

PG 2nd Semester

Paper: EWS801C (Core)

WILDLIFE BIOLOGY

CREDITS: 4 (3+1+0)

Unit 1: Mammalogy (10 lectures)

The evolution, phylogeny, global diversity and biogeography of major groups of mammals: global and Indian scenario; environmental adaptations; Sexual selection, parental care and mating systems; social behaviour; dispersal, habitat selection, and migration; populations and life history; community ecology of mammals; conservation status of Indian mammals; methods for studying mammals; the literature on the natural history and ecology of Indian vertebrates

Unit 2: Ornithology (10 lectures)

Bird anatomy, morphology, physiology; bird phylogeny and diversity: world, India; bird migration; bird vocalisation and communication; life history strategies (focus on annual cycles, breeding and nesting); breeding systems, social organisation and sexual selection; mixed flocks, guilds and community structure; bird extinctions and threatened birds; bird conservation issues and case studies; methods to study birds: surveys, censuses, migration and behaviour

Unit 3: Herpetology (9 lectures)

Evolution of tetrapod vertebrates; biogeography; classification and identification: amphibians; classification and identification: reptiles; community ecology; ecology of threatened species; survey and techniques (research methodologies); reproductive biology and behaviour; conservation: practices and challenges; books, journals, websites for herpetological research

Unit 4: Primatology (9 lectures)

Global diversity, biogeography adaptive radiations of primates; morphology, anatomy and their adaptations in primates; community ecology of primates; primate sociality, behaviour, life-history strategies and cultural traditions; primate cognition and communication; urbanisation of primates and human-primate relationships; conservation and management of primate populations; history and philosophy of primatological studies; methods in primatology: demography, ecology, field behaviour and laboratory studies

Unit 5: Introduction to Multivariate Statistics (10 lectures)

Introduction to multivariate statistics; measurement of multivariate distance; ordination: principal component analysis; factor analysis, principal coordination analysis, correspondence analysis, non-

metric multidimensional scaling; classification: cluster analysis, discriminant analysis; multivariate multiple regression

Suggested Readings

1. Feldhamer GA, Drickamer LC, Vessey SH and Merritt JF (2003). *Mammalogy: Adaptation, Diversity and Ecology (2nd Edition)*. McGraw Hill, New York
2. Lovette IJ and Fitzpatrick JW (eds) (2016). *Handbook of Bird Biology (3rd Edition)*. Cornell University
3. Cowlshaw G and Dunbar R (2000). *Primate Conservation Biology*. The University of Chicago Press
4. Fleagle JG (2013). *Primate Adaptation and Evolution (3rd Edition)*. Elsevier
5. Manly BFJ and Alberto JAN (2017). *Multivariate Statistical Methods: A Primer (4th Edition)*. CRC Press
6. Vitt, LJ and Janalee P Caldwell (2013). *Herpetology: An Introductory Biology of Amphibians and Reptiles*. Academic Press
7. Duellman WE and T Linda (1986). *Biology of Amphibians*. JHU Press

Paper: EWS802C (Core)

HABITAT ECOLOGY

CREDITS: 4 (3+1+0)

Unit 1: Tropical Forest Ecology (10 lectures)

What are where are the tropics; biogeography and evolution in the tropics; importance of tropical forests; characteristic of tropical forests; structure of the tropical rain forests; rainforest development and dynamics; carbon flux and climate change in tropical ecosystems; nutrient cycling and tropical soils; human as part of tropical ecosystem; tropical lowland rain forest of northeastern India, their composition, function and biodiversity; introduction to canopy ecology; animal communities of tropical forests.

Unit 2: Grassland Ecology (10 lectures)

Introduction to grasslands; general description of world grasslands; traditional versus modern views of grass classification; characteristics of Poaceae; C3 and C4 photosynthesis; secondary compounds; anti herbivores defences and allelochemicals; succession; when is a 'forest' a savanna and why does it matters; drivers of savanna structure and function-bottom-up and top down control of savannas; Indian savanna and its extent; animal communities of grassland.

Unit 3: Freshwater and Wetland Ecology (10 lectures)

Ecology of freshwater and wetland ecosystem; definition of wetland; wetland classification; wetland hydrology; wetland soils; wetland soil and biogeochemistry; wetland vegetation and succession; human impacts and management of wetlands; wetland laws and protection; wetland ecosystem services; wetlands and climate change; faunal communities of wetland; wetlands of Assam

Unit 4: High Altitude Ecology (10 lectures)

Ecology of high altitude habitats (alpine, subalpine and upper temperate); species diversity and abundance, vegetation structure and composition; quantification of habitats and animal use, conservation issues and management practices; research in the high altitudes of the Himalaya; animal communities of high altitudes of Indian Himalayas and determinant of their structure

Unit 5: Basic Study Design (8 lectures)

Designing successful field studies; study design - representativeness, independence (and associated statistical concept of degrees of freedom), sample sizes, power analysis; four classes of experimental design, managing and curating data

Suggested Readings

Books

1. Gibson DJ (2009). *Grasses and Grassland Ecology*. Oxford University Press
2. Mitsch WJ and Gosselink JG (2015). *Wetland (5th Edition)*. Wiley
3. Turner IM (2004). *The Ecology of Trees in the Tropical Rain Forest*. Cambridge University Press
4. Lowman MD and Rinker HB (eds) (2004). *Forest Canopies (2nd Edition)*. Elsevier Academic Press
5. Kricher J (2011). *Tropical Ecology*. Princeton University Press
6. Montagnini F and Jordan CF (2005). *Tropical Forest Ecology – The basis for conservation and management*. Springer
7. Gotelli NJ and Ellison AM (2012). *A Primer of Ecological Statistics (2nd Edition)*. Oxford University Press

PhD Thesis:

1. Mishra C (2001). *High altitude survival: conflict between pastoralism and wildlife in the Trans-Himalaya*. Wageningen University, Wageningen, The Netherlands
2. Namgail, T (2009). *Geography of mammalian herbivores in the Indian Trans-Himalaya: patterns and processes*. Doctoral Thesis, Wageningen University, Wageningen, The Netherlands

Paper: EWS803C (Core)
ENVIRONMENTAL TOXICOLOGY AND RISK ASSESSMENT
CREDITS: 4 (3+1+0)

Unit 1: Introduction to Environmental Toxicology (8 lectures)

Definition and scope; historical context of environmental toxicology; principles of toxicology; xenobiotics; toxic chemicals in the environment; transport and fate of some chemicals in the environment; metal toxicity and metal tolerance in plants; environmental issues due to emerging contaminants

Unit 2: Toxicity-Mechanism and Effects (10 lectures)

Dose response relationships; synergism and antagonism; biochemical effects; wildlife ecotoxicology; biomarkers; carcinogens, mutagens and teratogens; biochemical aspects of toxicity of arsenic, cadmium, lead, mercury, carbon monoxide, O₃ and PAN (Paroxy Acyl Nitrate), methyl isocyanate; pesticides

Unit 3: Disease Ecology (10 lectures)

Occupational health hazards; epidemiological issues: goitre, fluorosis, arsenic poisoning; vector borne diseases: Japanese encephalitis, malaria, tuberculosis and AIDS; coliforms and others as indicators of pollution; waterborne diseases

Unit 4: Nanotechnology and Environment (6 lectures)

Classification of nanomaterials; environmental aspects of nanotechnology; current state of nanomaterials applications; nanotoxicology; nanoparticles in food: intentional and accidental; risk assessment for nanotechnology

Unit 5: Environmental Risk Assessment (6 lectures)

Definition of risk, basic steps in risk assessment – hazard identification, dose-response assessment, exposure assessment, risk characterisation, risk communication and risk management; case studies related to environmental risk assessment; human health and ecological risk assessment

Unit 6: Environmental Instrumentation (8 lectures)

Principles and practices of: pH meter, chromatographic techniques; electron microscopy, spectrophotometric techniques (UV-Visible spectrophotometry, flame photometry, Atomic

Absorption spectrophotometry), Nuclear Magnetic Resonance (NMR), Inductively Coupled Plasma (ICP)

Suggested Readings

1. Phillip RB (1995). *Environmental Hazards and Human Health*, Lewis, Boca Raton
2. Chatterjee KD (2009). *Parasitology (Protozoology and Helminthology) with two hundred fourteen illustrations (13th Edition)*. CBS Publication
3. Shatkin JA (2008). *Nanotechnology Health and Environmental Risks*. Perspectives in Nanotechnology. CRC press
4. Canter LW (1996). *Environmental Impact Assessment (2nd Edition)*. McGraw-Hill, New York
5. Gilbert M (2008). *Introduction to Environmental Engineering and Science*, Pearson Education
6. Richards IS (2008). *Principles and Practice of Toxicology in Public Health*. Jones and Bartlett Publishers, London

7. Skoog DA, Holler FJ, Crouch SR (2006). *Principles of Instrumental Analysis*, 6th Edition, Thomson
8. Rouessac F and Rouessac A (1998). *Chemical Analysis: Modern Instrumental Methods and Techniques*, Wiley, Singapore

Paper: EWS804C (Core)

ENVIRONMENTAL STRESS BIOLOGY

CREDITS: 4 (3+1+0)

Unit 1: Primer of Physiology and Biochemistry (12 lectures)

Functions of cell, cell organelles, biomolecules, pigments, signal transducers, enzymes, hormones in plants and animals; gene expression, immunity, growth, development, reproduction, gaseous exchange, photoperiodism, homeostasis in plants and animals; vascular transport, vernalization, photomorphogenesis, thermoperiodism and movement in plants; neurotransmitters, thermoregulation, osmoregulation, blood circulation, digestion and excretion in animals

Unit 2: Introduction to Environmental Stress (12 lectures)

Definition of environmental stress; significance of environmental stress physiology and biochemistry; types of environmental stress: biotic stress (pathogens, bacteria, viruses, fungi, parasites, insects, herbivore attacks, weeds) and abiotic stress (water stress, heat stress, salinity stress, light stress, exposure to atmospheric pollutants- symptoms of pollution damage in plants, chemicals,

particulate matter, heavy metals, ozone, UV radiation, photo-oxidative stress, nutrient toxicity and deficiency)

Unit 3: Environmental Stress: Impacts and Adaptive Mechanisms (12 lectures)

Impact of abiotic and biotic stresses on plants, animals and ecosystems; photo-oxidative damage; lipid peroxidation; avoidance and tolerance – two contrasting stress adaptive mechanisms; heat shock proteins; anti-oxidative defence system

Unit 4: Hormonal Regulation of Stress Tolerance in Plants (12 lectures)

General characteristics and mode of action of plant growth hormones; major classes of plant hormones; mechanism of biosynthesis; role in plant growth and development; natural and synthetic hormones; synergistic and antagonistic effects; hormone signalling, molecular mechanism of signal transduction; endogenous and exogenous hormone interaction; hormones as mediators of stress responses; hormones in abiotic stress tolerance and plant defence

Suggested Readings

1. Tuteja N and Gill SS (eds) (2014). *Climate Change and Plant Abiotic Stress Tolerance*. Wiley Blackwell
2. Rai AK and Takabe T (eds) (2006). *Abiotic Stress Tolerance in Plants: Toward the Improvement of Global Environment and Food*. Springer
3. Davis PJ (ed) (2004). *Plant hormones: Biosynthesis, Signal Transduction, Action*. Kluwer Academic Publishers
4. Srivastava LM (2002). *Plant Growth and Development: Hormones and Environment*. Academic Press, USA
5. Khan et al (eds) (2012). *Phytohormones and Abiotic Stress Tolerance in Plants*. Springer

Paper: EWS805L (Lab)

FIELD WORK, TOXICOLOGY AND STRESS BIOLOGY

CREDITS: 4 (0+0+4)

Unit 1: Fieldwork and Hands-on Exercises

1. Animal home ranges and territories and home range estimators
2. Habitat evaluation: measuring use, selection, and importance
3. Investigating food habits of terrestrial vertebrates

4. Sampling and identification of herpetofauna
5. Point count methods of bird population abundance
6. Sampling methods in tropical forests, wetland, grassland and high altitude areas
7. Camera trapping and occupancy modeling
8. Museum specimen preparation, body and skull measurement and identification

Unit 1: Lab Work

1. Study of nutrient deficiency and toxicity symptoms
2. Study of leaf stomata in stress conditions
3. Leaf chlorophyll estimation
4. Proline estimation in plants
5. Nitrate reductase estimation in plants
6. Determination of heavy metals toxicity by germination and seedling growth tests

Suggested Readings

1. Gibbs JP, Hunter Jr ML and Sterling EJ (2008). *Problem-solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory*. Blackwell
2. Boitani L and Fuller TK (2000). *Research Techniques in Animal Ecology: Controversies and Consequences*. Columbia University Press
3. Cappuccinno JG (2014). *Microbiology: A Laboratory Manual (10th Edition)*. Pearson
4. Aneja KR (2017). *Experiments in Microbiology, Plant Pathology and Biotechnology (4th Edition)*. New Age International(P) Ltd
5. Mirajkar SR, Kale P and Shingote P (2017). *A Practical Manual for Plant Physiology and Biochemistry*. Lambert Academic Publishing

Paper: EWS806S (SEC)

SCIENCE COMMUNICATION

CREDITS: 2 (1+1+0)

Unit 1: Science Communication (2 lectures)

Principles of science communication; de-jargonising science, law and policy

Unit 2: Science Communication and Advocacy (3 lectures)

Is it okay for science communication to get political?; science communication and political ecology; principles of advocacy; advocacy for science; does advocacy take away from neutrality of science?; challenges to advocacy

Unit 3: Science Proposal Writing (2 lectures)

How to write an effective statement of purpose?; how to write a good proposal—and follow ups

Unit 4: Communicating Science through Photographs (4 lectures)

The whats, hows, whys, and why nows of photography; framing a visual narrative; visual style and storytelling; importance of history and context in narrative and visual construction; the dilemma of the frame as a point of view; photonaturalist versus photographer; power of photography; ethics in wildlife photography

Unit 5: Other Aspects (5 lectures)

Making the right CV; how to make an effective presentation – oral and poster presentation; how to read and write a scientific paper?; reference management and managing research; art of writing effective academic emails; plagiarism and intellectual property rights

Suggested Readings

Books

1. Sontag S (2008). *On Photography*. Penguin UK

Journal and other articles

1. Ellison AM (2016). It's time to get real about conservation. *Nature*. 538, 141
2. Garrard GE, Fidler F, Wintle BC, Chee YE and Bekessy SA (2016). Beyond Advocacy: Making Space for Conservation Scientists in Public Debate. *Conservation Letters*. 9, 208-212
3. Webster (2016). Recognize the Value of Social Science. *Nature*. 532, 7
4. David Thomas Media LTD (2014). *Engaging With the Media: A Companion to the advocacy Toolkit for Influencing the post-2015 Development Agenda*. Sustainable Development 2015
5. Datatri S and Sreenivasan R (2016). Ethics in Wildlife Photography. Conservation India http://www.conservationindia.org/wp-content/files_mf/Ethics-Web.pdf