

M.Sc. I SEMESTER

Wildlife Sciences

PAPER- I

PHYTOLOGY

Objective: The paper aims to enhance the understanding of the Plant taxonomy, its necessity and importance in reference to wildlife studies, forestry and agriculture. An overview of the phytogeographic regions has been discussed and some important families have been discussed in detail.

Credits: 4

Unit-I Plant taxonomy, its aims and approaches; importance to allied disciplines with special reference to wildlife studies, forestry and agriculture; units of classification, minor and major categories; concept of species as a basic unit of classification; brief idea of Binomial Nomenclature, vernacular names and scientific names, their disadvantages and utility, synonyms; salient features of International Code for Nomenclature of Algae Fungi and Plants (ICN) including the naming of taxa according to their rank.

Unit-II Necessity and importance of classification, a detailed treatment of Bentham and Hooker System of classification including the basis and outline of classification, application of the system as an aid for identification of plants up to family level representing Indian flora with special reference to North India.

Unit-III Diagnostic features of the following families; Magnoliaceae, Dilleniaceae, Nymphaeaceae, Capparidaceae, Malvaceae, Dipterocarpaceae, Sterculiaceae, Papilionaceae, Rubiaceae, Apocynaceae, Asclepiadaceae, Bignoniaceae, Verbenaceae, Ceratophyllaceae, Euphorbiaceae, Moraceae, Arecaceae, Pontederiaceae, Hydrocharitaceae, Cyperaceae and Poaceae.

Unit IV A brief idea of Phytogeography, Phyto-geographical regions of the world with special reference to the Indian sub-continent. Endemism, specific threats to plant species caused by extraction.

Suggested readings:

1. An Introduction to Plant Ecology by Maurice Ashby
2. Flora of Dehradun by U. Kanjilal
3. Flora of Upper Gangetic Plain by J. F. Duthei
4. The Forest Types Of India by Champions and Seth
5. Forest Ecology: Phytogeography and Forest Conservation by G. S. Puri
6. The Grasses of Burma, Ceylon, India and Pakistan by N. L. Bor
7. Grasses of Western India by Toby and Hodd
8. Himalaya: Our Fragile Privilege by N. D. Jayal
9. A Handbook on the Identification and Description of Trees and Shrubs by T.R. Somasundaram
10. A Class book of Botany by A. C. Dutta
11. An Introduction to World Vegetation by A. S. Collinson

PAPER- II

MAMMOLOGY

Objective: The paper aims to enhance the understanding about the Evolution and classification of mammalian fauna and its distribution in different biogeography zones. It discusses the morphological, physiological adaptation and reproductive strategies. The paper further discusses the major initiatives taken by the government of India for the conservation and protection of mammalian fauna.

Credits: 4

Unit-I Origin and evolution of mammals, mammalian characters, their evolutionary and functional significance, a brief introduction of world and Indian biogeographical zones

Unit-II Classification of mammals with detailed treatment of orders represented in the Indian sub-continent, Status and distribution of major mammalian taxa like, cervids, bovids, carnivores, primates

Unit-III Ecology and biology; Morphological adaptations and locomotion in mammals, Reproductive strategies of mammals and factors influencing their reproduction and reproductive success. physiological adaptations.

Unit-IV Major initiatives taken by Govt of India for conservation and preservation of mammals, captive breeding programs, population reintroductions, augmentations and translocations, cloning and its significance, role of existing protected areas in mammalian conservation in India.

Suggested Readings:

1. Mammal Ecology by M.J. Delany
2. The book of Indian Animals by S.H. Prater
3. The life of Vertebrates by J.Z. Young
4. Mammalogy by Terry A. Vaughan
5. Social behaviour in mammals by T. Poole
6. Threatened animals of India by B.K. Tikader
7. The Deer and the Tiger by George B. Schaller

PAPER- III

ORNITHOLOGY

Objective: The paper aims to enhance the knowledge about the evolution and classification of avifauna and its distribution. It discusses the morphology, ecology and biology of the birds. The paper further discusses the economic importance, threats and threatened birds of world.

Credits: 4

Unit-I Origin, speciation and evolution of birds, Classification and distribution of Indian avifauna upto species level. Bird species identification through morphological studies.

Unit-II Morphological adaptation; adaptation in bill and claws, development of feathers and flight adaptations, diurnal and nocturnal adaptations. Plumage and molt, camouflage and mimicry. General activities; roosting, calls and songs, imprinting and learning of calls, voice vs. vision, methods of analyzing and recording calls and songs.

Unit III Ecology and biology of birds; Feeding ecology; feeding adaptations and strategies, foraging behavior, solitary and colonial feeding, mixed hunting parties, food competition and selection. Breeding biology; courtship and pair selection, nest defense and territory, brood parasitism and cooperative breeding. Theories of clutch size; nestling and fledgling periods, orientation of young birds; causes of success and failure of breeding.

Unit-IV Economic importance of birds, beneficial and harmful role of birds, problem birds and their control. Threats faced by the avian community, threatened birds of the world and their categories, causes of decline of common birds and control measures.

Suggested readings:

1. The life of birds by Joel Carl Welty
2. Biology of Indian Barbet by H.S.A. Yahya
3. Ornithology by Frank, B. Gill
4. The book of Indian birds by Salim Ali
5. The fall of Sparrow by Salim Ali
6. Avian Ecology by Birkhead and Perrins
7. Bird Sound by Gerhard, A. Thellcke
8. Popular handbook of Indian bird by Hugh Whistler
9. A bundle of feathers by Sidney, Dhillan Ripley

Objectives: The paper aims to enhance understanding about the amphibians. The introduction, origin, evolution, classification, Biology and ecology of amphibians. The paper also deals with the conservation issues and initiatives taken by government of India.

Credits: 4

Unit I: A brief Introduction to amphibians, its origin and evolution. Adaptations in amphibians. Distribution of Important amphibian taxa in different biogeographical zones of India

UNIT II: Classification of amphibians with detail treatment of different orders. Detailed description, status and distribution of amphibians represented in Indian sub continent

UNIT III: Ecology and biology: Sexual and asexual modes of reproduction and parental care, evolution of parental care in amphibians, foraging methods in amphibians, predator avoidance strategies, communication mode in amphibians,.

UNIT IV: Conservation issues related to amphibian diversity. Amphibian 'hotspots' in India, threats to amphibians, impact of climate change on amphibians and global declines in their population. Captive breeding programs on amphibians.

Suggested Readings:

1. M. A. Smith., *The fauna of British India (Reptilia and Amphibia- Vol. -III, Serpentes Vol.IV)*
2. George R. Zug. *Herpetology- An Introductory Biology of Amphibians and reptiles.*

PAPER- V

REPTILES

Objectives: The objectives of this paper are to equip students through classroom teaching about the taxonomy of the reptilians following recent classification scheme. The teaching would ensure providing knowledge up to species and subspecies level with special reference of Indian species. It is not expected that students would learn taxonomy by heart but use taxonomic tools to identify species in the field.

The course also envisages disseminating information on basic biological and behavioural information related to the reptiles. The causes of decline of reptilian fauna and major conservation initiatives taken to conserve reptilian fauna in India would also be the focus of the course.

Credits: 4

Unit I Evolutionary history of reptiles, systematic and classification: An overview and taxonomic account of extant families of tuataras, turtles, crocodylians, lizards and snakes with special reference to Indian assemblage.

Unit II Biology: Morphology and adaptations in reptiles sexual dimorphism and sex determination, respiration, locomotion and thermoregulation. Status and distribution of some important Indian species of turtles, crocodylian, lizards and snakes.

Unit III Behavioral Ecology: Movements and migration, modes of communication, foraging and food habits, predator avoidance, reproduction and parental care.

Unit IV Conservation: Areas of high reptilian diversity an overview of the global scenario with special reference to India. Threats to reptilian community and its conservation.

Suggested readings:

1. M. A. Smith., *The fauna of British India (Reptilia and Amphibia- Vol. -III, Serpentes Vol.IV)*
2. George R. Zug. *Herpetology- An Introductory Biology of Amphibians and reptiles.*

Practical Paper VI

FIELD EXERCISE

Objective: The main objective of this practical paper is to enhance knowledge of the students about the field exercise in wildlife and biodiversity. Students should develop good understanding and identification of the birds, mammals, herpetofauna and vegetation of the surrounding. Emphasis has been given to develop good understanding about the different ecosystem, habitat and biodiversity values

Credits: 2

A. Exercises to be carried out in Aligarh

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|---|-------------|
| 1. Identification of flora and preparation of herbarium specimen | 05 visits |
| 2. Identification of mammalian fauna of Aligarh region | 05 visits |
| 3. Identification of avian fauna of Aligarh region using various techniques such as mist netting. | 15 visits |
| 4. Identification of herpeto-fauna of Aligarh region | 05 visits |
| 5. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses, Camera trap, Sherman trap, Camping gear). | 03 lectures |

Practical Paper VII

COMPUTER EXERCISE

Objective: The paper aims to enhance the basic understanding about the computer and its applications in wildlife field. Some of the program has been discussed in detail such as MS Word, Adobe Photoshop, Data based program and chart and graphs making in Excel and SPSS.

Credits: 2

Unit-I Basic concept of Computer systems, operating systems, hardware and software. Introduction to Windows. Management of files, folders. Word processing in MS-Word Drawing of various 2D & 3D shapes.

Unit-II Page designing and slide show in Power Point. Import and Export of data and images. Hyperlink between different software packages.

Unit-III Data entry, data summarization, data management and various statistical operations, Chart and graph making in Excel & SPSS. Basic statistical and mathematical functions and operation in Excel.

Unit-IV Drawing and designing in Adobe Photo shop. Photo and slide scanning and their editing. CD writing. System management and trouble-shooting. Internet and different web sites related to wildlife.

MSC II SEMENSTER

Wildlife Sciences

PAPER- I ECOSYSTEM AND COMMUNITY ECOLOGY

Objective: The paper aims to enhance the knowledge about the basic concept and structure of ecosystem, concept of community, animal habitat interaction, many behavioral aspects such as feeding ecology, frugivory and predation. Food selection and pattern of habitat utilization. Group size and mate selection.

Credits: 4

Unit-I Basic concepts and structure of ecosystem: biotic and a biotic components, trophic level, producers, consumers and decomposers, functions of ecosystem, energy flow, food chain/food web and bio-geo-chemical cycles. Concepts of productivity, types of productivity, GPP, NPP, Secondary productivity, community productivity. Ecological efficiencies, producer and consumer level efficiencies.

Unit-II Concept of community. Physical characteristics of community; vertical stratification, horizontal heterogeneity, edge and ecotone. Biological attributes of community; species richness, diversity and dominance. Change in community structure and function; temporal changes, colonization and extinction (theory of island bio-geography). Concept of ecological succession, characteristics and mechanism of succession.

Unit-III Animal-habitat interactions. Effects of. Inter and intra-specific competition, mechanism of competition within community; exclusion and co-existence. Concept of the niche; introduction and definition of niche, parameters of niche and factors affecting it. Niche separation and overlap. Measures of niche width.

Unit-IV Feeding ecology; review of optimal foraging theory, concept of herbivore, frugivory and predation. Food selection and pattern of habitat utilization. Group size and mate selection.

Suggested Readings:

1. Elements of ecology and Field Biology by R.L. Smith
2. Ecology and our endangered life support system by Eugene, P. Odum
3. The Science of Ecology by Roush Garden and Ehrlich
4. Concept of Ecology by Edward.J. Kormondy
5. Community Ecology: Pattern and Process by Anderson and Kikkawa
6. Ecological Concept by J.M. Cherrett
7. Comparative Ecology by Jiro Kikkawa

PAPER- II

POPULATION AND CONSERVATION BIOLOGY

Objective: The paper aims to enhance the knowledge about the Population, its definition and concept, growth rates, Population regulation, theories of population dispersal. The paper also emphasizes the definition of conservation biology, minimum viable population, population vortexes and inbreeding in natural population and impact of habitat fragmentation on diversity.

Credits: 4

Unit-I Population, its definition and concept, importance of population in wildlife studies, population attributes and their analysis, life tables; definition, construction and importance in wildlife management, concept of growth rate, exponential and logistic growth rates.

Unit-II Population regulation, density independent and density dependent population regulation, predator prey models, concept of carrying capacity, r and k selection theory. Animal movement, concept of home range and territory. Theories of population dispersal.

Unit-III Definition of conservation biology; minimum viable populations, inbreeding and out-breeding depression, population vulnerability analysis and its components. Stochastic and deterministic extinction process, demographic, genetic and environmental stochastic ties.

Unit-IV Inbreeding in natural populations of birds and mammals, heterozygosity, and fitness in natural populations. Co-adaptation and out-breeding depression, concept of diversity, rarity, endemism, impact of habitat fragmentation on diversity.

Suggested Readings:

1. Population Ecology: A unified study of Animals and Plants by M. Begon.
2. Population Ecology: Begon and Mortinur
3. Ecology of Populations by Boughy and S. Arthur
4. Viable Population for Conservation by Michael E. Soule
5. Ecology of Populations by Arthur S. and Boughey
6. An Introduction to Plant Population Ecology by J. Silvertown
7. Guide to the Study of Animal Population by J. T. Tanner
8. An Introduction to the Study of Animal Population by H. G. Andrewartha
9. Population Growth Estimation by E. S. Marks

Objective: This course is designed to inculcate among students a temperament to use modern techniques in research. The aim of this paper is to provide information on the application of remote sensing and geographical information system (GIS) technology in wildlife conservation and management. Students are provided information on the working principles of RS and GIS through lectures. They are also demonstrated some of the applications of RS and GIS in wildlife and biodiversity studies. The students also practice in lab data viewing, enhancement and interpretation.

Credits: 4

Unit-I Photogrammetry: Fundamentals of Photogrammetry, types of Aerial Cameras. Types of Aerial photographs scale of Aerial photographs and their correction (swing, tilt, pitch, yaw). Depth perception and stereoscopic viewing. Concept of digital Photogrammetry. Recent applications and examples. Photo-mosaic and its types.

Unit-II Remote Sensing: Basics of remote sensing, active and passive remote sensing. Concept of electromagnetic spectrum (EMR). Interaction of EMR and earth's surface. Atmospheric windows. Types of platforms and scanning systems. Base and thematic maps, elements of a good map. Sources of thematic maps.

Unit-III Image Interpretation: Elements of image interpretation. Sensors and image characteristics of LANDSAT, SPOT, NOAA and IRS series of satellites. Spatial, spectral and temporal resolutions. Digital image processing techniques-FCC, filtering, base rationing, IHS and PCA images. Supervised and unsupervised classification. Application in WL hatrical NDVI and vegetation analysis.

Unit-IV GIS & GPS applications: Fundamentals of GIS. Functions of GIS, Data format, spatial & non-spatial data-vector and Raster data. Applications in wildlife sciences. Working principle, advantage, limitations and applications of GPS. Exposure to image processing and GIS software (Erdas Imagine and Arc Info). Concept of map projection, geo-coding and image registration.

Suggested readings:

1. Remote sensing & image interpretation by Lillesand, T and Kiefer, R.W.
2. Principles of remote sensing by Sabins, F.F.
3. Fundamentals of GIS by Michael Dewers
4. Spatial Analysis & GIS by Fotheringhaw
5. Photo geology by V.C. Miller
6. Fundamentals of remote sensing by George Joseph
7. Application of RS by LRA Narayana
8. Elements of Photogrammetry by Paul R. Wolf
9. Fundamentals of RS by George Joseph
10. GIS solution resource management: balancing the tech-Political equation by Mortain Stan
11. GIS development.net www.ursa.gov.in, www.isro.org, ,
12. Journal Indian Society of Remote Sensing

Objective: The paper aims to enhance the knowledge about the laboratory techniques used in wildlife studies such as Micro-histology, chemical composition of food, scat analysis to understand the food and feeding habits of herbivores and carnivores. This paper also emphasizes on water quality monitoring techniques and biological parameters for evaluation of health of wetlands and riverine ecosystems.

Credits: 4

Unit-I Introduction to micro-histology techniques: Historical perspective and its utility in food habit studies for herbivores. An overview of plant anatomical features used in micro-histology. Salient features of micro-histology (complete procedure for reference slide preparation and slide preparation from pellet groups and rumen contents). Randomization and sample size considerations. Sampling methods for identification and counting of plant fragments. Derivatives attributes calculation from plant fragment identification. Data analysis and interpretation.

Unit-II Introduction to chemical composition of foods: Chemical analysis of food items of herbivores to determine nutritional status. Estimation of nitrogen, phosphorus, potassium. Age estimation of large herbivores by counting of cementum growth layers. Bone marrow analysis and estimate of kidney fat index to assess physical condition of ungulates.

Unit-III Scat analysis for studying food habits of carnivores: a historical perspective. An overview of hair and bone anatomical features used for species identification. Salient features of scat analysis. Randomization of scats and sample size considerations. Complete procedure for reference slide preparation and slide preparation from scats). Derivative attributes calculation from hair identification. Data analysis and interpretation.

Unit-IV Water quality monitoring techniques and biological parameters for evaluation of health of wetlands and riverine ecosystems. An overview of problem of water pollution in India. Sources of water pollution and different Chemical contaminants; nature and their impact mechanism, methods of studying contamination from water, blood and body tissues including feather samples.

Suggested readings:

1. Ecological Methods for Field and Laboratory Investigation by P. Michael
2. Laboratory and Field Manual of Ecology by Brewer and Richard
3. Research Techniques in Animal Ecology by Luige Boitani
4. Ecology: The experimental Analysis by Charles J. Krebs
5. Ecological Diversity and its Measurement by N. E. Magurran
6. Laboratory Instrumentation by Prakash and Arora
7. Differential and Integral Calculus by Bugrob and Nikolsky
8. Statistics for Ornithologists By Forhen and Fowler
9. Analysis of Vertebrate Population by G. Caughley
10. Birds Census Techniques by C. Bibby
11. Mathematical Ecology by E. C. Pielou
12. Choosing and Using Statistics by C. Dytham
13. Biometry by Sokal and Rohlf

Objective: The paper aims to enhance the knowledge about introduction of Bio-statistics and its application in wildlife studies. Introduction to statistical distribution. It emphasizes on parametric and non parametric tests, Type I and Type II error, and discuss many statistical tests such as t-test, Z test and Friedman Two Way ANOVA

Credits: 4

Unit-I Introduction to Bio-statistics and its application in wildlife studies. Definition of some statistical terms (Data, variable, sampling universe, sampling unit, sample size, accuracy and precision). Types of variables and scales of measurements (nominal, ordinal, interval/ratio scales). Data summarization, frequency tables and curves. Data presentation, Histogram, bar diagram, pie charts line diagram and scatter plot, skewness and kurtosis.

Unit-II Introduction to statistical distributions. Normal distribution and its salient features. Parametric vs. non parametric statistical techniques. Introduction to hypothesis testing. Null and alternative hypothesis. Level of significance. Type I and Type II errors. One tailed and two tailed tests. Parametric and non parametric test of significance. Data transformation,

Unit-III Student's t-test, Z-test, Mann-Whitney U test, Wilcoxon test for matched pairs. Analysis of variance, one way ANOVA, Kruskal Wallis one way ANOVA, Kolmogorov Smirnov test, Wald-Wolfowitz run test, sign test, Friedman two way ANOVA.

Unit-IV Introduction to correlation analysis. Spearman Rank Correlation Coefficient. Problem of tied ranks. Product Moment Correlation Analysis. Coefficient of determination. Significance of r. Chi-square test of association. Goodness of Fit Test. Contingency tables. Regression Analysis.

Suggested Readings:

1. Fowler, J. and Cohen, L. 1986. *Statistics for Ornithology*. British trust for Ornithology Glaser, A.N. 1995. High-Yield Biostatistics. Williams & Wilkins, Inc. PA.
2. Gore, S.M. and Altman, D.G. 1992. *Statistics in Practice*. British Medical Association, London.
3. Koul, L. 1984. *Methodology Of Educational Research*. Vikas Publishing House Pvt. Ltd., New Delhi. Pp. 511.
4. Kumar, R. 2005. *Research methodology*: Sage Publication, New Delhi. Pp. 332.
5. Lehner, P.N. 1968. *Handbook of Ethological methods*. Cambridge University press, UK.
6. Le, C.T. and Boen, J.R. 1994. *Health and Numbers. Basic Biostatistical Methods*. Wiley-Liss, NY.
7. Mahajan, B.K. *Methods in Biostatistics for medical students and research workers*. 1997. Jaypee Brothers Medical Publisher (P) Ltd., New Delhi.
8. Pagano, M., & Gauvreau, K. 1993. *Principles of Biostatistics*. Duxbury Press., Belmont, Ca.
9. Robert M. Groves, Floyd J. Fowler Jr., Mick P. Couper and James M. Lepkowski. 2009. *Survey Methodology*. John Wiley & Sons. Pp. 488.
10. Rosner, B. 1995. *Fundamentals of Biostatistics*. Duxbury Pr. Vol. 1. Pp. 688.
11. Sharma A. K. 2005. *Introductory Statistics for Environmentalists*. Discovery Publishing House. Pp. 480.
12. Singh, Y.K. 2006. *Fundamental of Research Methodology and Statistics*. New Age International P Limited, Publishers, New Delhi.
13. Sullivan, M III. *Fundamentals of Statistics*. 2009. Prentice Hall.
14. Winer, B. J. 1971. *Statistical Principle in Experimental Design*. Mcgraw Hill Kogakusha Ltd., London. Pp. 907.
15. Zolman, J.F. 1993. *Biostatistics*. Oxford University Press, NY.

PAPER- VI

LABORATORY PRACTICAL

Objectives: The main focus of the paper to enhance the knowledge of the students about the ecology, biology and conservation of different fauna through laboratory techniques. These techniques are microhistology, scat analysis, nutritional analysis etc.

Credits: 2

1. Study of food and feeding habits of herbivores through dropping analysis.
2. Study of food and feeding habits of birds through dropping analysis.
3. Study of food and feeding habits of carnivores through scat analysis.
4. Study of nutritional analysis of plant material.
5. Assessment of the health of a wetland.
6. Identification/preparation of museum specimens.
7. Study of drug delivery system.
8. Study of chemical capture operation and planning.
9. Study of Radio-telemetry system and its application.
10. Procedure of attachment of transmitter package and methods of data collection.
11. Multivariate statistical techniques and their applications in wildlife studies. Summarization of multivariate data. Ordination and classification. Cluster analysis. Principal component analysis, Discriminate Function Analysis, Multiple Regression Analysis using SPSS program. Program Distance, Cal home and other software's of utility in wildlife research.

PRACTICAL PAPER- VII

RS & GIS LAB EXERCISE

Objectives: This practical course is designed to inculcate among students a temperament to use modern techniques in research. The aim of this exercise is to provide information on the application of remote sensing and geographical information system (GIS) technology in wildlife conservation and management. Students are provided information on the working principles of RS and GIS. They are also demonstrated some of the applications of RS and GIS in wildlife and biodiversity studies.

Credits: 2

Exercise No.1 Test for stereo- vision & depth perception.

2. Identification of various cultural and natural features on aerial photographs and satellite imageries.
3. Vegetation analysis using FCCs.
4. Scale determination and conservation.
5. Base map and thematic map preparation.
6. Land use / Land cover mapping.
7. Sample exercises using digital image processing software.

M.Sc. III Semester (Wildlife Sciences)

PAPER- I WILDLIFE HABITAT MANAGEMENT

Objective: The paper aims to enhance the knowledge about the wildlife habitat management, an overview of protected area network. An overview of different terrestrial habitat in India, their management problems. It also emphasizes on the management and evaluation technique.

Credits: 4

Unit-I An overview of PA network in India: Strategies and guidelines for management planning of Wildlife Sanctuaries and National Parks in India-general strategies and issues, types of protected areas and the concept of zoning within the protected areas, objectives and preparation of management plan. Inviolable area. Critical habitat. An overview of different terrestrial habitats in India.

Unit-II An overview of management problem in PAs in India: Accidental and intentional fires and its impact on soil, fauna and flora. Fire as a management tool in grassland management. Livestock grazing and its impact on wildlife habitats. Weed infestation and its adverse impacts. Canopy opening and its beneficial and negative impacts. Inventory and classification of wetland. Wetland as an habitat for waterfowl. Introduction and spread of exotic and invasive wetland species in India and its impact on local ruminant fauna.

Unit-III Management and Evaluation Technique: Fire as management tool in grassland management. Habitat manipulation technique – control and regulation of grazing. Weed eradication, water hole management, canopy. Method of wetland evaluation: physical, chemical and biological assessment of wetland. Management of exotic and invasive wetland species in India.

Unit-IV An evaluation of PA- Current perspective in PA management. Human dimensions in protected area management: An introduction to human dimension in wildlife management and development, the nature of resources and human dependence on them, sustainable utilization of resources and development, a critical analysis of reducing human dependence on protected areas through case studies. Current practice in PA management eg. Eco-development, village relocation in TR, PRA. Climate change with special reference Carbon capture, carbon loss, carbon sink etc.

Suggested readings:

1. Wildlife Ecology and Management by Caughley and Sinclair
2. Wildlife in India by V. B. Saharia
3. Management of National Park and Sanctuaries in India by A. Kothari
4. Fundamental of Wildlife Management by R. Gopal
5. Managing Protected Areas in the Tropics by IUCN/ UNEP
6. Wildlife Management Techniques By R. H. Giles
7. Wildlife of India: Conservation and Management by K C. Agarwal
8. Wildlife of India by E. P. Gee
9. A Manual on the Management of Plantation Forest by A. I. Fraser
10. Forest Resources: Crisis and Mangement by Shiva and Vandana

PAPER- II

WILDLIFE SPECIES MANAGEMENT

Objective: This course is designed to impart knowledge about the techniques of wildlife species management. Natural populations in their habitat face many stresses and threats. Apart from inter and intra specific competitions, crowding and other biological and adaphic factors, disease is one of the most important area of concern as many species and populations have been exterminated just by the spread of diseases. In this course students are equipped with respect to health monitoring of wild populations to draw effective management strategy. Students are not expected to learn all diseases and their etiology, symptoms etc. but to be able to identify health related problems.

The course also pays attention towards providing students basic knowledge of modern technology available for the use of effective monitoring of species and population's ecology, behaviour and biological parameters.

Credits: 4

Unit-I Importance of wildlife health studies in population management, evaluation of animal health and condition through direct observations of free living animals, physical examination animals and collection of baseline data on health parameters, examination of dead animals in the field and necropsy procedure, collection and preservation of tissue samples for analysis.

Unit-II Chemical capture techniques; drug delivery system, basic physiological and biological concepts related to chemical capture, nature and classification of drugs used in chemical operations, factors affecting chemical capture. Captive breeding techniques and translocation and reintroduction.

Unit-III Introduction to bio-telemetry system; VHF, GPS and satellite telemetry. Transmitter, antenna and special sensors. Applications of bio-telemetry in wildlife studies. Introduction to bio-loggers and hydrophones and their applications.

Unit-IV Introduction to the problems of locally over-abundant wild animal populations causing damage, control versus conservation, animal damage control techniques; biological, chemical and mechanical. Species management for man wildlife conflict resolution and mitigation. General assessment of damage caused by wildlife in India and its mitigation in a case specific manner

Suggested readings:

1. V.B. Saharia and Stephen Berwick Wildlife research and management
2. Anthony, R.E.Sinclair, John M Fryxel, Graeme Caughley.(2005). Wildlife ecology, conservation and management. Blackwell, USA.Pp. 488.
3. Caughley, G. and Gunn, A. (1996). *Conservation Biology in Theory and Practice*. Blackwell Science, Cambridge.
4. Cox, G.W. (1997). *Conservation Biology*.(2nd ed.) McGraw-Hill Companies, Inc. Boston.
5. Manging protected area in Tropics. (1986).IUCN Conservation Monitoring Centre, Cambridge, UK, IUCN Conservation Monitoring Centre, Cambridge, UK.Pp.320.
6. Meffe and Carroll 1997. *Principles of Conservation Biology*. (2nd ed.) Sinauer Associates.
7. Van Dyke, F. (2003). *Conservation Biology: Foundations, Concepts, Applications*. McGraw-Hill, New York.
8. William J. Sutherland. (2006). *Ecological Census Techniques, A Handbook*. Cambridge University Press .Pp.448.

PAPER- III

WILDLIFE PROTECTION AND CONSERVATION

Objective: The paper aims to enhance the understanding about the National policies governing wildlife protection, historical perspective evolution of policies. The paper discuss the national and International policy and legislation such as National Wildlife Action Plan, Indian Wildlife protection Act 1972, RASAR, CITES, Forest policies etc.

Credits: 4

Unit-I National policy governing wildlife protection in India, Historical perspective evolution of policies during different eras. Current policy, National Wildlife action plan and its detailed review.

Unit-II Broad policy framework for wildlife protection at national and state level Organizational structure. Role of Indian Board of Wildlife and State wildlife advisory board, power and function.

Unit-III An overview of different acts related to Wildlife protection and conservation, Wildlife Protection Act (1972) and its detailed structure, recent amendments in WPA 1972 and their role in Wildlife protection and Conservation.

Unit-IV- Nation and International treaties, Treaties for Wetland conservation RAMSAR, Bonn convention, definition and concept of different categories of IUCN's red Data list, Convention of protection of Wild flora and Fauna (CITES)-1971. An overview of Different Forest Policies.

Suggested Readings:

1. Wildlife in India its conservation and control by P.D. Stracey
2. Forest Policy and Law by S.S. Negi
3. Natural Resources Law and Policy by Zafar Mahfooz Nomani
4. Widening Perspectives on Biodiversity by Anatole F. Krattiger ed.
5. Environmental law in India by P.Leelakrishnan
6. Environmental law case book by P.Leelakrishnan
7. The Wildlife (Protection) Act 1972, The wildlife (as amended up-to 2003)
8. Animal laws of India by Maneka Gandhi

PAPER- IV

ANIMAL BEHAVIOR

Objective: This paper aims to start with the basics of animal behavior, which includes the introduction evolution of behavior. The paper also emphasizes the genetic and environment basis of animal behavior, social behavior, migration and dispersal. It deals with many theories of animal behavior and its different aspects.

Credits: 4

Unit I: Introduction and evolution of behavior

Introduction and history of ethology, Units of studying animal behavior. Differential capacities of behavior, Anatomical, physiological, neural and hormonal mechanisms of behavior. Ecology and evolution of signals and communication pathways. Communication by sight smell, posture and vocalization

Unit II: Genetic and environmental bases of animal behavior

Genes and behavior: Specificity of genetic control, speciation and natural selection. Darwinian fitness and inclusive fitness concepts, fitness in natural environments and evolution of adaptive strategies. Environment and behavior: intelligence, problem solving, insight, tool use, Learning and cognition, habituation, conditioned reflex, trial and error learning, latent learning/ imprinting.

Unit III: Social behavior and its organization

Group living: Costs, benefits and optimal group size theory, fights, contests and assessment
Sexual conflict and sexual selection. Parental care and mating systems. Alternative reproductive strategies. Selfishness and altruism: Kin selection, manipulation and reciprocity.
Cooperation and helping

Unit IV: Migration and dispersal behavior

Costs and benefits of dispersal: Movement and migration: types of migration, factors governing migration, advantages and Patterns of migration, Evolution and theories of migration, Orientation and navigation, biological clocks and circadian rhythms, Impact of migrants on resident species of birds.

Suggested Readings:

1. An Introduction to Behavioural ecology by Davies and Krebs
2. Animal Behaviour by Jhon Alcock
3. The study of Animal Behaviour by Chapman and Hall
4. Animal Behaviour: Psychobiology, Ethology and Evolution by David McFarland
5. An Introduction to Animal Behaviour by Aubrey Manning and Dawkins
6. Animal Behaviour: Causes and effects by Slater and Halliday

Objective: This paper aims to enhance the knowledge of the students regarding different sampling theories and techniques for censuses, evaluation, protection and conservation of mammalian, avian and herpetofauna. Further it deals with the quantification of flora and fauna. The paper also deals with the methods of data collection and data analysis, summarization of data

Credits: 4

Unit-I Introduction to sampling theory, various types of sampling techniques. Concept of sampling effort and species area curve. Introduction to sample statistics. Measures of central tendency and dispersion. Mean, median and mode. Standard deviation and variance. Standard error. Coefficient of variation. Concept of confidence intervals.

Unit-II Plot and plot less techniques for estimation of plant abundance, frequency, dominance and Importance value Index. Preparation of vegetation profile. Various techniques for assessment of vegetation cover. Techniques for assessment of vertical structure and horizontal heterogeneity. Data summarization, analysis and interpretation.

Unit-III Status, abundance and distribution assessment techniques for fauna. Concept of direct and indirect methods of abundance estimation. Detailed treatment of various abundance estimation techniques for mammals (Line/trail/ road/vehicle transects; Waterhole census, total count, block count and camera trapping for carnivores), birds (Point count, line transects and mackinnen's sampling), reptiles and amphibians (time series count, surveys of coarse woody debris, Pit fall trapping, mark recapture). Data summarization, analysis and interpretation. Camera trapping for animal abundance estimation.

Unit-IV Field techniques for studying habitat use of various taxa. Techniques of field data collection for study of food and feeding habits. Field techniques for assessment of food availability. Harvest method for assessment of grass and browse biomass. Behavioural sampling techniques Methods of studying behavioural patterns: random haphazard sample, ad-libitum sampling, focal animal sampling, all occurrences, sequence sampling, one-zero sampling, scan sampling. Preparation of ethograms, time-activity budgets and social interaction matrices

Suggested Readings:

1. Quantitative Plant Ecology by Smith and P. Greig
2. An Introduction to Vegetation Analysis by David R. Causton
3. Aims and Methods of Vegetation Ecology by Mueller and Dombois
4. Handbook of Ecological Methods by Philips N. Lehner
5. Vegetation Description and Analysis by Kent, Martin and Paddy
6. Quantitative Ecology and Theory by M. R. Rose

PAPER- VI

SYNOPSIS WRITING & SEMINAR

Fundamentals of synopsis writing. Components of research synopsis (rationale, objectives and hypothesis formulation, literature review, methodology, data collection protocol, Data analysis protocol).

An overview of referencing system. Name and year system. Review of different journals and their guidelines for instructions to authors. Development of subject specific bibliography.

Each student after reaching 3rd semester will have two weeks time (18th July-31st July) to select a suitable topic for writing the research synopsis which should be submitted for evaluation at the end of the semester. Each Student will carry out the field dissertation on the topic selected for Research synopsis.

No.1 Systematic **05 marks**

No.2 Ecology & Biology **05 marks**

No 3. Wildlife Techniques **05 Marks**

No.4. Behavior **05 marks**

No.5. Policy, legislation & Conservation **05 marks**

Each student is required to deliver 5 seminar lectures-one each from above stated themes and also submit a detailed write up of the same at the time of seminar lecture.

PAPER- VII

FIELD TOURS

Objective: This paper is a field based paper. Under this exercise students are supposed to visit different protected areas of all the biogeographic zones of India. This exercise is meant to develop the understanding of the flora and fauna of different biogeographic zones, their management problems and to find out their possible solutions on the basis of the problems of the area.

Credits: 2

Field Tour 1: Study of avian community of Keoladeo National Park **3 days**

- a) Waterfowl counts
- b) Point counts
- c) Conservation problems

Field Tour 2: Biodiversity assessment Tour **7 days**

- a) Vegetation structure & composition
- b) Population estimation of Mammals
- c) Population estimation of Birds
- d) Population estimation of Herpeto-fauna
- e) Others

Field Tour 3: Management Tour: A study of management plan of a national park / sanctuary **3 days**

- a) Identification of conservation and management problem
- b) Preparation of mitigation plan

M.Sc. IV SEMESTER

1. M.Sc. Dissertation M.M. = 400
2. Viva-Voce M.M. = 200