CHAPTER 21: Populations

1. An overview of ecology. **Ecology** is the study of interactions between organisms and their environment.


3. A **population** is an interaction between individuals of same species at a place.

4. A **community** is an interaction between individuals of different species at a place.

5. An ecosystem is an interaction between living = biotic factors = community and nonliving = abiotic factors = Habitat at a place.

6. Population ecology: **Population density** is the number of organisms living per unit area (square mile). **Patterns of dispersion** can be clumped, uniform or random.

7. **Logistic Growth** Model – It is **S-shaped**. It includes fast growth in the middle part but becomes constant on reaching **Carrying Capacity** = maximum number of individuals the Habitat at a place can support. It is called Equilibrial Population. For example seals. Fig 21.3

8. **Exponential Growth** Model – It continues to grow very fast even beyond carrying capacity and faces population crash when the resources are exhausted. It is **J-shaped**. It is found in Opportunistic Populations. For example in wild flowers. Fig 21.2

9. Predators help keep the prey populations at suitable levels. Predation acts as a feedback mechanism and operates in cycling of prey and predator populations. Fig 21.21 shows cycling of snowshoe hare and lynx populations.

10. Human population Growth – In most of developed world population is either slowly growing (USA) or decreasing (Italy) but increasing very fast in most of the less developed world (Afganistan). The **age structure** figures help us understand population growth. When it is a fast growing population the base is broad and narrows to a point = **Pyramid shaped** (less developed country - Afganistan). A stable population has base and middle part equal; and declining population has narrow base than middle. Fig 30.7

11. Life history patterns fall in 2 ecological categories – opportunistic and equilibrium species.
## Chapter 21: Communities

1. **Community** is interaction between populations of different species living at a place.

2. **Community Species Composition**: We study Species richness and diversity of species to compare different communities.

3. **Species richness** is a list of species in a community.

4. **Diversity** includes both richness of species and relative abundance of different species.

5. **Coevolution** takes place when 2 species evolve to suit to each other – flowers and pollinators (bees, bats) fig 21.13

6. Disturbance of Communities, when moderate in severity and occurrence leads to increase in diversity of species in the community. Disturbance usually leads to Ecological Succession.

7. **Ecological Succession** means when communities change over time in a predictable manner. It can start on bare rock with no soil. It takes hundreds of years to reach climax community fig 21.31.

8. **Interactions in Community**: (between organisms of different species) in a community include Competition, Predation, Symbiosis. Table 31.1 tells the effect of relationship on the abundance of 2 species. For example, competition reduces the abundance of both species and you find – and – for both species. Predation is good (+) for predator but bad (-) for prey. In power point used in class lecture it showed host (-) and parasite (-). It is wrong, book correctly represents (-) for host and (+) for parasite. Mutualism is beneficial to both species. Lichens with one alga and a fungus
partners; plant roots and fungi; plant roots and nitrogen fixing bacteria are good examples of mutualism. Study the table.

9. Ecological Niche: Each species has a unique combination of a) role in community – if producer or consumer or decomposer b) habitat c) resource utilization. This unique combination is called Ecological Niche. Only one species occupies one niche.

10. Native versus Exotic = invasive species: A species evolved locally has its predators, parasites and competitors. Therefore its population is under feedback checks. Humans take 1 species and transfer it intentionally or unintentionally to different habitats even in far away continents. Its predators, parasites and competitors are not transferred. It grows at its biotic potential and more often than not eliminates native species. Fig 31.12

11. Food Chain is a linear transfer of energy when 1 species eats only 1 species. Fig 20.1. Food Webs form when 1 species feed on 2 or more species and communities have different food chains linked by predation. Complex food chains are Food Webs. Fig 20.2

12. Trophic Levels: Each level is called a trophic level. These always start with Autotrophs = producers that use the sunlight to make their food. Fig 31.18 and 31.19.

- Carnivore = Secondary consumer – praying mantis, osprey
- Herbivore = primary consumer – caterpillars and giraffe
- Producers = autotrophs - algae, plants

3rd trophic level
2nd trophic level
1st trophic level

13. Prevalent form of plants in a community, mainly determines the type of animals living in that community.

14. The dead bodies of each level are degraded into simple chemicals by Decomposers – bacteria and fungi.

15. Some animals like crabs, earthworms, millipedes and many larvae are Detrivores because these feed on dead matter.

16. Bacteria, slime molds and fungi are important decomposers

17. The different organisms like grass or plants, deer or antelope, cheetah or tiger present on same trophic level do not eat each other and are called Competitors.

18. The organisms feeding on different trophic levels like bears and humans are called Omnivores. Humans feed directly on plants and animals.
19. **Community stability** is very fragile and leads to ecological succession. Some species are capable of holding the food webs together. Many species depend on them. These species are **Keystone Species**. For example sea otters in Aleutian Islands.

### Chapter 20: Ecosystems

1. **Ecosystems**: are ecological interactions between organisms (community) and their non living surroundings (abiotic).

2. **Abiotic factors** of the environment include sunlight, Temperature, wind, soil, rock, water (precipitation = rain, snowfall, dew, hailstorm). The local conditions of abiotic factors vary and form patchiness of environment to form **Habitat** = natural surroundings or spatial location of a species. Different species can live in same habitat.

3. **Biotic factors**: community represents biotic factors of an ecosystem.

20. **Ecosystem Dynamics**: Trophic relationships in an ecosystem determine the routes of energy flow and chemical cycling. Refer review.

21. **Energy flow**: is unidirectional in the ecosystem. All the time energy must come from Sun → producers → carnivores → decomposers. All these lose energy as heat in the environment. The heat ultimately is lost from the biosphere to the space.

22. **Chemical cycling**: Plants take CO₂ from air and minerals from soil and form Biomass. Herbivores feed on bio-mass of plants and C and minerals transfer to them. Carnivores get them on feeding on herbivores. Producers and consumers release CO₂ into air. Decomposers or Detrivores break the dead bodies of producers, herbivores and carnivores and release the minerals back to the soil. Burning also releases back the CO₂ into air. Biogeochemical cycles can be **sedimentary – phosphorus cycle**, fig 20.11, when most nutrient is stored in sediments or rocks; **gaseous cycle – nitrogen cycle and carbon cycle** – important fraction of the nutrient is stored in gaseous state – like nitrogen gas and CO₂ gas in atmosphere. Fig 20.9

23. **Producers**: can fix only 1% of light energy falling on them

24. 10%: of energy / bio-mass is passed from one trophic level to the next trophic level. Ecological pyramids depict this fact. Therefore 90% of energy/biomass is lost at each trophic level. Fig 20.6 b = pyramid of biomass and d = pyramid of energy.

25. **Biomes**: are very large ecosystems easily recognized on earth. Starting from poles and moving toward equator: Polar ice → tundra – circum polar desert → taiga – northern belt of conifers – dominated by 1-2 species of trees → grasslands –
seasonal rain fall → deserts – most around 30°N or 30°S → deciduous forest – leaves fall → tropical rain forests – have richest diversity. These are major biomes and may have modifications to the order above. Fig 20.25

26. **Aquatic Biomes**: usually have upper Photic Zone with sufficient light for photosynthesis and deeper dark Benthic Zone. Open Sea = Pelagic Zone is rich in Phytoplanktons (microscopic autotrophs like diatoms and other unicellular algae) in the photic zone. These, along with the sea weeds, are the producers in the ocean. Fig 20.18

**Some facts:**

27. Temperature falls 6°C/1000m in elevation.

28. Air mass rises → gets colder → holds less water – produces rain at equator

29. Air mass lowers → gets warmer → holds more water – no rain results

30. Winds with moisture forced to climb up a mountain results in rain.

31. Passing to other side of mountain air lowers down, gets warmer and absorbs moisture. It results in a desert on that side. The condition is called Rain Shadow Effect. Fig 20.15

32. Tropics – area around equator, get straight sun rays and is hot and humid. Most tropical rain forests lie in this area.

33. Temperate (in winter) and polar areas receive oblique sun rays, are cold because same energy is distributed over larger area. Fig 20.12