

Short Introduction



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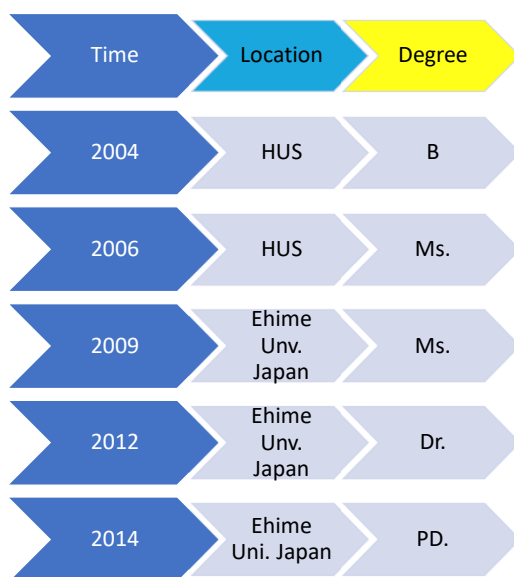
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1

Short Introduction



2

Nature and Ecosystem Based Adaptation

- **Lecture 1:** Biodiversity, Ecosystem service, and sustainable development goals
- **Lecture 2:** Valuing ecosystem services
- **Lecture 3:** Benefits of the ecosystem-based adaptation
- **Lecture 4:** The development decision-making tool for nature and ecosystem-based adaptation
- **Lecture 5:** The roles of natural conditions (geomorphology, geology, geography, etc.) in climate change adaptation and disaster mitigation

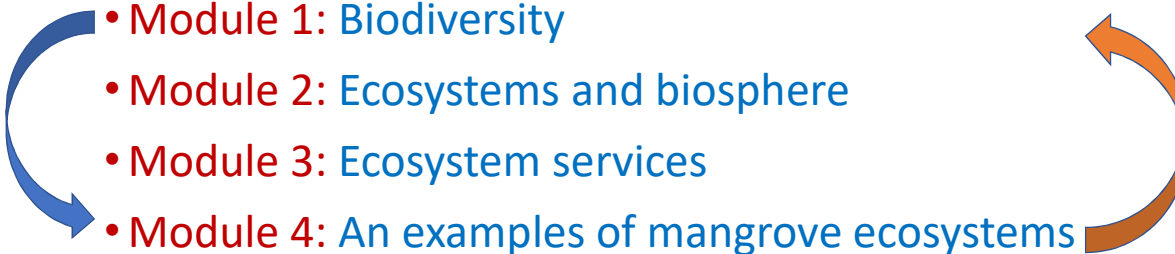
3

Nature and Ecosystem Based Adaptation

Biodiversity, Ecosystem service, and sustainable development goals

4

Lecture contents

- **Module 1: Biodiversity**
 - **Module 2: Ecosystems and biosphere**
 - **Module 3: Ecosystem services**
 - **Module 4: An examples of mangrove ecosystems**
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5

Module 1: Biodiversity

6

Biodiversity

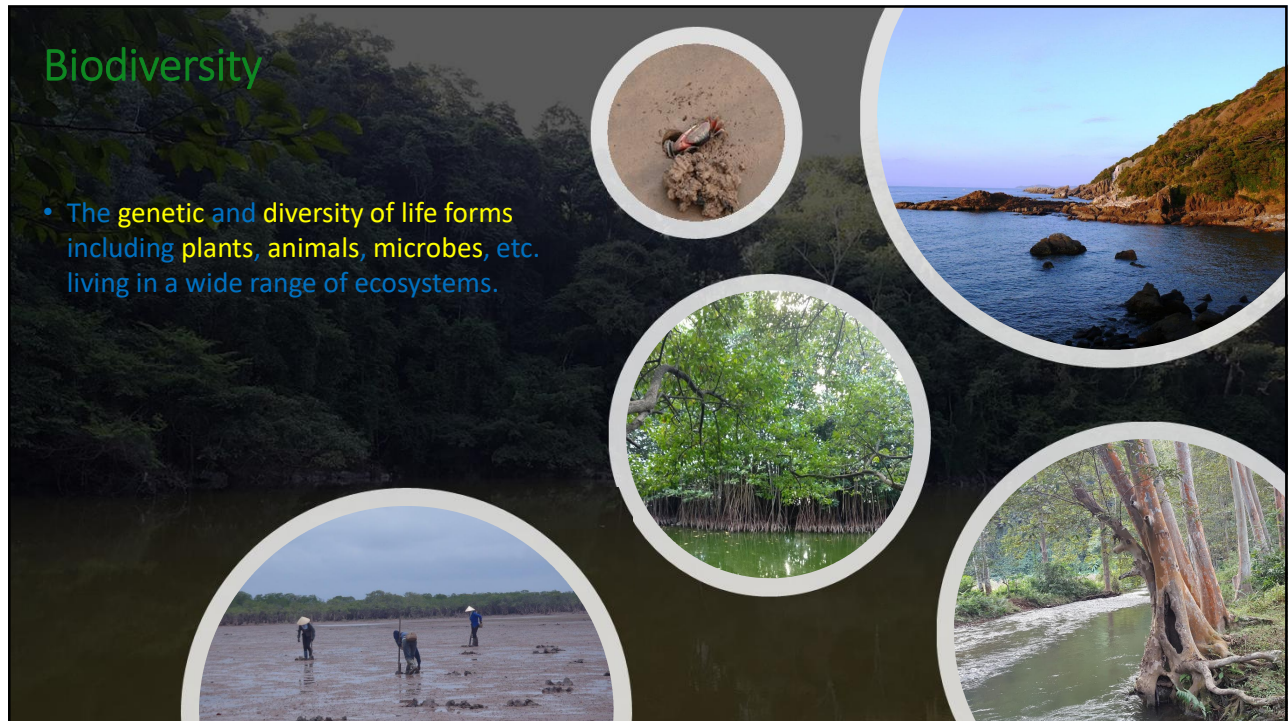
- *Biodiversity* commonly refers to the distribution and abundance of plant and animal species within an ecosystem (*US Forest Service 1989*).
- *Biodiversity*, which represents the variety and variability of life in all its forms (e.g., species, genes, etc.) (*J. Qi et al, 2018*).
- *Biodiversity (Biological diversity)* is the occurrence of different types of ecosystems, different species of organisms with the whole range of their variants and genes adapted to different climates, and environments along with their interactions and processes (*Muralikrishna et al., 2017*).



7

Biodiversity

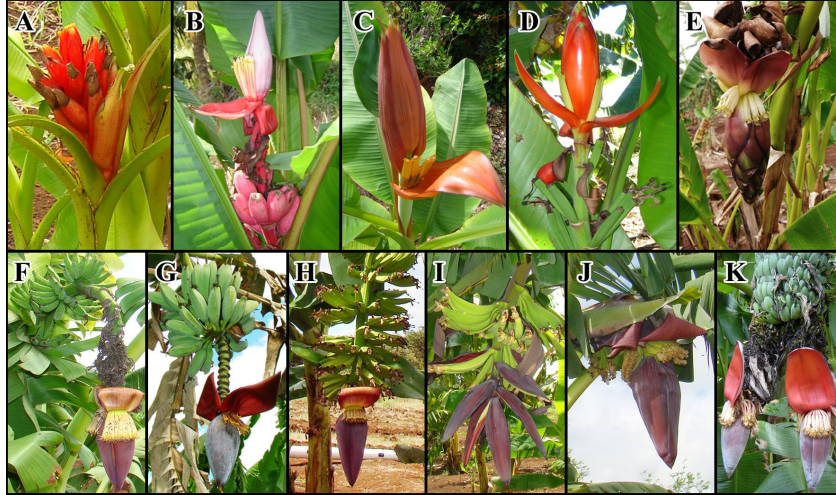
- The genetic and diversity of life forms including plants, animals, microbes, etc. living in a wide range of ecosystems.



8

Biodiversity

- Genetic diversity



G. Manzo-Sánchez et al. (2014)

9

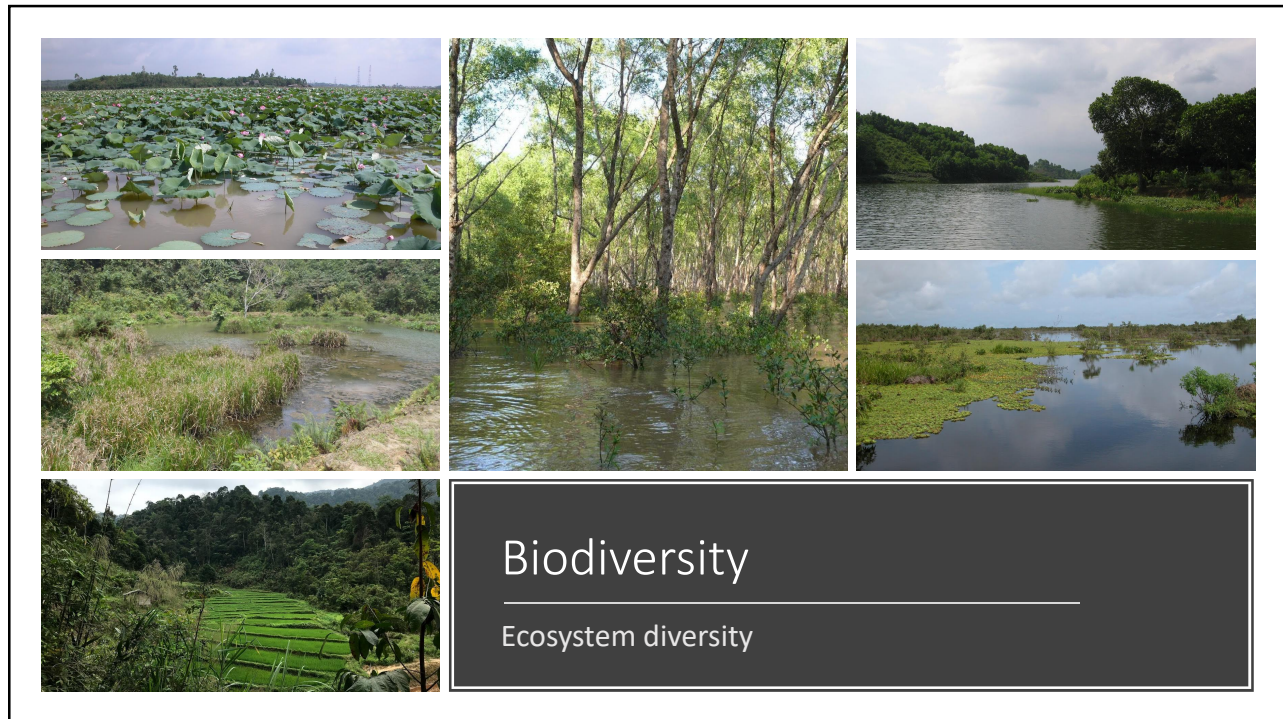
Biodiversity

- Species diversity

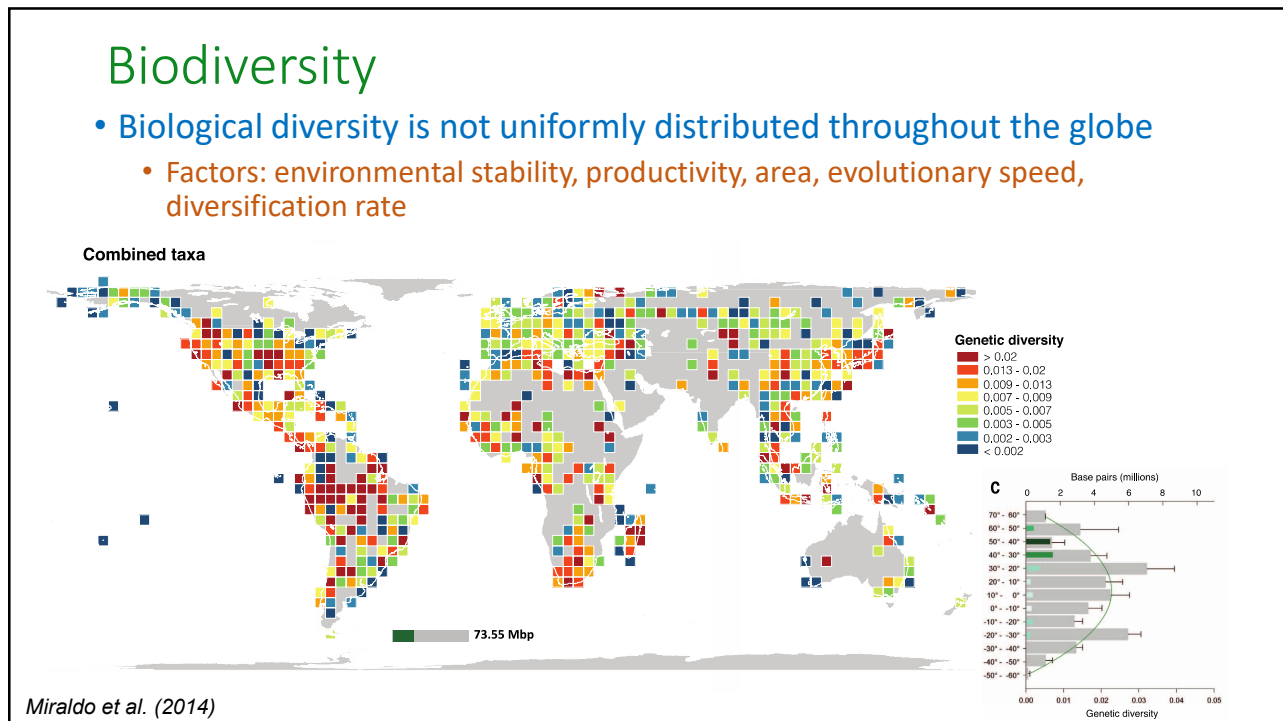


<https://www.earth.com>

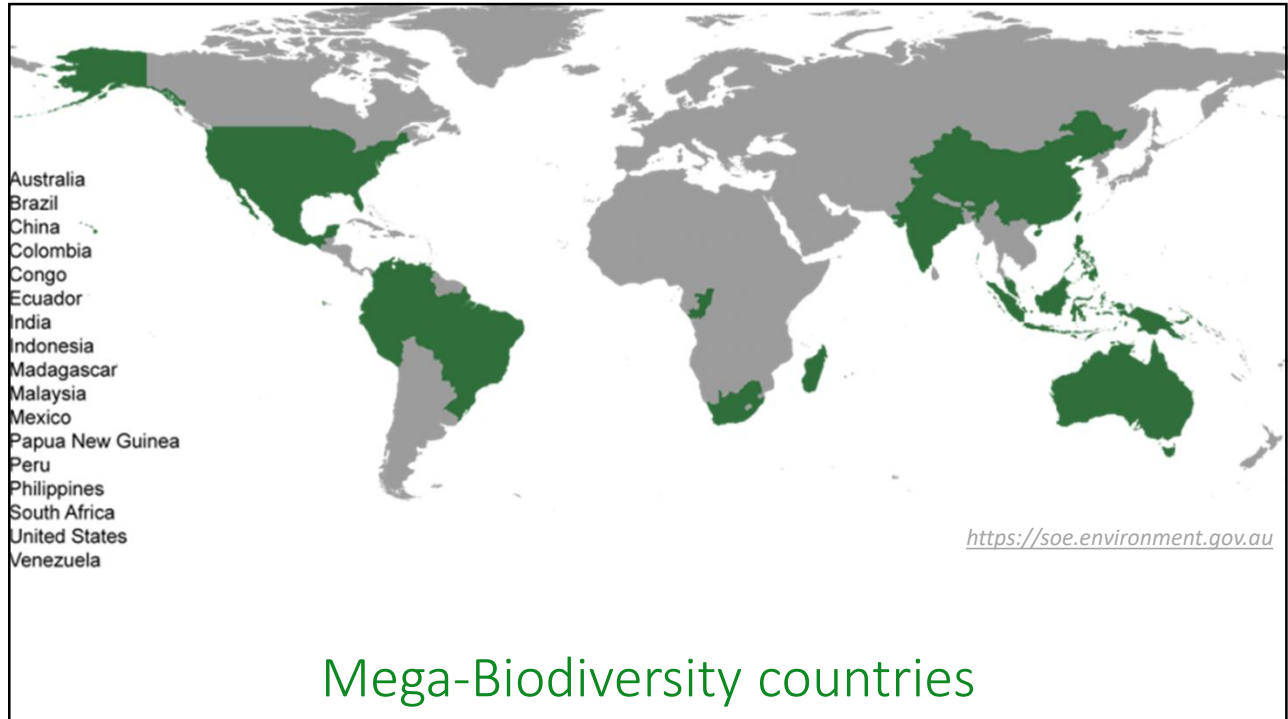
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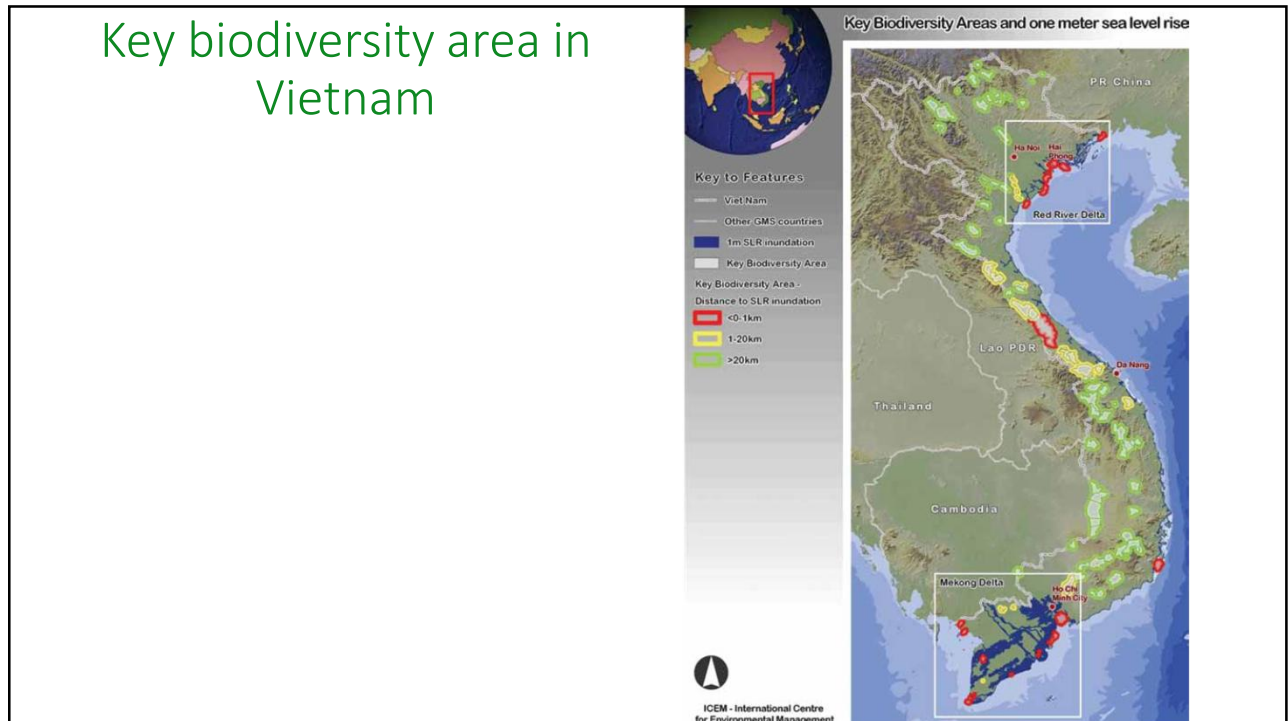
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12



13



14

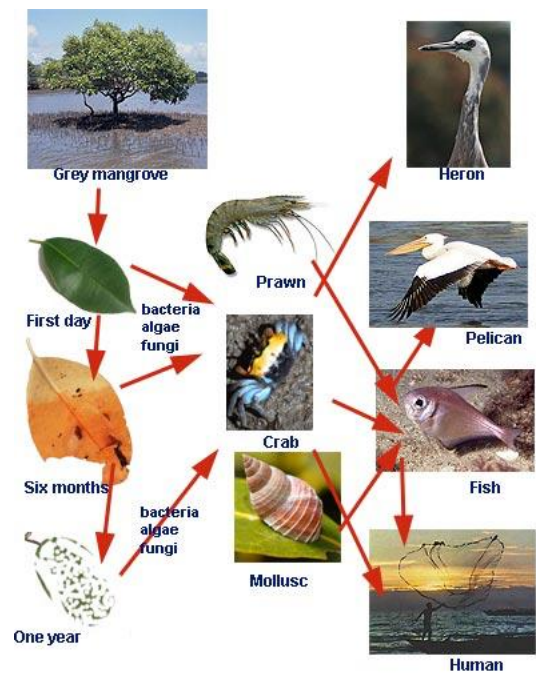
Quiz 1

- What is the importance of biodiversity?
 - You can take 10 minutes to think and write the keywords that indicate the importance of biodiversity?

15

The importance of biodiversity

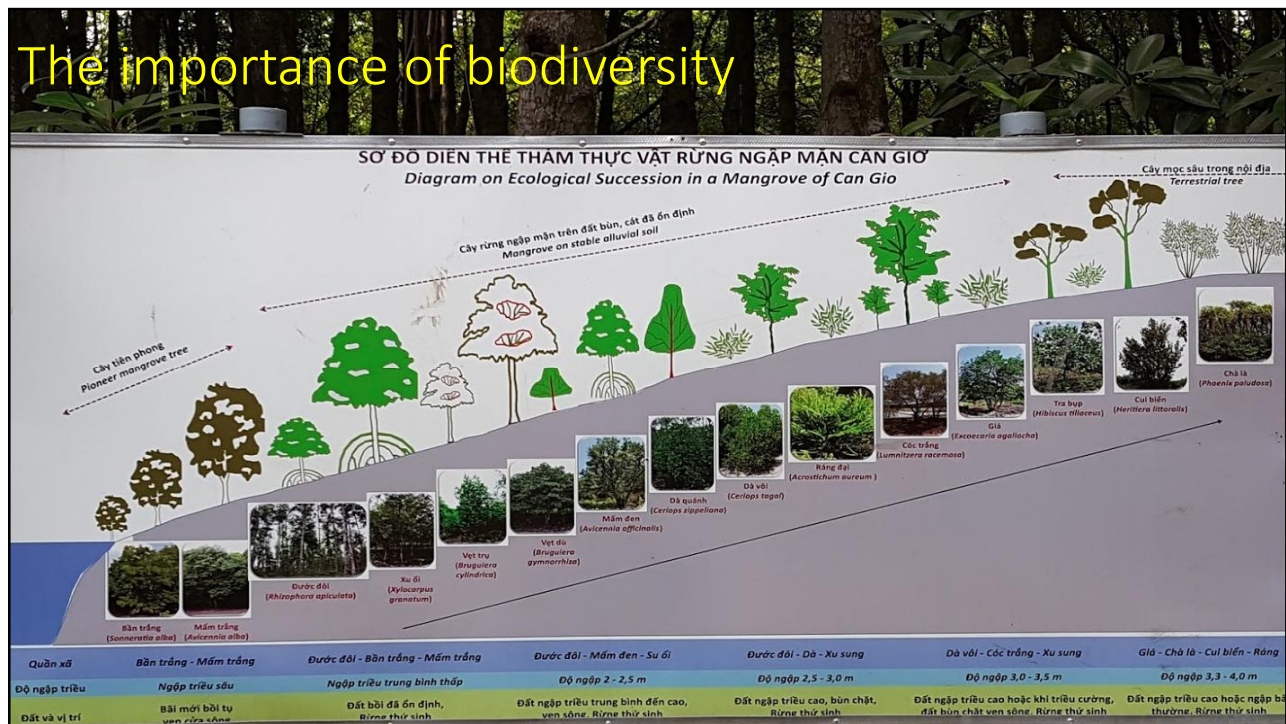
- Increase ecosystem productivity; each species in an ecosystem has a **specific niche**—a role to play.



www.mesa.edu.au

16

The importance of biodiversity



17



The importance of biodiversity

- Support a larger number of plant species and, therefore, a greater variety of crops: **Foods**
- Provide **protein** resources for human: **Food security.**

18

The importance of biodiversity

- Protect freshwater resources.
- Promote soils formation and protection.
- Provide for nutrient storage and recycling.



19

The importance of biodiversity

Biodiversity is essential for the Earth's functioning and our basic survival and well-being, which is not entirely correlated to consumption or monetary income, but relates to nature, social relationships, knowledge, and politics

- Provide for nutrient storage and recycling.
- Aid in breaking down pollutants.
- Contribute to climate stability.
- Speed recovery from natural disasters and climate change
- Provide more medicinal resources and pharmaceutical drugs.
- Offer environments for recreation and tourism.

20

Biodiversity loss

- Biodiversity loss is seen as a problem, given the vital importance of biodiversity for sustaining ecosystem functioning and preventing ecosystems from shifting into undesired states
- Causes of biodiversity loss
 - Habitat destruction
 - Habitat fragmentation
 - Pollution
 - Human impacts



21

Module 2: Ecosystems and biosphere

22

Ecosystem

- An energy-driven complex of a community of organisms and its controlling environment (*Billings 1978*).
- An ecosystem is a community of living organisms together with the physical processes that occur within an environment (*Pullin 2002*).
- Ecosystems are communities formed by the interaction between living (plants, animals, microbes) and non-living organisms (air, water, mineral soil).



23

Ecosystem

Trophic structure and
energy flow in an
ecosystem

Gordon Dickinson & Kevin Murphy (2010)

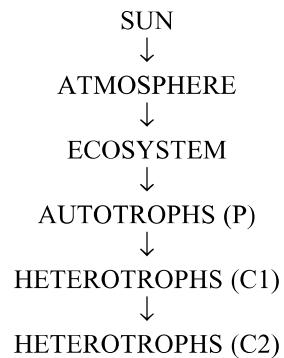
24

Ecosystem

Energy flow through an ecosystem

Energy sinks

atmospheric heating + weather
 water + mineral cycles
 photosynthesis losses
 conversion losses (P–C1)
 conversion losses (C1–C2)
 conversion losses (C2–C3)



Energy flow

(kJ.m⁻².yr⁻¹)
 20 × 10⁶
 4 × 10⁶
 2 × 10⁶
 8,000
 800
 150

Gordon Dickinson & Kevin Murphy (2010)

25

Ecosystem

Food web in an ecosystem

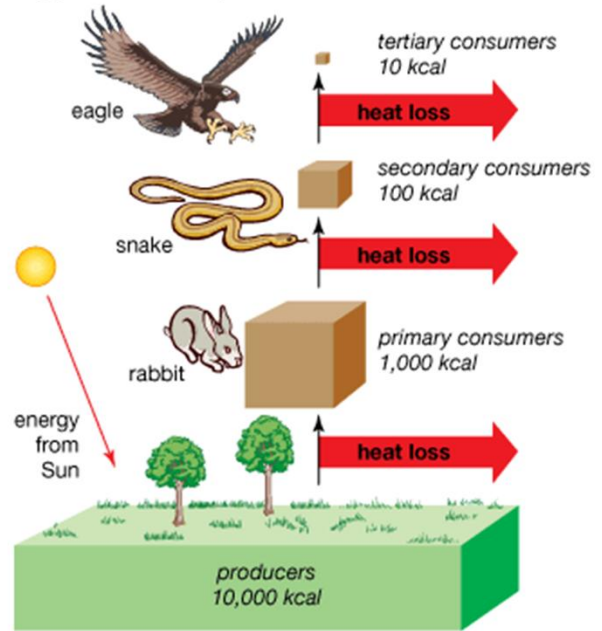


26

Ecosystem

Trophic structure and energy flow
in an ecosystem

Energy flow and trophic levels



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27

Ecosystem

- Carbon c

Gordon Dickinson & Kevin Murphy (2010)

28

Ecosystem

- Nitrogen cycle

Gordon Dickinson & Kevin Murphy (2010)

29

Ecosystem

- Phosphorus cycle

Gordon Dickinson & Kevin Murphy (2010)

30

Biosphere

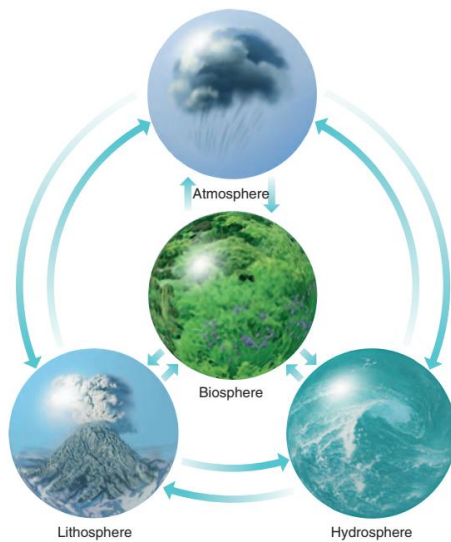
- Biosphere is the zone in which life is located, in a shell around the planet.



31

Biosphere

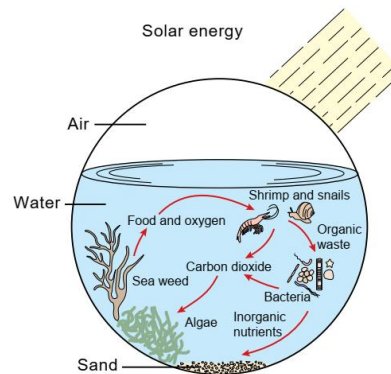
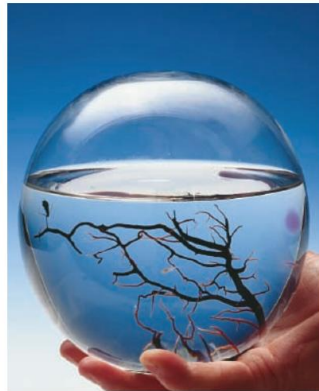
- Physical environment of biosphere



32

Ecosphere

Ecosphere = Biosphere + abiotic environmental life support systems



33

Many scales of ecosystem in biosphere

- Ecosystems exist at **spatial scales** from a crack in a rock to rainforest or oceanic ecosystems, covering areas of thousands of square kilometers
- **Boundaries** of ecosystems coincide with natural spatial features, such as an island or a type of vegetation, such as a forest.



34

<i>Hierarchy</i>	<i>Level of integration</i>		<i>Links</i>
Biosphere	↑	↓	Macro-scale environment
Biomes	↑	↓	Meso-scale environment
Ecosystems	↑	↓	Defined envelope of environment and biota conditions
Functional groups	↑	↓	Sets of environmental pressures within tolerance range of species making up functional group
Communities	↑	↓	Sets of environmental pressures within tolerance range of species making up community
Populations	↑	↓	Other populations and micro-scale environments
Organisms	↑	↓	Other individuals, of the same and other species, and micro-scale environments

35

Module 3: Ecosystem services

36

Quiz 2

- What are ecosystem services, please write some keywords of ecosystem services?

37

Ecosystem services

UK National Ecosystem Assessment
(UK-NEA, 2011)



- The benefits provided by ecosystems that contribute to making human life both possible and worth living

<https://www.bathnes.gov.uk>

38

Quiz 3

- Can you distinguish the goods/products and functions and services?

39

Ecosystem services

Products

- Food
- Fuel wood
- Non-timber forest products
- Fisheries products
- Marine products
- Wetland products
- Medicinal and biomedical products
- Forage and agricultural products
- Water
- Reeds
- Building material

Functions/Services

Hydrological services

- Purification of water
- Capture, storage and release of surface and groundwater
- Mitigation of floods and droughts

Biodiversity

- Maintenance of biodiversity (plants and animals)

Climate

- Partial stabilization of climate through carbon sequestration
- Moderation of temperature extremes and the force of winds and waves

Source: Adapted from Simpson (2001)

40

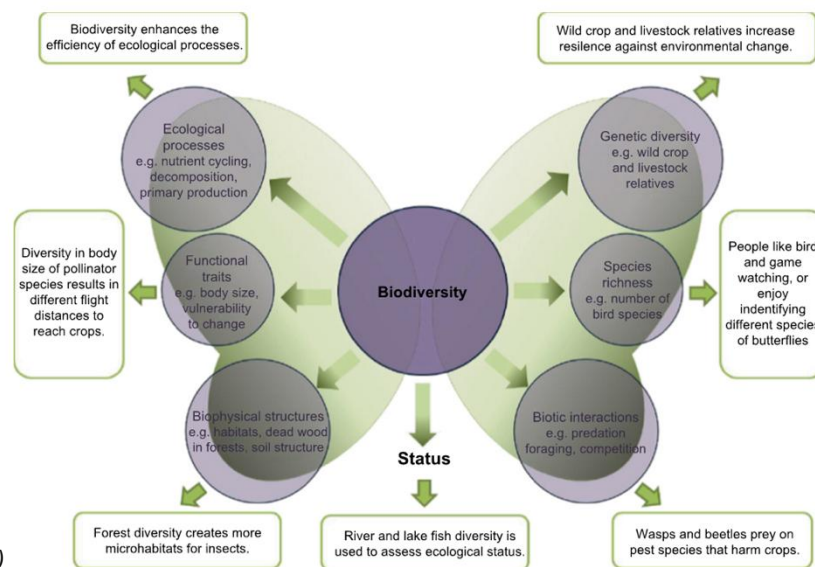
Ecosystem services

- Ecosystems create a breathable atmosphere and provide us with food, fiber, timber and a host of other raw materials.
- Ecosystems breakdown waste products, control water supplies and help regulate climate.
- Ecosystems provide space for recreation and contemplation
- Ecosystems play a pivotal role in creating a sense of place that underpins our mental and spiritual well-being.



41

Multifaceted role of biodiversity to support the delivery of ecosystem services



Sander et al. (2014)

42

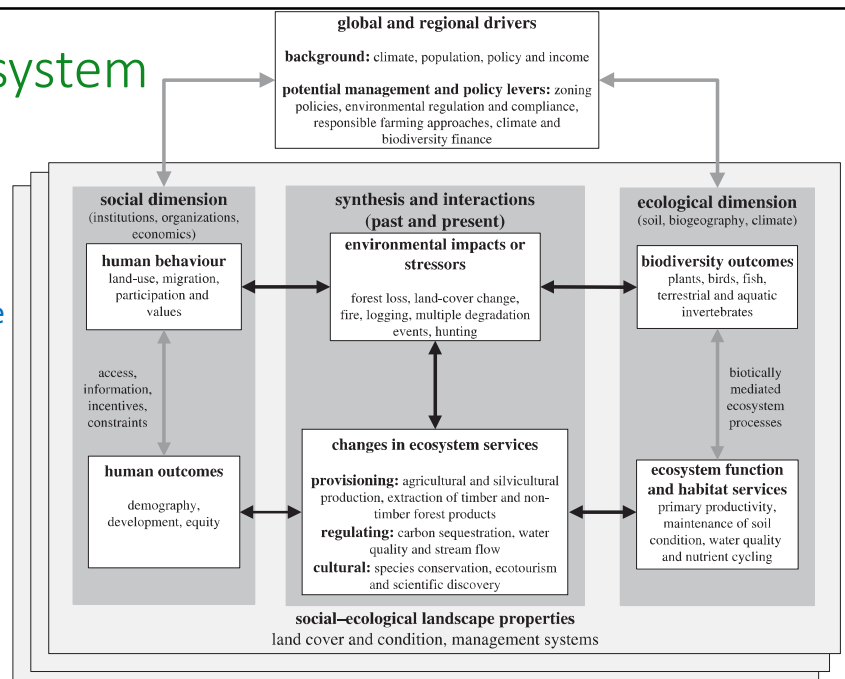
Socioecological system

- Ecosystem services research aims to analyze the relation between the natural environment and human society: the **socioecological system**
- Socioecological systems are highly complex and poorly understood

43

Socio-ecological system















- Social-ecological systems are linked systems of people and nature, emphasizing that humans must be seen as a part of, not apart from, nature (Berkes and Folke, 1998)



Gardner et al. (2013)

44

Overview of Aichi Biodiversity Targets

 1 Public awareness	 6 Sustainable fisheries	 11 Protected areas	 16 Nagoya ABS Protocol
 2 Value of biodiversity understood	 7 Sustainable agriculture	 12 Species	 17 NBSAP revision
 3 Removal of perverse incentives	 8 Pollution	 13 Genetic diversity	 18 Traditional environmental
 4 Sustainable production / consumption	 9 Invasive alien species	 14 Ecosystem services	 19 Knowledge transfer
 5 Loss of natural habitats	 10 Climate change / ocean acidification	 15 Ecosystem-based carbon sequestration	 20 Resource mobilisation

45

Sustainable development goals



46

Synergies between Aichi Biodiversity Targets and SDGS

the conservation of biodiversity and ecosystem services can lead to substantial gains in many facets of sustainable development

Schultz, M., Tyrrell, T.D. & Ebenhard, T. (2016)

47

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48



49

Homework

- Make short presentation presents the relationship between biodiversity, ecosystem functions, and human well being?
 - Divide class into four groups
 - Each group will have five minutes to present.
 - Q/A?

50

Module 4: An examples of mangrove ecosystems