

COURSE CATALOGUE & SYLLABUS



**SCHOOL OF FORESTRY & ENVIRONMENT
SAM HIGGINBOTTOM INSTITUTE OF AGRICULTURE,
TECHNOLOGY AND SCIENCES, ALLAHABAD – 211 007, U.P.**

COURSES OF M.SC. WILDLIFE SCIENCE PROGRAM

Course Code	Title of Course	L	P	Credits	Minimum Credit
MAJOR COURSES					
[Core Courses + Optional/Specialization Courses + Seminar]					
CORE COURSES					
WLS 701	Wildlife Ecology, biodiversity and conservation	1	1	2	15
WLS 702	Biology of Indian Wildlife	1	1	2	
WLS 703	Principles of Wildlife Health and Population Ecology	2	1	3	
WLS 704	Habitat Ecology, Techniques and Practices	1	1	2	
WLS 705	Management of Wildlife Protected Areas	1	1	2	
WLS 706	Conservation breeding and Reproduction in wild animals	2	0	2	
WLS 707	Wildlife Conservation and Management Practices Tour	1	1	2	
OPTIONAL/ SPECIALIZATION COURSES					
WLS 708	Human Ecology and Natural Resource Economics	1	1	2	10 - 15
WLS 709	Management and Husbandry of Zoo Animals	1	1	2	
WLS 710	Nutrition of Captive and Free Ranging Wild Fauna	1	1	2	
WLS 711	Wetland Conservation and Development	1	1	2	
WLS 712	Wildlife Forensics, Conservation Principles and Laws	2	1	3	
WLS 713	Wildlife Ecotourism	1	1	2	
WLS 714	Capture and handling of wild animals	1	1	2	
WLS 715	Natural Resource Management	1	0	1	
WLS 716	Specialized Wildlife Techniques Tour	0	2	2	
SEMINAR					
WLS 780	Seminar – I	0	1	1	2
WLS 880	Seminar – II	0	1	1	
BASIC/ SUPPORTING COURSES					
MAS 711	Statistics - I	2	1	3	8-10
MAS 715	Statistics - II	2	1	3	
COMP 709	Computer Orientation	2	1	3	
AGF 703	Research Methodology	0	1	1	
THESIS RESEARCH/ DISSERTATION					
WLS 899	Dissertation				15
Grand Total					50 to 60

(L – Lecture; P- Practical)

COURSE CATALOGUE WITH PAGE NUMBERS

Course Code	Title of Course	Page Number
<u>MAJOR COURSES</u>		
[Core Courses + Optional/Specialization Courses + Seminar]		
CORE COURSES		
WLS 701	Wildlife Ecology, biodiversity and conservation	6-9
WLS 702	Biology of Indian Wildlife	10-13
WLS 703	Principles of Wildlife Health and Population Ecology	14-15
WLS 704	Habitat Ecology, Techniques and Practices	16-19
WLS 705	Management of Wildlife Protected Areas	20-21
WLS 706	Conservation breeding and Reproduction in wild animals	22
WLS 707	Wildlife Conservation and Management Practices Tour	23
OPTIONAL/ SPECIALIZATION COURSES		
WLS 708	Human Ecology and Natural Resource Economics	24-26
WLS 709	Management and Husbandry of Zoo Animals	27-28
WLS 710	Nutrition of Captive and Free Ranging Wild Fauna	29
WLS 711	Wetland Conservation and Development	30
WLS 712	Wildlife Forensics, Conservation Principles and Laws	31-32
WLS 713	Wildlife Ecotourism	33-34
WLS 714	Capture and handling of wild animals	35-36
WLS 715	Natural Resource Management	37-38
WLS 716	Specialized Wildlife Techniques Tour	39
SEMINAR		
WLS 780	Seminar – I	40
WLS 880	Seminar – II	40
BASIC/ SUPPORTING COURSES		
MAS 711	Statistics - I	41
MAS 715	Statistics - II	42-43
COMP 709	Computer Orientation	44
AGF 703	Research Methodology	45
THESIS RESEARCH/ DISSERTATION		
WLS 899	Dissertation	46

SYLLABUS

1. WLS 701 Wildlife Ecology, biodiversity and conservation

2 (1+1)

Behavioural Ecology

Behavioural, ecology and evolution: An interconnected approach (including proximate and ultimate mechanisms, and causal and functional explanations in behavioural ecology).

Testing hypotheses in behavioural ecology: Comparative methods, experimental studies, Ecologic individuals decisions in ecology: Optimal foraging theory and other models. Pre-predator relationships and evolutionary arms races. Competition for resources: ideal free distributions and resource defence. Group living: Costs, benefits and optimal group size theory, fights, contests and assessment; Wars of attrition, hawk dove strategies and other models. Sexual conflict and sexual selection. Parental care and mating systems. Alternative reproductive strategies. Selfishness and altruism: Kin selection, mutualism, manipulation and reciprocity (including prisoner's dilemma models).

Cooperation and helping: Mammals, birds and fishes. Ecology and evolution of signals and communication pathways. Behavioural patterns in captivity and animals welfare.

Practicals: Methods of behavioural observation; Instantaneous scan, focal animal, all-occurrence and one-zero sampling, collection and analysis of behavioural data on some common availability species, preparation of ethograms, time-activity budgets and social interaction matrices; demonstration of radio-telemetry methods of study activity patterns (if feasible).

Community Ecology

Definitions and nature of communities; Energy & materials flux through communities; Productivity; Intra and inter-specific competition and mutualism; Community structure, organization and stability (guilds, resource partitioning, niche, competitive exclusion); measures of diversity and richness.

Practicals: Seminar based discussion and paper analysis and criticism. Calculations of energy and productivity. Analysis of species diversity.

Conservation Biology

Introduction to Conservation Biology: Conservation values, and ethics of Conservation of natural resources. Conservation of biodiversity: Patterns and processes; concepts of biodiversity, levels of biodiversity, which include genetic diversity, intra specific diversity, species richness, richness of higher taxa, ecosystem and biome diversity will be discussed, patterns of losses; loss of biodiversity, causes and factors of mass extinctions and critical hot spots extinctions patterns of species vulnerability, conservation of rare species, long lived species, key stone species and mutualist species.

Genetics: Conservation of diversity within species; Why genetics is important in conservation biology?, heterozygosity, Hardy-Weinberg equilibrium, variation within population, variation among populations, fitness consequences of variation, co-adaptations, local adaptations and outbreeding depression, loss of genetic variation, genetically effective population size, demographic bottleneck and inbreeding depression. Management and conservation of genetic variation in natural populations Ex-situ conservation role of zoos and aquariums, introduction/reintroduction and translocation.

Demographic issues: Management and conservation of population required an understanding of population fluctuations and relationship between several demographic processes. Habitat-specific demography, theories and concepts of sources and sinks,

meta-populations can be useful in management and planning a nature reserve. Population viability analysis.

Habitat alteration due to human activities and an introduction to problems related to fragmentation. Heterogeneity, processes of fragmentation, mosaics and patch dynamics, insularisation, area effects and island biogeography theory. Biological consequences of fragmentation, covering barriers and isolation, crowding effect, local and regional extinctions, edge effects, changes in species composition and problem of climate change. Ecological restoration: Role of ecological restoration in conservation and some of the concerns of restoration ecology.

Designing conservation reserve: Protection to ecosystem, conservation of biodiversity and targeted species. Theories of nature reserve design and its goals. Six critical issues in planning a nature reserve i.e. size of the reserve; heterogeneity and dynamics of habitat; area/perimeter ratio; corridors; natural and modified landscape elements; zonation will be discussed. Anthropological and cultural implication, political and economic constraints and regional networking of reserves.

Management to meet conservation goal; Basic principles of good management and how are management decisions are made? Control of invasive species, scales of management (on population level, habitat and landscape) of management and cultural context.

Practicals: Seminar based discussion and paper analysis. Calculations of degree of inbreeding, MVP sizes, PHVA, etc.

Lecture Schedule

Theory

Content	No. of classes
<ul style="list-style-type: none"> ● Behavioural Ecology Behavioural ecology and evolution: An interconnected approach (including proximate and ultimate mechanisms and causal and functional explanations in behavioural ecology). 	1
<ul style="list-style-type: none"> ● Testing hypotheses in behavioural ecology: Comparative methods, experimental studies, Ecological individuals decisions in ecology: Optimal foraging theory and other models. Prey-predator relationships and evolutionary arms races. Competition for resources: ideal free distributions and resource defence. 	1
<ul style="list-style-type: none"> ● Group living: Costs, benefits and optimal group size theory, fights, contests and assessment; Wars of attrition, hawk dove strategies and other models. Sexual conflict and sexual selection. Parental care and mating systems. Alternative reproductive strategies. Selfishness and altruism: Kin selection, mutualism, manipulation and reciprocity (including prisoner's dilemma models). 	2
<ul style="list-style-type: none"> ● Cooperation and helping: Mammals, birds and fishes. Ecology and evolution of signals and communication pathways. Behavioural patterns in captivity and animals welfare. 	1
<ul style="list-style-type: none"> ● Community Ecology Definitions and nature of communities; Energy & materials flux through communities; Productivity; Intra and inter-specific competition and mutualism; Community structure, organization and stability (guilds, resource partitioning, niche, competitive exclusion); measures of diversity 	2

and richness.

- **Conservation Biology** 2
Introduction to Conservation Biology: Conservation values, and ethics of Conservation of natural resources. Conservation of biodiversity: Patterns and processes; concepts of biodiversity, levels of biodiversity, which include genetic diversity, intra specific diversity, species richness, richness of higher taxa, ecosystem and biome diversity will be discussed, patterns of losses; loss of biodiversity, causes and factors of mass extinctions and critical hot spots extinctions patterns of species vulnerability, conservation of rare species, long lived species, key stone species and mutualist species.
- Genetics: Conservation of diversity within species; Why genetics is important in conservation biology?, heterozygosity, Hardy-Weinberg equilibrium, variation within population, variation among populations, fitness consequences of variation, co-adaptations, local adaptations and outbreeding depression, loss of genetic variation, genetically effective population size, demographic bottleneck and inbreeding depression. Management and conservation of genetic variation in natural populations Ex-situ conservation role of zoos and aquariums, introduction/reintroduction and translocation. 2
- Demographic issues: Management and conservation of population required an understanding of population fluctuations and relationship between several demographic processes. Habitat-specific demography, theories and concepts of sources and sinks, meta-populations can be useful in management and planning a nature reserve. Population viability analysis. Habitat alternation due to human activities and an introduction to problems related to fragmentation. Heterogeneity, processes of fragmentation, mosaics and patch dynamics, insularisation, area effects and island biogeography theory. Biological consequences of fragmentation, covering barriers and isolation, crowding effect, local and regional extinctions, edge effects, changes in species composition and problem of climate change. 3
- Ecological restoration: Role of ecological restoration in conservation and some of the concerns of restoration ecology. 1
- Designing conservation reserve: Protection to ecosystem, conservation of biodiversity and targeted species. Theories of nature reserve design and its goals. Six critical issues in planning a nature reserve i.e. size of the reserve; heterogeneity and dynamics of habitat; area/perimeter ratio; corridors; natural and modified landscape elements; zonation will be discussed. Anthropological and cultural implication, political and economic constraints and regional networking of reserves. Management to meet conservation goal; Basic principles of good management and how are management decisions are made? Control of invasive species, scales of management (on population level, habitat and landscape) of management and cultural context. 2

Practical

- Methods of behavioural observation; Instantaneous scan, focal animal, all-occurrence and one-zero sampling, collection and analysis of behavioural data on some common availability species, preparation of ethograms, time-activity budgets and social interaction matrices. 3
- demonstration of radio-telemetry methods of study activity patterns (if feasible). 2
- Seminar based discussion and paper analysis and criticism. 3
- Calculations of energy and productivity. 2
- Analysis of species diversity. 2
- Seminar based discussion and paper analysis. 2
- Calculations of degree of inbreeding, MVP sizes , PHVA, etc. 3

Suggested Readings:

1. Aaron, N.M. (1973). Wildlife ecology. W.H. Freeman Co. San Francisco, U.S.A.
2. Katwal/Banerjee (2002). Biodiversity conservation in managed and protected areas. Agrobios, India.
3. Negi, S.S. (1993). Biodiversity and its conservation in India. Indus Publishing Co., New Delhi.
4. Frankal, Otto H., Anthony, A., Brown, D. and Burdon, Jeremy J. (1995). The conservation of plant biodiversity. Cambridge University Press.
5. Kaul, B.L. (1999) Advances in Fish and Wildlife Ecology and Biology. Vol-1 & Vol-2.
6. Sharma, B.D. (1999), Indian Wildlife Resources Ecology and Development, Daya Publishing House, Delhi
7. Arora, B.M. (2002). Reproduction in Wild Mammalia & Conservation. AIZ & WV, Bareilly.
8. Arora, B.M. (2007). Rehabilitation in free living wild animals, AIZ & WV, Bareilly.
9. Anthony R.E. Sinclair, John M. Fryxell and Graeme Caughly (2006). Wildlife Ecology, Conservation and Management, 2nd Edn. Blackwell Publishing, U.S.A.
10. Sinha, P.C. (1998), Wildlife and Forest Conservation, Anmol Publishing Pvt. Ltd., New Delhi.
11. Odum, Eugene P. Fundamentals of Ecology, 3rd Ed. Natraj Publishers, Dehradun.
12. Sinclair, Anthony R.E., Fryxell, John M. and Caughly, Graeme (2006). Wildlife Ecology, Conservation and Management, 2nd Edn. Blackwell Publishing, U.S.A.
13. Sharma, B.D. Indian Wildlife Resources, Ecology and Development. Daya Publishing House, Delhi.
14. Robert, A.W. (1979). The ecology and evolution of animal behavior. Good Year Pub. Co. California, U.S.A.

2. WLS 702 Biology of Indian Wildlife

2 (1+1)

Mammalogy and Indian Mammals

Introduction to Mammalogy: Evolution of Mammalogy, its history and domain; mammalian characteristics, anatomy and skeleton. Evolution of mammals, early radiation and classifications up to orders. Zoo-geography of mammals, zoo-geographic regions, continental drift and zoogeography of Indian mammals. Adaptation in mammals- hibernation, torpor, aestivation, locomotion and water regulation. Metabolism and thermo-regulation; Ectothermy, homeothermy and cold stress, body size versus homiothermy. Influence of body size on life history, metabolic rate, weight constraints, feeding behaviour, niche and reproduction. Skin and its derivatives. Behaviour and social organization in mammals; social patterns, mating systems, territories; hierarchies, predatory behaviour and communications. Digestive systems, its anatomy, morphology and function.

Practicals: Epidermal derivatives; Comparative studies of dentition; Comparative studies of skull; Zoogeography of mammals of Indian sub-continent; Distribution of (i) Primates (ii) Carnivores, (iii) Elephants and (iv) Ungulates.

Ornithology and Indian Birds

Origin and radiation of Birds, Morphological and Physiological adaptation: Avian systematics. Review of Indian birds: Taxonomy, general natural history, literature. Biogeographic patterns in Indian avifauna and their affinities. Emphasis on montane avifauna; Himalayas, Western & Eastern Ghats; Island avifauna, waterfowl, desert avifauna; Birds of cultivation and degraded habitats. Habitat mosaics.

Birds migration: Migratory flyways, threats to migrant populations. Avian community ecology and habitat selection. Endangered and threatened birds; waterfowls, pheasants, bustards & fricicans, cranes, waterfowls, raptors. Birds census techniques, conservation of birds habitats, economic ornithology. Avian extinctions-past and present.

Practicals: Examination and drawing of museum materials: skins, skulls, feet, eggs and nests of characteristic species. Birds skin preparation. Measurement of specimens. Mist-net techniques and methods for handling to be observed and discussed in their natural habitat during appropriate field courses.

Indian Herpetofauna

Systematics and zoogeography of amphibians and reptiles: Factors affecting distribution and abundance of amphibian and reptilian fauna of Indian sub-continent. Biology of major Indian amphibians, fresh water and marine turtles, crocodilians, lizards and snakes. Thermo-regulation, its role, aestivation, hibernation and other eco-physiological adaptations. Role of temperature in sex determination in reptiles. An overview of conservation problems and issues of herpetofauna of Indian sub-continent. Case studies.

Ichthyology

Systematics and Ichthyogeography of India. Ecology of fish: fresh, brackish and marine water fish and their adaptations. Threats to fish biodiversity: global as well as in India. Threatened fish of India. Conservation status of fish fauna in India. Methods for fish ecological studies.

Entomology

Introduction to Entomology: Insect taxonomy and diversity. Their living and non-living environment, economic importance, ecological roles, adaptation, Insects as indicator for

biodiversity monitoring. Diversity patterns across biogeographic zones, provinces, regions and neighbouring countries. Insect fauna in prominent Indian PAs. Specific case studies on forest infestation by sal borer and other forest pests and their life cycle and management. Insects, the landscape and evaluation.

Practicals: Collection methods and equipment. Preservation and storage. Study and identification.

Lecture Schedule

Theory

- | ● Content | No. of
Classes |
|--|---------------------------|
| <ul style="list-style-type: none"> ● Mammalogy and Indian Mammals
Introduction to Mammalogy: Evolution of Mammalogy, its history and domain; mammalian characteristics, anatomy and skeleton. Evolution of mammals, early radiation and classifications up to orders. Zoo-geography of mammals, zoo-geographic regions, continental drift and zoogeography of Indian mammals. Adaptation in mammals-hibernation, torpor, aestivation, locomotion and water regulation. Metabolism and thermo-regulation; Ectothermy, homeothermy and cold stress, body size versus homiothermy. Influence of body size on life history, metabolic rate, weight constraints, feeding behaviour, niche and reproduction. Skin and its derivatives. Behaviour and social organization in mammals; social patterns, mating systems, territories; hierarchies, predatory behaviour and communications. Digestive systems, its anatomy, morphology and function. | 5 |
| <ul style="list-style-type: none"> ● Ornithology and Indian Birds
Origin and radiation of Birds, Morphological and Physiological adaptation: Avian systematics. Review of Indian birds: Taxonomy, general natural history, literature. Biogeographic patterns in Indian avifauna and their affinities. Emphasis on montane avifauna; Himalayas, Western & Eastern Ghats; Island avifauna, waterfowl, desert avifauna; Birds of cultivation and degraded habitats. Habitat mosaics. Sexual selection in birds.
Birds migration: Migratory flyways, threats to migrant populations. Avian community ecology and habitat selection. Endangered and threatened birds; waterfowls, pheasants, bustards & floricans, cranes, waterfowls, raptors. Birds census techniques, conservation of birds habitats, economic ornithology. Avian extinctions-past and present. | 4 |
| <ul style="list-style-type: none"> ● Indian Herpetofauna
Systematics and zoogeography of amphibians and reptiles: Factors affecting distribution and abundance of amphibian and reptilian fauna of Indian sub-continent. Biology of major Indian amphibians, fresh water and marine turtles, crocodilians, lizards and snakes. Thermo-regulation, its role, aestivation, hibernation and other eco-physiological adaptations. Role of temperature in sex determination in reptiles. An overview of conservation problems and issues of herpetofauna of Indian sub-continent. Case studies. | 4 |

- **Ichthyology** 2
Systematics and Ichthyogeography of India. Ecology of fish: fresh, brackish and marine water fish and their adaptations. Threats to fish biodiversity: global as well as in India. Threatened fish of India. Conservation status of fish fauna in India. Methods for fish ecological studies.
 - **Entomology** 2
Introduction to Entomology: Insect taxonomy and diversity. Their living and non-living environment, economic importance, ecological roles, adaptation, Insects as indicator for biodiversity monitoring. Diversity patterns across biogeographic zones, provinces, regions and neighbouring countries. Insect fauna in prominent Indian PAs. Specific case studies on forest infestation by sal borer and other forest pests and their life cycle and management. Insects, the landscape and evaluation.
- Practical**
- | ● Content | No. of Classes |
|---|-----------------------|
| ● Epidermal derivatives; Comparative studies of dentition; Comparative studies of skull. | 3 |
| ● Zoogeography of mammals of Indian sub-continent; Distribution of (i) Primates (ii) Carnivores, (iii) Elephants and (iv) Ungulates. | 4 |
| ● Examination and drawing of museum materials: skins, skulls, feet, eggs and nests of characteristic species. Birds skin preparation. Measurement of specimens. | 4 |
| ● Mist-net techniques and methods for handling to be observed and discussed in their natural habitat during appropriate field courses. | 3 |
| ● Entomology | 3 |
| Collection methods and equipment. Preservation and storage. Study and identification. | |
- Suggested Readings:**
1. Grzimek (1988). Encyclopedia of mammals. McGraw Hill Publishing House, New Delhi.
 2. Hornaday, W.T. (1989). Wild Animals, Their Minds and Manners. IBD, Dehradun.
 3. Tiwari, S.K. Zoogeography of India and Asia. CBS Publisher and Distributors, New Delhi.
 4. Yadav, B.N. (2000). Vertebrate Zoology and Evolution. IBD, Dehradun.
 5. Banerjee, S. (2001). A Text Book of Developmental Biology. IBD, Dehradun.
 6. Lydekker, R. Wild Animals of India, Burma, Malaya and Tibet, Natraj Publishers, Dehradun.
 7. Robert, A.W. (1979). The ecology and evolution of animal behavior. Good Year Pub. Co. California, U.S.A.
 8. Ali, Salim (1997). The Book of Indian Birds, Oxford University Press, Mumbai.
 9. Daniel, J.C. The Book of Indian Reptiles and Amphibians. Oxford University Press, Mumbai.
 10. Apte, Deepak. The Book of Indian Shells. Oxford University Press, Mumbai.

11. Prater, S.H. Book of Indian Animals. Bombay Natural History Society, Mumbai.
12. Brander, A.A., Wild Animals in Central India, Natraj Publishers, Dehradun.
13. Daniel, J.C., Asian Elephant, Natraj Publishers, Dehradun
14. Kotpal, R.L. Modern Textbook of Zoology. Vertebrates. Rastogi Publications, Merrut.

3. WLS 703 Principles of Wildlife Health and Population Ecology 3 (2+1)

Basic concepts of disease and health conditions. Review of major diseases of Indian wild mammals, birds, amphibians and reptiles. Epidemiology of disease. Disease and population dynamics. Disease transmission between domestic and wild populations. Malnutrition, starvation, dehydration as disease syndromes. Condition, health and nutritional assessment in free-ranging populations. Control of disease planning and management of wildlife health programmes. Zoonoses.

Population Ecology

Demographic and life history parameters, evolution of life history parameters: r & K selection, allometry, aging and sexing, life tables, age and stage structures models, methods of estimation of life history parameters, population dynamics: exponential, logistic and other forms of growth of population, density dependent and independent growth, population ecology of plants, population simulation, predator-prey systems, carrying capacity, population estimation methods: relative, absolute measures and age/sex composition.

Preparation of sampling designs for population estimation. Analysis of census data. (studies of various population parameters and use of census techniques will be carried out as part of field exercises).

Practicals: Seminars and discussion of relevant published literature; Simulation (stochastic and deterministic) modeling of populations.

Lecture Schedule

Theory

Content	No. of Classes
• Basic concepts of disease and health conditions.	3
• Review of major diseases of Indian wild mammals, birds, amphibians and reptiles.	4
• Epidemiology of disease. Disease and population dynamics.	4
• Disease transmission between domestic and wild populations.	2
• Malnutrition, starvation, dehydration as disease syndromes. Condition, health and nutritional assessment in free-ranging populations.	3
• Control of disease planning and management of wildlife health programmes. Zoonoses.	4
• Population Ecology Demographic and life history parameters, evolution of life history parameters: r & K selection, allometry, aging and sexing, life tables, age and stage structures models, methods of estimation of life history parameters.	6
• Population dynamics: exponential, logistic and other forms of growth of population, density dependent and independent growth, population ecology of plants, population simulation, predator-prey systems, carrying capacity, population estimation methods: relative, absolute measures and age/sex composition.	5
• Preparation of sampling designs for population estimation. Analysis of census data. (studies of various population parameters and use of census techniques will be carried out as part of field exercises).	3

Practical

Content	No. of Classes
• Practicals: Seminars and discussion of relevant published literature	9
• Simulation (stochastic and deterministic) modeling of populations.	8

Suggested Readings:

1. W.M. Samuel, M.J. Pybus and A.A. Kocan (2005). Parasitic Diseases of Wild Animals.
2. Peter J. Hudson, Annapaola Rizzoli, Bryan T. Grenfell, Hans Heestbeek and Andy P. Dobson (2002). The Ecology of Wildlife Diseases. Oxford University Press, Oxford
3. Ram Bramha Sanyal (1995). A Handbook of the Management of Animals in Captivity.
4. Arora, B.M. Indian Wildlife Diseases and Disorders.
5. W.M. Samuel, M.J. Pybus and A.A. Kocan (2005). Parasitic Diseases of Wild Animals.
6. Indian Wildlife Yearbook (2002). AIZ & WV, Bareilly and Central Zoo Authority, New Delhi
7. Indian Wildlife Yearbook (2003, 2004, 2005, 2006 & 2007). AIZ & WV, Bareilly.
8. B.M. Arora and Bipul Chakraborty (2008). Colorful Atlas on Indian Wildlife Diseases and Disorders. IBDC, Lucknow.
9. Arora, B.M. (2007). Rehabilitation in free living wild animals, AIZ & WV, Bareilly.
10. Anon, 1990. Collection and preservation of animals. Zoological Survey of India.

4. WLS 704 Habitat Ecology, Techniques and Practices

2 (1+1)

Habitat Ecology

Introduction to habitat ecology: Historical, ecological & evolutionary perspectives-concepts. Ecology of major habitats: Deserts, grasslands & forests.

Physical and anthropogenic factors influencing terrestrial habitats: Drought, flood, tides, soil erosion, grazing, lopping, felling, fire; encroachments; pollution, development projects; socio-economic resource practices. successional changes and wildlife habitat.

Habitat degradation and fragmentation, habitat diversity (edge, ecotones, interspersed and juxtaposition).

Measuring wildlife habitats: Availability, quality, palatability of graze and browse. Utilisation of habitats by wild animals. Cover classification and mapping, Inventory of unique habitats and their distribution, e.g. coasts, mangroves and coral reef ecosystems, estuaries, mud, sand and rocky shores.

Animals signs as indicators of use patterns: Use of map overlay approach in evaluation. Monitoring changes in vegetation and the relative abundance of animals. Use of photographic records for habitat monitoring. Use and availability of habitat resources. Development of predictive models.

Introduction to multivariate assessment of wildlife habitat.

Practicals: Comparison of several techniques for quantitative habitat survey and mapping. Evaluating habitat availability and utilization. Field visits for habitat evaluation, visit to wetland areas.

Remote Sensing and Geographical Information System

Principles and practical applications of remote sensing techniques, including aerial photography and satellite imagery. Use of photographs as maps and in map preparation. Interpretation of photography and imagery. Importance of ground truthing inputs. Introduction to digital analysis of imagery.

Geographical information systems: Applications in wildlife. Use and values of GIS approaches to wildlife ecology and management integrating wildlife into forest and human land use systems.

Practicals: Examination and interpretation of imagery. Use of imagery for quantitative analysis. Stereoscopy. Preparation of maps and field orientation. Introduction to computerized techniques.

Environmental Impact Assessment

Introduction to Environmental Impact Assessment (EIA) , Environmental Impact Analysis, Social Impact Assessment (SIA, Strategies Environmental Assessment (SEA), Environmental Impact Statement (EIS), Environmental Audits, definition of other useful terms in EIA. Scope and purpose of EIA: Introduction to environmental impacts linked to various stages of development projects, contents of an ideal EIA, general applicability of EIAs, current state of EIA in India and other Asian countries; Environmental Legislations and Regulations: Salient features of important environmental legislation, statutory obligations, environmental clearance procedures and GOI requirements.

EIA Procedures: Introduction to administrative and technical requirements, procedural steps in EIA-scoping, screening. Baseline study formats, evaluation of impacts on wildlife species and habitats, determination of impact significance criteria. Methods & Tools: Primary data-tools and secondary data sources, legislative documents, environmental guidelines and databases and impact indicators, EIA softwares.

Introduction to various impact assessment methods-checklist, matrices, networks, indices and weight scaling techniques and their scope and limitations; Environmental Mitigation Planning, Principles and practices, mitigatory approaches and feasibility analysis. Environmental Auditing and Monitoring Concepts, objectives and usefulness.

Environmental Economics. Introduction to some recent approaches in environmental economics for determination of monetary values of environmental goods and services.

Environmental Impact Assessment Report: Guidelines for developing formats for preparing and reviewing EIA reports and Environmental Management Plans, Case studies.

Lecture Schedule

Theory

Content	No. of Classes
<ul style="list-style-type: none"> Habitat Ecology Introduction to habitat ecology: Historical, ecological & evolutionary perspectives- concepts. Ecology of major habitats: Deserts, grasslands & forests. Wetlands: Classification, functions & values. Factors affecting wetland habitats. 	2
<ul style="list-style-type: none"> Physical and anthropogenic factors influencing terrestrial habitats: Drought, flood, tides, soil erosion, grazing, lopping, felling, fire; encroachments; pollution, development projects; socio-economic resource practices. successional changes and wildlife habitat. Habitat degradation and fragmentation, habitat diversity (edge, ecotones, interspersions and juxtaposition). 	2
<ul style="list-style-type: none"> Measuring wildlife habitats: Availability, quality, palatability of graze and browse. Utilisation of habitats by wild animals. Cover classification and mapping, Inventory of unique habitats and their distribution, e.g. coasts, mangroves and coral reef ecosystems, estuaries, mud, sand and rocky shores. 	2
<ul style="list-style-type: none"> Animals signs as indicators of use patterns: Use of map overlay approach in evaluation. Monitoring changes in vegetation and the relative abundance of animals. Use of photographic records for habitat monitoring. Use and availability of habitat resources. Development of predictive models. Introduction to multivariate assessment of wildlife habitat. 	2
<ul style="list-style-type: none"> Remote Sensing: Principles and practical applications of remote sensing techniques, including aerial photography and satellite imagery. Use of photographs as maps and in map preparation. Interpretation of photography and imagery. Importance of ground truthing inputs. Introduction to digital analysis of imagery. 	2
<ul style="list-style-type: none"> Geographical information systems: Applications in wildlife. Use and values of GIS approaches to wildlife ecology and management integrating wildlife into forest and human land use systems. 	2
<ul style="list-style-type: none"> Environmental Impact Assessment Introduction to Environmental Impact Assessment (EIA) , Environmental Impact Analysis, Social Impact Assessment (SIA, Strategies Environmental Assessment (SEA), Environmental Impact Statement 	2

(EIS), Environmental Audits, definition of other useful terms in EIA. Scope and purpose of EIA: Introduction to environmental impacts linked to various stages of development projects, contents of an ideal EIA, general applicability of EIAs, current state of EIA in India and other Asian countries; Environmental Legislations and Regulations: Salient features of important environmental legislation, statutory obligations, environmental clearance procedures and GOI requirements.

- EIA Procedures: Introduction to administrative and technical requirements, procedural steps in EIA-scoping, screening. Baseline study formats, evaluation of impacts on wildlife species and habitats, determination of impact significance criteria. Methods & Tools: Primary data-tools and secondary data sources, legislative documents, environmental guidelines and databases and impact indicators, EIA softwares. Introduction to various impact assessment methods-checklist, matrices, networks, indices and weight scaling techniques and their scope and limitations; Environmental Mitigation Planning, Principles and practices, mitigatory approaches and feasibility analysis. Environmental Auditing and Monitoring Concepts, objectives and usefulness. 2
- Environmental Impact Assessment Report: Guidelines for developing formats for preparing and reviewing EIA reports and Environmental Management Plans, Case studies. 1

Practical

Content	No. of Classes
• Comparison of several techniques for quantitative habitat survey and mapping.	2
• Evaluating habitat availability and utilization.	2
• Field visits for habitat evaluation.	2
• Examination and interpretation of imagery.	2
• Use of imagery for quantitative analysis.	2
• Stereoscopy.	2
• Preparation of maps and field orientation.	3
• Introduction to computerized techniques.	2

Suggested Readings:

1. Odum, Eugene P. Fundamentals of Ecology, 3rd Ed. Natraj Publishers, Dehradun.
2. Canter, L. W. and Graw, Mc, Environmental Impact Assessment, Hill Publication, New York.
3. Hosetti, B.B. (1997), Concepts in Wildlife Management, Daya Publishing House, Delhi.
4. Vanclay F. and Bronstein, D.A. (1995), Environmental and social impact assessment, John Wiley & Sons, New York.
5. Clark, B. D., Bissel, B. D. and Watheam, P. EIA – A Biography.

6. Baret, E.C. and Anton Micallef (1991). Remote Sensing for Hazard Monitoring and Disaster Assessment, Taylor and Francis,, London
7. Chang – Kang, Tsung (2002). Introduction to Geographic Information Systems, Tata McGraw -Hill Publishing Company Limited, New Delhi.
8. Paine, D.P., John Wiley and Sons. Aerial Photography and Image Interpretation for Resource Management.
9. Lilleand, T.M. and Kieffer, R.W., John Wiley and Sons. Remote Sensing and Image Interpretation,
10. Sabbins, F.E., Freeman. Remote Sensing: Principles and Applications.

5. WLS 705 Management of Wildlife Protected Areas 2 (1+1)

Management plan for Protected Areas: Objectives; Resource surveys. Analysis of surrounding region. Planning of boundaries, management zones, communications, staff and visitor amenities. The management programme: institutional framework and infrastructure; establishing control habitat and wildlife management; data collection; monitoring; extension and education; tourism, finance.

Wildlife in Managed Forests: Analysis of wildlife problems in plantation and exploited forests; Indian, American and south east Asian case histories. Discussion of potential management inputs and solutions and search needs to allow such inputs.

Practicals: Review of forest working plan and maps. Study of nearby forests and grasslands under various management regimes. (Management practices will also be studied on field courses).

Forest Management: Review of forest management in India. Principles of forest management, silvicultural systems. Erosion control. Management of fire. Management of weeds. Wildlife in plantations and managed forests. Management of riparian zones. Range/Grassland management practices. Basic principles of wildlife management; Role of Biology in management; The need for wildlife management; Lion, Rhino etc and habitat management techniques. Classroom based discussion and literature review. Field discussion of management practices in the tour.

Lecture schedule

Theory

● Content	No. of Classes
● Management plan for Protected Areas: Objectives; Resource surveys. Analysis of surrounding region. Planning of boundaries, management zones, communications, staff and visitor amenities.	3
● The management programme: institutional framework and infrastructure; establishing control habitat and wildlife management; data collection; monitoring; extension and education; finance.	4
● Wildlife in Managed Forests: Analysis of wildlife problems in plantation and exploited forests; Indian, American and south east Asian case histories.	3
● Discussion of potential management inputs and solutions and search needs to allow such inputs.	3
● Forest Management: Review of forest management in India. Principles of forest management, silvicultural systems. Erosion control. Management of fire. Management of weeds. Wildlife in plantations and managed forests. Management of riparian zones. Range/Grassland management practices. Basic principles of wildlife management; Role of Biology in management; The need for wildlife management; Lion, Rhino etc and habitat management techniques. Classroom based discussion and literature review. Field discussion of management practices in the tour.	4

Practical

● Content	No. of Classes
● Review of forest working plans and maps.	8

- Study of nearby forests and grasslands under various management regimes. 9

Suggested Readings:

1. Hosetti, B.B. (1997), Concepts in Wildlife Management, Daya Publishing House, Delhi.
2. Stephen, H.B. and V.B. Saharia. 1995. Wildlife research and management. Asian and American Approaches. Oxford University Press, Delhi.
3. Brander, A.A.. Wild Animals in Central India. Natraj Publisher, Dehradun.
4. Negi, S.S. Manual for Wildlife Management in India.
5. Sinh, P.C. (1998), Wildlife, Anmol Publishing Pvt. Ltd., New Delhi.
6. Singh, S.K. (2005). Text Book of Wildlife Management. IBDC, Lucknow.
7. Gopal, Rajesh (1992). Fundamentals of Wildlife Management, Justice Home, Allahabad, India.
8. Hosetti, B.B. Concepts in Wildlife Management. Daya Publishing House, Delhi.
9. Vishwas Sawarkar. Guide for Planning Wildlife Management in Protected Areas and Managed Landscapes. Natraj Publisher. Dehradun.
10. Negi, S.S. (2005). A handbook of forestry. International Book Distributor, Dehradun.
11. Robert, G.H. 1978. Wildlife management. W.H. Freeman and Co., San Francisco, U.S.A.
12. Sale, J.B. and Berkmuller, K. (1988). Manual of wildlife techniques for India. WII, FAO, Dehra Dun, India.

6. WLS 706 Conservation breeding and Reproduction in wild animals 2 (2+0)

Reproductive ecology, dispersion, patterns of growth and development. Reproduction and life histories of mammals. Sexual selection in birds. Ecophysiology-water and temperature physiology and its ecological implications. Effects of day length and temperature on reproduction, and migration. Importance of minerals in animal health, growth and reproduction.

Environmental pollutants and toxins.

Wildlife Utilisation : Non-consumptive and consumptive utilization, their economic benefit. Wildlife farming: objectives, management design. Wildlife products: skins, meat, musk, etc.

Captive breeding and Propagation: rehabilitation, education, utilization, gene banks, Principles: understanding biological requirements of species; design of facilities, food, hygiene, disease control, breeding. Propagation of threatened plants. Case histories.

Lecture Schedule

Theory

Content	No. of Classes
• Reproductive ecology, dispersion, patterns of growth and development. Reproduction and life histories of mammals. Sexual selection in birds.	4
• Ecophysiology-water and temperature physiology and its ecological implications.	4
• Effects of day length and temperature on reproduction, and migration.	4
• Importance of minerals in animal health, growth and reproduction.	4
• Environmental pollutants and toxins.	4
• Wildlife Utilisation : Non-consumptive and consumptive utilization, their economic benefit. Wildlife farming: objectives, management design. Wildlife products: skins, meat, musk, etc.	4
• Captive breeding and Propagation: rehabilitation, education, utilization, gene banks	3
• Principles: understanding biological requirements of species; design of facilities, food, hygiene, disease control, breeding.	3
• Propagation of threatened plants.	2
• Case histories.	2

Suggested Readings:

1. Daniel, J.C., Asian Elephant, Natraj Publishers, Dehradun
2. Arora, B.M. (2002). Reproduction in Wild Mammalia & Conservation. AIZ & WV, Bareilly.
3. Daniel, J.C. The Book of Indian Reptiles and Amphibians. Oxford University Press, Mumbai.
4. Prater, S.H. Book of Indian Animals. Bombay Natural History Society, Mumbai.
5. Arora, B.M. (2007). Rehabilitation in free living wild animals, AIZ & WV, Bareilly.

7. WLS 707 Wildlife Conservation and Management Practices Tour **2 (0+2)**

Orientation Tour

Orientation to field biology and natural history. Observations and collection of study material, wildlife signs and evidences. Field visit and visit to any zoological park. Weekend trips to nearby natural areas would also form the part of the orientation.

Conservation Practices Tour

Field tour designed to examine wildlife conservation issues in a variety of ecological situations in a bio-geographic zone of India.

Management and Ecodevelopment Tour

Field tour designed to understand wildlife management practices, Ecodevelopment applications and field exercises in PRA, RRA, etc.

Tour Schedule

Content	Duration
<ul style="list-style-type: none">● Orientation Tour Orientation to field biology and natural history. Observations and collection of study material, wildlife signs and evidences. Field visit and visit to any zoological park. Weekend trips to nearby natural areas would also form the part of the orientation.	2 Weeks
<ul style="list-style-type: none">● Conservation Practices Tour Field tour designed to examine wildlife conservation issues in a variety of ecological situations in a bio-geographic zone of India. Field based discussions about human aspects of conservation	1 Week
<ul style="list-style-type: none">● Management and Ecodevelopment Tour Field tour designed to understand wildlife management practices, Ecodevelopment applications and field exercises in PRA, RRA, etc.	2 Weeks

8. WLS 708 Human Ecology & Natural Resource Economics

2 (1+1)

Human Ecology

Human Populations, Resources & Environment Dilemma: Scope of Human Ecology, its importance in understanding conservation issues; People of India, diversity of culture and lifestyles; Different modes of resource use and differences with respect to technology, economy, social organization, ideology, and nature of ecological impact; Human population growth/structure and its implications for the natural environment.

Ecology and Economy of Rural Communities: Rural ecosystem structure, organization and function; Characteristics of rural subsistence economy, role of wildlands in subsistence economy, and the impact of market economy.

Social Development initiatives in India: Review of rural and tribal development programmes, and the impact of resource use practices and development programmes on local people and natural resources of the regions; Reasons for failure/success and lessons learnt; Alternative approaches to development, integrated development, small is beautiful, eco-development.

Property Rights and Tenures in Natural Resources: Types of property and property regimes; Multiple functions of common property systems and principles governing the use of common's land, tragedy of the common; Alternative resource management systems-privatization, public management, collective management; Common property institutions and development; Tenures in natural resources and effects of tenancy.

Working with local communities: community diversity, beliefs and value systems, and how this relates to resources use and management; Community participation-dimensions and typology; Gender concern, importance of gender based role, needs and priorities in relation to resource use and management; Community survey methods including the participatory learning methods; Conflict management, what is conflict resolution and how does it work? Processes used in conflict resolution.

Ecodevelopment for biodiversity Conservation: Park-people interface, conflict and objectives of human dimensions management; Basics of Eco-development-what, why, where, and whether, Stakeholder identification and analysis, problems, and potentials in working with different stakeholders, stakeholders mapping; PA-People Mutual Influence Zone Analysis (MIZA) and demarcation of the influence zone: Village prioritization for taking up pilot eco-development projects; Project planning-participatory problem analysis (problem tree), objective setting, identifying external factors or assumptions that have an impact on the initiative(if-then), log-frame approach, selecting and developing strategy; Monitoring and evaluation.

Displacement and Resettlement of local communities with respect to creation of Protected Areas: Legal situations, PA manager's role and responsibility in resettlement: Characteristics of an ideal resettlement scheme-what can go wrong and how to forestall these problems.

Practicals: Field based discussions about human aspects of conservation (two days during orientation tour); Analysis of pressure and resource dependency of local communities upon PAs; and Community survey methods including participatory learning methods.

Natural Resource Economics

Need for integrating environment and ecology; The economic reasons for over-exploitation of natural resources; Benefits of Protected Areas (PAs): direct, indirect;

Costs of protected areas: direct, indirect, opportunities; Internalizing externalities - property rights approach; Need for valuation of PAs and its difficulties; Valuation techniques-Theory and application including case studies; Concept of total economic value.

Environmental Economics. Introduction to some recent approaches in environmental economics for determination of monetary values of environmental goods and services.

Lecture Schedule

Theory

- | • Content | No. of Classes |
|---|-----------------------|
| <ul style="list-style-type: none"> • Human Ecology
Human Populations, Resources & Environment Dilemma: Scope of Human Ecology, its importance in understanding conservation issues; People of India, diversity of culture and lifestyles; Different modes of resource use and differences with respect to technology, economy, social organization, ideology, and nature of ecological impact; Human population growth/structure and its implications for the natural environment. | 4 |
| <ul style="list-style-type: none"> • Ecology and Economy of Rural Communities: Rural ecosystem structure, organization and function; Characteristics of rural subsistence economy, role of wildlands in subsistence economy, and the impact of market economy. | 2 |
| <ul style="list-style-type: none"> • Social Development initiatives in India: Review of rural and tribal development programmes, and the impact of resource use practices and development programmes on local people and natural resources of the regions; Reasons for failure/success and lessons learnt; Alternative approaches to development, integrated development, small is beautiful, eco-development. | 2 |
| <ul style="list-style-type: none"> • Property Rights and Tenures in Natural Resources: Types of property and property regimes; Multiple functions of common property systems and principles governing the use of common's land, tragedy of the common; Alternative resource management systems-privatization, public management, collective management; Common property institutions and development; Tenures in natural resources and effects of tenancy. | 2 |
| <ul style="list-style-type: none"> • Working with local communities: community diversity, beliefs and value systems, and how this relates to resources use and management; Community participation-dimensions and typology; Gender concern, importance of gender based role, needs and priorities in relation to resource use and management; Community survey methods including the participatory learning methods; Conflict management, what is conflict resolution and how does it work? Processes used in conflict resolution. | 2 |
| <ul style="list-style-type: none"> • Ecodevelopment for biodiversity Conservation: Park-people interface, conflict and objectives of human dimensions management; Basics of Eco-development-what, why, where, and whether, Stakeholder identification and analysis, problems, and potentials in working with | 3 |

different stakeholders, stakeholders mapping; PA-People Mutual Influence Zone Analysis (MIZA) and demarcation of the influence zone; Village prioritization for taking up pilot ecodevelopment projects; Project planning-participatory problem analysis (problem tree), objective setting, identifying external factors or assumptions that have an impact on the initiative(if-then), log-frame approach, selecting and developing strategy; Monitoring and evaluation.

- Displacement and Resettlement of local communities with respect to creation of Protected Areas: Legal situations, PA manager's role and responsibility in resettlement: Characteristics of an ideal resettlement scheme-what can go wrong and how to forestall these problems. 2
- **Natural Resource Economics** 2
 Need for integrating environment and ecology; The economic reasons for over-exploitation of natural resources; Benefits of Protected Areas (PAs): direct, indirect; Costs of protected areas: direct, indirect, opportunities; Internalizing externalities - property rights approach; Need for valuation of PAs and its difficulties; Valuation techniques-Theory and application including case studies; Concept of total economic value.

Practical

Content	No. of Classes
• Analysis of pressure and resource dependency of local communities upon Pas.	9
• Community survey methods including participatory learning methods.	8

Suggested Readings:

1. Singh and Vijaykumar. 2001. Economics of PA's and its effect on biodiversity. APH Publishing Corporation, New Delhi.
2. Fisher, A.C., *Resource and Environmental Economics* (New York: John Wiley & Sons), 1979.
3. Orris C. Herfindahl, *Natural Resource Information for Economic Development* (Baltimore: The Johns Hopkins University Press), 1969.
4. Sharma, S.D., *A New Approach to Linear Programming* (Meerut: Kedarnath, Ramnath and Co.), 1975.
5. Tony Prato, *Natural Resource and Environmental Economics* (Ames: Iowa State University Press), 1998.

9. WLS 709 Management and Husbandry of Zoo Animals 2 (1+1)

Management Plan for Zoos: Objectives, Administrative set up of zoos, Planning of boundaries, management zones, communications, staff and visitor amenities. The management programme: institutional framework and infrastructure; data collection; monitoring; extension and education; finance.

Enrichment of zoo animals, Classification of Zoos, Central Zoo Authority, National Zoo Policy (1998), Recognition of zoo rules, 1992. Guidelines on creation of Zoos/ Safari Parks, Development of Zoos, upkeep, exchange of animals, health & hygiene, welfare.

Practicals:

Study of nearby zoos and captive wild animals under various management regimes, study of the animal captive facilities, food preparation and presentation to zoo animals. Designing the animal housings, enclosures, moats, kraal etc. Study of different types of cages. Review of zoo working plans and maps.

Lecture Schedule

Theory

• Content	No. of Classes
• Management Plan for Zoos: Objectives, Administrative set up of zoos	2
• Planning of boundaries, management zones, communications, staff and visitor amenities.	2
• The management program: institutional framework and infrastructure; data collection; monitoring; extension and education; finance	3
• Enrichment of zoo animals, Classification of Zoos,	2
• Central Zoo Authority	1
• National Zoo Policy (1998)	1
• Recognition of zoo rules, 1992.	1
• Guidelines on creation of Zoos/ Safari Parks	2
• Development of Zoos, upkeep, exchange of animals, health & hygiene, welfare	3

Practical

• Content	No. of Classes
• Study of nearby zoos and captive wild animals under various management regimes	3
• Study of the animal captive facilities	2
• food preparation and presentation to zoo animals	2
• Designing the animal housings, enclosures, moats, kraal etc.	4
• Study of different types of cages.	3
• Review of zoo working plans and maps.	3

Suggested Readings:

1. Sanyal, Ram Bramha (1995). A Handbook of the Management of Animals in Captivity.
2. Arora, B.M. (2001). Dietary Husbandry of Wild Mammalia. AIZ & WV, Bareilly and CZA, New Delhi.
3. Zoos in India; Legislation, Policy, Guidelines and Strategy (2007), Central Zoo Authority, New Delhi.

4. Arora, B.M. (2002). Reproduction in Wild Mammalia & Conservation. AIZ & WV, Bareilly.
5. Arora, B.M. (2007). Rehabilitation in free living wild animals, AIZ & WV, Bareilly.
6. Anon, 1990. Collection and preservation of animals. Zoological Survey of India.

10. WLS 710 Nutrition of Captive and Free Ranging Wild Fauna **2 (1+1)**

Feeding ecology of herbivores-carnivores, insectivores and omnivores-food selection, quantity, quality (nutritional value), seasonal variations, relation of food to animal condition. Predator-prey interactions. Avoidance of competition for food and shelter. The niche concept.

Practicals: A study of habitat specificity in birds or small mammals on campus. Field methods of studying diet. Examination and recording of stomach contents of a browser, grazer carnivore, insectivore and omnivore. Examination of faeces. Experiments with captive reptiles and mammals in various situations of ambient temperature/isolation.

Lecture schedule

Theory

• Content	No. of Classes
• Feeding ecology of herbivores-carnivores, insectivores and omnivores.	4
• Food selection, quantity, quality (nutritional value), seasonal variations, relation of food to animal condition.	4
• Predator-prey interactions.	3
• Avoidance of competition for food and shelter.	3
• The niche concept.	3

Practical

•	
• A study of habitat specificity in birds or small mammals on campus.	3
• Field methods of studying diet.	2
• Examination and recording of stomach contents of a browser, grazer carnivore, insectivore and omnivore.	5
• Examination of faeces.	3
• Experiments with captive reptiles and mammals in various situations of ambient temperature/isolation.	4

Suggested Readings:

1. S.M.L. Grose. The Care and Feeding of Infant Orphaned Wild Birds. IBD, Dehradun.
2. Arora, B.M. (2001). Dietary Husbandry of Wild Mammalia. AIZ & WV, Bareilly and CZA, New Delhi.
3. Ram Bramha Sanyal (1995). A Handbook of the Management of Animals in Captivity.
4. Prater, S.H. Book of Indian Animals. Bombay Natural History Society, Mumbai.

11. WLS 711 Wetland Conservation and Development

2 (1+1)

Wetlands: Classification, functions & values. Wetland ecosystems and its environmental significance. Factors affecting wetland habitats. Wetland Management -- Definition and classification. Wetland values and functions, wetland degradation and loss. Conservation of wetlands. Wetland management principles. Identifying major problems and setting objectives and priorities. Management of wetland habitats for ecological processes and wildlife.

Practicals:

Visit to wetland areas. Visit important wetlands in the country, the appraisal of the habitat, waterfowl census, documentation of threats to wetlands.

Lecture Schedule

Theory

• Content	No. of Classes
• Wetlands: Classification, functions & values.	2
• Wetland ecosystems and its environmental significance.	2
• Factors affecting wetland habitats.	1
• Wetland Management -- Definition and classification.	2
• Wetland values and functions, wetland degradation and loss.	2
• Conservation of wetlands.	2
• Wetland management principles.	2
• Identifying major problems and setting objectives and priorities.	2
• Management of wetland habitats for ecological processes and wildlife.	2

Practical

• Content	No. of Classes
• Visit to wetland areas	3
• Visit important wetlands in the country	3
• The appraisal of the habitat	2
• Waterfowl census	4
• Documentation of threats to wetlands	5

Suggested Readings:

1. Rahmani, Asad R. & Ugra, Gayatri. Birds of Wetlands and Grasslands. Bombay Natural History Society, Mumbai.
2. Ali, Salim (1997). The Book of Indian Birds, Oxford University Press, Mumbai.

12. WLS 712 Wildlife Forensics, Conservation Principles and Laws 3 (2+1)

Forest Policy; foundation, need and scope. National Forest policies of 1894, 1952 and 1988; salient features Forest Law: Legal definitions, objectives of special forest law. Indian Forest Act 1927; Forest (Conservation) Act 1980 and Rules 2003, Environmental (Protection) Act 1986. Indian Biological Diversity Act 2002. Pollution policy in practice, Environmental quality standards, Environmental Guidelines, Regulations and Rules Important case studies relating to Acts above stated with preliminary idea of Indian Penal code, Cr P.C and other enactments in India.

Major International Agreements : CITES, CBD, ITTA, UNFCCC, Kyoto Protocol TRIPS etc. Conservation laws, national wildlife conservation policy and action plan, national forest policy, Wildlife (Protection) Act, 1972, international conventions. Conservation and development; Conservation movement in India, socio-economic and political realities, different phases of the conservation and how it has impacted people at large. What is integrated conservation? Participation in conservation and development of linkages and interest groups.

Practical

Class based discussion with faculty and a range of conservation activists. Review of literature. Preparation of conservation statements. Collection of evidences. Forensic necropsy examination. Detecting time of death, Differentiating wounds in carcasses. Necropsy examination techniques. Hair Analysis. Comparative osteology. Biotechnological Tools.

Lecture Schedule

Theory

• Content	No. of Classes
• Forest Policy; foundation, need and scope.	4
• National Forest policies of 1894, 1952 and 1988; salient features	4
• Forest Law: Legal definitions, objectives of special forest law.	4
• Indian Forest Act 1927; Forest (Conservation) Act 1980 and Rules 2003, Environmental (Protection) Act 1986.	4
• Indian Biological Diversity Act 2002.	2
• Pollution policy in practice, Environmental quality standards, Environmental Guidelines, Regulations and Rules Important case studies relating to Acts above stated with preliminary idea of Indian Penal code, Cr P.C and other enactments in India.	4
• Major International Agreements : CITES, CBD, ITTA, UNFCCC, Kyoto Protocol TRIPS etc.	4
• Conservation laws, national wildlife conservation policy and action plan, national forest policy, Wildlife (protection) act, 1972, international conventions.	4
• Conservation and development; Conservation movement in India, socio-economic and political realities, different phases of the conservation and how it has impacted people at large. What is integrated conservation? Participation in conservation and development of linkages and interest groups.	4

Practical

• Content	No. of Classes
• Class based discussion with faculty and a range of conservation activists. Review of literature. Preparation of conservation statements	3
• Collection of evidences	1
• Forensic necropsy examination	2
• Detecting time of death, Differentiating wounds in carcasses	2
• Necropsy examination techniques	2
• Hair Analysis	2
• Comparative osteology	2
• Biotechnological Tools	3

Suggested Readings:

1. Rangarajan, Mahesh (1999). Hunting and Shooting, Vol.1. The Oxford Anthology of Indian Wildlife.
2. Watching and Conserving, Vol.11., Oxford Anthology of Indian Wildlife; Oxford University Press, New Delhi.
3. Singh, Samar (1987), Conserving India's Natural Heritage, Natraj Publication, Dehra Dun.
4. Ommer, P.A. and Harshan, K.R. Applied Anatomy of the Domestic Animals. Jaypee Brothers Medical Publishers (P) Ltd., New Delhi.
5. Sokolov, V.E. (1982). Mammals Skin. IBD, Dehradun.
6. Menon, Vivek and Kumar, Ashok (1999). Wildlife Crime, Second Edition. Natraj Publisher, Dehradun.
7. Handbook of Environment, Forest and Wildlife Protection Laws in India. Natraj Publishers, Dehradun.

13. WLS 713 Wildlife Ecotourism

2 (1+1)

Tourism: objectives, planning, economics. Eco tourism, Protected areas in India Tourism in protected areas.- Ecotourism- a worldwide view. Ecotourism in Indian context. Development of Interpretative facilities, visitor characteristics, expectations and motivations, sustainability in Wildlife Tourism. Planning ecotourism in protected areas. - Visitor management in ecotourism areas - zoning, carrying capacity. Game ranching and controlled off-take from wild population, rationale, management design, harvesting by management or hunting licences, marketing procedures. Conflicts in PA's. Participation of local people in ecotourism. Ecotourism for sustainable development of PA's. New directions in ecotourism industry. Ecotourism in practice in important PA's of India - case studies of Periyar Tiger Reserve, Keoladlo National Park, Kanha National Park and Jim Corbet National Park and Sunderbans Tiger Reserve. Limitations and problems of ecotourism. Ecotourism as a way for sustainable management of natural resources. Local livelihoods and eco-tourism like nomadic grazing, agro- pasturatism).

Practical: Visits to surrounding ecotourism destinations- prepare ecotourism activity maps- Preparation of route maps to important National parks and sanctuaries of India-Preparation of information procedure about wildlife tourist spots in India. Exercises on the preparation of location-specific model eco-tourism plans.

Lecture Schedule

Theory

• Content	No. of Classes
• Tourism: objectives, planning, economics.	1
• Protected areas in India, Tourism in protected areas.	1
• Eco tourism, Ecotourism- a worldwide view. Ecotourism in Indian context.	1
• Development of Interpretative facilities, visitor characteristics, expectations and motivations, sustainability in Wildlife Tourism.	2
• Planning ecotourism in protected areas. - Visitor management in ecotourism areas - zoning, carrying capacity.	2
• Game ranching and controlled off-take from wild population, rationale, management design, harvesting by management or hunting licences, marketing procedures.	2
• Conflicts in PA's. Participation of local people in ecotourism.	1
• Ecotourism for sustainable development of PA's. New directions in ecotourism industry.	1
• Ecotourism in practice in important PA's of India - case studies of Periyar Tiger Reserve, Keoladlo National Park, Kanha National Park and Jim Corbet National Park and Sunderbans Tiger Reserve.	3
• Limitations and problems of ecotourism.	1
• Ecotourism as a way for sustainable management of natural resources.	1
• Local livelihoods and eco-tourism like nomadic grazing, agro- pasturatism).	1

Practical

• Content	No. of Classes
-----------	----------------

- Visits to surrounding ecotourism destinations. 4
- Prepare ecotourism activity maps- Preparation of route maps to 5 important National parks and sanctuaries of India.
- Preparation of information procedure about wildlife tourist spots in 4 India.
- Exercises on the preparation of location-specific model eco-tourism 4 plans.

Suggested Readings:

1. Corbett, Jim (2007). The Temple Tiger. Oxford University Press, New Delhi.
2. A Vet in Wilderness. Central Zoo Authority, New Delhi.
3. Sharma, B.D. 1999. Indian wildlife resources: Ecology and development. Daya Publishing House, Delhi.
4. Sharma, V.B. 1998. Wildlife in India. Nataraj Publications, Dehra Dun.

14. WLS 714 Capture and handling of Wild Animals 2 (1+1)

Restraints, Capture and Animals Barriers: Purposes, live traps, snares, pits, nets, canon (rocket) nets, net gun, mist nets, corrals, stockade, spotlighting. Animal barriers: Reasons for use; trenches, walls, stockades, mechanical fences, electric fences, repellents.

Drug immobilization: Jabstick, blowpipe, pistol, rifle, crossbow, dart design; radio darts. Drug action, dosages, responses, side effects, safety measures, complications. Handling and transport, design of sledge, crate and holding enclosures.

Individuals identification and location: Purposes, identification by natural marking, individual damage; behavioural idiosyncrasies etc, passive marking collars, tags, branding, rings etc. Dynamic marking-beta light, radio-tracking-harnesses, collars; telemetering of physiological parameters etc.

Practicals: Demonstration of equipment-traps, net, dart gun etc. Mist netting and trapping on campus. Participation in capture operations as appropriate. Examination of various types of barrier in the field. Field identification by natural markings. Equipment and its use tags, collars, radio tracking equipment. Bird ringing.

Lecture Schedule

Theory

• Content	No. of Classes
• Restraints, Capture and Animals Barriers: Purposes, live traps, snares, pits, nets, canon (rocket) nets, net gun, mist nets, corrals, stockade, spotlighting.	3
• Animal barriers: Reasons for use; trenches, walls, stockades, mechanical fences, electric fences, repellents.	3
• Drug immobilization: Jabstick, blowpipe, pistol, rifle, crossbow, dart design; radio darts.	2
• Drug action, dosages, responses, side effects, safety measures, complications. Handling and transport, design of sledge, crate and holding enclosures.	3
• Individuals identification and location: Purposes, identification by natural marking, individual damage; behavioural idiosyncrasies etc, passive marking collars, tags, branding, rings etc.	3
• Dynamic marking-beta light, radio-tracking-harnesses, collars; telemetering of physiological parameters etc.	3

Practical

• Content	No. of Classes
• Demonstration of equipment-traps, net, dart gun etc.	2
• Mist netting and trapping on campus.	2
• Participation in capture operations as appropriate.	3
• Examination of various types of barrier in the field.	2
• Field identification by natural markings.	3
• Equipment and its use tags, collars, radio tracking equipment.	3
• Bird ringing.	2

Suggested Readings:

1. Chowdhury, Sushant and Malik, Pradeep. A guide to Chemical Restraint of Wild Animals. Natraj Publishers, Dehradun.
2. Arora, B.M. Rehabilitation in free living wild animals.
3. Sanyal, Ram Bramha (1995). A Handbook of the Management of Animals in Captivity.

15. WLS 715 Natural Resource Management

1 (1+0)

Introduction to Forestry & Natural Resource Conservation

Introduction to forestry, concept of conservation with special reference to wildlife management and the management of forests in India. Philosophies of science, conservation and sustainable development. Philosophy of wildlife management, conservation versus preservation, valuing wildlife: the western viewpoint of wildlife management in India. Conservation project in India, Environmental movements, international conservation bodies; IUCN UNDP, FAO, WWF.

Conservation laws, national wildlife conservation policy and action plan, national forest policy, wildlife (protection) act, 1972, international conventions. Conservation and development; Conservation movement in India, socio-economic and political realities, different phases of the conservation and how it has impacted people at large. What is integrated conservation? Participation in conservation and development of linkages and interest groups.

Practicals: Class based discussion with faculty and a range of conservation activists. Review of literature. Preparation of conservation statements.

Lecture Schedule

Theory

• Content	No. of Classes
• Introduction to forestry, concept of conservation with special reference to wildlife management and the management of forests in India.	2
• Philosophies of science, conservation and sustainable development. Philosophy of wildlife management, conservation versus preservation, valuing wildlife: the western viewpoint of wildlife management in India.	4
• Conservation project in India, Environmental movements, international conservation bodies; IUCN UNDP, FAO, WWF.	3
• Conservation laws, national wildlife conservation policy and action plan, national forest policy, wildlife (protection) act, 1972, international conventions.	3
• Conservation and development; Conservation movement in India, socio-economic and political realities, different phases of the conservation and how it has impacted people at large.	3
• What is integrated conservation? Participation in conservation and development of linkages and interest groups.	2

Suggested Readings:

1. Singh, Samar (1987), *Conserving India's Natural Heritage*, Natraj Publication, Dehra Dun.
3. Fisher, A.C., *Resource and Environmental Economics* (New York: John Wiley & Sons), 1979.
3. Orris C. Herfindahl, *Natural Resource Information for Economic Development* (Baltimore: The Johns Hopkins University Press), 1969.
4. Sharma, S.D., *A New Approach to Linear Programming* (Meerut: Kedarnath, Ramnath and Co.), 1975.

5. Tony Prato, *Natural Resource and Environmental Economics* (Ames: Iowa State University Press), 1998.

16. WLS 716 Specialized Wildlife Techniques Tour 2 (0+2)

Techniques Tour-1 (Ecology, Study Techniques, Wildlife & Vegetation Studies).

Exercises on Wildlife Population parameters and census methods for various species. Vegetation studies. Studies on animal ecology.

Techniques Tour - 2

Habitat evaluation, Inventory, animal behaviour, EIA

Techniques Tour - 3

Visit important wetlands in the country, the appraisal of the habitat, waterfowl census, documentation of threats to wetlands.

Tour Schedule

- | Content | Duration |
|--|-----------------|
| Techniques Tour-1 (Ecology, Study Techniques, Wildlife & Vegetation Studies).
Exercises on Wildlife Population parameters and census methods for various species. Vegetation studies. Studies on animal ecology. | 4 Weeks |
| Techniques Tour - 2
Habitat evaluation, Inventory, animal behaviour, EIA | 2 Weeks |
| Techniques Tour - 3
Visit important wetlands in the country, the appraisal of the habitat, waterfowl census, documentation of threats to wetlands. | 2 Weeks |

17. WLS 780 Seminar – I
18. WLS 880 Seminar – II

19. MAS 711 Statistics – I

Analysis of variance: Definition and assumptions, one way classification, two way classification. Sampling Techniques: Simple random sampling, stratified random sampling, systematic sampling. Design Experiments: Randomized Block design, Latin Square design, Factorial design (2^2 , 2^3 , 3^2 , 3^3 factorials), Some P x Q experiments, Split Plot Experiments. Balanced Incomplete Block design

Practical

Analysis of variance, Randomized Block Design.

Theory

Content	Lecture
• Analysis of variance	2
• Definition and assumptions,	2
• one way classification,	2
• two way classification.	2
• Sampling Techniques	2
• Simple random sampling	2
• stratified random sampling	2
• systematic sampling.	2
• Design Experiments	2
• Randomized Block design	2
• Latin Square design	2
• Factorial design (2^2 , 2^3 , 3^2 , 3^3 factorials)	3
• Some P x Q experiments	3
• Split Plot Experiments	3
• Balanced Incomplete Block design	3

Practical

Content	Lecture
• Analysis of variance	6
• Randomized Block Design	11

Suggested Readings:

1. Bernard Ostle and R.W.Mensing, Statistics in Research.
2. C.H. Goulden, Method of Statistical Analysis.
3. G.W. Snedecor and W.G. Cochran, Statistical Methods.
4. R.G. Steel and J.H. Torrie, Principles and Procedures of Statistics (with special reference to Biological Sciences)
5. R.Rangaswamy, A Text Book of Agricultural Statistics.
6. Chandel S.R.S, A Text Book of Agricultural Statistics.
7. W.G. Cochran and G.M.Cox, Experimental Designs.

20. MAS 715 Statistics – II

Statistical Methods: Measures of Skewness and Kurtosis, standard error of mean, Coefficient of variation. Theory of Probability : Definitions, Additions and Multiplication rules of Probability, Conditional Probability. Probability distributions: Normal, Binomial and Poisson distributions. Correlation and Regression : Simple correlation, Rank correlation, Regression Coefficient, Multiple and Partial Correlation, Regression lines between two variables, Multiple Regression. Tests of Significance: X^2 - test, t - test one sample, two sample t – tests, paired t-test, F – test, Fisher’s 2 – transformation

Practical

Coefficient of variation, SE of mean, Skewness and Kurtosis. Fitting of Normal, Binomial and Poisson distribution. Simple Correlation, Multiple and Partial Correlation with three variables only. Regression lines between two variables. X^2 , t and F – tests

Theory

Content	Lecture
• Statistical Methods: Measures of Skewness and Kurtosis	2
• Standard error of mean	2
• Coefficient of variation	2
• Theory of Probability : Definitions	2
• Additions and Multiplication rules of Probability	2
• Conditional Probability	2
• Probability distributions: Normal, Binomial and Poisson distributions	2
• Correlation and Regression : Simple correlation	2
• Rank correlation	2
• Regression Coefficient	2
• Multiple and Partial Correlation	3
• Regression lines between two variables	3
• Multiple Regression	3
• Tests of Significance: X^2 - test	3
• t - test one sample	2
• Two sample t – tests	2
• Paired t-test, F – test	2
• Fisher’s 2 – transformation	2

Practical

Content	Lecture
• Coefficient of variation	2
• SE of mean	1
• Skewness and Kurtosis	2
• Fitting of Normal	2
• Binomial and Poisson distribution	2
• Simple Correlation	2
• Multiple and Partial Correlation with three variables only	2

- Regression lines between two variables 2
- X^2 , t and F – tests 2

Suggested Readings:

1. C.H. Goulden, Method of Statistical Analysis.
2. Bernard Ostle and R.W.Mensing, Statistics in Research.
3. R.Rangaswamy, A Text Book of Agricultural Statistics.
4. Chandel S.R.S, A Text Book of Agricultural Statistics.
5. W.G. Cochran and G.M.Cox, Experimental Designs.

21. COMP 709 Computer Orientation

Introduction to multi programming and time sharing computers - Login and creation of files - Introduction to structured programming with reference to BASIC - Variables and constants, complex, double precision, logical, character - Arithmetic expressions, arrays, control statements (DO, IF, Computed GOTO) - Functions and subroutines - I/O statements - Elementary programming of algorithms.

Practical

Loading Windows and other features in Windows. MS Word – creation, editing of a document. Using features like underlining, bold, italics, spell check etc. and printing. Creation of excel sheet and processing for statistical analysis. Creation of a database in access - Mstat – creation of a data file. Internet – getting connected and email Internet – retrieval of information.

Theory

Content	Lecture
• Introduction to multi programming and time sharing computers	3
• Login and creation of files	3
• Introduction to structured programming with reference to BASIC	4
• Variables and constants	3
• Complex, double precision	3
• Logical, character	3
• Arithmetic expressions	3
• Arrays, control statements (DO, IF, Computed GOTO)	4
• Functions and subroutines - I/O statements	4
• Elementary programming of algorithms	4

Practical

Content	Lecture
• Loading Windows and other features in Windows	3
• MS Word – creation, editing of a document	2
• Using features like underlining, bold, italics, spell check etc. and printing	3
• Creation of excel sheet and processing for statistical analysis	2
• Creation of a database in access - Mstat – creation of a data file	3
• Internet – getting connected and email Internet – retrieval of information	3

Suggested Readings:

1. Chris Lewis, Essential Tips: Using the Internet
2. Gene Weisskopf, ABCs of Excel 97
3. Kenneth N.Berk, Introductory Statistics with Systat
4. Kris N, Advanced Data Analysis with Systat
5. Mark Wallace, Things to do on the Internet
6. Ron Mansfield, The Compact Guide to Microsoft Office

22. AGF 703 Research Methodology**1(0+1)**

Project formulation - Problem identification - formulation of objectives and technical program - data collection - data interpretation and deriving inferences and conclusions - literature collection - Review writing - Research article writing - Technical report preparation - Research abstracting - Research Scheme proposal.

Theory

	Content	Lecture
•	Project formulation	1
•	Problem identification	1
•	Formulation of objectives and technical program	1
•	Data collection	2
•	Data interpretation and deriving inferences and conclusions	2
•	Literature collection	2
•	Review writing	2
•	Research article writing	2
•	Technical report preparation	2
•	Research abstracting	1
•	Research Scheme proposal.	1

Suggested Readings:

1. Agarwal. S.K. 2003. Research Methodology. International Book Distributors, Dehradun.
2. Gupta. R.K. 2001. Research Methodology. IBH publications, New Delhi.
3. Gopal Lal Jain. 2003. Research Methodology – Methods, tools and techniques. Mangal Deep Publication, Jaipur. P.303.
4. Singh, V.P. 2003. Research Methodology. Scientific for Publication, New Delhi. P.300
5. Kothari, C.R. 1997. Research Methodology – Methods and Teaching. Pub: Wishwa Prakashm, New Delhi.

23. WLS 899 Dissertation

15(0+15)