Course goal: to provide students with the instruments for rationally managing animal and plant populations and ecosystems.

Topics

Species and populations threatened by extinction:

– The causes of extinction: review. Local extinction, global extinction, extinction in the wild.

– Analysis of the main extinction mechanisms and quantitative approaches for evaluating the extinction risk. Allee effect and depensation. Genetic deterioration. Fundamentals of population genetics. Hardy-Weinberg law. Genetic drift and the Sewall Wright model. Extinction thresholds.

– Demographic and environmental stochasticity. Extinction probability in small populations. Stochastic models of populations driven by environmental variability. Quasi-extinction thresholds. Extinction vortices. Population viability analysis (PVA). Review of the main PVA software tools.

Populations in spatially explicit landscapes:

– The importance of space in ecology. Habitat loss and fragmentation as important mechanisms of extinction. The problem of alien species invasion.

– Dispersal in animals and plants. Diffusion as a way to describe dispersal. Diffusion equation in limited and unlimited habitat. Adding demography to diffusion: the reaction-diffusion equation. Speed of colonization and invasion. Critical reserve dimension.

– Habitat fragmentation and the metapopulation concept. Various metapopulation models. The Levins boolean model. Incorporating habitat loss and environmental catastrophes. Persistence boundaries in metapopulations. Spatially explicit metapopulation models. Ecological corridors.

Sustainabilty of biomass harvesting and its management:

– The overexploitation and depletion of biological renewable resources. Examples from forestry and fisheries. The tragedy of the commons. Open access and the consequences of not regulating the exploitation of renewable resources. Different management goals.

– The dynamics of harvested populations. The concept and measure of harvesting effort. Different regulation policies: exclusive, nonexclusive, economic. Production curves. Maximum sustainable yield. Schaefer's model.

– Principles of bioeconomics. Gordon's analysis. Bionomic equilibrium and the effect of the opportunity cost. Socioeconomic impacts of various regulation policies. The bioeconomic optimum.

– The management of age-structured populations. The optimal rotation period in forest management. The effect of the discount rate. Fish populations with constant recruitment. The problem of optimal effort and mesh size. Beverton and Holt's analysis. The eumetric mesh size and eumetric production curves. Bioeconomic considerations.

Parasite and disease ecology:

– Ecology and public health. Emerging and reemerging diseases. Zoonoses. Parasitism and its importance for population regulation. Microparasites and macroparasites. Parasitoids.

– Dynamics of diseases caused by microparasites. Various transmission mechanisms: direct, water and airborne, environmental, vertical. Susceptible, exposed, infected and recovered individuals. Incidence and prevalence. Diseases with permanent and temporary immunity. SI and SIR models. The regulation of Malthusian populations. The basic reproduction number of a microparasitic disease. Vector-borne diseases. Ross-MacDonald model. Water-borne diseases. SIB models. Vaccination and culling policies.

– Dynamics of diseases caused by macroparasites. Anderson and May's model for the dynamics of hosts and parasites. Distribution of parasite burden inside a host and the clumping parameter. The basic reproduction number of a macroparasitic disease.

– Parasitoids and hosts. Nicholson and Bailey's model. Biological control of alien and noxious organisms.