha-suba forest and parts of the Harrena forest in the Bale Mountains National Park
 - the state forest department has identified and demarcated 58 most important remaining forest areas as national Forest Priority areas (NFPA)
 - However, none of these NFPAs are protected
 - To bridge the gap, or lack of appropriate policy and tenure rights, some NGOs are working with the local governments and local community, making arrangements which involve the local community in management and benefit sharing.
- (1) Adaba-Dodola participatory (PFM) project by GTZ,
 - (2) PFM projects in Chilimo, Borana, Bonga areas by FARM-Africa and SOS-Sahel; and
 - (3) Belete-Gera PFM project in Jimma by JICA.

Genetic resources conservation

Genetic resources of Ethiopia

- Genetic resources are genetic materials of actual or potential value.
- Ethiopia has high genetic resources of crop plants, livestock and microorganisms.
- known for its high genetic resources of cultivated plant species or crops
- 12 centers of crop genetic resources, among which Ethiopia is one and among the most diverse centers (like coffee, teff, Niger seed, Ensete)
- 38 crop plants are believed have their center of gene diversity in Ethiopia

Genetic resources conservation problems

- The broad range of genetic diversity, including the primitive landraces and wild gene pools are to serious genetic erosion
- replacement of the primitive landraces with modern, genetically uniform crop cultivars, drought, civil war, habitat destruction/fragmentation, changes and intensification of land uses.

Conservation measures

- Institute of Biodiversity Conservation-IBC (formerly the plant Genetic Resources Center-PGRC/Ethiopia) is mandated to conserve biodiversity, with particular focus on genetic resources in Ethiopia.
- In-situ conservation is defined in article two of the Convention on Biological Diversity (CBD) as the conservation of ecosystems and natural habitats & the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties.
- Ex-situ conservation is defined as the conservation of components of biological diversity outside their natural habitats.

CHAPTER EIGHT

THE ROLE OF GOVERNMENTS AND OTHER INSTITUTIONS IN CONSERVATION

International Conventions

- 1. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (1973)- Controls international trade in endangered species of plants and animals whether they are live or dead, whole organisms, or materials derived from organisms.**
 - Species cannot be traded internationally for commercial purposes. And some species is regulated and monitored.**

2. **The Convention on the Conservation of Migratory Species of Wild Animals (1979)** protects wild animals that migrate across international borders through international agreements.
3. **The International Convention for the Regulation of Whaling (1946)**

International Conventions...

- 4. The Convention on the Conservation of Antarctic Marine Living Resources (1980)**
- 5. The Convention Concerning the Protection of World Cultural and Natural Heritage (1972)** establishes a system of World Heritage Sites that are protected for their natural and cultural values.
 - Another international system of reserves called Biosphere Reserves has been established by UNESCO's Man and the Biosphere Programme to demonstrate the integration of rural development and environmental protection.

6. The Convention on Wetlands of International Importance, Especially as Water-fowl Habitat (1971) (often known as the Ramsar Convention because it was signed in Ramsar, Iran) promotes protection of wetland resources in general and establishes a system of Wetlands of International Importance.

International Conventions...

- 7. The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (1972)-** prohibits the ocean dumping of some pollutants and regulates others.
- 8. The United Nations Convention on the Law of the Sea (1982)** establishes a comprehensive legal framework for oceans, including regulation of marine pollution and harvesting natural resources.

9. The Protocol on Substances that Deplete the Ozone Layer

(1987) requires reduction in emissions of
chlorofluorocarbons and halons that deplete the ozone.

10. The Treaty Banning Nuclear Weapon Tests in the

Atmosphere, in Outer Space, and Under Water (1963)

prohibits tests that could distribute radioactive debris across
international boundaries.

- The following **five documents** were signed by heads of state at the United Nations Conference of Environment and Development (**UNCED**) in 1992; the first two are binding treaties.
 - i. **The Convention on Biodiversity.** This convention's objectives are "the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources." (This last item has proven contentious, at least in the United States, because it attempts to establish a mechanism by which nations that are the site of origin for a species or gene would benefit financially if this species or gene were developed into a marketable product (e.g. a new medicine) in another country. This treaty has been signed and ratified by 188 nations but not by the United States.)

ii. The Convention on Climate Change.

Requires stabilization of the concentrations of carbon dioxide, methane, and other greenhouse gases to avoid interfering with the earth's climate. The Kyoto Protocol is the latest manifestation of this convention, but it still has not been ratified.

Cont...

iii. The Statements on Forest Principles. A formal treaty on sustainable management of forests could not be negotiated, in large part because industrialized nations insisted that it apply only to tropical forests. A nonbinding statement of 17 principles was signed.

iv. The Rio Declaration promotes general principles to guide nations in their programs for development and environmental protection.

- **v. Agenda 21** describes environmental problems and associated issues such as health and poverty and puts forth a series of action plans. These cover the legal, technical, financial, and institutional aspects of tackling a host of problems such as deforestation, desertification, atmospheric pollution, and so on. The difficult part of Agenda 21 was determining how to pay for its estimated cost of \$600 billion per year.

- **The Framework for Action on Biodiversity and Ecosystem Management derived from the World Summit on Sustainable Development (the Johannesburg Summit 2002) outlines concrete steps toward implementing the vision outlined in the Rio Declaration.**
- **The Durban Accord: Action Plan resulted from the Fifth World Parks Congress in 2003 and placed protected areas on the global sustainable development and biodiversity agenda by articulating the following six desired outcomes:**

- 1) A global system of protected areas linked to surrounding landscapes and seascapes achieved**
- 2) Improved effectiveness of protected areas management in place**
- 3) Empowerment of indigenous peoples and local communities achieved**
- 4) Significantly greater support for protected areas from other constituencies agreed**
- 5) New forms of governance, recognizing traditional forms of great value for conservation, implemented**
- (6) And increased resources for protected areas secured.**

International laws and policies

- **United Nations Environment Programme (UNEP, Nairobi)**
 - ✓ facilitates international cooperation on environmental issues chiefly as a catalyst and source of information.
 - ✓ also administers some funds for environmental projects, but this is a secondary role.
 - ✓ oversees the **World Conservation Monitoring Centre (WCMC)**
- **United Nations Development Programme (UNDP, New York)**
 - ✓ the world's largest source of multilateral grants and funds a wide variety of projects (agriculture, transportation systems, health care, etc.) with environmental consequences.
 - ✓ funds projects designed to aid conservation and is a major participant in a new program, the Global Environmental Facility, along with UNEP and the World Bank.

International laws and policies...

- **United Nations Educational Scientific and Cultural Organization (UNESCO, Paris)**
 - ✓ facilitates international intellectual endeavors such as improving world literacy.
 - ✓ Its mission also includes protecting the world's cultural and natural heritage,
 - ✓ administers the Man and the Biosphere Programme and the list of World Heritage Sites

- **United Nations Population Fund (UNFPA, New York)**
 - ✓ gathers population statistics and funds family planning services.
 - ✓ Several other United Nations organizations administer programs that have strong links to conservation issues, (including FAO (Rome), WHO (Geneva), the World Food Program (Rome), and the United Nations International Children's Emergency Fund (UNICEF, New York)).

International laws and policies...

- **The World Bank (Washington, DC)**
 - ✓ distributing funds provided by wealthier nations.
 - ✓ It does this primarily through loans and grants for developing infrastructure such as roads, dams, electrical systems, and so on.
 - ✓ There are also regional development banks: the Asian Development Bank (ADB), the African Development Bank (AFDB), and the Inter-American Development Bank (IDB).
- **The International Monetary Fund (IMF, Washington, DC)**
 - ✓ created simultaneously with the World Bank, oversees the international system for currency exchange and loans, and negotiates loans itself.

International laws and policies...

- **The World Trade Organization (WTO)**
- **The World Conservation Union**
 - ✓ **formerly the International Union for Conservation of Nature and Natural Resources and still usually known as the IUCN)**
is a hybrid organization formed by over 1000 member organizations: governments (chiefly national-level, natural-resource agencies), nongovernmental conservation groups, and research institutions.
 - ✓ **Its goal is to promote the protection and sustainable use of living resources.**

Institutions

International Agencies

- Fostering a global conservation ethic-
 - ✓ *The World Conservation Strategy,*
 - ✓ *The World Charter for Nature,*
 - ✓ *Rio Declaration,*
 - ✓ “Framework for Action on Biodiversity and Ecosystem Management” agreed to at the World Summit on Sustainable Development (the so-called “Johannesburg Summit” of 2002).
- Regulating globally shared resources
- Facilitating the sharing of financial resources
- Facilitating the sharing of information

Governments

- **Developing and enforcing environmental regulations**
- **conserving publicly owned resources**
- **Encouraging conservation through economic policy**
- **Supporting environmental education and research**

Nongovernmental Organizations

- **Representing members to governments and other organizations**
- **Using their flexibility to undertake actions that are not open to governments**

Corporations

- Corporations usually have a single primary goal – to make money – but most corporate managers believe that to achieve this goal it is necessary that they be perceived as “good corporate citizens.”
 - some corporations are seeking proactive relations with local communities and adequate protection of fragile ecosystems
-
- ✓ Internalizing the environmental costs of doing business
 - ✓ Exceeding the standards of environmental regulations
 - ✓ Finding innovative ways to advance conservation

Communities

- Groups of people who live in the same area, who share common resources, who are confronted with common problems, or who share common interests can be a very effective force for conservation
- effective conservation requires empowerment of the communities
- sharing of the authority and responsibility of management by different stakeholders has been called *comanagement* or *participatory management*.

Individuals

- All organizations are simply assemblages of individuals, and all actions begin with one person, one catalyst.
- The standard advice for individual conservationists is **“Think globally, act locally.”**
 1. Be informed
 2. Become experienced
 3. Communicate
 4. Make your lifestyle consistent with your values
 5. Support conservation groups
 6. Become a professional conservationist
 7. Keep your perspective

End of the course!!!

Thank you!!!