Final exam topics
Biology MSc
Ecology, Evolution, Conservation Biology specialization
(for students starting MSc in 2018 or later)

1. An overview of the history of evolution. Trends and major transitions. Changing of complexity and diversity. The common characters of the major innovations. The list of the major transitions.
2. The origin of animal societies. Why is the development of animal societies a major transition? The definition of social animals and differences on the level of sociality. Examples. The costs and benefits of group living. The importance of multilevel selection and kin selection. Two alternative hypotheses of the evolution of eusociality. The connection between the promiscuity and complexity of societies.
3. The evolution of human cooperation. The nature of human cooperation. What do we think about the evolutionary background of human hyper-cooperation in the light of experiments?
4. The origin of language. Are the language and the human behavior complex a major transition? What is the difference between the animal communication and human language? Alternative theories for the evolution of language. Adaptive and non-adaptive explanations.
5. Describe through examples such proximal and ultimate processes that can modify behavioral patterns either on the individual or the population level. *KEYWORDS: ontogeny, evolution, ritualization, learning, early learning, domestication, urbanization, feralization.*
6. Demonstrate the consequences of individual and kin-selection through their effect on the evolution of behavior. *KEYWORDS: fitness, relatedness, parental investment, parental care, cooperation, altruism, eusocial species, reliable signals.*
7. Describe the proximal and ultimate effects of the interactions with humans (human environment) on animal behavior. *KEYWORDS: inter-specific communication, domestication, taming, attachment, urbanization.*
8. How do we use the comparative method in ethology to understand the evolution of problem solving behavior? *KEYWORDS: comparative method, convergent operations, food caching, spatial memory.*
9. Ecological consideration in the management of protected areas (theoretical grounds, examples of management for conservation in grasslands and in forests).
10. Basic principles of planning and implementation of nature conservation monitoring programs (theoretical expectations, difficulties of realization, examples).
11. Nature conservation in the era of climate change.
12. Conservation of biodiversity in forests. Maintenance of biological diversity in agricultural landscapes. Threats imposed by invasive alien species, and opportunities for their control.
13. Unregulated and regulated growth of asexual populations in continuous time: exponential growth and decay, logistic growth, Allee effect. Optimal harvesting in systems with logistic growth: maximal yield, stability of equilibrium points, extinction.
14. Formalization of simple continuous time dynamics of two interacting populations (e.g. Lotka--Volterra system). Interpretation of parameters, finding equilibria. Analysis of linear stability of equilibria (Jacobian matrix, eigenvalues, eigenvectors, Trace--Det plot), classification of equilibria. Phase portrait.
15. Species richness and species composition. The estimated number of species on Earth. Regional and local species richness. Texture and cotexture. Diversity.

16. Spatial patterns in ecological communities. Zones, patches, layers. Pattern analysis. Pattern-generating processes. The significance of spatial patterns.
17. Community dynamics. Succession. Fine-scale dynamics. Disturbances and their significance in the dynamics of communities. Stability of communities.
18. Habitat loss and fragmentation. Characteristic problems in small populations. Metapopulations, metacommunities. Isolation and merging of habitat patches. The design of networks of nature reserves: some basic considerations.
19: The definition and estimation of fitness. Definition and types of phenotypic plasticity. Benefits, costs and limits of phenotypic plasticity. Evolution and phenotypic plasticity in creating adaptive phenotypic variation. The relationship between evolution and phenotypic plasticity.
20. The definition and types of natural selection. Quantitative genetic approach: components of phenotypic variation and the evolutionary roles of heritability and genetic correlations. The effects of natural selection, genetic drift and gene flow on the allele frequencies and evolution of a population.
21. Principles and basic concepts of Darwinian ecology. Models and empirical results illustrating the principles. Sources and treatments of complexities. Stochasticity of individual life histories, individual traits and population structures, interactions between individuals, complex dynamics, environments changing in space and time, linking theory and empirical data.
22. Ecological tolerance and niche. Potentials for exponential growth and the characterisation of the tolerance function. Condition for exponential growth. Comparative studies of ecological tolerance. The niche space. Niche in terms of population regulation. Niche construction and evolutionary branching.
23. Please, describe those evolutionary/ecological factors that favor the emergence of either the individual or the social learning phenomena.
24. Which are the mechanisms of social learning and how can we experimentally separate them in ethology?
25. Sexual selection: mechanisms and consequences.
26. Communication, signalization and mating systems.
27. The definition of ESS, basic assumptions and terms. The H-D model. The Bishop-Cannings theorem. The definition of mixed ESS and the equilibrium polymorph state. Games with more ESSs. The main characters of spatial games.
28. The rock-scissors-paper game and its main characters. The replicator dynamics and some use of it in game evolutionary theory. Some biological examples on rock-scissors-paper game.

The topics are covered in the following subjects:
1-4: nagyevsb17em Major evolutionary transitions L.
5-8: etologsb17em Ethology L.
9-12: konzbisb17em Conservation biology L.
13-14: matmb1sb17em Mathematical modelling in biology L.
15-18: okologsb17em Ecology L.
19-20: adevo1sb17em Adaptive evolution L.
21-22: elmokosb17em Theory-based ecology L.
23-24: szoctasb17em Social learning L.
25-26: visokosb17em Behavioral ecology L.

27-28: evojatsb17em Evolutionary game theory L.