

## Biology Msc from 2018

Name of the specialisation:

### **Ecology, Evolution and Conservation Biology (EECB)**

#### **OVERVIEW OF THE FIELD**

This specialisation might offer the broadest variety of choices within the MSc program in Biology, including all fields involved with the study of individuals or higher levels of organization—populations, ecosystems and evolutionary systems. It invites those who have been attracted to biology through their love of nature, and wish to make a career in field research or environmental studies; but also those who are interested in animal behaviour or in the laws that govern complex biological systems; and also those who would like to tackle the ultimate mystery of life: the nature and mechanisms of evolution.

#### **TEACHING CONTENT**

With a flexible curriculum, students can choose to specialize in one of the fields (e.g., ecology, ethology or evolutionary biology), but also to follow a balanced, diverse study plan to acquire comprehensive integrative knowledge across a broad selection of topics. The study of the classical fields of ‘natural history’ is complemented by the use of up-to-date molecular and instrumental methods. The main topics of the specialisation are listed below.

**Ecology and Conservation Biology:** in addition to classic theory and practical skills in ecology, students are introduced to the use of up-to-date molecular techniques; fieldwork is complemented by laboratory practice. The courses also cover statistical methods in ecology, the fauna and flora of the Carpathian Basin, and the local and global challenges of conservation biology.

**Ethology and Behavioural Ecology:** students are introduced to a functional and mechanistic description of animal behaviour, and have the opportunity to study behaviour both in the laboratory and in the field. Further courses are offered on social learning, neuroethology, and the molecular biology of behaviour.

**Theoretical and Evolutionary Biology:** the courses emphasize evolutionary thinking across all fields of biology. The students learn about the mechanisms and history of evolution, and are introduced to the paradigm of the major evolutionary transitions. They acquire practical skills in computer (simulation) and mathematical (dynamical systems, game theory) modelling, and in the analysis of complex data from various fields of biology (evolutionary processes, ecosystems, epidemics).

#### **RESEARCH PERSPECTIVES**

Maintaining the health of ecosystems and a liveable human environment in the face of increasing human population and anthropogenic effects is among the greatest challenges of the 21<sup>st</sup> century. Researchers at the Department for Plant Systematics, Ecology and Theoretical Biology conduct long-term studies to monitor changes in the natural environment of Hungary, and perform controlled treatment experiments to predict how global warming and the expected increasing frequency of droughts and forest fires might affect natural vegetation within the

country. They collaborate with experts in forestry to develop forest management practices aimed to maintain forests close to their natural state.

The theoretical biology group at the same department studies fundamental problems of evolution: the origin and early evolution of life, the general laws and major transitions of evolution, the emergence of cooperation and language, and the evolutionary background of diseases. They work with the complete toolbox of theoretical and computational biology: mathematical and computer simulations, complex data analysis, and formulating hypotheses based on literature mining.

Researchers at the Department of Ethology conduct comparative non-invasive neuroethological research on dogs and miniature pigs to determine how words and linguistic constructs are represented in the brain of these animals. This research also contributes to our understanding of the evolution of the human language capacity. Another working group at the department studies the role of genetic, neural and cognitive processes in aging in dogs. The study of dogs that grow old in families offers a unique opportunity to identify genetic factors that aid or compromise healthy aging. Research on the plasticity of processes in the brain might also contribute to our understanding of what lifestyle factors can help to minimize the risk of early-onset dementia.

Research at the Department of Animal Taxonomy and Ecology includes observational and experimental field studies to understand how ecological and social factors affect reproduction in vertebrates, and to elucidate the underlying physiological processes. Adaptation to environmental variation (adaptive evolution, adaptive phenotypic plasticity) is studied in several model species (from small aquatic crustaceans to reptiles). Further projects involve the assessment of the geographical range and conservation status of various taxons (from protists to orthopterid insects).

## **TEACHERS AND RESEARCHERS**

### **Department of Animal Taxonomy and Ecology:**

**Gábor Herczeg** studies the emergence of stable between-individual behavioural variation (animal personality, behavioural syndrome) in fish, amphibians, lizards and birds. His further research focuses on adaptations to cave (relatively stable) and surface (variable) environments, with aquatic crustaceans as model species.

**János Török** uses observational and experimental methods to study associations between physiological variables (blood counts, androgenic hormone levels etc.) and selected phenotypic fitness components (e.g., brood size, reproductive success, short- and long-term survival).

### **Department of Ethology:**

**Ádám Miklósi**'s main research interests include dog-human interactions and ethorobotics. The study of social problem-solving skills in dogs might provide clues about the evolution of cooperation between humans and dogs. The behaviour of dogs towards humans might provide a starting point for the development of behavioural skills in companion robots.

**Péter Pongrácz** focuses on the behaviour forms of communication between humans and their companion animals (dogs and cats). The study of vocal communication in dogs might improve our understanding of convergent evolution in complex interspecies communication

systems, and might yield new insights to improve animal well-being in veterinary practice and behavioural therapy.

### **Department of Plant Systematics, Ecology and Theoretical Biology:**

**János Podani** develops multivariate statistical methods to analyze complex biological data, e.g., in the fields of ecology, coenology and phylogenetics. He is refining the evolutionary history and classification of plants using the latest data and state-of-the-art methods.

**Tibor Standovár**'s research involves forest ecology and conservation biology. He coordinates projects to monitor the condition of forest ecosystems in Hungary, including assessment of the divergence from the original natural state.

**Eörs Szathmáry** is co-creator of the paradigm of major transitions in evolution. His main interests include the origin and early evolution of life, but he is also active in other diverse fields such as the evolution of language capacity, Darwinian processes in advanced nervous systems, and the possibility of extraterrestrial life.

### **CAREER OPPORTUNITIES**

In addition to universities, the research institutes of the Hungarian Academy of Sciences also offer an academic career in topics covered by the specialisation such as climate change, ecosystem management, mitigating biological invasions, assessing and improving ecosystem services, and the study of evolutionary systems and animal behaviour.

After their degree, students can find employment in the environmental branch of state administration (ministries, regulatory bodies, national parks) or at NGOs. High-priority tasks include the assessment of the conservation status and possible development of EU Natura 2000 habitats, and the ecology-based development of conservation plans for endangered species.