**Ecology and Environment**

**Course title: Ecology and Environment** **Full Marks: 100**
**Course No. Zool. 611** **Pass Marks: 40**
**Nature of the course: Theory** **Year: II**
**Course description: Ecological and Environmental Theories and Principles (Terrestrial and Aquatic)**

**Course Objectives**: Existing ecological theories and principles used in terrestrial and aquatic environment. Lectures and assigned required readings are designed to provide a basic foundation in these areas provided in the course of study. Students will be examined from all of these sources.
The main objective of this course is to provide students with existing knowledge of ecological theories and principles.
**Specific Objectives**: Specific objectives are to make students understand;

- how physical, biological, and social sciences have contributed to generate ecological theories and principles in population, community, and ecosystem studies
- how ecology is a distinct discipline within biological sciences
- why ecological science is an integrated subject
- what are the existing global ecological and environmental issues

**Course contents:**
**Population ecology, community dynamics and animal behavior:** Population ecology: Natural Population- Concept and principles, regulation and dispersal. Population dispersion, structure and organization. Natural population growth and carrying capacity. Community dynamics: Natural community- Concept and principles, structure and organization. Species interactions – Competition, predation, and herbivory and mutualism, co evolution. Community change – Succession/animal communities. Behavioral ecology: Population behavior: Foraging, Social organization, Communication in birds and mammals. **30 hrs**

**Ecosystem dynamics and landscape ecology:** Ecosystem dynamics: Concept and principles, structure and organization and functions. Ecosystem energetics. Biogeochemical cycles – types and examples, cycling of organic nutrients, nutrient cycling; Acid rain and associated cycles (e.g., sulpur, nitrogen). Ecosystem evolution and development – strategy and stages of development. Landscape ecology: Concept, principles, and methods. Models for examining spatial patterns and processes of natural and managed landscapes and their effects on ecological dynamics. Landscape change. **30 hrs**

**Mountain ecology**: Mountain environment - Mountain ranges, origin and evolution, distribution, and their characteristics. Mountain natural hazards - Landslides, flood, and earthquake. Himalayan region: Himalayan environmental degradation - Deforestation, loss of biodiversity, agriculture), impacts of tourism (scientific basis). Causes and perception of causes of Himalayan environmental degradation/hazards. Prospects for future development in the Himalaya (scientific basis). **30hrs**

**Global ecology and environment – Climate change and biological invasion**: Climate Change: Introduction, greenhouse gases and climate forcing agents. Climate change prediction and biological indicators. Climate change impacts – terrestrial ecosystems (agriculture, forests and wildlife, and urban and human settlements), aquatic ecosystems (wetland/water resources), and air quality. Ecologically significant changes – Shift of species range (altitudinal), habitat destruction, responses of animals, host-parasite and disease-vector relationship (case studies). Climate change and mitigation measures and adaptations and preparedness (scientific basis). Invasive and alien species: Introduction. theory, invasive species, transportation and establishment, impacts (case studies). **30hrs**

**List of required reading materials and lecture aids**

Barber, N.A., R.J. Marquis and W. P.Tori. 2008. Invasive prey impacts the abundance and distribution of native predators. Ecology 89(10): 2678-2683.

Campos-arceiz, A, A.R.Larrinaga, et al. 2008. Behavior rather than diet mediates seasonal differences in seed dispersal by Asian elephants. Ecology 89(10): 2684-2691.

Gret-Regamey, A, A. Walz and P. Bebi 2008. Valuing ecosystem services for sustainable landscape planning in Alpine regions. Mountain Research and Development 28 (2):156-165.

Janzen, D.H. 1980. When is it coevolution? Evolution 34(3):611-612.

Jennifer L. Funk1 & Peter M. Vitousek. 2007. Resource-use efficiency and plant invasion in low-resource systems. Nature 446. |26 April 2007| doi:10.1038/nature05719

Preisser, E.L. and Elkinton, J.S. 2008. Exploitative competition between invasive herbivores benefits a native host plant. Ecology 89(10): 2671-2677.

Yunling, He, Zhang Yiping 2005. Climate Change from 1960 to 2000 in the Lancang River Valley, China. Monutain Research and Development 25 (4):341-348.

**Text books and references**

Begon, M, J.L.Harper, C.R. Townsend 1996. Ecology. Blackwell Science, Massachusetts, USA.

Bormann, H. and G.E. Likens. 1979. Ecosystem development: patterns and processes. Springer-Verlag, New York.

Ives, J. D. 2006. Himalayan Perceptions. HimAAS, Nepal.

Gurung, H. 2000. Mountains of Asia: a Regional Inventory. ICIMOD, Nepal.

Huston, M.A. 2002. Biological diversity. Cambridge University Press, Cambridge, U.K.

IPCC 1990. Climate change. WMO/UNEP, Australia.

Korner, C. and E.M. Spehn. 2002. Mountain Biodiversity. The Parthenon Publishing Group, New York.

Krebs, C.J. 1996. Ecology harper Collins College Publishers, Inc. New York.

Likens, G.E and h. Borman 1981. Bigeochemical cycles. Springer-Verlag, New York.

Messerli, B. and J. D. Ives. 1997. Mountain of the World: A Global Priority

Odum, E.P. 1971. Fundamentals of Ecology. Saunders College Publishing, Philadelphia USA.

Peters, R.L. and Thomas E. Lovejoy 1992. Global Warming and Biological Diversity. Yale University Press, USA.

Smith and Smith 1998. Ecology and Field Biology. Benjamin Cumming, USA.

WMO 1991. Climate Change: Science, Impacts and Policy. Cambridge University Press, Cambridge, U.K.

## Ecology and Environment

**Course title: Ecology and Environment** **Full Marks: 100**
**Course No. Zool. 612** **Pass Marks: 40**
**Nature of the course: Theory** **Year: II**
**Course description: Ecological Application in Natural Resource Management**

**Course Objectives**: Application of ecological theories and principles in natural resource management and environmental conservation is complex but an important aspect of teaching ecology. Lectures and assigned required readings (see the list of required readings below) are designed to provide a basic foundation in these areas provided in the course of study. Students will be examined from all of these sources. The main objective of this course is to provide students with areas and examples of transforming ecological theories and principles to natural resource management and environmental conservation
**Specific Objectives**: Specific objectives are to make students understand;

- biodiversity conservation in a broad context
- wildlife management in a broad context
- ecosystem/watershed management
- environmental impact assessment

**Course contents:**

**Biodiversity conservation:**

- **Conservation Ecology:** Introduction: Concept, scope and field of conservation ecology; a brief history of conservation ecology. Principles of biodiversity conservation and recent trends in conservation.
- **Biodiversity: patterns and processes**: Biodiversity concept, principles and scope, Hierarchical levels, and values of biodiversity. Biodiversity and associated factors, latitudinal gradients in species richness, species richness and productivity, diversity and sample area, diversity and disturbances. Measuring and understanding biodiversity - Inventory, assessments and mapping.
- **Threats to biodiversity:** Concept of rare, endemic, threatened and endangered species. Natural and human induced threats - overexploitation, habitat disruption, fragmentation, and pollution. Global endangerment and extinction - extinction in geological time, current extinction rates, extinction processes, the biology of human-caused extinction, types of species most vulnerable to extinction. Examples of threats to biodiversity from the Eastern Himalaya and Nepal.
- **Conservation approaches and strategies**:
- **Introduction**: traditional, conventional and community-based approaches; current practices (*in-situ* and *ex-situ* conservation); protected areas, conservation policies and legislation of Nepal.
- **Population approach**: conservation biology of small populations; metapopulation, concepts and conservation; approaches for population monitoring, prediction to resilience and conservation (population viability analysis; case studies: optimal harvesting and population management, pest control and management of biological invasion).
- **Species approach**: conservation through protected area systems; habitat management and conservation; conservation of rare, endangered, threatened and endemic species; conservation of species of medicinal values); ecological restoration and conservation, animal reintroduction (case studies such as rhinoceros of Nepal).
- **Landscape approach:** Challenges and opportunities, landscape-based models for conservation, corridors and trans-boundary conservation, integrated conservation and development. Ecoregion approach: concept, scope and scale; ecoregion conservation principles, Global ecoregions. **30 hrs**

**Wildlife ecology and management:** Wildlife Fundamentals – concept and scope, values, and conservation. Wildlife ecology and population dynamics of important species (tiger, rhinoceros, elephants, snow leopard, blue sheep, sloth bear, swamp deer, dolphin, crocodiles and small mammals etc,). Wildlife management: Principles of Wildlife Management and techniques. Wildlife Habitat (components) and habitat management. Wildlife Habitat Evaluation. Managing Human-Wildlife Conflicts. Wildlife Policy and Law and Legal framework of wildlife conservation in Nepal. Conservation and Management of Large Mammals including Translocation (capture and handling etc). **30 hrs**

**Ecosystem management**: Integrated ecosystem management: Ecosystem resilience and key elements. Examples of ecosystem approach – Watershed management and major river basins of Nepal (from ecological/habitat of perspective). Protected areas - protection of threatened ecosystems. Grassland ecosystems and management - introduction, savanna, temperate grassland, shrubs and meadows. Wetland ecosystem: Characteristics, status, and distribution of wetlands in Nepal (with particular focus on Ramsar sites and recent initiatives). Wetland and global change (scientific basis). **30 hrs**

**Environmental Impact Assessment**: Introduction: Concept of EIA, IEE, SIA, and objectives. History - Evolution/development from national and international perspective. Policy- General EIA and EIA related policies and acts including environmental policies and acts of Nepal. Project screening and initial environmental examination: Objective, criteria; factors and timing of the IEE. Scoping: Methods, responsible organizations, timing, terms of reference for EIA. Identification of environmental impacts: Types of impacts. Methods of impact identification (existing environmental conditions, altered conditions, impact prediction and impact ranking). Environmental impact mitigation measures and enhancement. Environmental Impact Monitoring- types, principles, process and timing. Environmental Impact Auditing – types, process and timing. Preparing Environmental Report- Integration of screening, scoping, and detail EIA. **30 hrs**

**List of required reading materials and lecture aids**


Basnet, K. 2003. Environmental Management and Biodiversity Conservation in the New Millenium. Pages 178-191 in M. Domroes (editor). Translating Development: The Case of Nepal. Social Science Press.

Basnet, K. 2003. Transboundary Conservation: An example from Nepal. Journal of Sustainable Forestry (USA) 17: 205-226.

Basnet, K. 2004. Large-scale Conservation in the Eastern Himalayas: An Ecotourism Perspective. Tribhuvan University Journal. 24(1):1-11.

Basnet, K. 2006. Effects of Anthropogenic Disturbances on Biodiversity: A Major Issue of Protected Area Management in Nepal. Pages 295-308 in E. Spehn, M. Liberman, and C.Korner (editors). Land use changes and Biodiversity. CRC Press, USA.

Bestelmeyer, B.T., J.R. Miller and J.A.Weins. 2003. Applying species diversity theory to land management. Ecological Applications 13 (6):150-1761.

Shrestha, R. and Per Wegge 2008. Habitat relationships between wild and domestic ungulates in Nepalese trans-Himalaya. Journal of Arid Environments 72 (2008) 914–925

Spiteri, A. and S. K. Nepal 2008. Evaluating Local Benefits from Conservation in Nepal's Annapurna Conservation Area. Environmental Management 42:391–401


**Text books and references**


Basnet, K. and P. Kindlmann 2009. Himalayan Biodiversity: Linking Research and Conservation. Springer

Begon, M, J.L.Harper, C.R. Townsend 1996. Ecology. Blackwell Science, Massachusetts, USA.

Berwick and Sahana 2000. Wildlife Management – Asian and American Approach. Natraj Publishing House, India.

Dinerstein, E. 2003. The return of the unicorn. Columbia University Press, New York.
Domrose, M. 2003. Translating Development in Nepal. Social Science press, New Delhi.
Gilpin, A. 1995. Environmental Impact Assessment. Cambridge University Press, UK.
GoN ----National Environmental Impact Assessment Guidelines
Gopal, R. 199..Fundamentals of wildlife management, India.
Goodale, U.M., M. Stern et al. 2003. Transboundary Protected Areas. The Haworth Press, New York.
Groom, M.J. G.K. Meffe, and C.R. Carroll. 2005. Principles of Conservation biology. Sinauer Associates Inc.
Jnawali, S.R. and S. Gundersen (editor).1988. Tiger manual – indirect field techniques for the Kingdom of Nepal, WWF Nepal Program, Kathmandu.
Krebs, C.J. 1996. Ecology. Harper and Collins College Publishers, Inc. New York,
Odum, E.P. 1971. Fundamentals of Ecology. Saunders College Publishing, Philadelphia USA.
Peters, R.L. and Thomas E. Lovejoy 1992. Global Warming and Biological Diversity. Yale University Press, USA.
Richards, C., K. Basnet et al. 2000. Grassland ecology and management in protected areas of Nepal. Volumes 1-3. ICIMOD, Kathmandu.
Rodgers, W.A. 1991.Techniques of Wildlife Census. Dehradun, India.
Spehn, E., M. Liberman, and C.Korner (editors). Land use changes and Biodiversity. CRC Press, USA
Sutherland, W.J. 2000. The Conservation Handbook: Research, Management and Policy
WCMC 1992. Global Biodiversity: Status of the Earth's Living Resources. Chapman and Hall, London.
Wikramanayake, E. et al. 2003. Terrestrial Ecoregion. Island Press, Washington, D.C., USA.

## Ecology and Environment

**Course title: Ecology and Environment** **Full Marks: 100**
**Course No. Zool. 613** **Pass Marks: 40**
**Nature of the course: Theory** **Year: II**
**Course description: Biogeoraphy, Quantitative Methods, and Technology in Ecology**

**Course Objectives**: Biogeography, quantitative methods, and technology provide essential ingredients for critical analysis and understanding ecological theories and principles. Lectures and assigned required readings (see the list of required readings below) are designed to provide a basic foundation in these areas provided in the course of study. Students will be examined from all of these sources. The main objective of this course is to provide students with a broad knowledge of ecological phenomena, analytical tools and techniques, and applicable technology in ecological field.
**Specific Objectives**: Specific objectives are to make students understand;

- the meaning and scope of biogeography
- various quantitative analytical tools and methods used in ecology
- research design and writing scientific proposal, theses/dissertations, papers and reports
- basic concept of GPS, GIS and Remote sensing as tool for natural resources management

**Course contents:**
**Biogeography:** Concept, scope and principles. History of Biogeography: Origin and development of ecological biogeography. Biogeographical regions. Pattern and hypothesis - Global and local pattern, endemism and invasion (detail). Biodiversity distribution - Distribution of species, communities, biodiversity hotspots (detail). Biodiversity distribution - Distribution of species, communities and ecosystems, biomes, limits of distribution, barriers and environmental gradients, biodiversity hotspots (Global and local in detail). Biogeography processes - Dispersal, immigration, speciation, and extinction (detail). Island biogeography: Theory and practice (detail). Theory and design of nature reserve. Adaptive radiation. Examples from major islands. Mountain biogeography: Theory and practice; Examples from the Himalaya. Biogeographical consequences of global change. **26 hrs**
**Basics of quantitative ecology and ecological models:** Introduction – concept and scope, ecological data/classification. Ecological ordination and gradient analysis: Principal component analysis (PCA). DCA, and relevant analysis. Ecological models: Nature of ecological/mathematical models. Development of ecological models. Single population and two populations examples. Ecological Methods (Terrestrial environment and aquatic environment): Sampling – Size, number, timing. Quadrat and transects –types, sizes, and numbers. Absolute population estimate – marking technique (capture-recapture). Relative population estimate . Population estimates of wildlife - Data collection by direct and indirect methods; Indices of population abundance, direct count, sample count, Camera trapping and analysis, Translocation process (with example of large mammals). **34 hrs**
**Research methods and biostatics: research designing - thesis/paper writing**: Introduction: Background and identification of research problem, objectives, justifications. Research design: Hypothesis setting, types of research design, principles of experimental designs; sampling, types of sampling (simple random sampling, stratified random sampling, systematic sampling, cluster sampling, multistage sampling); basic unit of study and variables for measurement, data collection (primary and secondary), and analytical tools (see below). Data analysis: Hypothesis testing, measurement of central tendency, dispersion, relationship (simple correlation and regression analysis), multiple correlation and regression, chi-square test, t-test and z-test, analysis of variance (ANOVA) and analysis of covariance (ANCOVA), Multivariate analysis (see above). Interpretation of results: outcome of the data analysis, acceptance and rejection levels, assumptions, evidence from literature, and tentative conclusion. Writing thesis, scientific papers, and reports. **30 hrs**

**Technology for ecological research:**
**Application of GPS, GIS, and Remote Sensing:**
**Introduction to GPS**
**Introduction to geographic information systems (GIS)** - Introduction: Definition and basic concepts of GIS, Component of GIS, Commonly used software, GIS applications. Database Structure: Geographic data and its representation, Raster and vector data. Data capture and database: Concept Sources of data, database design, spatial data and non-spatial data, database management. Spatial (GIS) analysis: proximity and overlay analysis (measurement operation, overlaying operation, neighborhood operation and connectivity operation). Output: Types of output, map design. Application of Geographic Information Systems in Natural Resource Management: Case Studies presentation.
**Remote Sensing and Aerial Photograph** - Introduction: An overview, characteristics and application of Remote Sensing. Photogrammetry: Introduction, aerial photography, aerial photo interpretation and analysis, and its application. Image Interpretation and Analysis: Introduction, basic principles, methods of image interpretation and analysis. Digital Image Processing: Introduction, Image processing, and classification. Application of Remote Sensing in Natural Resource Management: Case Studies presentation.
Analytical tools - Qualitative and quantitative analysis, EXCL and SPSS.

**30 hrs**

**List of required reading materials and lecture aids**


Gilbert, F.S. 1980. The equilibrium theory of island biogeography:fact or fiction. Journal of Biogeography. 7: 209-235.

Brown, J.H. 1971. Mammals on mountain tops: non-equilibrium insular biogeography. The American Naturalist 105:467-477.

Simberloff, D. 1976. Species turnover and equilibrium island biogeography. Science 194: 572-578.

G.L. Jerde and D.r. Visscher 2005. GPS measurement error influences on movement model parametrization. Ecological Applications 15(3);806-810.

Gorresen, P. Marcos, M.R. Willig and R.E. Strauss. 2005. Multivariate analysis of scale-dependent association between bats and landscape structure. Ecological Applications 15 (6): 2126-2136.

Lewis, K.P. 2004. How important is the statistical approach for analyzing categorical data? A critique using artificial nests. Oikos 104:305-315.

Wilson, P. et al. 2004. Multivariate search for pollination syndrome among penstemons. Oikos 104:345-361.


**Text books and references**


Aronoff, Stan 1989. Geographic Information Systems: A Management Perspective, WDL Publications, Ottawa.

Avery, Thomas Eugene and Graydon Lennis Berlin. 1992. Fundamentals of Remote Sensing and Airphoto Interpretation, Fifth Edition, Macmillan Publishing Company, New York.

Bernhardsen, Tor 1992. Geographic Information Systems, VIAK IT.

CDZ 2009. Biostatistics: A Handbook for Students of Biological Sciences. Kathmandu

Cox, C.B. and P.D. Moore 2007. Biogeography. Blackwell Publishing, Massachusetts, USA.

CSSTEAP 2004. Remote Sensing & Geographic Information System: Lecture Notes Module – 1. Volumes I and II, Second Edition, Indian Institute of Remote Sensing, Dehradun, India.

Hicks, R. C. 19… Fndamental concepts in the Design of Experiments. Holt, Inehart and Winston, New York.

Jeffrey Star and John Estes 1990. Geographic Information Systems: An Introduction. Prentice Hall, New Jersey, USA.

Kothari, C.R. 2000. Research Methodology. Vishwa Prakashan, New Delhi.

Lillesand, Thomas M. and Ralph W. Kiefer. 1987. Remote Sensing and Image Interpretation, (2nd Edition), John Wiley and Sons, New York.
Lomolino, M.V., B.R. Riddle, and J.H. Brown. 2006. Biogeography. Sinauer Associates, Inc., Massachusetts, USA.
Otto, S.P. and T. Day 2007. A Biologists Guide to Mathematical Modeling in Ecology and Evolution. Princeton University Press, USA.
Pielou E.C. 19….An Introduction to Mathematical Ecology…..
Pielou, E.C 1994. The interpretation of ecological data. Wiley-Interscience. New York.

## Ecology and Environment

**Course title: Ecology and Environment** **Full Marks: 50**
**Course No. Zool. 614** **Pass Marks: 20**
**Nature of the course: Practical I** **Year: II**
**Course description:** Analysis of terrestrial and aquatic ecosystems

**Course Objective**: The main objective of this practical is to provide students with practical knowledge of population, community and ecosystem analysis commonly used in ecological studies.

**Specific Objectives**: Specific objectives are to make students understand;

- how important are proper sampling/methods in ecological study
- how to explore structure, organization and functions of population, community, and ecosystems
- how to analyze ecological and environmental processes
- how to write term papers and give good presentations (learning by doing)

**Course contents:**

**Ecological methods in terrestrial and aquatic environment:**

a) Sampling: Determining sample size and timing. Quadrat method - types, size and their use (at least one example of each). Transect methods - types, size/length and their use (at least one example of each). Trapping/collecting, bin sampling, grab sampling etc.Aerial sampling

b) Population measurement : Population structure and composition. Population growth/increase. Construction of life table

**Community analysis:**

a) Community measurement: Biodiversity. Structure and composition. Community diversity indices. Community similarity indices.

**Ecosystem analysis (Field and lab experimental analysis):**

a) Habitat analysis
b) Biota analysis
c) Ecological relationships
d) Productivity
e) Environmental component - Water analysis and soil analysis

**Climate analysis - using real secondary data**

a) Temperature variations – Daily, monthly, seasonal, annual; long-term periodic
b) Local and regional trend of temperature change

## Ecology and Environment

**Course title: Ecology and Environment** **Full Marks: 50**
**Course No. Zool. 615** **Pass Marks: 20**
**Nature of the course: Practical II** **Year: II**
**Course description:** Quantitative methods and tools in ecological and environmental analysis methods and tools in ecological and environmental analysis

**Course Objective**: The main objective of this practical is to provide students with analytical tools and their use in ecological studies
**Specific Objectives**: Specific objectives are to make students understand;

- how to use analytical tools in ecological research
- how to use GPS and GIS and apply them in ecological analysis
- how to use RS and aerial photography in resource management
- how to prepare GIS maps

**Course contents:**
**Biodiversity conservation:** Biodiversity Assessment: Biodiversity survey/inventory- Extensive and intensive methods (at least one example of each). Developing database (simple electronic database). Measuring conservation status - Conservation value, conservation threat, and indices
Measuring species diversity: experiment associated factors
**Wildlife management:** Population census/estimation: Direct and indirect methods/survey. Scat analysis. Camera trapping: Field preparation and setting cameras. Collecting data. Analyzing data. Wildlife darting and translocation: Demonstration/observation
**Ecological technology and techniques/tools:** Maps reading and interpretation: Topo maps, geological maps. Aerial photo interpretation and analysis. Application of remote sensing - data analysis. Spatial data collection using GPS. Preparing GIS maps: Digitizing/input. Spatial analysis/overlays. Map design/output. Ecological data analysis: SPSS

**Ecology and Environment**

**Course title: Thesis in Ecology and Environment** **Full Marks: 100**
**Course No. Zool. 616** **Pass Marks: 40**
**Nature of the course: Field/lab research for thesis** **Year: II**
**Course description:**

Course description: Students have to conduct field or lab research for their theses in consultation with the head of the department and respective supervisors and submit (the theses) to the department. The department will make an arrangement for internal and external evaluation and invite the concerned students to defend the submitted theses. Students can choose their research topics from the existing framework of the course of studies in consultation with the proposed supervisors and get approval from the head of the department. The main focus and specialization of the Ecology and Environment Program will be geared towards mountain ecology and environment –theories, principles, and practices. Students have to follow the department's format for their theses and the recent research guides for graduate students.

**Suggested areas of research include;**

1) Acid rain – causes and consequences
2) Animal behavior
3) Biodiversity conservation approach
4) Biodiversity maintenance
5) Biogeographical processes
6) Climate change and impacts
7) Community dynamics
8) Ecoregion based conservation
9) Ecosystem dynamics
10) Environmental impacts
11) Environmental management
12) Invasive species
13) Landscape level conservation
14) Mountain biogeography
15) Mountain degradation
16) Natural hazards and biodiversity/wildlife
17) Nutrient cycle
18) Population dynamics (animals)
19) Watersheds
20) Wetlands
21) Wildlife and wildlife management
22) Wildlife-livestock conflict

**Criteria:**

Research must be scientific. No sociological and anthropological studies will be accepted in the science department.

**Acknowledgements**

Courses for Ecology and Environment was developed and approved by

1) Standing Committee of Zoology
2) Subject Committee of Zoology
3) Faculties involved in teaching ecology
4) Courses developed, reviewed, and compiled by
Dr. Khadga Basnet
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ii) Prof. Jack D.Ives, Canada
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v) Dr. Pralad Yonzon. Resources Himalaya, Kathmandu
vi) Dr. Siddhartha B. Bajracharya . NTNC, Kathmandu
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7) All the people involved in the process are highly acknowledged for their interest, time, and ideas. Thank you all.

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**Tribhuvan University**

**Master Level (2 Yrs/IIst Yr)Sc. & Tech.** **Full Mark: 100**
**Zoology 611 (Ecological and Environmental Theories and Principles (Terrestrial and Aquatic)** **Pass Marks: 40**
**Time : 4 hrs**

**Model Question (New course, 2065)**

*Candidates are required to give their answers in their own words as far as practicable. The figures in the margin indicate full marks.*
*Illustrate your answers with suitable diagrams wherever necessary.*

**Group A (Pop. ecol., Commun. dynam. and animal behav., Ecosy. dynam. and landscape ecol.)**
*Attempt any two questions only* 2x10=20

1. How do geometric growth and logistic growth of population compare? Provide adequate materials in your comparison.
2. What does Lotka-Voltera model of competition between organisms explain? Describe it with appropriate equations.
3. Ecosystem exhibits a dynamic process that undergoes through different stages of development. Explain thoses stages with their biological characteristics and compare with regular succession.

**Group B (Mountain ecol., Global ecol. and env. – Climate change and biol. invasion)**
*Attempt any two questions only* 2x10=20

4. Which of the small, medium, or large-scale natural hazards is more important for the maintenance of biodiversity and why? Justify your answer with examples of landslides in the middle mountains of Nepal.
5. Deforestation is a major cause of biodiversity loss. Justify it with suitable examples.
6. One of the major effects of climate change is vertical shift in vegetation zone and animal communities. Provide your justifications weather you agree or disagree with the statement.

**Group C**

*Attempt all questions* 8x5=40

7. What is a community? Clarify it providing the main characteristics of the community.
8. What is couple oscillation theory related to? Describe it briefly.
9. How do ecosystems in developmental stage and mature stage behave in their structure and function?

   Or

   Communication in birds is the most studied area in biology. Describe it briefly.

10. Define biogeochemcial cycle and describe a gaseous cycle in nature.
11. What are the major mountain ranges? Provide biophysical characteristics of the Eastern Himalaya.

    Or

    How tourism affect wildlife protection? Back up your arguments by scientific reasoning.

12. What are the basic assumptions of the Himalayan environmental degradation theory? Explain them briefly.
13. What are the major interfaces between biodiversity and climate change? Outline them with explanatory notes.
14. Write short notes on any two
    a) Foraging behavior and distribution of animals

b) Social organization in mammals
c) Invasive species in Nepalese wetlands

## Group D

*All are compulsory* 8x2.5=20

15. Give the very short answers of the following:
    i. Define the term carrying capacity.
    ii. How biodiversity is measured?
    iii. What is the measure of similarity index?
    iv. Differentiate between mutualism and parasitism with examples.
    v. Name the trace elements.
    vi. Is herbivory a predation?
    vii. What does the coevolution explain?
    viii. How acid rain is formed?
    ix. Which are the youngest mountain ranges?
    x. How the strength of an earthquake is measured?
    xi. Which is a stronger greenhouse gas – carbon dioxide or methane?
    xii. Are all invasive species alien? Why?

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**Tribhuvan University**

**Master Level (2 Yrs/IIst Yr)Sc. & Tech.** **Full Mark: 100**
**Zoology 613 (Ecological Application in Natural Resource Management)** **Pass Marks: 40**
**Time : 4 hrs**

**Model Question (New course, 2065)**

*Candidates are required to give their answers in their own words as far as practicable. The figures in the margin indicate full marks.*
*Illustrate your answers with suitable diagrams wherever necessary.*

**Group A (Biod. conserv., Wildlife ecol. and manag. )**

*Attempt any two questions only* 2x10=20

1. How protected area system is categorized in Nepal? Trace their evolution in the context of biodiversity conservation.
2. What are different threats to biodiversity? Elaborate biological threats in the Himalayan range and Nepal.
3. Biological events in geological time scale suggest that species extinction is a natural process. If so, how the role of present conservation initiatives can be justified in protecting wildlife species?

**Group B (Ecos. manag., Env. Imp. Asses.)**

*Attempt any two questions only* 2x10=20

4. What functions do wetlands play in climate change and its impacts? Describe it briefly.
5. How IEE differs from EIA? Describe major methods that are commonly used in EIA citing the case of hydropower development in Nepal.
6. Why environmental management plan of any development projects is necessary? Describe defferent components of such plan and their implications.

**Group C**

*Attempt all questions* 8x5=40

7. Define biodiversity. Explain what message global and local biodiversity convey with examples.
8. Why biodiversity mapping is essential? Enumerate the techniques used in the process.
9. Differentiate between endangered, rare, and protected species with good examples of each.

   Or

   Compare reproductive behavior and present status of tiger and snow leopard in Nepal.
10. Outline basic components of a protected area management plan that a manager can implement in the field and also attract funding agencies?

    Or

    How translocation of large mammals takes place? Describe stepwise processes with explanatory notes
11. There is a set of traditional criteria for a habitat evaluation. Provide your comments if the set is adequate or complete.
12. What are the major causes of species extinction? Explain them with suitable examples.
13. Ecoregion-based conservation is a large-scale initiative with a set of fundamental principles. Point out those principles with a short assessment.
14. How EIA emerged in Nepal? Describe the events of its development in a chronological order.

**Group D**

*All are compulsory* 8x2.5=20

15. Give the very short answers of the following:

i. What is the main indicator of the recent trend in conservation?
ii. How do you prioritize the groups of individuals for conservation based on biodiversity parameters?
iii. Which is a stronger force in species richness – latitudinal gradient or local conditions?
iv. Why mass extinction occurred in certain periods of the earth history?
v. How endangered species are protected by a nation?
vi. Define the meaning of habitat suitability index (HSI). Elaborate its use.
vii. Why small population in a small area may have a greater chance of extinction?
viii. Which of the following species are included in CITES.
ix. How many mammal and bird species of are protected? Name two of each.
x. Which group of animals are most vulnerable to extinction and why?
xi. Differentiate between translocation and reintroduction.
xii. Is screening preceded by scoping in EIA? Why?

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**Tribhuvan University**

**Master Level (2 Yrs/IIst Yr)Sc. & Tech.** **Full Mark: 100**
**Zoology 613 (Biogeoraphy, Quantitative Methods, and Technology in Ecology)** **Pass Marks: 40**
**Time : 4 hrs**

**Model Question (New course, 2065)**

*Candidates are required to give their answers in their own words as far as practicable. The figures in the margin indicate full marks.*
*Illustrate your answers with suitable diagrams wherever necessary.*

**Group A (Biogeog., Basics of quant. ecol. and ecological models)**

*Attempt any two questions only* 2x10=20

1. What does island biogeography theory explain? Describe it briefly
2. Speciation is one of the major processes of biogeography. Explain how it occurs in nature.
3. Which conditions demand PCA for a data analysis? How it is employed in testing hypotheses, if it is done so? Interpret the following plots with Axis 1 and Axis 2 generated by PCA (Figure is provided).

**Group B (Research method. and biostat., Tech. for ecological research)**

*Attempt any two questions only* 2x10=20

4. A biologist conducted an experiment to investigate the effect of temperature on population growth of Paramecium sp. He selected 20 small beakers filled with 150 ml of tap water and added 20 experimental organisms to each of them to start with and then set them at different temperatures (5 beakers at room temperature, 5 each at 10%, 15% and 20% above the room temperature). He counted the number of Paramecium per 1 cc of water sampled from each beaker every other day for 10 days. Average numbers of Paramecium are given below.

| Temperature | Beakers | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Room temperature RT | 255 | 250 | 265 | 245 | 20 |
| 10% above RT | 280 | 265 | 285 | 275 | 270 |
| 15% above RT | 295 | 280 | 295 | 285 | 290 |
| 20% above RT | 310 | 300 | 320 | 295 | 305 |

   Use one way analysis of variance to test the effect of temperature treatments on the growth of Paramecium population. Tabulated value of F (d.f=3, 16 at 95% confidence level) is 3.2. Set up your hypothesis, set up your ANOVA table, and sate your conclusion clearly.

5. Develop two hypotheses for your research with a problem statement and justifications and write down detail analytical tool or ways of testing them.
6. What are the major processes of GIS spatial analysis? Explain them with examples and interpret the given GIS map.

**Group C**

*Attempt all questions* 8x5=40

7. Explain the meaning of turnover rate in biogeography providing a case study of avifauna.
8. What were the main characteristics of MacArthur and Wilson's (1963 and 1967) proposition about the theory of island biogeography?

9. Use the following (data provided) capture and recapture data to estimate the absolute population. Explain its meaning.
10. Differentiate between tundra and alpine biomes providing their specific characteristics.

Or

How terrestrial biomes are categorized? Describe it briefly.

11. Diferentiate between PCA and DCA in their application and strength.

Or

Interpret the given figure/plot generated by DCA

12. How ecological models are developed? Explain it providing fundmental characteristics of models.
13. Compare parametric and non-parametric tests with examples and uses in ecological researches. Which test does $X^2$ fall to and why?
14. Write short notes on any two;

a) Endemism
b) GPS
c) Remote sensing

## Group D

*All are compulsory* 8x2.5=20

15. Give the very short answers of the following:

i. Why communities do not have the same pattern of distribution?
ii. What is invasion?
iii. How faunal equilibrium is explained?
iv. Define ordination.
v. When gradient analysis is done?
vi. Differentiate between single and two population models providing basic equations.
vii. Point out the fundamental properties of an experiment?
viii. When ANCOVA is used?
ix. List down the sampling techniques used in studying terrestrial mammals?
x. Differentiate between raster and vector data.
xi. What is photogrammetry?
xii. Why Digital Image Processing is needed?

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