

## 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); metapopulation 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-Volterra 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).

**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 patterns; 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