

Masters Program in Wildlife Biology and Conservation

National Centre for Biological Sciences
(NCBS-TIFR)

Bengaluru Campus

COURSE SYLLABUS

Course Title: MATHEMATICS FOR BIOLOGISTS

Course Code: WLBC-151.6

Credits: 2

Subject Board: Biology

Course offered at: NCBS, Bengaluru Campus

Course Type: Core Course (Basic)

Course description

Coverage of basic arithmetic, algebra and calculus in preparation for subsequent advanced courses in statistical methods.

Topics covered

Number classifications, measurements, inequalities, summations and powers

Sets and symbolic logic

Power functions

Logarithms and Exponents

Graphical methods

Basics of Differential and Integral calculus

Basics of Matrix algebra.

Course Faculty (2020-22)

Sandeep Pulla, Centre for Ecological Sciences, Indian Institute of Science, Bangalore, India

Course Title: INTRODUCTION TO R PROGRAMMING

Course Code: WLBC-152.6

Credits: 2

Subject Board: Biology

Course offered at: NCBS, Bengaluru Campus

Course Type: Core course (basic)

Course description

Programming in the R environment in preparation for applications in statistical data analyses.

Topics covered

Understanding the R environment and its primary components.

Basic R code and functions

Datasets with different data types, and analyses using function packages

R programming to organise datasets of different types as required for planned analyses

Navigation and use of multiple web resources to trouble-shoot and use R programming in an independent manner

Course Faculty (2020-22)

Anand M Osuri, Nature Conservation Foundation, Mysore, India

Akshay M Surendra, (Teaching Assistant) Yale School of Forestry and Environment, Massachusetts, USA

Course Title: FOUNDATIONS OF ECOLOGY

Course Code: WLBC-153.6

Credits: 3

Subject Board: Biology

Course offered at: NCBS, Bengaluru Campus

Course Type: Core course (basic)

Course description

Foundational course in the basic concepts and theoretical frameworks that underpin modern-day Ecology, with applications in global change, wildlife and ecosystem conservation

Topics covered

Basic theories that underpin modern ecology

Definitions of key terms and concepts

Scales, scope and practice of ecology

Factors driving the distributions and abundances of organisms

Relationships of organisms to their physical environments

Interactions between organisms- From competition to facilitation

Factors structuring population growth and regulation

Nature and diversity of biological communities

Energy and nutrient cycling

Ecosystem structure and function

Applications in global change and biodiversity conservation.

Course Faculty (2020-22)

Jayashree Ratnam, National Centre for Biological Sciences, Bengaluru, India

Mahesh Sankaran, National Centre for Biological Sciences, Bengaluru, India

Course Title: RESEARCH METHODS- STUDY DESIGN AND BASIC STATISTICS

Course Code: WLBC-155.6

Credits: 4

Subject Board: Biology

Course offered at: NCBS, Bengaluru Campus

Course Type: Core course (basic)

Course description

An introduction to the principles of study design for robust and statistically sound data collection and basic statistical analytical techniques

Topics covered

Common types of data distributions

Basic statistics to describe the most common types of data distributions

Principles of study design and data collection for robust statistical analyses

Basic techniques for statistical analyses within the hypothesis testing framework

R software for basic statistical analyses

Course Faculty (2020-22)

Suhel Quader, Nature Conservation Foundation, Mysore, India

Priti Bangal (Teaching Assistant) Nature Conservation Foundation, Mysore, India

Course Title: PHILOSOPHY OF SCIENCE AND CONSERVATION

Course Code: WLBC-156.6

Credits: 2

Subject Board: Biology

Course offered at: NCBS, Bengaluru Campus

Course Type: Core course (basic)

Course description

An interactive course on the philosophical underpinning of science and conservation

Topics covered

Philosophical foundations of science, particularly ecology, sociobiology, evolutionary biology and conservation science

The role of human ideology in natural history, ecology, evolution and conservation

The social and environmental impacts of modern biology and its sub-disciplines

Ethical issues in ecological science and conservation practice.

Course Faculty (2020-22)

Anindya Sinha, National Institute of Advanced Studies, Bengaluru, India

Course Title: SCIENTIFIC WRITING AND COMMUNICATION

Course Code: WLBC-157.6

Credits: 3

Subject Board: Biology

Course offered at: NCBS, Bengaluru Campus

Course Type: Core course (basic)

Course description

A course to prepare students to be able to write scientific papers based on original research, write scientific proposals for grant funding and be able to communicate scientific work in presentations to scientific audiences, practitioner and policy makers

Topics covered

Primary

Elements of Scientific writing: clarity, flow, concision, shape, paragraph construction, essay construction

Scientific research papers - Structural Organization, flow and construction

Additional

Proposal writing for fundraising.

How to identify funding opportunities for conservation science and practice

How to apply for funding

Communication of scientific findings to wider, non-scientist audience

Course Faculty (2020-22)

Karthik Ramaswamy (Lead Faculty), Indian Institute of Science, Bengaluru, India

Ad-hoc Guest Faculty

Course Title: GIS & REMOTE SENSING
Course Code: WLBC-158.6
Credits: 4
Subject Board: Biology
Course offered at: NCBS, Bengaluru Campus
Course Type: Core course (basic)

Course description

An introductory course in the use of remote sensing and GIS for vegetation and landscape mapping in the ecological sciences

Topics covered

Geodesy, mapping, coordinate systems
Ground surveys and positioning systems
Use of remote sensing, cartography and GIS.
Analysis of land-use and land-cover change through time using remotely sensed images and maps across time using open source software
Analysis of patch dynamics, patch size and number, boundaries and edges, edge effects, patch shape corridors, matrix effects, and mosaics, across space and time using open source software

Course Faculty (2020-22)

Ravinder Singh Bhalla, Foundation for Ecological Research, Advocacy and Learning (FERAL), Pondicherry, India
Tara Rajendran (Teaching Assistant), World Wild Fund for Nature, India (WWF-India), New Delhi, India

Course Title: CLASSICAL READINGS IN ECOLOGY AND CONSERVATION
Course Code: WLBC-159.6
No. of Credits: Audit
Subject Board: Biology
Course offered at: NCBS Campus, Bangalore
Course Type: Core course (basic)

Course description

A seminar course that introduces students to seminal papers in the ecological and conservation sciences, to enable students to understand the development of these subjects and to develop critical reading skills in scientific literature

Topics covered

Variable seminal and landmark papers that led to the development of major ideas in Ecology and Conservation science

Course Faculty (2020-22)

Jayashree Ratnam, National Centre for Biological Sciences, Bengaluru, India
Hari Sridhar, Independent Scientist and Researcher, Bengaluru, India

Course Title: VERTEBRATE ECOLOGY
Course Code: WLBC-160.6
Credits: 3
Subject Board: Biology
Course offered at: NCBS, Bengaluru Campus
Course Type: Core course (basic)

Course description

A foundation course on the ecology and biology of vertebrates

Topics covered

Evolution, phylogeny, global diversity and biogeography of major groups of vertebrates.
Diversity and biogeography of Indian vertebrates at genus or species level.
Factors influencing the abundance, ecology and behaviour of vertebrates
Major methods used for studying the ecology and behaviour of vertebrates
Major threats facing vertebrate species in India.
Natural history and ecology of Indian vertebrates.

Course Faculty (2020-22)

Ajith Kumar (Lead Faculty) Centre for Wildlife Studies, Bangalore, India
Guest Faculty
Vivek Ramachandran, National Centre for Biological Sciences, Bengaluru, India
Girish Punjabi, Wildlife Trust of India, Mumbai, India
Varun Goswami, Conservation Initiatives, Guwahati, India
Tarun Menon (Teaching Assistant) Center for Ecological Sciences, Indian Institute of Science, Bangalore, India

Course Title: INVERTEBRATE ECOLOGY
Course Code: WLBC-161.6
Credits: 3
Subject Board: Biology
Course offered at: NCBS, Bengaluru Campus
Course Type: Core course (basic)

Course description

A foundation course on the ecology and biology of invertebrates

Topics covered

Evolution, diversification and distribution of biodiversity in invertebrates
Evolution of life histories, body form, survival strategies, and mating systems of invertebrates
Role of invertebrates in ecosystem stability and functioning.
Methods used in collection, preservation and curation of invertebrate samples.
Conservation issues, especially affecting preservation of invertebrate biodiversity.

Course Faculty (2020-22)

Sanjay Sane, National Centre for Biological Sciences, Bangalore, India

Course Title: CONSERVATION PHOTOGRAPHY

Course Code: WLBC-163.6

Credits: Audit

Subject Board: Biology

Course offered at: NCBS, Bengaluru Campus

Course Type: Core course (basic)

Course description

An introductory course in photography of wildlife and nature, and story-telling using visual tools

Topics covered

Basic technical elements of photography

Use of light and speed for different kinds of photographs, motion photography

Workings of different kinds of cameras and lenses

Basic rules for composing good wildlife and nature photography

Using photography as an effective tool for conservation story telling

Course Faculty (2020-22)

Prasenjeet Yadav, Independent Photographer

Ad-hoc guest lecturers

Course Title: CONSERVATION LAW, POLICY AND MANAGEMENT

Course Code: WLBC- 164.6

Credits: 3

Subject Board: Biology

Course offered at: NCBS, Bengaluru Campus

Course Type: Core course (basic)

Course description

An introductory course on key legal and policy frameworks for wildlife and nature conservation and management in India, and major international legislations for wildlife protection

Topics covered

Provisions of the major acts and laws for wildlife protection and forest Conservation in India

Impacts of major laws and acts on wildlife and forest conservation in India

Management plans and working plans for forest and protected areas in India.

Important international conventions and agreements that for wildlife trade and conservation

Course Faculty (2020-22)

Ravi Chellam (Lead Faculty) Meta-String Foundation, Bangalore, India

Guest Faculty

Kanchi Kohli, Researcher, Centre for Policy Research, New Delhi, India

Stella James, Independent Environmental Law Consultant, Bangalore, India

Shomona Khanna, Delhi University & Advocate, Supreme Court of India, New Delhi

Nitin Kakodkar (IFS), Retd. PCCF and CWW, Maharashtra State Forest Department

Course Title: ECOLOGICAL HISTORY- CONSERVATION, SCIENCE AND SOCIETY

Course Code: WLBC-165.6

Credits: 3

Subject Board: Biology

Course offered at: NCBS, Bengaluru Campus

Course Type: Core course (basic)

Course description

An introductory course on the history of the environmental and conservation movements globally, followed by a detailed focus on India, to understand how political and social history shape contemporary conservation in India today.

Topics covered:

History of the global environmental movement

Social and political histories of global conservation movements

Tracing the conservation movement in India- From colonial to contemporary

History, context and positioning in the construction of conservation narratives

Values, morals and ethics in conservation

Conservation as a social process

Conservation as a political process

Course Faculty (2020-22)

Meera Oommen (Lead Faculty), Dakshin Foundation, Bangalore, India

M D Madhusudhan (Lead Faculty), National Centre for Biological Sciences, Bangalore, India
Guest Faculty

Mahesh Rangarajan, Krea University, Sri City, India

Madhuri Ramesh, Azim Premji University (APU), Bangalore, India

Ad-hoc guest lectures

Course Title: POPULAR WRITING

Course Code: WLBC-167.6

Credits: Audit

Subject Board: Biology

Course offered at: NCBS, Bengaluru Campus

Course Type: Core course (basic)

Course description

A course in popular science writing

Topics covered

Different writing for different target audiences

Different writing techniques for different media

Analysis of popular articles for their responses from target audiences

Course Faculty (2020-22)

TBA

Course Title: EVOLUTION AND BIOGEOGRAPHY

Course Code: WLBC-181.6

Credits: 3

Subject Board: Biology

Course offered at: NCBS, Bengaluru Campus

Course Type: Core course (basic)

Course description

A foundation course on evolution and natural selection, the production and maintenance of biological diversity, and the scaling of biodiversity across space and time to generate biogeographic patterns in the origins and distributions of species across earth.

Topics covered

Basic concepts in evolution- natural selection and genetic drift.

History of evolutionary thought- Darwin, Wallace, Lamarck and other thinkers

Processes that generate biological diversity- speciation and hybridization.

Geographic patterns of diversity- biogeography and macroecology.

Evolution of species interactions

Tools to quantify evolutionary processes- phylogenetics and basic population genetics.

Course Faculty (2020-2022)

Uma Ramakrishnan, National Centre for Biological Sciences, Bangalore, India

SP Vijaykumar, Centre for Ecological Science, Indian Institute of Science, Bangalore, India

Ad-hoc Guest Lecturers

Course Title: CONSERVATION SOCIAL SCIENCE- ETHICS AND METHODS

Course Code: WLBC-183.6

Credits: 2

Subject Board: Biology

Course offered at: NCBS, Bengaluru Campus

Course Type: Core course (basic)

Course description

An introductory course in the application of theory and methods from the social sciences in conservation science

Topics covered

Introduction to Social science theory

Application of SS theory to socio-ecological and conservation studies

Methods of data collection- Qualitative and semi-quantitative

Methods of Data analyses- Inductive coding and reasoning.

Importance of cultural norms and scientific ethics as they apply to conservation science in settings with human subjects.

Course Faculty (2020-2022)

Divya Karnad, Ashoka University, Sonapat, India

Course Title: PLANT ANIMAL INTERACTIONS

Course Code: WLBC-251.6

Credits: 2

Subject Board: Biology

Course offered at: NCBS, Bengaluru Campus

Course Type: Core Course (advanced)

Course description

An advanced course on the major categories of plant-animal interactions, their evolution and functional implications for plant communities, and their responses to global change drivers

Topics covered

Main types interactions between plants and animals,

Plant-herbivore interactions – types of herbivory, herbivore feeding patterns and plant defences, herbivory and primary production

Plant-pollinator interactions-Types of interactions, two-way interactions to networks, Co-evolution of plants and pollinators,

Plant interactions with seed dispersers and seed predators - Types of dispersal and disperser, Types of predation and predators, Seed fates following dispersal, Dispersal and plant community structure

Global change and plant-animal interactions.

Course Faculty (2020-2022)

Jayashree Ratnam, National Centre for Biological Sciences, Bengaluru, India

Mahesh Sankaran, National Centre for Biological Sciences, Bengaluru, India

Course Title: ADVANCED STATISTICS

Course Code: WLBC- 252.6

Credits: 3

Subject Board: Biology

Course offered at: NCBS, Bengaluru Campus

Course Type: Core Course (advanced)

Course description

Advanced statistical techniques for the analyses of multivariate ecological datasets

Topics covered

Regression Analyses- Multiple, Logistic, Non-Linear, Piece-wise

ANOVAs and ANCOVAs

Generalized Linear Models

Model Selection

Multivariate statistics- PCA, NMDS

Introduction to Bayesian statistics

Course Faculty (2020-2022)

Jagdish Krishnaswamy, Indian Institute for Human Settlements, Bangalore, India

Sandeep Pulla, Centre for Ecological Sciences, Indian Institute of Science, Bangalore, India

Course Title: BEHAVIORAL ECOLOGY

Course Code: WLBC- 253.6

Credits: 3

Subject Board: Biology

Course offered at: NCBS, Bengaluru Campus

Course Type: Core Course (advanced)

Course description

A course in animal behaviour and behavioural ecology, theoretical frameworks for such study, and methods and approaches used in the study of behaviour in wild animal populations.

Topics covered

Impacts of ecological context and natural selection on animal behaviour in the wild.
General framework of comparative studies in animal behaviour
Economic decision-making in animals and optimal foraging theory.
Prey-predator relationships and evolutionary arms races
Costs and benefits of group-living
Sexual conflict and sexual selection
Parental care and mating systems
Alternative reproductive strategies
Selfishness and altruism, cooperation and helping in mammals
Ecology and evolution of signals and communication pathways.

Course Faculty (2020-22)

Anindya Sinha, Professor, National Institute of Advanced Studies, Bengaluru, India

Course Title: MARINE AND COASTAL ECOLOGY

Course Code: WLBC-254.6

Credits: 3

Subject Board: Biology

Course offered at: NCBS, Bengaluru Campus

Course Type: Core Course (advanced)

Course description

Foundation course in marine and coastal ecology

Topics covered

Basic oceanographic, atmospheric and terrestrial processes that define marine and coastal ecosystems
Biology and ecology of the major forms of marine plant and animal life
Major marine and coastal ecosystems- intertidal and near-shore ecosystems, coral reefs, seagrasses and mangrove ecosystems
Productivity in marine and coastal systems- biophysical controls of marine micro-climates, bottom-up versus top-down controls and supply-side ecology
Major issues and challenges in marine and coastal wildlife and ecosystem conservation
Methods for data collection in marine and coastal ecosystems

Course Faculty (2020-2022)

Rohan Arthur (Lead Faculty), Nature Conservation Foundation, Mysore, India

Teresa Alcoverro (Lead Faculty), CSIC-CEAB, Blanes, Spain

Naveen Namboodiri (Lead Faculty), Dakshin Foundation, Bangalore

Guest Faculty

Elrika D'Souza, Nature Conservation Foundation, Mysore, India

Manish Chandi, Independent Researcher, Goa, India

Course Title: POPULATION ECOLOGY AND ESTIMATION**Course Code: WLBC-255.6****Credits: 3****Subject Board: Biology****Course offered at: NCBS, Bengaluru Campus****Course Type: Core Course (advanced)****Course description**

A course on the basic processes that drive population dynamics in nature, and basic and advanced methods for the estimations of population numbers in nature

Topics covered

Commonly observed population growth models,

States and processes that describe population dynamics.

Population life tables

Evolution of life history strategies.

Population regulation mechanisms.

Simple population models, and interpretations of results of model analysis.

Basic and advanced methods used to estimate populations of birds and mammals

Occupancy modelling and model selection

Course Faculty (2020-2022)

Divya Vasudev, Conservation Initiatives, Guwahati, India

Varun Goswami, Conservation Initiatives, Guwahati, India

Course Title: CONSERVATION ECOLOGY AND PRACTICE**Course Code: WLBC-256.6****Credits: 3****Subject Board: Biology****Course offered at: NCBS, Bengaluru Campus****Course Type: Core Course (advanced)****Course description**

A broad coverage of the major categories of threats to wildlife, the management and conservation of wildlife in the context of these threats and human-wildlife interactions in shared landscapes

Topics covered

Major human impacts on wildlife and their habitats: Habitat loss, Habitat change and fragmentation; Large scale development projects; Dams; Agriculture; Biomass extraction: livestock grazing, logging, MFP and fuelwood extraction: Hunting; Shifting cultivation.

Direct and collateral effects of various threats to wildlife
Impact of livestock grazing on vegetation, habitat, and wildlife disease, competition and facilitation between livestock and wildlife.
Impacts of MFP, fuelwood extraction and logging on wildlife.
Varied contexts and impacts of hunting.
Socio-economic and political contexts of human resource use
Complex issues and changing impacts related to near extinct species; case study of Tibetan gazelle
Human-wildlife conflicts (HWC): livestock and crop depredation, loss of property, loss of life; and the importance of perception vis-à-vis reality of HWC
Understanding and managing HWC: contextual knowledge and adaptive management; case studies on leopards and elephants.
Overview of 's Protected Area (PA) network, including types, conservation schemes, the importance of shape, size, and zonation in effectiveness of PA network

Course Faculty (2020-2022)

Krithi Karanth, Centre for Wildlife Studies, Bangalore, India
Ad-hoc guest lectures

Course Title: FRESHWATER ECOLOGY

Course Code: WLBC- 257.6

Credits: 3

Subject Board: Biology

Course offered at: NCBS, Bengaluru Campus

Course Type: Elective Course (advanced)

Course description

An overview of the eco-hydrology and diversity of freshwater ecosystems, and conservation issues relating to these systems

Topics covered

Categories of freshwater ecosystems

Eco-hydrology and biodiversity of freshwater ecosystems

Methods of estimating water quality and flow-rate parameters in freshwater systems

Methods of measuring freshwater biodiversity

Freshwater biodiversity conservation through ecological, hydrological, socio-economic and policy viewpoints.

Looking beyond land-based conservation policies that dominate conservation discourse.

Course Faculty (2020-2022)

Jagdish Krishnaswamy, Indian Institute for Human Settlements (IIHS), Bangalore, India

Rasikapriya Sriramamurthy (Teaching Assistant), ATREE, Bangalore, India

Ad-hoc guest lectures

Course Title: CONSERVATION GENETICS

Course Code: WLBC- 258.6

Credits: 3

Subject Board: Biology

Course offered at: NCBS, Bengaluru Campus

Course Type: Elective Course (advanced)

Course description

Theory and methods relating the estimation of genetics of wild populations

Topics covered

Phylogenetics and species delineation,

Phylogenetic diversity and conservation, assessing cryptic diversity and DNA barcoding

Conservation consequences of hybridization

Genetic population structure, population assignment and forensics.

Landscape genetic outcomes in exploited/hunted populations, inbreeding and its consequence

Captive breeding

Laboratory procedures for genetics, reproductive physiology, analyses of faecal droppings for estimating diet and leaf chemistry.

Course Faculty (2020-2022)

Uma Ramakrishnan, National Centre for Biological Sciences, Bangalore, India

Ad-Hoc Guest Lecturers

Course Title: COMMUNITY AND ECOSYSTEMS ECOLOGY

Course Code: WLBC-259.6

Credits: 3

Subject Board: Biology

Course offered at: NCBS, Bengaluru Campus

Course Type: Core Course (advanced)

Course description

Principles, concepts and advanced topics community and ecosystem ecology

Topics covered

Community structuring – resources, predation, competition and facilitation.

Community functioning - keystone species, functional redundancy and ecosystems services.

Universal patterns in ecological communities: commonness and rarity, mass-abundance

scaling species relationships and phylogenetic relationships between species.

Global and local patterns in species richness

Advances in community ecology, and the future of community ecology.

Biomes and ecosystems, ecosystem processes and functions

Biodiversity and Ecosystem function

Course Faculty (2020-2022)

Umesh Srinivasan, Centre for Ecological Sciences, Indian Institute of Science, Bangalore, India

Course Title: LANDSCAPE ECOLOGY

Course Code: WLBC- 260.6

Credits: 3

Subject Board: Biology

Course offered at: NCBS, Bengaluru Campus

Course Type: Elective Course (advanced)

Course description

Principles and methods in Landscape Ecology and its applications in conservation planning

Topics covered

Foundational ideas in landscape ecology

Research methods in landscape ecology

Heterogeneous landscapes

Concepts of scale and processes relevant to large landscapes

Processes of dispersal and connectivity, and how these scale with landscape unit size

Spatial conservation planning at scales that are meaningful for management actions and policy implementation

Course Faculty (2020-2022)

Divya Vasudev (Lead faculty), Conservation Initiatives, Guwahati, India

Ad-Hoc guest lecturers

COURSE ASSESSMENTS

Course assessments are continuous and include a combination of assessment modes,. These include take-home assignments, presentations, topic and paper discussions, class tests, exams (both closed and open book), research projects, short and medium-length essays and full-length term papers. The specific combination of assessment modes vary from course to course.