

## Ecology and Evolution

### Section 1: Ecology

Population ecology; metapopulation dynamics; growth rates; density independent growth; density dependent growth; niche concept;

**Species interactions:** Plant-animal interactions; mutualism, commensalism, competition and predation; trophic interactions; functional ecology; ecophysiology; behavioural ecology;

**Community ecology:** Community assembly, organization and evolution; biodiversity: species richness, evenness and diversity indices; endemism; species-area relationships;

Ecosystem structure, function and services; nutrient cycles; biomes; habitat ecology; primary and secondary productivity; invasive species; global and climate change; applied ecology.

### Section 2: Evolution

Origin, evolution and diversification of life; natural selection; levels of selection.

Types of selection (stabilizing, directional etc.); sexual selection; genetic drift; gene flow; adaptation; convergence; species concepts;

Life history strategies; adaptive radiation; biogeography and evolutionary ecology;

Origin of genetic variation; Mendelian genetics; polygenic traits, linkage and recombination; epistasis, gene-environment interaction; heritability; population genetics;

Molecular evolution; molecular clocks; systems of classification: cladistics and phenetics; molecular systematics; gene expression and evolution.

### 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; neuroethology; evolutionary ethology; chemical, acoustic and visual signaling Mating systems; sexual dimorphism; mate choice; parenting behaviour Competition; aggression; foraging behaviour; predator-prey interactions; Sociobiology: kin selection, altruism, costs and benefits of group-living.