EY Ecology and Evolution

Section 1: Ecology

Fundamental Concepts: Abiotic and biotic components; scales (population, species, community, ecosystems, biomes); niches and habitats.

Population Ecology: Population growth rates (density dependent/independent); meta population ecology (colonization, persistence, extinction, patches, sources, sinks); age-structured populations.

Interactions: Types (mutualism, symbiosis, commensalism, competition, parasitism, predation, etc); ecophysiology (physiological adaptations to abiotic environment); prey-predator interactions (Lotka-Voltera equation, etc.)

Community Ecology: Community assembly, organization and succession; species richness, evenness and diversity indices, species-area relationships; theory of island biogeography

Ecosystems Structure and Function: Trophic levels and their interactions; nutrient cycles; primary and secondary productivity

Section 2: Evolution

History of Evolutionary Thought: Lamarckism; Darwinism; Modern Synthesis

Fundamentals: Variation; heritability; natural selection; fitness and adaptation; types of selection (stabilizing, directional, disruptive)

Diversity of Life: Origin and history of life on earth; diversity and classification of life; systems of classification (cladistics and phenetics)

Life History Strategies: Allocation of resources; tradeoffs; r/K selection; semelparity and iteroparity

Interactions: Co-evolution (co-adaptations, arms race, Red Queen hypothesis, co-speciation); prey-predator interactions (mimicry, crypsis, etc)

Population and Quantitative Genetics: Origins of genetic variation; Mendelian genetics; Hardy- Weinberg equilibrium; drift; selection (one-locus two-alleles model); population genetic structure (panmixia, gene flow, F_{ST}); polygenic traits; gene-environment interactions (phenotypic plasticity); heritability

Molecular Evolution and Phylogenetics: Neutral theory; molecular clocks; rates of evolution; phylogenetic reconstruction; molecular systematics

Macroevolution: Species concepts and speciation; adaptive radiation; convergence; biogeography

Section 3: Mathematics and Quantitative Ecology

Mathematics and Statistics in Ecology: Simple functions (linear, quadratic, exponential, logarithmic, etc); concept of derivatives and slope of a function; permutations and combinations; basic probability (probability of random events; sequences of events, etc); frequency distributions and their descriptive statistics (mean, variance, coefficient of variation, correlation, etc).

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Statistical Hypothesis Testing: Concept of p-value; Type I and Type II error, test statistics like t- test and Chi-square test; basics of linear regression and ANOVA.

Section 4: Behavioural Ecology

Classical Ethology: Instinct; fixed action patters; imprinting; learnt behavior; proximate and ultimate questions.

Sensory Ecology: Neuroethology; communication (chemical, acoustic and visual signaling); recognition systems.

Foraging Ecology: Foraging behaviour; optimal foraging theory.

Reproduction: Cost of sex; sexual dimorphism; mate choice; sexual selection (runaway selection, good-genes, handicap principle, etc); sexual conflict; mating systems; parental care.

Social Living: Costs and benefits of group-living (including responses to predators); effect of competition (scramble and contest) on group formation; dominance relationships; eusociality; kin selection; altruism; reciprocity; human behaviour.

Section 5: Applied Ecology & Evolution

Biodiversity and Conservation: Importance of conserving biodiversity; ecosystem services; threats to biodiversity; invasive species; in-situ conservation (endemism, biodiversity hotspots, protected areas); ex-situ conservation; conservation genetics (genetic diversity, inbreeding depression); DNA fingerprinting and DNA barcoding.

Disease Ecology and Evolution: Epidemiology; zoonotic diseases; antibiotic resistance; vector Control Plant and animal breeding: Marker assisted breeding; genetic basis of economically important traits.

Global Climate Change: Causes; consequences; mitigation

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