Option C Notes

Definitions
Limiting factor: a factor that is most scarce in relation to an organism's needs
Niche: mode of existence, role within ecosystem, specific location in habitat
Competitive Exclusion Principle: states that 2 species cannot occupy the same niche indefinitely
Keystone Species: a species that has a disproportionate effect on the structure of an ecological community
Trophic Level: feeding position of an organism
Gross Production: total amount of organic matter produced per unit time per unit area by a t. l
Net production: Gross production remaining after subtraction of that which is used for respiration
Biomass: total dry mass of organisms in a given area
Endemic Species: a species native to an area
Alien Species: a species brought into a foreign ecosystem by unnatural means
Invasive Species: An alien species that increases in numbers and spreads rapidly
Biomagnification: The process by which toxic or chemical substances become more concentrated as you ascend trophic levels
Indicator Species: a species/organism used to assess a specific environmental condition

Diagrams

1. Ecosystem Cycles

Rainforest

Biomass

Tundra

Terrestrial

Desert

Biomass

2. S and J graphs

\[ y = e^x \]  → limiting or no limiting factor: American plain bison

\[ k = r \]  → carrying capacity
Statistics

1. **FCR** → intaglio → if low, high diet sustainability and vice versa
2. **Biotic index**
3. **Simpson's Diversity Index** → \( \frac{N(N-1)}{2 \sum n(n-1)} \) - species richness and heterogeneity → ↑, ↓ species diversity
4. **Lincoln’s Index**
   \[ \frac{N_1 \times N_2}{N_3} \]
   - \( N_1 \) = first capture
   - \( N_2 \) = second capture
   - \( N_3 \) = marked individuals captured a third time

Methods

1. **Controlling Invasive Species**
   - Biological Control
   - Mechanical clearing
   - Chemical warfare
   - Entrapment
   - Interbreed with reproduction
   - Controlled fires
   - Use as food source

2. **Indicator Species**
   - Simple, specific
   - No disturbance to ecosystem
   - Easy to discern between species
   - Not a reflection of pollution
   - Cash money

3. **Nitrogen Cycle**
   - Rhizobium/Alcohol
   - Beilomona dephthitilanos [anaerobic condition]
   - Decomposers
   - \( \text{N}_2 \) → \( \text{N}_2 \text{O}_4 \) → \( \text{N}_2 \text{H}_4 \) → \( \text{N}_2 \text{H}_3 \text{N}_2 \text{O}_3 \)
3. In Situ - (Nature Reserves)
   +ve
   - natural evolution
   - niche + ecosystem + food chain maintained
   - cheap + convenient
   - active management (e.g., rewetting wetlands, culling invasive)
   - space

4. Ex Situ - (Peregrine Falcon because of Ca - deficient shells)
   +ve
   - disease free + optimised environment
   - botanic gardens
   - seed banks
   - rapid breeding

   Concepts + Arguments
   1. LF (Plants) → T, pH, salinity, water, minerals, light
   2. LF (Animals) → T, water, food supply, breeding sites, territory
   3. Interactions - Herbivory
      Predation
      Mutualism
      Commensalism
      Parasitism
   4. Keystone Species - e.g., Disaster led to interspecific competition, loss biodiversity, sea otters and elephant
   5. Food chain + Web → feeding habit, position (trophic level) varies, web like nature of feeding patterns
   6. Succession

   4. Change in conditions + loss of pre-existing climax community
   5. Pioneer species, e.g., lichen (roots to nutrients), reduces toxicity of environment
   6. Availability of niche = biodiversity ↑
   7. Stable climax community reached

7. Biomagnification (large quantities of prey consumed in lifetime) → bioaccumulate toxin
   → varies with how lipid soluble it is + availability in abiotic environment

8. Bio Control / Invasive Species → Cane Toad, how LF spread and no rapidly - invasive → poisonous
   → Zebra Mussel - ballast water from black K50 to USA - block pipe

9. PPA → insidious approved by WHO but liver, fertility, cancer, metabolise block male hormones
   → bioaccumulates + magnifies lipid soluble
10. Biodiversity (biogeographic factors)
   - ↑ Area
     - corridor effect → corridor between nature reserves → fragmented habitats ↑ biodiversity
   - ↑ Area while minimizing perimeter

11. Why Protect Rainforests
   - Economic
     - ecotourism
     - pharmaceutical products
   - Ecological
     - deforestation ↑ CO₂
     - change pattern of light reflection ↓ enhanced G. effect
     - take in CO₂ and O₂
   - Ethical
     - role as stewards of Earth
     - protect home of indigenous people
     - preserve for future generations

12. Sigmoid Growth

   1. rapid period of growth as \( N \rightarrow M \), hence abundant resource, low pop.: competition is low
   2. slow down due to higher comp. fewer resources:
      \[ M \rightarrow N \downarrow, J \rightarrow I, I \rightarrow E \]
   3. when it approaches \( K \), slows down because \( J = E \) and \( N = M \), limiting factors keep it at \( K \), oscillate around

13. TD and BU limiting factors
   - TD: resource applied by higher trophic level → e.g. predation on algae
   - BU: lower trophic level → N(availability) for algae

14. Lincoln Index (consideration)
   - small markings → so as to not make the prey obvious to predators
   - only for small population
   - assumes no reproduction, immigration or immigration, mortality or natality
Fish & Sustainability
- 1 billion dependent
- lots of young = high rate of pop. growth, ideal time to fish
- If fisheries collapse = loss of revenue, recession, lost of food source
- harvest at high rate of growth = maximum sustainable yield
- How?
  1. bon on trawler
  2. Closed fishing season
  3. large net gap to let young escape (reduction on catch size)
  4. bon on fishing endangered fish

Population Estimation
- for lakes, \( \frac{N_1 \times N_2}{N_3} \)
- salmon - shoal size
- check stomach and count rings to determine age; how young population is
- Mathematical Model

Nitrogen Fixation \( [N_2(g) \rightarrow NH_4^+(aq)] \)
- by nitrogen-fixing bacteria, e.g. Azotobacter and Rhizobium
  - Rhizobium has a mutualistic relationship with legumes, who supply them with shelter and root carbohydrate
  - Azotobacter is free-living

Nitrification \( [NH_4^+(aq) \rightarrow NO_2^-(aq) \rightarrow NO_3^-(aq)] \)
- i. \( \rightarrow \) by nitrosomonas
- ii. \( \rightarrow \) by nitrobacter (chemoautotroph)

Lightning strikes, \( \text{fix} N_2(g) \rightarrow NO_3^-(aq) \)

Amination: converts N compounds in dead organic matter into \( NH_4^+ \) by saprophagy

Denitrification \( [N_2 + NO_3^- \rightarrow N_2] \)
- P. denitrification usually needs O\(_2\), but in anaerobic condition uses NO\(_3^-\), \( \downarrow \) CN\(^-\) in soil
- hence, carnivorous plants uniquely \( \rightarrow \) gain N from other species' organisms
22 Phosphorus Cycle
- Phosphorite has high P levels
- Weathering + erosion release P into soil
- Low turnover (low rate of recycling), due to slow erosion and weathering
- Added by NPK fertilisers + harvesting (move from field)
- But being removed faster than being regenerated
- No synthetic way to produce P

23 Eutrophication
- Caused by leaching/run off/detritus
- Nutrient availability is a BULF for algae, ↑ nutrient, P, S, A of algal growth
- Block sunlight, photosynthetic aquatic plants die
- Decomposers act on them, ↓ CO₂
- ↑ BOD, COD
- Death of fish, → emigration + mortality ↑, ↓ biodiversity