M. Sc. Wildlife Science
CHOICE BASED CREDIT SYSTEM (CBCS)

2011-2013

Course Outline & Syllabus

April 2011

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

DEHRADUN 248001

Saurashtra University
Rajkot – 360 005

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BACKGROUND

Under the Eleventh Five-Year Plan, the University Grants Commission (UGC) tabled an Action Plan for Academic and Administrative Reforms. The plan sought the speedy and substantive academic and administrative reforms in higher education for promotion of quality and excellence in university education. The Action Plan outlined steps to consider and adopt Semester System, Choice-based Credit System, Curriculum Development, and Admission Procedure, Examination Reforms in the Central and State Universities, Colleges, and other educational Institutions of higher education.

The Wildlife Institute of India (WII) established in 1982 is an internationally acclaimed Institution, offering training programmes, academic courses and advisory services in wildlife research and management. The Institute is actively engaged in research across the country on a range wild animal plant and animal species and ecosystems in different biogeographic zones. In response to the felt need of developing competent biologists a two-year M.Sc. Wildlife Science course was started in 1988 which is affiliated to the Saurashtra University, Rajkot, Gujarat. This course has been offered in the form of Semester system since its inception and now with the new initiatives of the UGC a Choice-based Credit System (CBCS) is to be implemented from June 2011 onwards.

WILDLIFE INSTITUTE OF INDIA

Ever since official attempts at preservation of living natural resources began in India, the need had been felt for institutions that could undertake training, education and research in the rapidly developing science of conservation. In particular, the vast field of wildlife conservation, research and protected area management remained largely unattended over for the long decades after independence. It was in response to this need that the Wildlife Institute of India was set up in 1982 as a nodal national agency by the Government of India with a view to meet the urgent training needs of wildlife managers and biologists for scientific planning, management and research in the field of wildlife conservation. To aid it in its academic, training and research pursuits, the Institute was granted autonomy in April 1986 by the Ministry of Environment & Forests (MoEF), Government of India (GoI). It has a Governing Body chaired by the Secretary of the MoEF, GoI that facilitates its functioning.

SAURASHTRA UNIVERSITY

Saurashtra University at Rajkot, Gujarat was established in 1965, and has been recognized as a seat of learning under the University Grants Commission.

The Wildlife Institute of India is affiliated to Saurashtra University for the award of the Master's degree in Wildlife Science. The Board of Studies of Saurashtra University regulates the M.Sc. programme, and determines the eligibility for the course and reviews the scheduling of course activities.

1.   INTRODUCTION

The M.Sc. Wildlife Science course at the Wildlife Institute of India has been developed to impart education and training in the field of wildlife science to support the cause of wildlife conservation in India and elsewhere. The threat of species extinction is constantly increasing and the ways to mitigate them requires a scientific approach. The management plans for Protected Areas in India require a strong scientific basis for their successful implementation. Further, the management practices, wildlife habitat and species populations need constant monitoring if conservation efforts are to be effective. All this require trained personnel. This course aims to create trained wildlife biologists who will effectively tackle these issues and challenges.

1.1   The Course

The M.Sc. course in wildlife science is a two year full time curriculum organised in four semesters of 24 credits each. Each semester is structured into theory papers, assignments, field practicals, tour journal and lab practical papers which will be evaluated during the semester. The first three semesters have three theory papers with five credits each and one assignment topic based on any of the theory papers with 3 credits respectively. In addition, the three semesters will also have a tour journal assignment, field and laboratory practical of 2 credits each. Each theory paper is sub-divided into modules which will be administered by Module Coordinators. The assignment and practical exercises will also be administered separately by coordinators. In the third semester two of the three theory papers offered will be in the form of specialised papers in select thematic areas. The students need to choose one of the thematic areas offered. The number of students for a particular thematic area should not be less than three. Third semester will also have one specialised module on research design and for developing pre-proposal for dissertation. The fourth semester is a six month dissertation programme (four months field/lab work and two months for data analysis and writing).

There is an equal emphasis on providing theoretical understanding and developing practical skills. Classroom lectures, assignments, group discussions and extended field visits are therefore given equal importance. Each month will have about 20 working days, and each day will have three lecture hours in the forenoon.

An important activity during the course is critical review of published research. The students are expected to read and discuss original research papers as background to lectures and seminars. In order to inculcate the attitude and imbibe knowledge required to become a competent field biologist, critical review and seminar based discussions of research papers will form a major part of the course. In the assignments and presentations the student is expected to provide an overview, synthesis of work done in the past and critical evaluation based on the information that has been gathered.

1.2 Mode of Teaching

Each credit will be having 16 lectures, 3 lectures each day in forenoon hours. Sixty percent of the credit will be taught as regular class-room teaching and 40% will be interactive learning. The interactive learning will include seminars, group discussions, assignments, power-point and poster presentations etc. The purpose of CBCS is to make the course more interactive and discussion based where the involvement of both students and teachers is equal.

1.3 Field Tours

In all there will be six field tours namely the Orientation tour, Techniques tour, National Park tour, Wetland tour, High Altitude Techniques tour, and Conservation Practice and Management tour. These tours are compulsory and part of the curriculum and will be conducted during the first three semesters. The students will be required to prepare tour journals and these will be evaluated during the respective semester.

1.4 Assignments and Seminars

Substantial time is made available for these, especially in afternoon hours, besides additional time during particular semester. These assignments will be based on the theory papers in the respective semesters. Each module within the semester will have at least one assignment. Seminars based on assignment topics will be organised during the respective semester and are compulsory.

1.5 Dissertation

Wildlife Science is essentially a field-based subject, and therefore due emphasis is given to this. The entire duration of the fourth semester is allotted for an independent field and or lab based dissertation project. As part of the preparations for the dissertation project students are required to submit a Pre-Proposal of 1000 words by the end of August of the third semester (Format of pre-proposal will be circulated at the start of the semester). The pre- proposals will be evaluated by a Dissertation Committee. The Dissertation Committee will screen the proposals and will recommend a Student Dissertation Committee for every student. Student Dissertation Committee will comprise three faculty members – one supervisor and two co-supervisors. Upon acceptance of their pre-proposal, a detailed proposal needs to be submitted in the first week of 4th Semester starting 15th December. The students will present and defend their final proposal in the third week of December and initiate work after that. The dissertation will be submitted in the prescribed format. Each dissertation will have two sections – one will be literature review of the subject and other in the form of research paper of actual field work, both of these must be written following the format of journal (Bioscience).

1.6 Attendance

Admitted students have to attend all the lectures, practical and field tours. A minimum of 80% attendance in each semester is required to be allowed to appear in the University examination.

1.7 Examinations

Evaluation of the theory papers will be both external and internal in the ratio of 70:30 respectively. The theory paper examination for 70 marks will be conducted by the Saurashtra University at the end of each semester. The internal examination for 30 marks will be conducted by the respective paper coordinator(s). Further, each of the first three semester examinations will be administered by a designated Internal Examiner and external examiners for Lab/Field Practicals. The fourth semester examination will be evaluation of the dissertation by external examiners including dissertation presentation and *viva-voce.*

Students are required to apply in the prescribed application form for appearing in the theory examination and need to pay the necessary examination fees on the

date to be notified by the University. The pass mark is 40% and the mark for a distinction is 75%. The semester wise distribution of the courses and papers are given below:

Semester-Wise Distribution of Marks
* 70 Theory (University Exam) + 30 Theory (Internal Evaluation)

Semesters	Papers	Marks
1	3 Papers (100 marks each*)	300
	One Assignment	60
	One Tour Journal	40
	Lab/Field Practical (40 marks each)	80
	Total	**480**
2	3 Papers (100 marks each*)	300
	One Assignment	60
	One Tour Journal	40
	Lab/Field Practical (40 marks each)	80
	Total	**480**
3	1 Paper (100 marks)	100
	Two Choice Based Papers on different Thematic Areas (100 marks each*)	200
	Research Design and Development of Pre-Proposal	60
	One Tour Journal	40
	Lab/Field Practical (40 marks each)	80
	Total	**480**
4	Dissertation	400
	Presentation and *Viva-Voce*	80
	Total	**480**
	GRAND TOTAL	**1920**

In order to qualify for the M.Sc. degree, a student should:
  (a) Secure minimum 40% in each theory paper and practical examinations.
  (b) Secure minimum 40% in his/her dissertation and *viva-voce* examinations.

The successful completion of the course will lead to the award of M.Sc. Wildlife Science Degree by the Saurashtra University, Rajkot, Gujarat.

2. COURSE SCHEDULE

Course Schedule	Start and end date of semester & vacation	Semester Duration	Number of working days	Number of field tour days
1st Semester	16th June - 30th November	168 days	130 days	20 days
1st Semester exam dates: 20-30 November				
1st Semester break (1st December to 15th December - 15 days)				
2nd Semester	16th December – 31st May	168 days	130 days	30 days
2nd Semester exam dates: 20 – 31 May				
2nd Semester break (1st June to 30th June -30 days)				
3rd Semester	1st July – 30th November	153 days	130 days	20 days
3rd Semester exam dates: 20 – 30 November				
3rd Semester break (1st December to 15th December - 15 days)				
4th Semester	16th December – 15th June	183 days	183 days	
Viva voce dates: 15 – 25 July				

Note: Vacation may change based on the semester's activity

3. COURSE ADMISSION & ELIGIBILITY

i. Bachelor of Science degree with Biological Science as a major subject - Bachelor degree holder in Veterinary, Forestry, Agriculture and Environmental Sciences are also eligible.
ii. Minimum of 15 years of formal education (either 10+2+3 or 11+2+2)
iii. Minimum of 55% aggregate marks in B.Sc.

Candidates appearing for final year/semester B.Sc. exam are also eligible to apply, provided they have secured a minimum of 50% aggregate till second year and on completion of their degree will achieve a minimum of 55% aggregate. Such candidates must produce mark sheet of their graduation at the time of their Personality and Aptitude Test, failing which, their candidature will be treated as cancelled.

Foreign nationals who do not have English as their native language should provide evidence of proficiency in English (TOEFL or IELTS Score) for admission to this course. The TOEFL or IELTS score reports should not be more than two years since taking the

Test to submission of the application. A minimum TOEFL Score of 213 (computer-based), 550 (paper-based), or 79 (internet-based), or a minimum of 6.0 IELTS score is required. Also, candidates with Bachelor Degree from Universities outside India should obtain certificates of equivalence from "The Secretary General, Association of Indian Universities, AIU House, 16, Comrade Indrajit Gupta Marg, New Delhi-110002 or email to administration@aiuweb.org".

3.1 Age Limit

The age limit is 25 years with relaxation of 5 years for reservation candidates, and for those candidates who are working in Forest and Wildlife Departments it is 35 years as on 1st July, 2011.

3.2 Application Process

i.   The application has to be made in the prescribed format and the form can be downloaded from the Institute website (www.wii.gov.in). Attested legible photocopies of all the certificates and mark sheets providing proof of eligibility, age of the candidate and certificate if belonging to SC/ST/OBC must be sent along with the application by Registered/Speed Post.

ii.   Candidates who have Grade Point Average (GPA) scores should provide a Certificate from their University on its equivalence in percentage. Candidates must highlight aggregate percentage and date of birth in the attested photocopies. Three recent passport size photographs with signature of the candidate besides the one posted on the application form, and an application fee in form of a Bank Draft for Rs 300/- in favour of Director, Wildlife Institute of India payable at Dehradun should accompany the application. SC/ST candidates are exempted from application fee. Foreign nationals are required to deposit an application fee for $ 50. The amount can be transferred electronically to WII account.

Applications incomplete in any aspect will be rejected without assigning any reasons thereof. In-service candidates should route their applications through proper channel. The envelope containing the application or annexure as the case should be marked on top "APPLICATION FOR M.Sc. WILDLIFE SCIENCE" and sent to the Course Director, M.Sc. Course, Wildlife Institute of India, Chandrabani, Dehradun 248 001, Uttarakhand. The last date for receiving application is 28th February 2011. Applications received after the last date and incomplete applications would be summarily rejected.

3.3 Selection Process

Eligible candidates will be required to appear for a written National Entrance Test (NET) in one of the six Centres (Bengaluru, Dehradun, Kolkata, Mumbai, Delhi and Guwahati) which is nearest to his/her permanent residence. The NET is likely to be held on 27th March 2011. The NET will be for two hours and will have objective type multiple-choice questions for 60% marks with sections on general knowledge, general science and optional subject (Life Science/Forestry/Veterinary Science/Agricultural Science). The remaining 40% marks will be essay based questions dealing with environmental issues.

Short-listed candidates will be called to take a Personality and Aptitude Test at Dehradun and final selection will be made on the basis of marks obtained in NET and Aptitude Test. The SC/ST candidates called for the Aptitude test will be paid travel expenses as per rules by the shortest route. Short-listed foreign candidates will be interviewed through audio or video conferencing following which their final selection will be based. The date and time of the interview will be informed to them by email. Candidates selected for the course will be governed by the rules and regulations of the MSc program.

4. NUMBER OF SEATS

The number of seats is Twelve (12) for Indian nationals and Two (02) for foreign nationals. The break-up of seats is as follows:

Category	Number of seats
General Candidates	06
SC Candidate	01
ST Candidates	02
OBC Candidates*	03
Total Indian Candidates	**12**
Foreign Candidates	**02**
Total Seats	**14**

The Socially and Educationally Backward Classes/OBCs who are eligible for availing the benefits of reservation will be determined as per the extant Central List of SEBCs/OBCs as notified from time to time and maintained at the website http://ncbc.nic.in/backward-classes/index.html.

5.   FEE

The Fee structure for the entire course is as follows:

1.   Indian candidates   -   Rs. 2,30,000.00 per candidate
2.   SAARC nationals   -   US $ 11,000.00 per candidate
3.   Other nationals   -   US $ 12,000.00 per candidate

6.   SCHOLARSHIPS

Eight Institute scholarships will be awarded on merit to selected candidates as indicated below. Other candidates selected will be treated as self-sponsored. Candidates belonging to the OBC category should provide a certificate from a competent authority.

General   -   04
SC   -   01
ST   -   01
OBC   -   02

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M. Sc. WILDLIFE SCIENCE - CHOICE BASED CREDIT SYSTEM (CBCS)

COURSE STRUCTURE

SEMESTER - I

Course Code	Type of evaluation	Course Name	Credits
WLSC – 101	Theory Paper 1 – Primer in Wildlife Science - I		
	1	Biogeography	01
	2	Fundamentals in Ecology	02
	3	Plant Systematics and Vegetation Science	01
	4	Forestry and Natural Resource Conservation	01
		TOTAL	05
WLSC – 102	Theory Paper 2 – Primer in Wildlife Science - II		
	1	Mammalogy	01
	2	Ornithology	01
	3	Herpetology	01
	4	Ichthyology	01
	5	Entomology & Invertebrates	01
		TOTAL	05
WLSC – 103	Theory Paper 3 – Population Ecology and Quantitative Methods		
	1	Population Ecology	03
	2	Quantitative Methods	02
		TOTAL	05
WLSC – 104	A – 1	Assignment in WLSC – 101/102/103	03
WLSC – 105	A – 2	Tour Journal	02
WLSC – 106	LP – 1	Laboratory Practical	02
WLSC – 107	FP – 1	Field Practical	02
		TOTAL	09
		SEMESTER TOTAL	24

SEMESTER - II

Course Code	Type of evaluation	Course Name	Credits
WLSC – 208	**Theory Paper 4 – Habitat Ecology**		
	1	Habitat Ecology	02
	2	Landscape Ecology	02
	3	Advanced Population Ecology	01
		TOTAL	**05**
WLSC – 209	**Theory Paper 5 – Wildlife Ecology & Conservation Biology**		
	1	Behavioural Ecology	01
	2	Community Ecology	01
	3	Animal Physiology and Nutritional Ecology	01
	4	Conservation Biology	02
		TOTAL	**05**
WLSC – 210	**Theory Paper 6 – Wildlife Health and Population Management**		
	1	Wildlife Health	01
	2	Population Mgt - Capture and Hand. of Wild Animals	01
	3	Advanced Quantitative Methods	02
	4	Conservation Genetics and Wildlife Forensics	01
		TOTAL	**05**
WLSC – 211	**A – 3**	Assignment in WLSC – 208/209/210	**03**
WLSC – 212	**A – 4**	Tour Journal (Specialised Techniques Tours)	**02**
WLSC – 213	**LP – 2**	Laboratory Practical	**02**
WLSC – 214	**FP – 2**	Field Practical	**02**
		TOTAL	**09**
		SEMESTER TOTAL	**24**

SEMESTER - III

Course Code	Type of evaluation	Course Name	Credits
WLSC – 315		**Theory Paper 7 – Applied Wildlife Science**	
	1	Wildlife Management	02
	2	Conservation Breeding and Wildlife Utilization	01
	3	Environment Impact Assessment	01
	4	Human dimensions in Wildlife Management	01
		TOTAL	**05**
WLSC – 316	**TP – 8**	**Specialised Paper in any One of the five Thematic Areas (Elective)**	
		High Altitude Ecology Wetland Ecology Conservation Genetics Landscape Ecology (RS and GIS) Climate Change	05
		TOTAL	**05**
WLSC – 317	**TP – 9**	**Specialised Paper in any One of the five Thematic Areas (Elective)**	
		Wildlife Forensics Coastal and Marine Management Environment Impact Assessment (EIA) Human Dimensions in Wildlife Management Wildlife Health Management	05
		TOTAL	**05**
WLSC – 318	**A – 5**	Research Design & Development of Pre-Proposal	03
WLSC – 319	**A – 6**	Tour Journal	02
WLSC – 320	**LP – 3**	Laboratory Practical	02
WLSC – 321	**FP – 3**	Field Practical	02
		TOTAL	**09**
		SEMESTER TOTAL	**24**

SEMESTER - IV

Course Code	Type of evaluation	Course Name	Credits
WLSC- 422	**D – 1**	**Field Research and Dissertation**	
		Dissertation	20
		Presentation and viva-voce	04
		SEMESTER TOTAL	**24**
		GRAND TOTAL	**96**

M. Sc. WILDLIFE SCIENCE - CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER-WISE DETAILS

WLSC – 101: Primer in Wildlife Science – Part 1 (05 Credits)

Module – 1: Biogeography (1 Credit)

History of biogeography. Ecology of dispersal and faunal exchange, barriers, mode of dispersal, origins and radiation; island biogeography theory. Historical biogeography, biogeographical processes, endemism, refugia. Continental drift; dispersal and vicariance biogeography; cladistics; dispersal mechanisms and dispersal barriers; reconciling distribution of fauna and flora. Applied Biogeography; biogeographical realms, provinces and ecoregions. The biogeographic affinities of the fauna and flora of the Indian sub-continent. India's biogeographic classification and Protected Area network.

Practicals: Mapping distribution of bird fauna and identification of distinct biotic regions; inferences from species area relationship; area cladograms.

Module – 2: Fundamentals in Ecology (2 Credits)

Basic concepts and structure of ecosystems: abiotic and biotic components; climatic and edaphic regimes; nutrients and minerals; producers, consumers and decomposers. Communities, populations, groups and individuals. Functioning of ecosystem: energy flow and nutrient cycles, Systems approach to ecological functioning. History of evolutionary thought; natural selection and speciation; evolutionarily significant units. Species concepts; biological, phylogenetic, evolutionary and ecological species concepts. Macroevolution, coevolution and mutualism.

Module – 3: Introduction to Plant Systematics and Vegetation Science (1 credit)

Introduction to angiosperm systematics and evolution: Morphology and Taxonomy of major groups, Plant identification and use of Taxonomic literature. Principles of plant nomenclature, Type methods, Citation of authorities and name changes. Floral diversity and botanical regions of India. Plant conservation issues and strategies. Principles of vegetation classification. Major vegetation types of India (Champion & Seth's classification). Structural and functional attributes of vegetation. Plant succession: concepts and processes. Techniques of vegetation surveys and quantification.

Practicals: Systematic study of common plants, Field and Herbarium techniques, Study of WII campus flora, Status of litter layer in various forest types, Study the successional stages of various forest communities in WII campus, Rapid assessment of riverine vegetation in nearby areas and Demonstration/on-site discussion on topographic features and corresponding vegetation types.

Module – 4: Forestry and Natural Resource Conservation (1 Credit)

Philosophies of science, conservation and sustainable development. Concept of conservation with special reference to forest and wildlife management, conservation verses preservation. Introduction to forestry, principles of forest management, forest and wildlife as natural resources. Conservation movement in India, socio-economic and political realities, different phases of the conservation and how it has impacted people at large. Concept of stakeholders. International conservation bodies; IUCN UNDP, FAO, WWF.

Natural resource economics: Need for integrating environment and economics, the economic reasons for over-exploitation of natural resources, ecosystem functions and services, cost and benefits of biodiversity conservation. Need for ecosystem service valuation.

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

WLSC – 102: Primer in Wildlife Science – Part 2 (05 Credits)

Module 5: Mammalogy   (1 Credit)

History of mammalogy. Evolution of mammals and morphology. Adaptations in mammals; hibernation, torpor, aestivation, locomotion and water regulation. Metabolism and thermo-regulation; ectothermy, homeothermy and cold stress, body size versus homeothermy. Body size variation in mammals and its influence on life history, metabolic rate, weight constraints, feeding behaviour, niche width and reproduction. Mammalian skin and its derivatives. Behaviour and social organization in mammals; social and mating systems; territories; communication. Mammalian diet; digestive systems; anatomy, morphology and function.

Practicals: Study of epidermal derivatives; comparative morphology of dentition and skull; mapping distribution of primates, carnivores and ungulates.

Module 6: Ornithology (1 Credit)

Origin and radiation of birds, morphological and physiological adaptations. Avian systematics and classification of Indian birds. 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. Economic ornithology. Avian extinctions - past and present, endangered and threatened birds. Avian community ecology and habitat selection. Sexual selection in birds. Bird migration. Bird census techniques.

Practicals: Examination and drawing of museum materials: skins, skulls, feet, eggs and nests of characteristic species. Birds skin preparation and measurement of specimens. Mist-net techniques, methods for handling and ringing.

Module 7: Herpetology (1 Credit)

Systematics and zoogeography of amphibians and reptiles: Factors affecting distribution and abundance of amphibian and reptilian fauna of the 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.

Practicals: Examination and drawing of museum materials and morphometric study.

Module 8: Ichthyology (1 Credit)

Classification and evolution of major groups of fishes in India. Ichthyogeography and diversity of freshwater fishes of India. Ecology and adaptation of fishes in different ecosystems. Economic importance of sport fishes of India. Threats and conservation perspectives of fish biodiversity in India as well as at global level. Threatened fishes of India. Methods to study ecology of fish diversity, abundance, growth and their habitats.

Laboratory and Field study: Laboratory and Field study: Fish morphometric study (in lab), Methods for fish ecological studies (in field).

Module 9: Entomology & Invertebrates (1 Credit)

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.

Invertebrates: Classification and ecology of marine invertebrates especially corals, sponges, molluscs and echinoderms. Different types of coral reefs and their associated species. Ecological services and management of coral habitats in India.

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

WLSC – 103: Population Ecology & Quantitative Methods (5 credits)

Module 10: Population Ecology (3 Credits)

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,

Sampling designs for population estimation, population estimation methods: Distance based Sampling Methods, Mark-Recapture for Closed Population, Indices, and Estimation of Demographic parameters.

Practicals: Analysis of Abundance Data Using Distance, Mark, Density and R software. Simulation (stochastic and deterministic) modelling of populations using RAMAS and Vortex.

Module 11: Quantitative Methods (2 Credits)

Philosophy of science, scientific method and hypothesis testing. Overview of sampling and experimental design. Exploratory data analysis. Probability theory, Distributions-binomial, poisson, normal and t and chi square. Introduction to Bayesian statistics. Hypothesis testing: One and Two Variable (Parametric and Non Parametric). Correlation and Simple Regression. Data Transformations, Boot-strap and Jack-knife procedure.

Lab: Data Analysis in R and NCSS

WLSC – 104: Assignment in WLSC - 101/102/103 (3 Credits)

WLSC – 105: Tour Journal (2 Credits)

WLSC – 106: Laboratory Practical (2 Credits)

WLSC – 107 Field Practical (2 Credits)

WLSC – 208 : Habitat Ecology (5 Credits)

Module 12: Habitat Ecology (2 Credits)

Introduction to Habitat Ecology - Historical, ecological & evolutionary perspectives of Habitat Ecology, basic concepts. Ecology of major terrestrial habitats: Deserts, Grasslands, Wetlands, Forests. Habitat diversity: edge, ecotones, interspersion and juxtaposition. Physical and anthropogenic factors influencing terrestrial habitats. Habitat degradation and fragmentation. Successional changes and wildlife habitat.

Inventory, evaluation and monitoring of wildlife habitat - Measuring wildlife habitat, availability, quality, palatability of graze and browse. Inventory of unique habitats and their distribution, Animals signs as indicators of habitat use, use of map overlay approach in habitat evaluation. Monitoring changes in habitat parameters, use and availability of habitat resources.

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 and demonstration of habitat quantification techniques.

Module 13: Landscape Ecology (2 Credit)

Concept of Space, Basics of Cartography, Principles of Remote Sensing, Sensors, Image interpretation and Digital Image Processing, , Global Positioning System, Geographical information Systems: Data Entry and Preparation, Spatial Data Generation, Concept of Database and Metadata, Spatial Modelling and Data Visualization. Basics of Landscape Ecology.

Lab: Data Input - Digitization of Maps and Projection. Remote Sensing - Georectification and Radiometric Correction. Image Classification Technique for Mapping of Earth Resources. Landscape Ecology - Logical and Quantitative Models for Species and Habitat. Map making.

Module 14: Advanced Population Ecology (1 Credit)

Monitoring population and other demographic parameters, Predator-Prey Dynamics, Population Genetics, Estimation of Survival, Recruitment, and other transition states using Mark-Recapture models, Modelling Occupancy. Bayesian models in Abundance Estimation (Spatial and Non Spatial).

Lab: MarK, Presence, Models in R Progaram

WLSC – 209: Wildlife Ecology and Conservation Biology (5 credit)

Module 15: Behavioural Ecology (1 Credit)

An interconnected approach understanding proximate and ultimate mechanisms, and causal and functional explanations in animal behaviour. Group living: costs, benefits and optimal group size. Selfishness and altruism. Evolutionarily stable strategies; predator prey relationships and evolutionary arms race. Competition for resources: ideal free distributions and resource defence. Concept of optimality in decision making in animals; optimal foraging theory and other models. Testing hypotheses in behavioural ecology: Comparative methods, experimental studies, individual decisions in ecology. Sexual selection; parental care and mating systems. Cooperation and helping in mammals, birds and fishes. Ecology and evolution of signals and communication pathways. Behavioural patterns in captivity and animal welfare issues.

Practicals: Methods of behavioural observation; Instantaneous scan, focal animal, all-occurrence and one-zero sampling, collection and analysis of behvioural data on few commonly seen species, preparation of ethograms, time-activity budgets and social interaction matrices; demonstration of radio-telemetry methods to study activity patterns.

Module 16: Community Ecology (1 Credit)

Definition and nature of communities; scale and approaches. Historical perspective in community ecology studies. Measurement of species richness; diversity; evenness. Community structure, organization and its stability (guilds, resource partitioning, niche, competitive exclusion). Factors governing species diversity. Models of competition; simple community models. Concept and measurement of niche. Trophic interactions; top-down and bottom-up processes. Null models and their application in ecology. Energy and productivity and its implications for species diversity. Functional diversity and food webs. Evolution of communities and neutral theory.

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

Module 17: Animal Physiology and Nutritional Ecology (1 Credit)

Feeding ecology of herbivores, carnivores, insectivores and omnivores – food selection, quantity, quality (nutritional value), seasonal variations, relations to food to animal condition. Predator-prey interactions.   Eco-physiology with special reference to adaptations to water and temperature. Importance of minerals to animal health, growth and reproduction.

Lab Practical: Lab practical will be organized for estimation of food quality with respect to nutritional significance in herbivores. Estimation of food habits in herbivores and carnivores. Use of biotelemetry in understanding eco-physiology of free ranging animals. Assignment related to nutritional ecology and eco-physiological aspects.

Module 18: Conservation Biology (2 Credits)

Introduction to conservation biology, values of biodiversity and conservation ethics, Patterns and process of biodiversity, losses and threats to biodiversity. Biological consequences of habitat fragmentation, covering barriers and isolation, crowding effect, local and regional extinctions, edge effects, changes in species composition and problem of climate change. Population genetics and conservation; community and ecosystem level conservation. Theories, planning and designing conservation reserves; scales of management and cultural context. Conservation outside protected areas. Control of invasive species. Significance of ecological restoration in conservation.

Discussions: the role of zoos, aquariums and botanic gardens in conservation. Introduction/reintroduction and translocation.

WLSC – 210: Wildlife Health and Population Management (5 credit)

Module 19: Wildlife Health (1 Credit)

Introduction to disease and epizootiology, Determinants of disease and disease transmission, Disease and population dynamics. Review of major viral, bacterial, protozoan, fungal and parasitic diseases of Indian wild mammals, birds, amphibians and reptiles. Non-infectious diseases- nutritional diseases, poisoning, stress, shock, capture myopathy, physical trauma. Emerging and re-emerging diseases. Zoonoses. Assessment of condition, health and nutritional status in free-ranging populations. Disease control

operations, Investigation of disease outbreaks including biological sampling and laboratory analysis, Planning and management of wildlife health programmes.

Module 20: Population Management – Capture and handling of wild animals (1 Credit)

Capture and handling of animals - purpose, restraint techniques, different capture methods and animal barriers. Drug immobilization - drug delivery equipment and accessories. Immobilization drugs - action, dosage, response and side effects, safety measures, complications. Handling and transport of wild animals, designing sledge, crate and holding enclosures. Management and identification of animals in conflict, identification by natural marking, individual damage; behavioural idiosyncrasies etc, managing problem animals using passive marking collars, tags, branding, rings etc. Dynamic marking-beta light, radio-tracking-harnesses, collars; tele-metering of physiological parameters.

Practicals: Demonstration of equipment-traps, remote drug delivery equipments etc. Participation in capture operations as appropriate. Examination of various types of barrier in the field. Demonstration of the use tags, collars, radio tracking equipment; biological sampling, preservation and transport of samples

Module 21: Advanced Quantitative Methods (2 Credits)

Analysis of variance (one and Multiway). Analysis of Covariance. Ordination: Principal Component Analysis, Discriminant Analysis, Non-Metric Multidimensional Scaling, Cluster Analysis, Tree Models, Generalised Linear Models - Normal, Binomial, Poison and Gamma. Logistic and Multinomial Logistic Rergression, Log Linear Models for Contingency Tables. Model Criticism and Model Simplification.

Lab: Data Analysis in R and NCSS

Module 22: Conservation Genetics and Wildlife Forensics (1 Credit)

Introduction to Bio-molecules-DNA, RNA and Proteins; Central Dogma of Molecular Biology- Replication, Transcription and Translation; Mendelian Genetics- Mendal's Laws; Genetic Code- Characteristics and feature of genetic code; Molecular markers; PCR, DNA Sequencing, Genotyping; Allelic variation; Interpretation of genetic data; Application of genetics for wildlife conservation; Loss of genetic diversity, Resolving taxonomic uncertainties; Wildlife Forensics- Overview, various forensic protocols for species identification, Molecular markers used in wildlife forensics; Wildlife forensics based on DNA analysis and morphometry; Wildlife crime case studies.

Practicals: Extraction of DNA from biological sample, PCR amplification by mtDNA, sex and microsatellite markers, DNA sequencing and genotyping by ABI Genetic analyser and interpretation of genetic data.

WLSC – 211: Assignment in WLSC - 208/209/210 (3 credit)

WLSC – 212: Tour Journal (2 Credits)

WLSC – 213: Laboratory Practical (2 Credits)

WLSC – 214 Field Practical (2 Credits)

WLSC - 315: Applied Wildlife Science (5 credit)

Module 23: Wildlife Management (2 Credits)

Interface between forest and wildlife management in India. Legal instruments for managing wildlife in India. Principles and practices of wildlife management. Course and fine filter approaches for wildlife management. Management of special habitats; riparian zones. Grasslands etc. Analysis of wildlife management problems in plantations and exploited forests; Indian and global scenario. Species conservation projects; tiger, lion, rhino, crocodile etc. Role of Biology in management.

Management plan for Protected Areas: Forest working plans and wildlife management plans. Need for wildlife management planning. Principles of planning, objectives, resource surveys, analysis of surrounding region, management zones, theme plans, communications, staff and visitor amenities, monitoring. Financing protected areas.

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

Module 24: Conservation Breeding and Wildlife Utilisation (1 Credit)

Captive breeding and Propagation: Founder population, rehabilitation, education, utilization, gene banks, Ex-situ and in-situ linkages, conservation breeding Management Plans, Role of scientific institution and NGOs in Conservation Breeding Programme. Principles: understanding biological requirements of species; design of facilities, food, hygiene, disease control, breeding. Propagation of threatened plants. Case studies on Conservation Breeding Programme of endangered wild animals.

Wildlife Utilisation: Non-consumptive and consumptive utilization, their economic benefit. Game ranching and controlled off-take from wild population, rationale, management design, harvesting by management or hunting licences, marketing procedures. Use of wildlife products - skins, meat, musk, etc. Wildlife Tourism - objectives, planning, economics.

Module 25: Environmental Impact Assessment (1 Credit)

Introduction to Environmental Impact Assessment (EIA) and other emerging decision support tools historical perspective, scope and purpose of EIA. Salient features of important environmental legislation, statutory obligations, national environmental clearance procedures and factors affecting the success of EIA as a decision support tool.

Procedural steps in generic EIA and adaptations for promoting biodiversity inclusive impact assessment. Mitigation objectives, approaches, hierarchy and feasibility analysis. Introduction to concepts of biodiversity offsets. Introduction to some recent approaches of economic valuation of impacts and monetising values of environmental goods and services.

Module 26: Human dimensions in Wildlife Management (1 Credit)

Park-people interface conflict and objectives of human dimensions in management; Eco-development-what, why, where, and whether; Community participation; Conservation-Development linkages; Livelihood analysis; Stakeholders in conservation; Conflict management; PA-People Mutual Influence Zone Analysis and village prioritization for pilot ecodevelopment projects; Project planning, monitoring and evaluation.

WLSC – 316: Specialised Paper in any One of the Five Thematic Areas

Module 27: Five Thematic Areas (5 Credits each) – Elective

1. **High Altitude Ecology**

    Scheduled lectures (1 Credit): Ecology of high altitude habitats (alpine, subalpine and upper temperate), species diversity & abundance, vegetation structure and composition, quantification of habitats and animal use, conservation issues and management practices. Research in the high altitudes of the Himalaya: use of modern tools and techniques.

    Guided Discussion and Self Learning (2 Credits): High altitude rangelands, pastoralism and wildlife conservation in the Himalaya, habitat degradation and loss: impacts of anthropogenic pressures and developmental projects; long-term

monitoring sites, climate change impact monitoring, Strategic Environmental Assessment; involvement of local communities in conservation; landscape and trans-boundary approaches to conservation and management – Project Snow Leopard, Regional Rangeland Management Programmes & other initiatives

Field Exercises (2 Credits): Measuring and mapping habitat variables in the high altitudes, estimating abundance and monitoring of wildlife species and their habitats using different tools and techniques

2. **Wetland Ecology**

Scheduled Lectures (1 Credit): Ecology of inland wetlands, mangroves and coral reefs. Wetland hydrology and water budget. Wetland soil and biogeochemistry. Wetland vegetation and plant production, seed bank and succession.

Guided Discussion and Self Learning (2 Credits): Environmental flow and methods of flow determination. Wetlands laws and acts. Impacts of climate change on wetlands. Wetland ecosystem services and valuation of wetlands.

Field Exercise (2 Credits): Measuring wetland variables including water quality and biomass production. Wetland fauna with special reference to monitoring of aquatic vertebrates. Wetland water quality and sediment properties.

3. **Conservation Genetics**

Scheduled Lectures (1 Credit): Genetic management of threatened species; Characterizing genetic diversity: single loci, Frequencies of alleles and genotypes; Population genetics; Evolutionary genetics; Mitochondrial DNA analysis; Microsatellite markers.

Guided Discussion and Self Learning (2 Credits): Designing a genetic study related to conservation of a species; Recombinant DNA Technology; Molecular techniques in diagnosing of infectious diseases in wildlife.

Field/Practical Exercise (2 Credits): Extraction of DNA from various biological samples; PCR amplification by using mtDNA, sex and microsatellite markers; DNA sequencing and genotyping by ABI Genetic analyser and interpretation of genetic data; further use of genetic data.

4. **Landscape Ecology**

Scheduled Lectures (1 credit): Fundamentals of Landscape Ecology (genesis, definition and central concepts); Ecological and Spatial Scales; Landscape Pattern

and Process; Fragmentation and Habitat Heterogeneity; Hierarchy Theory and Application; Drivers of Landscape Change; Landscape Equilibrium; Landscape Metrics; Spatial Statistics.

Guided Discussion and Self Learning (1 credit): Landscape Ecology and Wildlife Management; Species Distribution Models (Associative and Predictive Models); Landscape Genetics; Spatial Autocorrelation.

Lab Attachment (3 credits): Fragstats; Creating Landscape Pattern; Landscape Metrics; Meta-population Analysis (RAMAS GIS); Fractal and Neutral Landscape Models; Spatial Interpolations; Quantification of Energy and Flow; Habitat Suitability Index; Predictive Models (Presence Only and Presence/Absence Data).

5. **Global Warming and Climate Change**

Scheduled Lectures (1 credit): Introduction to global warming and climate change - the earth's natural greenhouse effect. Sources of green house gases. The role of CO_2 and Methane. The Carbon cycle. Global and regional drivers of accelerating CO_2 emissions. Climate change and changes in global weather patterns. Climate change Impacts on ecosystems such as wetlands, coral reefs, glaciers, Arctic and Antarctic ecosystems and flora and fauna. Climate change vulnerability, response and adaptations.

Guided Discussion and Self Learning (2 credits): Global warming and climate change implications - Consequences of global warming. Link between biodiversity and climate change. Climate change Impacts on ecosystems and flora and fauna. Climate change vulnerability, response and adaptations, including impacts on local communities and human well being. National strategies and policy options.

Exercises (2 credits): Current adaptation measures and policies - Tools for mitigating global warming and climate change impacts including international agreements and protocols. The role of UN Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation (REDD) and REDD+ and Clean Development Mechanism (CDM) and methods for carbon footprint analysis. Critical analysis of IPCC assessment reports.

WLSC – 317: Specialised Paper in any One of the Five Thematic Areas

Module 28: Five Thematic Areas (5 Credits Each) – Elective

1. **Wildlife Forensics**

   Scheduled Lectures (1 Credit): Extent and kind of wildlife trade at national and international levels; ramification of wildlife trade on in-situ conservation specially related to species demography; illegal trade in flora and fauna with special reference to turtles, reptiles, birds and mammals and plant trade. Principles of crime scene investigation and collection of physical and biological evidences from crime scene; use of different techniques in wildlife forensics with special emphasis on identification of species from different parts of reptiles, birds, mammals and plants. Use of forensic tools and wildlife crimes – a few case studies.

   Guided Discussion and Self Learning (1 Credit): Significance of forensic entomology in wildlife crimes; wildlife toxicology; cyber forensics in wildlife offences; forensic veterinary pathology; forensic photography; role of diatoms and wildlife forensics; ballistics, expert witness and expert opinion writing and how to face defence in the court of law.

   Field/Lab Exercise (3 Credits): Use of different techniques in identification of different parts and products of flora and fauna reported in the wildlife trade. Exercise on crime scene investigation using proper protocols, collection of different evidences from site, preparation of relevant documents. "Hands on Training" on use of DNA technology in isolation of DNA from varied forms of wildlife parts, species identification and linking accused to crime scene.

2. **Coastal and Marine Management**

   Scheduled Lectures (1 Credit): Introduction to coastal systems and their process. Management of corals, mangroves, sea grass and coastal fisheries. Planning and management of Marine Protected Areas. By-catch and Discards. Ecological significance of biorhythms. Migration in marine fauna. Ecology, conservation and management of marine arthropods, fishes, reptiles and mammals. Effects of global warming on the coastal regions. Adaptive coastal ecosystem management

   Guided Discussion and Self Learning (2 Credits): Legal frameworks and policies. International treaties and conventions. Impacts of coastal and marine activities on climate change fisheries issues and Sustainable aquaculture – case studies and

solution. Sustainable tourism – case studies and solution. Remotely sensed SST, Chlorophyll and Wind pattern features of Indian seas used in locating Potential Fish Zones (PFZ).

Field Exercise (2 Credits): Baseline inventory, sampling methods for wetland habitats, features and different wetland-dependent taxa assessment, monitoring and management of Persistent Organic Pollutants (POPs) and Persistent Toxic Substances (PTS) in coastal ecosystems, change detection and assessment methods, Resource sustainability and economics.

3. **Environment Impact Assessment**

Scheduled Lectures (2 credit): Evolution of EIA; global directives, policy support and regulatory options; worldwide adoption of EIA, and comparative review of trends around the world. History, landmarks and development of EIA in India; relevance of EIA as a planning, decision support and governance tool; review of strengths and weaknesses in current EIA practices. Types of impact assessment and requirements for conducting multidisciplinary and objective driven EIA; decision making process in India including institutional arrangements, regulatory, obligations and best practice guidance. Assessment Framework and methodological approaches for mainstreaming biodiversity in impact assessment; mitigation approaches highlighting avoidance, reduction, rectification and compensation enhancement approaches, concepts of offsets, type of offsets, examples of bio-banking and wetland banking and market based mitigation strategies. Structure and contents of EIA report, best practice guidance for quality assurances; guidelines for developing formats for preparing and reviewing EIA reports and Environmental Management Plans, Case studies. Future of EIAs and new generation Impact Assessment Tools for mainstreaming impacts on landscape, gender, climate change and ecosystem benefits in impact assessment.

Guided Discussion and Self Learning (1 Credit): Review of case studies, public hearings, undertaking review of EIAs, Developing scoping matrices. Review EIAs for evaluating the treatment given to information on biodiversity in EIA

Field Exercise (2 Credits): Short term placement with industries (Hydropower, mining and infrastructure) to appreciate the information need for conducting a scoping exercise prior to EIA. Undertake follow up of an already commissioned project to assess the robustness of evaluation phase of EIA. Undertake rapid assessment of impacts of existing developments (e.g. study of impacts of a road, rail or a canal

section) to flag issues, and threats and to guide actions to address threats. Develop alternatives of design and routes for minimising project induced impacts using computer aided decision support tools and techniques

4. **Human Dimensions in Wildlife Management**

Scheduled lectures (1 Credit): Human dimensions of wildlife conservation-challenges; Review of community based conservation initiatives- reasons for failure, success and lessons learnt; Conservation induced displacement and rehabilitation; Community survey methods including participatory tools and techniques.

Guided Discussion and Self Learning (1 Credit): Costs and benefits of protected areas for local livelihoods-displacement, changes in land tenure and community structures, restricted access to resources, human-wildlife conflicts and degradation of resources, ecotourism, payments for ecosystem services, sustainable resource management and development initiatives; Distribution of the costs and benefits of PAs; Quantifying the costs and benefits of PAs; Community natural resource management institutions.

Field Exercise (3 Credits): Hands on participatory tools and techniques for social survey; Village micro planning; Quantifying the costs and benefits of protected areas-economic costs benefit analyses, attitudinal surveys, direct impact studies.

5. **Wildlife Health Management**

Scheduled Lectures (2 credits): Role of disease and health-related issues on the larger issues facing wildlife conservation and ecosystem health, emerging wildlife and zoonotic diseases, causes and consequences of infectious disease at the levels of whole organisms, populations, communities, and ecosystems. Wildlife-livestock interface and conservation. biodiversity loss, climate change and its impact on wildlife health. Introduced/Invasive species issues and ecosystem health monitoring. Wildlife pharmacology, special medicines to treat infectious diseases in primates, carnivores, elephants, ungulates and birds.

Guided Discussion and Self Learning (1 Credit): Use of technology in wildlife health, role of veterinary medicine in wildlife rehabilitation. Case studies on disease outbreaks.

Exercise (2 Credits): Wildlife disease investigation & general field procedures. Wildlife disease risk assessment and control operations. Post-mortem examination and familiarization of instruments for necropsy for wildlife species.

WLSC – 318: Research Design and Development of Pre-Proposal (3 Credits)

Module 29:

a. Research Design (2 Credits): Scientific Logic, Biological Thoughts, Ethics in Science, Synthesis of Biogeography, Evolution, Population Ecology, Community Ecology, Habitat Ecology, Behaviour, Human Ecology, Genetics and Conservation. Critique of Ecology, Framework and Process in Ecological Research, History of Theory Development in Ecology (Science), Methods of Reasoning in Research, Principles of Measurements and Experiment. Modelling in Ecology, Impact assessment, Role of Criticism in Science, Conceptualization and Development of Research Plan.

   Lab: Log frame analysis, Modelling in Biogeography, Evolution, Population Ecology, Community Ecology, Habitat - Landscape Ecology, Behaviour, Genetics, Human Ecology ,Conservation, Impact assessment and Management

b. Development of Pre-Proposal (1 Credit)

WLSC – 319: Tour Journal (2 Credits)

WLSC – 320: Laboratory Practical (2 Credits)

WLSC – 321: Field Practical (2 Credits)

FIELD EXERCISES

The following field courses and tours will be undertaken in association with the course unit programme prescribed above.

Semester-I

1. Orientation Tour   **1 week**

Orientation to field biology and natural history. Observations and collection of study material, wildlife signs and evidences.

2. Techniques Tour (Ecology, Study Techniques, Wildlife   **2 weeks**
& Vegetation Studies).

Exercise on wildlife population parameters and census methods for various species. Vegetation studies. Studies on animal ecology.

Semester-II

3. National Park Tour   **1 week**

Visit a well known National Park (Corbett, Kanha, Ranthambore, Bharatpur)

4. Specialized Techniques Tour -1   **2 weeks**

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

5. Specialized Techniques Tour - 2   **2 weeks**

Visit a high altitude PA in the country, the appraisal of the habitat, techniques for abundance estimation and monitoring of selected Himalayan species. Exposure to management issues

Semester-III

6. Conservation Practice and Management Tour   **3 weeks**

Field tour designed to examine wildlife conservation issues in a variety of ecological situations in a bio-geographic zone of India. And, designed to understand wildlife management practices, eco-development applications and field exercises in Protected Areas.

Total - 11 weeks

DISSERTATION PROJECTS

The student is required to undertake 6 month project consisting of approximately four months field investigation, followed by 2 months data analysis and writing up. The course will provide a certified amount towards the dissertation project expenses. Dissertation topics will be offered in the field of Wildlife Ecology, Conservation Genetics, Wildlife Forensics, Wildlife health, Remote-sensing and GIS, and Human dimensions in wildlife management. Students in consultation with faculty members will be asked to take up a study on the above mentioned areas of research during the third semester. Each dissertation will be supervised by three committee members. One of the committee members will be the primary supervisor and two other will be the core committee members. Each faculty can be primary supervisor of one student and can be core committee member for up to of three students.

Once his/her dissertation topic has been selected and supervisors identified, the student should familiarize with existing literature on the subject. The students will be encouraged to develop a study design and improve it through consultations. A detail proposal to execute the study will also be essential. The student should be prepared with necessary equipment, lab resources by the end of the III semester before he/she starts field work.

The supervisors should be frequently consulted at every stage of the dissertation project, from preparation of proposal to writing the thesis. This exercise is important as it provides the student with the experience to develop a research proposal and execute it efficiently.

Students are generally encouraged to start data entry and analyses in the field to save time. A draft of chapters on methods and study area should be ready at the end of the first six months. This ensures that the supervisors have enough time to edit the chapters and provide their inputs.

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