8. ORGANISMS & POPULATIONS

Single Page Simple Synopsis

An **organism** is an individual living being, while a **population** refers to a group of individuals of the same species living together in a specific geographical area and interacting with one another.

1. **Organismal Ecology:** Organismal ecology studies how individual living beings interact with their physical (abiotic) environments.
   The primary abiotic factors that shape these environments: Temperature, Water, Light, Soil
2. **Population Attributes & Dynamics**
   - **Birth & Death Rates:** Expressed as per capita rates (e.g., if 8 new births occur in a population of 20, the birth rate is (0.4) offspring per individual per year).
   - **Sex Ratio:** The proportion of males to females in a population.
   - **Age Pyramids:** The distribution of varying age groups
   - **Population Density:** The number of individuals per unit area at a given time.
3. **Population size fluctuates based on four core processes:**
   - **Natality (Births):** Increases population size.
   - **Immigration:** Individuals entering the habitat from elsewhere, increasing size.
   - **Mortality (Deaths):** Decreases population size.
   - **Emigration:** Individuals leaving the habitat, decreasing size.
4. **Population Growth Models:**
   - **Exponential Growth Equation:** $\frac{dN}{dt} = rN$, N is the population size.
     When resources are unlimited, a population grows at its maximum intrinsic rate (r) (forming a J-shaped curve)
   - **Logistic Growth Equation:** $\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$
     In reality, resources are finite. As population density rises, resources dwindle, slowing growth until it plateaus at the *carrying capacity* (K) (forming an S-shaped curve)
5. **Population Interactions (Community Ecology)**
   When populations of different species interact in a shared area, these relationships directly impact the survival and fitness of each species. These interactions include:
   - **Mutualism (+, +):** Both species benefit **Ex:** Flowering plants and insect pollinators.
   - **Competition (–, –):** Both species suffer as they fight for the same limited resources **Ex:** Competition between different bird species.
   - **Predation (+, –):** One organism (predator) benefits by killing and eating another (prey).
   - **Parasitism (+, -):** One organism benefits at the expense of the host **Ex:** Ticks on a dog.
   - **Commensalism (+, 0):** One species benefits while the other is neither helped nor harmed **Ex:** An orchid growing on a mango tree)

FRUIT POINTS

1. **Organisms** are living beings that can perform all vital life processes such as metabolism, growth, reproduction, responsiveness & adaptation.
2. A **population** consists of individuals of a species living in a well-defined area, sharing or competing for resources, and potentially interbreed.
3. **Natural selection** operates at the population level rather than the individual level to evolve desired traits.
4. **Birth and death rates** in a population refer to per capita changes over a specified time interval.
5. The shape of an age pyramid reflects whether a population is **growing, stable, or declining**.
6. **Population size or density (N)** reflects the status of a species within its specific habitat.
7. **Relative density**, such as the number of fish caught per trap, can be used when absolute counting is impossible.
8. Four basic processes fluctuate density: **natality, mortality, immigration, and emigration**.
9. **Natality (B)** is the number of births during a given period added to the initial density.
10. **Mortality (D)** is the number of deaths in the population during a given period.
11. **Immigration (I)** refers to individuals of the same species moving into the habitat from elsewhere.
12. **Emigration (E)** refers to individuals leaving the habitat for another location.
13. Exponential growth results in a **J-shaped curve** when population density is plotted against time.
14. **Logistic growth** is more realistic because natural resources are finite and eventually become limiting.
15. Habitats have a **carrying capacity (K)**, the maximum number of individuals they can support.
16. This S-shaped plot is known as the **Verhulst-Pearl Logistic Growth** model.
17. **Interspecific interactions** occur between populations of two different species and can be beneficial (+), detrimental (-), or neutral (0).

18. **Mutualism** is a (+/+) interaction where both species benefit.
19. **Competition** is a (-/-) interaction where both species lose.
20. **Predation** and **parasitism** are (+/-) interactions where one species benefits and the other is harmed.
21. **Commensalism** (+/0) benefits one species while the other is unaffected.
22. **Amensalism** (-/0) harms one species while the other is unaffected.
23. **Predators** keep prey populations under control and maintain community species diversity.
24. **Parasites** are often host-specific and may evolve complex life cycles involving intermediate hosts.
25. **Brood parasitism** occurs when birds like the cuckoo lay eggs in a host's nest for them to incubate.
26. The principle of competitive exclusion was stated by **G.F Gause.** **[NEET-2016]**
27. Mycorrhizae are example of **Mutualism.** **[NEET-2017]**
28. Asympote in a logistic growth curve is obtained when **k=N** **[NEET-2017]**
29. The process of growth is maximum during **Log phase.** **[NEET-2020]**
30. The impact of immigration on population density is **positive.** **[NEET-2020]**
31. Secondary metabolites such as nicotine, strychnine and caffeine are produced by plants for their defence action. **[NEET-2020]**
32. The equation of Verhulst-pearl logistic growth is $\frac{dN}{dt} = rN\left(\frac{k-N}{k}\right)$, **[NEET-2024]**

    k indicates **carrying capacity.**
33. Epiphytes that are growing on a mango branch is an example of commensalism. **[NEET-2025]**
34. Verhulst-pearl logistic growth of population is represented as $\frac{dN}{dt} = rN\left(\frac{k-N}{k}\right)$ **[NEET-2025]**