Unit 4 · Ecology

STUDY NOTES

Key terms

Ecology: how living things interact with each other and their environment (Haeckel, 1866; *oikos*, home).

Population: one species, one area, one time; can interbreed.

Community: all the populations of an area.

Ecosystem: a community + its abiotic environment (Tansley, 1935).

Biosphere: all the Earth's ecosystems.

Habitat / niche: where it lives / its whole way of life (address / job).

Trophic cascade: effects tumbling down the feeding levels.

Keystone species: its loss changes the whole ecosystem, far beyond its numbers.

Resurgence: a pest bouncing back after spraying.

Invasive species: brought to a new place, spreads out of control.

Decomposition: complex organic matter → simpler → inorganic, mainly by bacteria and fungi.

Detritus: dead matter decomposers feed on.

Saprotroph: lives on dead matter; extracellular digestion.

Detritivore: small animal that eats detritus, cuts it up (earthworm, termite, millipede).

Humus: dark, crumbly remains; holds water and minerals.

Wetland: land under shallow water or waterlogged, all or much of the year.

Hydrophyte: plant adapted to water; **aerenchyma**, air-filled tissue.

Numbers to remember

$$\%\ \text{lost} = \frac{\text{mass lost}}{\text{starting mass}} \times 100$$

use dried masses
Use: litter bags

- sal leaves, 25.0 g → 11.5 g: 13.5 ÷ 25.0 × 100 = 54%
- **new size** = old + births + immigration − deaths − emigration
- immigration = moving in; emigration = moving out

4.1 Ecology and ecosystem

- levels: organism → population → community → ecosystem → biosphere
- density: how many per unit area (12 frogs in 100 m^2)
- **structure**: abiotic (light, temperature, water, air, soil, minerals) + biotic (producers, consumers, decomposers)
- **functions**
  - **energy flows** one way, sunlight → food → heat
  - **materials cycle**
  - it controls itself

Natural	Artificial
keeps itself going	made and kept going by people
many species	fewer species
forest, lake, river	paddy field, fish pond, aquarium

- terrestrial
  - forest
  - grassland
  - desert
- aquatic: fresh, marine (about 71% of the Earth)

4.2 One population changes others

The rule

- increases → its eaters increase, its food decreases
- decreases → its eaters decrease, its food increases
- passes on along each link; say which way and through which link

Chain: rice → grasshopper → frog → snake → hawk. Frogs fall:

- up: snakes fall, then hawks fall
- down: grasshoppers rise, then rice falls

Web

- softens a loss (other foods); effects can pull both ways (only counting tells)
- more links, more biodiversity → more stable

Case	What changed	What followed
Asia, rice	spray killed spiders, bugs, wasps	planthoppers came back: hopperburn; Indonesia banned 57 products, 1986
India, frogs	caught for legs	feared more pests, mosquitoes; banned 1987 (never measured well)
China, 1958	sparrows killed	insect pests spread; off the list, 1960
South Asia	diclofenac killed vultures	carcasses rot, dogs and rabies up; Nepal ban 2006
Nepal, tigers	121 (2009) → 429 (2026)	deer, boar eaten; attacks near parks
Chitwan	*Mikania*	smothers grasses rhinos and deer eat
N. Pacific	otters killed	urchins up, kelp gone

4.3 Decomposition

Steps (they overlap)

1. **fragmentation**: detritivores chew; more surface
2. **leaching**: rain carries soluble sugars and salts down
3. **catabolism**: enzymes outside the cell; large molecules → small; absorbed
4. **humification**: what resists (lignin) → humus
5. **mineralization**: humus → CO_2, water, ammonium, nitrates, phosphates; for roots

Bacteria	Fungi
single cells, about 1–2 μm	hyphae, mycelium
soft: proteins, sugars, fats; animals, dung	tough: cellulose, **lignin**; wood
aerobic or anaerobic	mostly aerobic
surface of the matter	hyphae grow deep inside
moist, warm, near-neutral	drier, cooler, more acid
Bacillus, *Pseudomonas*, *Clostridium*	*Rhizopus*, *Penicillium*, *Agaricus*, brackets

- nitrogen: proteins → **ammonia** (ammonification) → nitrites (*Nitrosomonas*) → nitrates (*Nitrobacter*)
- *Streptomyces*: smell of first rain (geosmin), streptomycin

Rate depends on

- temperature: faster up to about 35 °C
- moisture: dry matter hardly decays (sukuti)
- oxygen: little oxygen → slow; peat
- kind of matter: soft, nitrogen-rich fast; lignin, wax, resin slow
- pH: acid soil, slower, mostly fungi

	Aerobic	Anaerobic
speed	fast, complete	slow, often incomplete
who	most fungi, many bacteria	anaerobic bacteria, archaea
gives	CO_2, water, minerals, humus, heat	methane, CO_2, H_2S, ammonia, organic acids
where	litter, turned compost	flooded paddy, swamp, biogas plant, cow's stomach
use	compost	biogas, sewage treatment

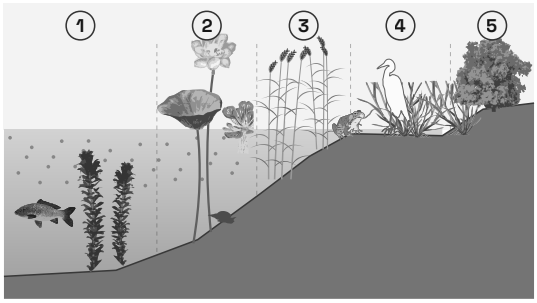
Why it matters:

- recycling
- soil fertility
- cleaning up
- compost and biogas

Harm: spoils food, rots timber.

4.4 Wetland ecosystem

- Ramsar: includes marine water no deeper than 6 m at low tide; natural or artificial, permanent or temporary
- about 5% of Nepal
- natural
  - tal
  - pokhari
  - simsar
  - rivers and floodplains
- human-made
  - reservoirs
  - fish ponds
  - paddy fields



1. Open water: phytoplankton, Hydrilla, fish
2. Floating plants: lotus, water lettuce, snails
3. Reed swamp: reeds, frogs, young fish
4. Marsh: grasses and sedges, egrets
5. Bank: trees that stand wet ground

A wetland's zones, from open water to the bank.

- **abiotic**
  - water
  - sunlight
  - dissolved gases
  - temperature
  - mud (low in oxygen)
- **producers**
  - phytoplankton
  - submerged *Hydrilla*, *Vallisneria*
  - floating lotus, *Pistia*
  - emergent reeds, cattails
- **consumers**
  - zooplankton
  - snails
  - fish
  - frogs
  - mugger
  - egrets
  - otters
  - arna
- **decomposers**: bacteria, fungi, in mud especially
- grazing chain: phytoplankton → zooplankton → small fish → large fish → heron
- detritus chain: dead reeds → bacteria, fungi → snails → small fish → kingfisher; often carries more energy

Why they matter	Threats
homes: fish breed, winter birds	encroachment, draining
sponges: floods, groundwater	siltation (Phewa)
filters: cleaner water	pollution, eutrophication
carbon: peatlands 3% of land, twice the forests' carbon	invasive species
livelihoods: Tharu, Majhi, Bote, Mallaha	overfishing, hunting
culture: Gosaikunda, Tal Barahi	dams, climate change

Ramsar Convention: Ramsar, Iran, 2 February 1971 (**World Wetlands Day**). Nepal: **10 sites** as of 2026.

Listed	Sites
1987	Koshi Tappu (arna): the first
2003	Beeshazar, Ghodaghodi, Jagdishpur
2007	Gokyo, Gosaikunda, Phoksundo (deepest), Rara (largest)
2008	Mai Pokhari
2016	Lake Cluster of Pokhara Valley

- National Wetlands Policy, 2012

COMMON MISTAKES

✗ all frogs and toads are a population
✓ one species only.

✗ energy cycles
✓ energy flows; materials cycle.

✗ vultures and earthworms are decomposers
✓ scavengers and detritivores; only bacteria and fungi.

✗ fewer foxes: grass increases
✓ rabbits rise, so grass falls.

✗ humus and peat are the same
✓ peat is partly decayed; humus is formed in soil.

✗ anaerobic decay gives CO_2 only
✓ methane and others too.

✗ immigration takes away
✓ moving in adds.