

Juhász-Nagy Pál Doctoral School – Course descriptions

Movement Ecology; T_PB9872-K2

Movement is a critical and consequential phenomenon in biology influencing survival and reproductive success and impacting population and eventually eco-evolutionary processes. During this seminar, PhD students will explore the topics relating to the mechanistic as well as theoretical background of animal movement, as well as focus on the population-level consequences of different movement strategies. The majority of the course will consist of discussions of the current primary literature, but students will also use their own or sample data sets to characterize and quantify home ranges, levels of habitat selection, and individual movement patterns.

Evolution & Biodiversity PhD student Conference; T_PB9869-K4

Evolution and biodiversity are tightly linked, and this conference aims at investigating their links in two different ways. Invited speakers from Debrecen and abroad will cover a wide range of evolutionary and conservation topic including ecology, behaviour and genetics. In addition, students will present the results of their research that falls within the broad fields of evolution & biodiversity. This conference-based course will provide students with a foundational understanding of evolutionary and biodiversity research, with a focus on active learning through analysis, presentation, and discussion of recent findings. Students will gain knowledge in the evolution, genetics, ecology, behavior, and conservation related to biodiversity, and apply this understanding through collaborative work and seminar presentations. The students will also benefit from feedbacks by senior scientists and conservationists on their presentation.

Relevance: Evolutionary and biodiversity research is critical for understanding and conserving the variety of life on Earth. This course is highly relevant for students interested in ecology, genetics, environmental science, and conservation, as it provides insights into both historical and modern trends in evolution, biodiversity and conservation. Via lectures by internationally leading experts and student-led presentations, the conference-based course will provide an outstanding learning experience for MSc students, PhD students and early-career scientists.

Standing water ecology; T_PB9229-K2

The primary objective of this course is to allow the students to become familiar with the scope of standing water ecology and to master its basic facts, principles, concept and fundamental processes. The course explores the structure and function of standing water types, including physical, chemical and biological controls of productivity and species composition of aquatic plants and animals and effects of pollution on organisms and water quality. The laboratory emphasizes modern, hands-on techniques for answering fundamental and applied questions. During the practice/field work the students will learn the qualitative and quantitative techniques for studying lakes, ponds and various standing water types. During the laboratory work the students will identify various aquatic organisms and will learn about adaptation mechanism as regards nutrition, life cycles.

Aquatic microbiology; T_PB9228-K2

The course gives an overview of the organization, taxonomy (morphology, DNA and RNA based classification), evolution and ecology of bacteria and heterothrophic eukaryotes (protozoa and fungus-like organisms) from hydrobiological point of view. Activity of prokaryotic and heterothrophic eukaryotic microorganisms is discussed on the basis of their role in nutrient cycles. The course shows the interactions among bacteria and between bacteria and eukaryotic microorganisms, deals with their roles in the life of aquatic habitats, introduces the formation and functions of biofilms.

Algology; T_PB9227-K2

The course provides a comprehensive overview of classical and contemporary aspects of freshwater algae biology and ecology. Possibilities of functional grouping of planktic and benthic algae (traits, strategies, functional groups). Interactions of algal populations. Algae based ecological status assessment: species composition, stress specificity, importance of biomass and taxonomic composition.

Water Chemistry; T_PB9226-K2

The course introduces the chemical and physical properties of water and processes occurring in aqueous media; discusses the main laws of behavior of aqueous solutions. Basic knowledge: the structure of the water molecule, water phase diagram, different states (consistence, phases) of water. Water as solvent will be introduced. Chemical equilibrium and kinetic principles will be introduced for the acid-base reactions, complex formation, precipitation/dissolution, oxidation/reduction reactions, and for dilution processes.

Water Quality Monitoring; T_PB9225-K2

During the course the participant should be able to understand and apply: (i) concepts of water quality and pollution processes in various standing and running water types; (ii) apply the different steps of the monitoring cycle in rivers and lakes; (iii) the basic concepts of groundwater quality and monitoring; (iv) apply common statistical techniques for water quality data evaluation; (v) design sustainable freshwater quality monitoring and assessment programmes under specified conditions; (vi) the entire thought process that underlies the planning of an environmental monitoring effort and receive systematic planning tools, templates, checklists, labor and budget spreadsheets for use in any future monitoring work.

Paleolimnology; T_PB9224-K2

This course will introduce the students to analyses the relationships between zooplankton remains and an ancient lake history. Sampling and data collections methods, problems and solutions. Sediment collecting and analysing. Laboratory methods using for analyses different lake sediments. Geochemical analyses. Dating using ^{137}Cs , ^{210}Pb and radiokarbon methods. Subfossil remains responses to climate changes. Verification of lake level changes using subfossil remains. Effects of environmental pollutions in diversity and abundance. Problems of bioturbations. Statistical analyses of results.

Wetland ecology; T_PB9223-K2(M)

The course emphasizes wetlands functions and values in an ecosystem perspective. Saltwater and freshwater wetlands will also be addressed in the course. The relationship of wetlands to adjacent terrestrial and deep water habitats, along with wetlands succession and dynamics will be discussed. Students will be provided with state-of-the-art basic knowledge of wetland flora and fauna and ecology. The topics of the course concern the hydrology of wetlands, the classification systems of wetlands, the principles of ecology and dynamics of wetlands, the assessment of the functions of wetlands, overview of wetland development, restoration, and constructed wetlands.

Fish Ecology; T_PB9222-K2

During this subject we will study the main properties and themes of the freshwater fish ecology. This is an comprehensive subject about fishes, it contains the following main subjects: taxonomy; evolution; organization; morphological and meristic characters; anatomy; freshwater fish fauna; reproductive biology; ecology; diet; diseases; conservation biology; migration; fisheries management; biomanipulation.

Preparing a Scientific Conference Presentation

Conference presentation is one of the key transferable skills MSc and PhD students need to acquire. This postgraduate course will take place in spring 2024 and it aims at helping students to prepare for and deliver a conference presentation at scientific meetings. To make the postgraduate course effective, we will focus on biodiversity – one of the global issues that drive natural sciences currently. Biodiversity includes studies of plants, animals and microbes, and it covers subjects such as ecology, conservation biology, evolutionary biology, ethology, botany, zoology and microbiology. The course will take place between 1 and 10 May 2024, and it will consist of four parts: Part 1 – a 1 h lecture that explains the key features of a scientific conference presentation. This part of the course will be online. Part 2 – preparation for the conference. The student will be allocated an academic mentor who help the student to prepare for the conference presentation. The student's task is to prepare a 15 minute conference presentation that is based on her/his own work. The presentation will be followed by a 5-minute Q & A section (questions & Answers). This part of the course is online. Part 3 – to learn good practice, the student will need to attend a full day of international conference on BIODIVERSITY. The conference will take place in Debrecen, most likely on 9th May 2024. This part of the course is in person. Part 4 – the student will need to deliver her/his conference presentation within the broad field of BIODIVERSITY. The student presentations will be attended by international scientists within the broad field of BIODIVERSITY. These experts will provide detailed feedback to the students in regard to their presentation and performance. The student presentations will take place on 10th May 2024 in Debrecen. This part of the course is in person. For further details, please contact Dr. Balázs Vági bi.vagi@gmail.com

Journal Club in Ecology, Evolution and Conservation II.; T_PB8789-K2

The objective of this course is to discuss recent advances in ecology, evolution and biodiversity conservation. Each week a lecturer or a postgraduate student will present a current research paper that was published in a high profile international journal, introduce the topic to the audience and critically evaluate methods, results and scientific achievements of a specific research paper. We recommend this course to all postgraduate and master students with interest in research areas associated with behaviour, evolution and nature conservation. To receive the credit, the students will be required to present one presentation during the semester.

Conservation Behaviour and Physiology; T_PB8566-K2

Can knowledge and tools of animal behaviour and physiology be used to better understand and predict how organisms and populations respond to environmental change and stressors? We address this question in this seminar course by reviewing theoretical and empirical studies and evaluate their actual and potential contributions to real life, pressing conservation problems. Students will use material provided by the instructor and supplement it by their own literature search to lead discussions on selected topics.

Writing in Conservation Behaviour; T_PB8514-K2

The course provides an opportunity for students who previously took the facultative course Conservation Behaviour and Physiology to learn and practice skills that are necessary to write and publish scientific journal articles, particularly systematic reviews. Students will work on a collaborative writing project in the field of conservation behavior and will produce a manuscript by the end of the semester. The manuscript will be submitted to and ideally published by one of the journals of the field.

Scientific communication for graduate students; T_PB7900-K2

In this course, students will learn how to communicate their work more effectively, as well as to the current professional academic standard. We will cover both oral presentations and scientific writing. We will alternate between an in-person class one week and a preparation class the next, when students will have time to prepare for the activity of the coming week. In-person classes will involve active student participation, for instance presentations and group work. We recommend this class to PhD and masters students who want to improve their ability to communicate their scientific work. To receive the credits, students must give a talk during the student presentation session, and develop a conceptual map containing the essential components of effective scientific communication.

Modelling Population Dynamics: Estimating Demographic Parameters for Wildlife Conservation; T_PB7894-K2

We will explore applications of demographic methods for conservation and management of plant, fish, and wildlife populations. Quantitative methods for demographic analyses are currently used in three arenas of modern ecology. In evolutionary ecology, researchers use demographic methods to investigate patterns of variation in the life-history traits of organisms. In conservation biology, biologists use demographic tools to devise conservation strategies for threatened species, and to reduce population declines. In wildlife management, the same

techniques are applied to questions in developing strategies for control and sustainable harvest. The course will cover the quantitative techniques commonly used for modelling population dynamics, including occupancy models, count-based models, and structured models based on demographic rates. We will consider some of the common drivers of population dynamics including density-dependence, trophic interactions, and sustainable harvest. The course will cover basic concepts and theory of wildlife demography and will introduce useful packages in Program R that can be used to estimate demographic parameters and model population dynamics.

Ivari konfliktus; T_PB7791-K3

Sexual selection and sexual conflict are some of the major driving forces in evolution and they impact on ecology and behaviour of many organisms. This course will overview these processes with special attention to the origin of different evolutionary interests of males and females, sex roles, mating systems and parental care, and the significance of sexual size dimorphism. In addition, the course will investigate the implications of sexual conflict for speciation, diversification and extinctions. The course has 2 parts: lectures by the course leader, and seminars by students. Student seminars will focus around analysing and explaining recent research papers relevant to a particular topic. This course will benefit students with interest in evolution, ecology and behaviour, and will provide the opportunity to develop critical thinking and communication skills.

Phytoremediation; T_PB7790-K2

Within this course students get familiar with the recent findings related to the phytoremediation on an international as well as institutional scale. Lecture participants are introduced to the methods used during the field- and laboratory work, followed by the core steps in the analyses of the results and the preparation of scientific presentations.

Comparative Analyses in Ecology and Evolution; T_PB7781

Our aim is to teach how to conjugate state-of-the-art ecological and evolutionary statistical methods to answer basic fundamental questions in biology, and to use this knowledge to inform conservation policies.

Relevance: 1.As professional ecologists, students need to understand the importance of accounting for shared ancestry when trying to manage conservation problems across taxa, 2.Students need to get familiar to currently used methods in ecology and evolution to develop their career competitively.

Journal Club in Ecology, Evolution and Conservation; T_PB7780-K2

The objective of this course is to discuss recent advances in ecology, evolution and biodiversity conservation. Each week a lecturer or a postgraduate student will present a current research paper that was published in a high-profile international journal, introduce the topic to the

audience and critically evaluate methods, results and scientific achievements of a specific research paper. We recommend this course to all postgraduate and master students with interest in research areas associated with behaviour, evolution and nature conservation. To receive the credit, the students will be required to present one presentation during the semester.

Introduction to Phd; T_PB7696

The PhD is an important stage in the life of professional scientists, researchers and academics. This course aims at explaining the rationale of a PhD, and illustrating the typical progress and requirements. The first lectures of the course will focus on the structure of a PhD and the expectations of the student and of the supervisor. The second part will focus on scientific communication, and will train the students in designing, writing and delivering presentations at conferences and meetings. The course will help not only the starting PhD students at the University of Debrecen but will also benefit those who already advanced in their postgraduate studies. Whilst the focus of the course is on ecology, evolution and biodiversity conservation, PhD students and MSc students from other scientific fields can also benefit from attending the course. The first lecture will be on Monday 22 September 2025.

Evolutionary ecology of birds; T_PB7695-K3

During this advanced course using birds as an excellent model group, we will explore ecological and evolutionary processes underpinning extremely diverse avian life history strategies. We will cover long-standing fundamental questions as well as novel insights and hot scientific debates on the frontiers of ecology and evolution. The course will be held as a series of lectures over one weekend, followed by written exam several weeks later complemented with student's presentation and discussion on the chosen topic. Topics: Introduction to life history strategies – Ecomorphologic diversity in birds, life history strategies, trade-offs current vs. future reproduction, slow vs. fast strategies, precocial vs. altricial species, capital vs. income breeders, optimal clutch size and egg size. Interactions – Kleptoparasitism, mutualism, commensalism, interspecific competition, heterospecific attraction, ecological traps, inter and intraspecific parasitism, arm races and adaptations. Predation – Importance of predation, anti-predatory strategies, protective umbrella, nest predators, edge effect, gradients in predation pressure, nest crypsis. Sexual selection and Sex roles evolution – Bateman's principle, Fisher's sexy sons' hypothesis, good genes model, assortative mating, monogamy, polygamy, lekking, extra-pair paternity, sex roles and sex roles reversal, parental conflicts. Migration and invasions – Migratory strategies, flyways, why migrate to the North? Evolution of migratory behaviour, how to navigate? How to study migration? Nomadism, bird invasions. Biogeography of birds – Zoogeographic areas and characteristic bird taxa, distribution ranges, endemism, Rapoport's rule. Population dynamics – Metapopulation dynamics, theory of island biogeography, source-sink localities, speciation and extinction processes, mass extinctions, small populations issues and extinction vortex. Macroecology of birds – Why there are so many species in the tropics?, latitudinal diversity gradient and exceptions, abundance distribution, species-area relationship, temporal diversity changes, climate change velocity, tropical vs. temperate life histories, comparative approach in ecology. What is the future of biodiversity? – Biodiversity value, drivers of extinctions in Anthropocene – habitat destruction, human pressure, climate change, Has the sixth mass extinction arrived? What can be done? Conservation strategies and prioritization.