

Scheme of Studies

and

Course Contents

(Revised in July 2013)

for

**M.Sc., M. Phil. & Ph.D. Degrees
in Wildlife Management**

**Department of Wildlife Management
Faculty of Forestry, Range Management & Wildlife
PMAS Arid Agriculture University, Rawalpindi**

**List of Courses for Postgraduate Courses for
M.Sc., M. Phil., Ph.D. Degrees in Wildlife Management**

Sr. No.	Course No.	Course Title	Credit hours
01	WL-701	An Introduction to Wildlife of Pakistan	3 (2-2)
02	WL-702	Wildlife Population Ecology	3 (3-0)
03	WL-703	Principles of Wildlife Management	3 (3-0)
04	WL-704	Wildlife Study Techniques-I: Biological Aspects	3 (2-2)
05	WL-705	Wildlife Study Techniques-II: Management Aspects	3 (2-2)
06	WL-706	Wildlife Management at Wetlands	3 (2-2)
07	WL-707	Terrestrial Wildlife Management	3 (3-0)
08	WL-708	Wildlife Damage Management	3 (2-2)
09	WL-709	Society, Values & Economics of Wildlife	3 (3-0)
10	WL-710	Protected Areas and their Management	3 (3-0)
11	WL-711	Research Planning and Report Writing	3 (1-4)
12	WL-712	Conservation Biology of Wildlife	3 (3-0)
13	WL-713	Wildlife Food and Foraging	3 (3-0)
14	WL-714	Reproductive Biology and Breeding	3 (2-2)
15	WL-715	Management Aspects of Wildlife Behavior	3 (3-0)
16	WL-716	Wild Fish fauna of Pakistan	3 (3-0)
17	WL-717	Endangered Species and their Management	3 (3-0)
18	WL-718	Captive Wildlife Management	3 (3-0)
19	WL-719	Special Problem	1 (1-0)
20	WL-720-I	Seminar-I	1 (1-0)
	WL-720-II	Seminar-II	1 (1-0)
21	WL-721	Wildlife Habitat Evaluation and Restoration	3 (3-0)
22	WL-722	Predator Ecology and Management	3 (3-0)
23	WL-723	Wildlife Eco-toxicology	3 (3-0)
24	WL-724	Wildlife Diseases and their Management	3 (3-0)
25	WL-725	Museum Science	3 (2-2)
26	WL-726	Essentials of Wildlife Conservation-National Perspectives	3 (3-0)
27	WL-727	Capture, Care and Transportation of Wildlife	3 (2-2)
28	WL-728	Wildlife Policy, Legislation and International Conventions	3 (3-0)
29	WL-729	Biology and Conservation of Amphibians and Reptiles	3 (2-2)
30	WL-730	Captive Breeding and Assisted Reproduction in Wildlife	3 (2-2)
31	WL-731	Wildlife Farming and Ranching	3 (3-0)
32	WL-732	Wildlife Data Analysis	3(1-4)

Course Contents and Recommended Books for M.Sc., M. Phil., Ph.D. in Wildlife Management

WL-701	An Introduction to Wildlife of Pakistan	3(2-2)
---------------	--	---------------

Theory

General principles of wildlife distribution. Zoogeographical regions of the world and Pakistan. Classification, distribution, status and general account of mammalian fauna, avian fauna and herpeto-fauna of Pakistan.

Practical

Identification of wildlife species based on museum specimen and live captive animals belonging to major groups of mammals, birds, reptiles and amphibians.

Book Recommended:

- 1) Daniel, J.C. 1992. The Book of Indian Reptiles. Bombay Natural History Society, India.
- 2) Darlington, P. J. 1957. Zoogeography: The Geographical Distribution of Animals. John Wiley and Sons. N.Y.
- 3) Khan, M. S. 2006. Amphibians and Reptiles of Pakistan. Krieger Publishing Company. 311pp.
- 4) Muller, P.J. 2006. Aspects of Zoogeography. W. Junk Publishers, Hague, Netherlands
- 5) Roberts, T. J. 1997. The Mammals of Pakistan. Oxford University Press. 525pp.
- 6) Roberts. T. J. 1992. The Birds of Pakistan (Vol. I& II). Oxford University Press. 598, 617pp.

WL-702	Wildlife Population Ecology	3(3-0)
---------------	------------------------------------	---------------

Theory

Introduction to biomes, describing populations, population processes, population theories, community structures and life tables (populations' case histories, structure, age, sex classes, patterns of growth, survival, niche concept, carrying capacity, biomass, mortality and natality). Wildlife population regulation. Home range and territory. Animal as individuals, animal in populations, dispersal, dispersion and distribution. Competition within species, competition and facilitation between species. Genetic concepts and tools to support wildlife population biology, estimating population vital rates, density dependent and density independent population change, genetic variation and fitness of wildlife populations, dynamics of multiple populations, dynamics of small and declining populations, population biology of harvested populations. Philosophy and techniques for estimation of animal abundance. Field visits of natural wildlife habitats for observing the animal population and ecologies.

Books recommended

- 1) Bailey, J.A., Elder, W. and McKinney. 1974. Readings in Wildlife Conservation. The Wildlife Society, Washington D.C.
- 2) Begon, M. and M. Mortiner. 1981. Population Ecology: a unified study of animals and plants. Sinauer associates Inc. Publishers. Sunderland Massachusetts. 200pp.
- 3) Caughley, G and Anthony R.E. Sinclair, 1994. Wildlife Ecology and Management. Blackwell science publication. 334 p.
- 4) Mills, L.S. 2007. Conservation of Wildlife Populations: Demography, Genetics and Management. Blackwell Publishing, USA

- 5) Pielon, E. C. 1983. Population and Community Ecology: Principles and Methods. Gordon and Breach Science Publishers.
- 6) Ringer, P.G. 1991. Long Term Ecological Research. An International Perspective. John Wiley London.
- 7) Robinson W.L. and E.G. Bolen. 1984. Wildlife Ecology and Management. MacMillan Publishing Company, New York.
- 8) Soule, M. E. 1987. Viable populations for Conservation. Cambridge University Press. Cambridge. 189 pp.

WL-703	Principles of Wildlife Management	3(3-0)
---------------	--	---------------

Theory

History and basic concepts in management of wildlife resources i.e. Ecology, Population Dynamics, Biology, Conservation. Wildlife Ecology (Habitat factors & analysis, Ecological Succession and Wildlife, Weather, Climate and Wildlife). Population Dynamics (population analysis and manipulation, carrying capacity, perennial patterns of abundance). Wildlife Biology (wildlife and soils, food, nutrition and water requirements, cover requirements, movements, reproduction, behavior and physiology, mortality). Wildlife Conservation (resource conservation and quality of life, values). Wildlife Management (data bases requirements, applications of ecological principles, art of wildlife management, administration, public awareness). Wildlife Damage Management (brief introduction of pest species and their impact).

Books Recommended:

1. Bailey, J.A. 1984. Principals of Wildlife Management. John Wiley London.
2. Gilbert, F. F. and D. G. Dodds. 1987. The Philosophy and Practice of Wildlife Management. Robert E. Kreiger, Publishing Company, Malabar, Florida.
3. Giles, Jr. R. H. 1978. Wildlife Management. W. H. Freeman and Company, San Fransisco.
4. Peine, John D. 1999. Ecosystem Management for Sustainability: Principles and Practices. CRC Press.
5. Scott et al. 1995. Conservation of Biological Diversity; Perspectives and the Future for Wildlife Profession. Wildlife Society Bulletin 23(4): 645-657.
6. Tiwaei, P.C. and Bhagwati, J. 1997. Wildlife in the Himalayan Foothills: Conservation and Management. 376 pp.

WL-704	Wildlife Study Techniques-I: Biological Aspects	3(2-2)
---------------	--	---------------

Theory

Introduction to laboratory techniques, post mortem examination, sample collection and tissue storage. Wildlife nutrition, procedures for food habits analysis. Techniques for capturing, trapping, immobilization, marking, weight measurement and estimation ageing, sexing/reproduction, and handling etc. of wild animals. Taxonomical techniques for identification and classification of different groups of wild animals. Instruments/equipments for wildlife studies.

Practical

- Methods of trapping, capturing, marking, ultrasound, sample collection and tissue storage. Identification of mammals, birds, reptiles, amphibians, and fish.
- Field collection of fecal materials and stomach contents for food habit analysis in herbivore, carnivore and omnivore mammals, birds, reptiles, amphibians and fish.

- Laboratory analysis of fecal and stomach contents in herbivore, carnivore and omnivore vertebrate species.

Books recommended

- 1) Cormack, R. M., G. P. Patil and D. S. Robson. 1979. Sampling biological populations. International Co-operative Publishing House, Fairland, Maryland, USA.
- 2) Peterson, R.T. and Murie, O.J. 1992. A Field Guide to Animal Tracks. Houghton Mifflin Field Guides publishers.
- 3) Sale, J.B. 1988. Manual of Wildlife Techniques for India. Special Publication of the Wildlife Institute of India.
- 4) Schemnitz, S.D. 1980. Wildlife Management Techniques Manual. The Wildlife Society Washington, D.C.
- 5) Tanner, J.T. 1978. Guide to the Study of Animal Populations. The University of Tennessee Press, Knoxville.

WL-705	Wildlife Study Techniques-II: Management Aspects	3(2-2)
---------------	---	---------------

Theory

Study of environmental factors; 1) **Soil**: type, pH, Moisture, Organic Composition. 2) **Weather**: Temperature, Barometric Pressure, Precipitation, Wind speed and direction, Humidity. 3) **Water**: Availability, Chemistry, pH, contaminants, Turbidity. Introduction to field techniques for habitat analysis and evaluation, Habitat improvement techniques, estimating the numbers of wildlife populations (estimates, total counts, sample counts: the logic, models and arithmetic, indirect estimates of population size indices). Specialized techniques; audio instruments, visual instruments, radio-telemetry, GIS techniques and other activity recording instruments. Radioisotopes and their use in wildlife. Experimental design (fundamentals, applications, impact assessment). Sampling strategies/techniques: principles, basics and layout of sampling, inventory, surveillance and monitoring. Instruments/equipments for wildlife studies.

Practical

Practical application of radio-telemetry, field surveys of forest, rangelands, wetlands ecosystems for the study of environmental factors and wildlife populations for practical application of different wildlife techniques.

Books recommended

- 1) Bibby, C. J., Burgess, N.D. and Hill, D.A. 1992. Bird Census Techniques. Academic Press London.
- 2) Blower, J. G., L. M. Cock and J. A. Bishop. 1980. Estimating the size of animal populations. George Allen and Unwin Limited. London.
- 3) Cormack, R. M., G. P. Patil. and D. S. Robson. 1979. Sampling biological populations. International co-operative publishing House, Fairland, Maryland, USA.
- 4) Giles, R.H. Jr. 1989. Wildlife Management Techniques. Wildlife Society. Washington DC. USA.
- 5) Herts Kenward, R. E. 1987. Wildlife Radio-tagging. Equipment, Field Techniques and Data Analysis. Academic Press Limited. London.
- 6) Peterson, R.T. and Murie, O.J. 1992. A Field Guide to Animal Tracks. Houghton Mifflin Field Guides publishers.
- 7) Schemnitz, S.D. 1980. Wildlife Management Techniques Manual. The Wildlife Society Washington, D.C.

- 8) Tanner, J.T. 1978. Guide to the Study of Animal Populations. The University of Tennessee Press, Knoxville.
- 9) White, G.C. and Garrott, R.A. 1990. Analysis of Wildlife Radio-Tracking Data. Academic Press Limited London.

WL-706	Wildlife Management at Wetlands	3(2-2)
---------------	--	---------------

Theory:

Introduction; Functions and values; Classification schemes; Types (swamps, marshes, lakes, peatlands, man-made reservoirs and coastal wetlands); Physico-chemical characterization of wetlands; Wetland communities (microorganism, algae, flora, invertebrates and vertebrates); Threats; Ramsar Convention; Ramsar criteria for identifying wetlands of international importance; Ramsar Sites of Pakistan; Wetland systems and associated wildlife in Pakistan; Wetland bio-assessment; Socio-economic valuation; Management of different wetland types for wildlife conservation; man and wildlife conflicts; Public awareness; Wetland policies & legislation in Pakistan.

Practical:

Preparing a Ramsar Information Sheet for a wetland; Wetland inventory for the management of associated wildlife; Field visits to various wetland types (lakes, streams, rivers and man-made reservoirs) to characterize habitat of wetland and catchment areas, to identify and record associated flora, fauna and issues.

Books Recommended

1. Dobson, M. and Frid, C. 2009. Ecology of aquatic ecosystems (2nd Ed.). Oxford University Press, USA. 368 pp.
2. Dodds, W.K. and Whiles, M.R. 2010. Freshwater ecology: concepts and environmental applications of limnology. Academic Press. 892 pp.
3. Khan, R.S. and Akber, G. 2012. Coastal Lagoons to alpine lakes: A global handbook to Pakistan significant wetlands. WWF-Pakistan. 191 pp.
4. Keddy, P.A. 2010. Wetland ecology: Principles and Conservation (2nd Ed.). Cambridge University Press, UK. 516 pp.
5. Mitsch, W.J. and Gooselink, J.G. 2007. Wetlands (4th Ed.). John Wiley and Sons, USA. 600 pp.
6. Roberts, T. J. 1991. The Birds of Pakistan. Vol. I, (Non-Passeriformes): Oxford University Press.
7. Roberts, T. J. 1992. The Birds of Pakistan. Vol. II, (Passeriformes): Oxford University Press.
8. Roberts, T. J. 1997. Mammals of Pakistan: Ernest Benn Ltd., London.
9. Russo, R.E. 2008. Wetlands: ecology, conservation and restoration. Nova Science Pub. Inc. 446 pp.
10. Scott, D. A. 1989. A Directory of Asian Wetlands. U.K: IUCN, Gland, Switzerland and Cambridge, U.K.
11. Valk, A.G. 2006. The Biology of Freshwater Wetlands. Oxford University Press, USA. 192 pp.
12. World Wide Fund for Nature. 2000. Pakistan's wetland action plan. World Wide Fund for Nature and National Council for the conservation of wildlife, Government of Pakistan. 80 pp.

Theory

Introduction to terrestrial ecosystems and associated wildlife in Pakistan: mountains, rangelands, foothill forests, deserts, agro-ecosystems. Status and threats to wildlife in these ecosystems. Wildlife and farmlands (Farm crops as wildlife food, erosion, sedimentation and wildlife, agricultural chemicals and wildlife). Wildlife and rangelands (management of range vegetation, livestock grazing and wildlife, range fires and wildlife, fencing, game ranching). Forest management and wildlife (basics of forest management, clear cutting and wildlife, snags, deadwood and fuel wood, forest fire and wildlife). Urban wildlife (urban wildlife resources, urban monoculture, multiple use management in the city, urban wildlife as pest). Exotic wildlife (exotic species, concerns, guidelines and policies) Wildlife and water (ecological influences on wildlife, populations, physiological and behavioral responses, reservoir effect and management, water and raw sewage, water developments and wildlife). Wildlife and soils (relationship of soil & wildlife, fertilization).

Wildlife Management Planning. Management efforts by public sector agencies and departments, NGO's and Community organizations, major projects of wildlife conservation; concept of community based wildlife management, wildlife and ecotourism.

Books Recommended

1. Bailey, J.A. 1984. Principals of Wildlife Management. John Wiley London.
2. Bolen, E. G. and W. L. Robinson. 1995. Wildlife ecology and management. 3rd edition. Prentice Hall, Inc, New Jersey, USA. 620pp.
3. Khan, M. S. 2006. Amphibians and Reptiles of Pakistan. Krieger Publishing Company. 311pp.
4. Peine, John D. 1999. Ecosystem Management for Sustainability: Principles and Practices Illustrated by a Regional . CRC Press.
5. Roberts, T. J. 1997. The Mammals of Pakistan. Oxford University Press. 525pp.
6. Roberts, T. J. 1992. The Birds of Pakistan (Vol. I& II). Oxford University Press. 598, 617 pp.
7. Teague, Richard. D. A. Manual of wildlife conservation, Colorado State University, Fort Collins, Colorado. The Wildlife Society Washington D.C.
8. Tiwaei, P.C. and Bhagwati, J. 1997. Wildlife in the Himalayan Foothills: Conservation and Management. 376 pp.

Theory

Introduction to basic need for appropriate control of animal damage, socioeconomic, ecological, and political factors. Major vertebrate pest species of Pakistan (commensal and field rodents, porcupine, wildboar and birds): ecology, distribution, biology and behaviour. Damage pattern and damage assessment methods (pre-harvest and post-harvest). Wildlife hazards to Aviation industry. Economical impact of vertebrate pests (damage & diseases etc.). Management of vertebrate pests; ecologically based management, cultural and non-chemical methods, and chemical control methods. Rodenticides/pesticides for control of vertebrate pests: classification, modes of action and related issues. Current legal, ethical, and biological principles for the control and/or management of problem vertebrate species.

Practical:

- Observation and assessment of animal damage to field crops at pre- and post-harvest stages.

- Trapping, netting and scarring techniques in preventing wildlife damage
- Preparation of different rodenticide bait materials for control of vertebrate pests (rats, mice, porcupine, wild boar and birds)
- Methods of field applications of different rodenticide baits for management of wildlife (pests) populations

Books Recommended

- 1) Ahmad, E., J.E. Brooks, S. Muir and I. Hussain. 1990. Vertebrate Pest Management in Grain Storage. A GOP/USAID/DWRC Vertebrate Pest Control Project, NARC, Islamabad. 39 p.
- 2) Aplin, K.P., P.R. Brown, J. Jacob, C.J. Krebs and G.R. Singleton. 2003. Field methods for rodent studies in Asia and the Indo-Pacific. Australian Centre for International Agricultural Research, Canberra. 223 p.
- 3) Brooks, J.E., E. Ahmad, I. Hussain, S. Munir and A.A. Khan. (eds.). 1990. Training Manual: Vertebrate Pest Management. A GOP/USAID/DWRC Vertebrate Pest Control Project, NARC, Islamabad. 206 p.
- 4) Buckle, A.P. and R.H. Smith. 1994. Rodent Pests and their Control. CAB International. Wallingford, Oxon OX10 8DE, UK, 405 p.
- 5) Cleary, E.C. and R.A. Dolbeer. 1999. Wildlife Hazard and Management at Airports. National Wildlife Research Centre, APHIS/WS, USDA, 248 p.
- 6) Singleton, G.R., L. A. Hinds, C.J. Krebs and D.M. Spratt. 2002. Rats, Mice and People: Rodent Biology and Management. Australian Centre for International Agricultural Research, Canberra. 564 p.
- 7) Singleton, G.R., L. A. Hinds, H. Leirs and Z. Zhang. (eds.). 1999. Ecologically-based Rodent Management. Australian Centre for International Agricultural Research, Canberra. 494 p.

WL-709	Society, Values & Economics of Wildlife	3(3-0)
---------------	--	---------------

Theory

Human dimensions of wildlife; values, satisfactions, and attitudes associated with consumptive and non-consumptive uses of wildlife. Concepts of wildlife utilization (history, early relations between man and animals, domestication of wild animals, management of wildlife resources). Forms of wildlife utilizations (reason for utilization, wildlife utilization as form of land use, role of hunting in wildlife utilization, exploitation of captive tamed animals). Importance of wildlife utilization (abundance and sustainability of wildlife resources, range of utilized species and derived products, wildlife as source of food and commercial products, impact of utilization on conservation). Economics of wildlife utilization (utilization value in the context of total economic value, application of economic theory in natural resource use, development of wildlife economics and its future), wildlife based tourism (history, national parks, safari and hunting tourism, economic importance, impact of tourism on conservation). Utilization of specific animal groups (reptiles, birds, mammals). Wildlife products (constraints on use of wildlife products, commodities derived from wildlife resources- game meat, fats, oil, gamskins, furskins and hairs, feathers, trophies and curios, ivory and others). Public relations; the philosophy and ethics of wildlife resource use, conservation education and communication. Interactions among various stakeholders, resource management agencies.

Books recommended

- 1) Bolton, M. 1997. Conservation and the Use of Wildlife Resources. Springer

- 2) Chandra, R. 2005. Wildlife and Eco-Tourism: Trends, Issues and Challenges. Akansha New Delhi. 281 p.
- 3) Conover, M. R. 2001. Resolving Human-Wildlife Conflicts: the science of wildlife damage management. CRC Press
- 4) Gray, G. G. 1993. Wildlife and People: The Human Dimensions of Wildlife Ecology. University of Illinois Press. 260pp.
- 5) Knight, J. 2004. Wildlife in Asia: Cultural Perspectives. Rutledge Publishers.
- 6) Shackleton, D. M. 2001. A Review of Community- Based Trophy Hunting Programs In Pakistan. Mountain Areas Conservancy Project/ IUCN/ Ministry of Environment. 59pp.

WL-710	Protected Areas and their Management	3(3-0)
---------------	---	---------------

Theory

Introduction, definitions, characteristics and significance of Protected Areas. New approaches in PA selection, bioregional planning, Indigenous PAs. Marine PAs. Protected areas of Pakistan: National Park, Wildlife Sanctuaries and Game Reserves (statistics, habitats, important wildlife species and their status). National system planning for PAs. Management rules, procedures and practices of protected areas of Pakistan and future trends. Conservation through development of PAs (protected landscapes: concepts and approaches), valuation and management of PAs, commercialization, structure and sustainability of PAs. Challenges for PAs in the 21st Century. PAs and local people, building stronger alliances with people, people oriented conservation, seeking wider range of partners and values, Role of NGO's in promoting alliances and collaborative management of PAs. Designation and management planning for PAs, Ramsar sites and special PAs.

Books Recommended

- 1) IUCN, Pakistan. 1996. Management Conflicts in Protected Areas. 100 pp.
- 2) IUCN. 2000. Pakistan Protected Areas System Review and Action Plan. IUCN-Pakistan. 45pp.
- 3) Majupuria, T.C. and Rohit, K. 1998. Wildlife, National Parks and Reserves: Resources, Management and Wildlife Safaris. Saharanpur, India: S. devi, 427 pp.
- 4) Stolton, S. and N. Dudley. 1999. Partnerships for Protection: new strategies for planning and management for protected areas. James & James/Earthscan
- 5) Walkey, M., I. R. Swingland and S. Russell. 1999. Integrated Protected Area Management. Springer.
- 6) WWF. 2002. Workshop Report: Development of performance indicators for the management of protected areas of Pakistan. WWF/World Bank 116pp.

WL-711	Research Planning and Report Writing	3(1-4)
---------------	---	---------------

Theory:

Introduction to nature of wildlife research enquiry, problem identification, objectives, analysis, development of hypothesis. Use of the library and the internet for literature search. Literature review, reference writing for books, journals, anonymous, internet etc. Selection of study subjects and size; development of study design. Research ethics.

Practical:

Development of research plan, preparation of synopsis, precautions in execution of research, data collection, tabulation, analysis of data graphically and statistically and presentation, exercise in interpretation of results, writing of results, logical inferring, composing and presentation of report.

Books Recommended:

1. Arifullah, S. and K. M. Bhatti. 1998. Research process simplified. Pen Graphic (pvt) limited, Islamabad.
2. Hashmi, N. 1983. Style manual of technical writing. Pakistan Economic analysis network project, Islamabad
3. Jones, A., R. Reed and J. Weyer. 1994. Practical skills in Biology. Longman Scientific and Technical.
4. O' Connor, M. 1993. Writing Successfully in Science. Chapman and Hall. N.Y.

WL-712**Conservation Biology of Wildlife****3(3-0)****Theory**

Introduction to conservation biology; species diversity, ecosystem diversity, genetic diversity. Threats to biodiversity: mass extinction and global changes, ecosystem degradation and loss, over exploitation, deforestation, fragmentation and reduction in wildlife habitats, island biogeography, exotic species, inbreeding and out breeding depressions, loss of genetic variability, environmental fluctuations, factors limiting the population size. Human factors; economic factors, politics and actions. The risks faced by small populations, Risk assessment, diagnosis of declines, treatment of declines, and role of economic and trades in wildlife conservation, role of national and international legislation in wildlife conservation. Population genetics, extinction, restoration ecology, management, and conservation policy. Conservation through population and ecosystem management. Role of zoos, national parks, sanctuaries and game reserves for maintaining the biological diversity. The mandate for the management and conservation of rare, over-abundant, and harvested wildlife populations.

Books Recommended

- 1) Caughley, G and A. Gunn. Conservation biology in theory and practice. Blackwell Science Publication.
- 2) Eric. G. Bolen and William L. Robinson. 1995. Wildlife Ecology and Management. 3rd Edition. Prentice Hall, Upper Saddle River, New Jersey.
- 3) Hosetti, B. B. and M. Venkateshwarlu. 2001. Trends in Wildlife Biodiversity, Conservation and Management. Daya Publishing House Delhi-11035.
- 4) Malcolm L. Hunter, Jr. 2001. Fundamentals of Conservation Biology, 2nd Edition. Blackwell Science Inc.
- 5) Mills, L.S. 2007. Conservation of Wildlife Populations: Demography, Genetics and Management. Blackwell Publishing, USA.
- 6) Richard B. Primack. 2002. Essentials of Conservation Biology. 3rd Edition. Sinauer Associates Inc. Publishers, Sunderland, Massachusetts, U.S.A.
- 7) Soule, M. E. 1987. Viable populations for Conservation. Cambridge University Press. Cambridge. 189 pp.
- 8) Soule, M.E. and B.A. Wilcox. 1980. Conservation Biology. Sinauer Associates Inc. Sunderland. Massachusetts.

WL-713**Wildlife Food and Foraging****3(3-0)****Theory**

Indices of body conditions, body size and diet selection, food passage, basal metabolic rate and food requirement. Constituents of food, variation in food supply, measurement of food supply. Natural selection and optimality, habitat selection, exploration of home range, optimal foraging, differences between carnivores and herbivores, consequences of eating specific foods, taste, diet selection. Learning to foraging, discrimination and generalization, observational and probability learning, social facilitation and invitation. Evolution of feeding

behaviour; origin of prey locating mechanism, the value of recognition, adaptive value, locating prey by deceit, food selection, evolution of alternate diet. Habitat preferences in a territorial species, dispersing, cost and benefits of migration, migration as a conditional tactics, territoriality, territoriality and calories, territorial puzzles. Foraging and habitat preference of different birds, mammals, reptiles, fish and amphibians. Field observation of animal foraging and feeding habits by direct and indirect evidences.

Books Recommended

- 1) Bakker, J. P., M. F. Wallis DeVries and S. E. Van Wieren. 1998. Grazing and Conservation Management. Springer. 390pp.
- 2) Galef, B., G. Galef, M. Mainardi and P. Valsecchi. 1994. Behavioral Aspects of Feeding: Basic and Applied Research in Mammals. CRC Press.
- 3) Halle, S. and N. C. Stenseth. 2000. Activity Patterns in Small Mammals: An Ecological Approach. Springer.
- 4) Stephens, D. W. and J. R. Krebs. 1986. Foraging Theory. Princeton University Press, Princeton, New Jersey USA.

WL-714	Reproductive Biology and Breeding	3(2-2)
---------------	--	---------------

Theory

General and comparative aspects regarding reproduction and breeding of wild vertebrates (mammals, birds, amphibians, reptiles and fish). Reproductive patterns, gonadal functions and endocrine systems, fertilization & development. Post-natal development in different wild animal groups (mammals, birds, amphibians, reptiles and fish). Seasonal breeders, environmental factors influencing breeding. Role of various hormones in gestation and parturition. Introduction to assisted reproductive technologies (invitro fertilization, embryo transfer technology, artificial insemination) and their application in wildlife reproduction.

Practical

- Field visits to Wildlife Parks and Zoos for observation of animal reproductive and post-natal development behaviors in different wildlife species.
- Light microscopic study of structure of vertebrate male and female gonads, structure of various gametes of vertebrates, stages of estrous cycle in female mice, study of development of chick embryo.
- Application of ultrasonography in wild animals.

Books Recommended

- 1) DeGroot, L.J. 1995. Endocrinology. Vol. III. Saunders Publishers U.S.A.
- 2) G. Jan, François Olivennes, Petra de Sutter. 2001. Assisted Reproductive Technologies: Quality and Safety. 338.
- 3) Hafez, E.S.E. and Hafez, B. 2000. Reproduction in Farm Animals. John Wiley Sons Inc. 509 PP.
- 4) Knobil, E. and Neill, J.D. 1995. The Physiology of Reproduction. Raven Press, U.S.A.
- 5) Scott, F. Gilbert. 2000. Developmental Biology. Sixth Edition. Sinauer Associates, Inc. Publishers Sunderland, Massachusetts.

WL-715	Management Aspects of Wildlife Behavior	3(3-0)
---------------	--	---------------

Theory

Basic theories and mechanisms of behaviours. Special behaviors of wild vertebrates (mammals, birds, amphibians, reptiles and fish); social organizations, foraging behavior,

marking, territoriality, communication, environmental influences, reproductive behaviour, mother-offspring relationships. Linking conservation and behaviors. Adaptive behavior and population viability; dispersal and conservation: a behavioral perspective; migration and conservation; reproductive behavior and conservation; genetic structure and conservation.

Books Recommended

- 1) Festa-Bianchet, M and M. Apollonio. 2003. Animal Behavior and Wildlife Conservation. Island Press
- 2) Galef, B., G. Galef, M. Mainardi and P. Valsecchi. 1994. Behavioral Aspects of Feeding: Basic and Applied Research in Mammals. CRC Press.
- 3) McFarland, D. 1987. Animal Behaviour. Oxford University Press. 685pp.
- 4) Monaghan, P. 1990. Managing the Behaviour of Animals. Springer Publishers.
- 5) Sherman, P.W. and Alcock, J. 1998. Exploring Animal Behavior. Second edition. Sinauer Associates, NY USA.

WL-716	Wild Fish Fauna of Pakistan	3(3-0)
---------------	------------------------------------	---------------

Theory

Evolutionary perspective, life history. Classification and characteristics of fishes. Diversity and ecology. Fish fauna (endemic and exotic species) of Pakistan. Taxonomy, morphology and physiology, migration, adaptations and other behaviors of major groups of fishes. Economic importance. Brief introduction to fish diseases/predators and their management.

Visit to PMNH for study of museum specimens with respect to different ecologies of Pakistan. Visit of fish hatcheries and natural waters for external and internal characteristics and their modification in different groups of fishes.

Books recommended

- 1) Ali, S. S. 1999. Fresh water fishery biology. University Grants Commission. Islamabad.
- 2) Mirza, M.R. 1975. Fresh water fishes and zoogeography of Pakistan. Bijdr. Dierk. (Amsterdam).
- 3) Talwar, P. K. and A. G. Thingran. 1991. Inland fish of India and adjacent countries. Vol 1 & 2. Oxford IBH publishing Co Ltd, New Delhi.

WL-717	Endangered Species and their Management	3(3-0)
---------------	--	---------------

Theory

Definitions of various threat levels to wildlife. Causes of extinction, small island effect, modern threats to wildlife populations, environmental contaminations, loss of critical habitat, the wildlife trade, excessive human predation. Critical habitat: definition and designation of critical habitat and its significance, recovery planning (meaning of recovery, recovery plan development and implementation), protecting species through interagency cooperation. Restoration programs, Conceptual issues in restoration ecology, organizational and managerial guidelines for endangered species restoration programs, managing genetic diversity in captive population of animals. Promoting protection through pride, the value of bird watchers. Threatened wildlife species of Pakistan. Biology/ecology and level of threat to the individual wildlife species under threat in Pakistan. Recovery programs for threatened wildlife species: current management practices and problems affecting their success.

Books recommended:

- 1) Bolen, E. G. and W. L. Robinson. 1995. Wildlife ecology and management. 3rd edition. Prentice Hall, Inc, New Jersey, USA. 620pp.
- 2) Bowles, M. 1994. Restoration of endangered species. Cambridge University Press.
- 3) Gilbert, F. F. and D. G. Dodds. 1987. The philosophy and practice of Wildlife management. Robert E. Kreiger, Publishing Company, Malabar, Florida
- 4) Gill, F.B. 1995. Ornithology. 2nd edition. W. H. Freeman and company, New York. 766pp.

WL-718	Captive Wildlife Management	3(3-0)
---------------	------------------------------------	---------------

Theory

Role of captive wildlife management in conservation, research, economics, recreation, and education. Impact of confinement on behavior, nutrition and health. Design and administration of facilities; techniques for restraining and handling captive wildlife; sanitation and common diseases, parasites and other problems associated with confining wild animals. Species extinction, endangerment and captive breeding. Use of flagship species for conservation (criteria for selection of flagship species). Role of environmental enrichment in captive breeding, reintroduction of endangered species, disease risks associated with wildlife translocation (types of risks, diseases introduced and encountered by translocated animals, minimizing the risks, post release health monitoring). Captive bred animals, criteria for reintroduction (condition of the species, environmental condition, bio-political consideration). Legislation relating to the capture, transport, and housing of wild animals.

Books Recommended:

- 1) Bellamy, R. 2005. Saving Wildlife. Black Rabbit Books.
- 2) Bolton, M. 1997. Conservation and the Use of Wildlife Resources. Springer.
- 3) Olney, P. J. S., A. Feistner and G. M. Mace. 1994. Creative Conservation: Interactive Management of Wild and Captive Animals. Springer.

WL-719	Special Problem	1(1-0)
---------------	------------------------	---------------

WL-720-I	Seminar-I	1(1-0)
WL-720-II	Seminar-II	1(1-0)

WL-721	Wildlife Habitat Evaluation and Restoration	3(3-0)
---------------	--	---------------

Theory

Concepts of wildlife habitat relationships (habitat, niche, population perspectives). Wildlife Habitat requirements (water, energy and nutrients (food), cover etc.). Site description and community definition; ecosystems, habitat and land types, wetlands. Site factors and indices; geology and topography, soils, weather and climate, cultural features, history, indices of site quality (plant indicators, site index). Habitat evaluation methods: terrestrial and aquatic habitat features (assessment of food/water quality and quantity, cover, studying animal feeding habits). Habitat mapping, measurements of vegetative components of communities; sampling procedures; plots, plotless methods etc. Habitat capability ratings, impact evaluation. Habitat improvement; food and cover production (propagation, regeneration, rejuvenation), cover practices, specialized nest structures, water developments, wetland improvements, constructing water control devices, structural improvements and facilities; fences, study exclosures, etc. Strategy of ecosystem development. The concept of carrying capacity. Threats to wildlife habitats. Field visits.

Books Recommended

- 1) Bailey, J.A., Elder, W. and McKinney. 1974. Readings in Wildlife Conservation. The Wildlife Society, Washington D.C.
- 2) Gilbert, F. F. and D. G. Dodds. 1987. The philosophy and practice of Wildlife management. Robert E. Kreiger, Publishing Company, Malabar, Florida.
- 3) Morrison, M. L., B. G. Marcot and R. W. Mannan. 2006. Wildlife-Habitat Relationships: Concepts and Applications. Island Press. 493pp.
- 4) Negi, S.S. 1992. Himalayan Wildlife-Habitat and Conservation. 207 p.
- 5) Verner, J., M. L. Morrison and C. J. Ralph. 1984. Wildlife 2000: Modeling habitat relationships of terrestrial vertebrates. The University of Wisconsin Press.

WL-722

Predator Ecology and Management

3(3-0)

Theory

Definition of predation. Predators and predation. Predation theory. Self limitation of prey and predator populations. The evolution of predator-prey systems. Age and size structure in prey and predator populations. Predator morphology and evolution, risk sensitive foraging, prey avoidance behaviors, social organization of predators. Neural mechanisms of prey recognition. Prey refugia. Effect of predators on prey density, numerical response of predators to prey density. The influence of predatory behaviour on population dynamics. Spatial structure in prey populations. Predation and population cycles. Field visits

Books Recommended

1. Feder, M. E., and G.V. Lauder. 1986. Predator-Prey relationships: Perspectives and Approaches from the study of lower vertebrates. The University of Chicago Press. 198pp.
2. Mills, L.S. 2007. Conservation of Wildlife Populations: Demography, Genetics and Management. Blackwell Publishing, USA
3. Taylor, R.J. 1984. Predation: population and community biology series. Chapman and Hall. New York, London, 166 pp.

WL-723

Wildlife Eco-Toxicology

3(3-0)

Theory

Various forms of environmental pollution in relation to fish and wildlife (air pollution, marine and fresh water pollution, radiations, pesticides). Effects and mechanisms of pollutants: effects on individuals and systems. Routes of exposure and modes of actions of various pollutants/toxicants. Measuring wildlife toxicology, assessing impacts of toxic chemicals: temporal and spatial variations in wildlife, implications for assessing ecological effects of pesticides, impacts of toxicants on population dynamics and gene diversity in wildlife, immuno-toxicology of captive and wild animals. Effects of inorganic gaseous pollutants on human and animals, ecological/biological factors effecting toxicity (genetic factors, developmental factors, behavioral factors, diseases, sex variations, nutrition, starvation). Effects of heavy metals (lead, cadmium, mercury) on community and ecosystems. Environmental legislation and ecological risk assessment.

Books Recommended

- 1) Greaves, M.P. Smith, B.D. P.W. Greig-Smith. 1998. Field Methods for the study of Environmental Effects of Pesticides. (BCPC Monograph No. 40.). The British Crop Protection Council, 20 Bridport Road, Thornton Heath CR4 7QG, UK, 370 p.
- 2) Kenaga, E. E. 1980. Avian and mammalian wildlife toxicology. Blackwell Science.

- 3) Kendall, R.J. and T.E. Lacher.1994. Wildlife toxicology and population modeling: Integrated studies of Agro-ecosystems. CRC Press.
- 4) Landis, W. G. and Ming-Ho Yu. 2004. Introduction to environmental toxicology; Impacts of chemicals upon ecological systems. CRC Press.
- 5) Rand, G. M.1995. Fundamentals of Aquatic Toxicology: Effects, Environmental Fate, and Risk Assessment. Taylor & Francis.
- 6) Sheehum, et.al. 1984. Effects of Pollution on the Ecosystem. John Wiley London.
- 7) Wright, D.A. (Pamela Welbourn).2002. Environmental Toxicology. Cambridge University Press.

WL-724	Wildlife Diseases and their management	3(3-0)
---------------	---	---------------

Theory

Ecology of wildlife diseases: occurrence, importance, and ecological impact of infectious and parasitic diseases. Mode of transmission and epidemiology, clinical, signs, symptoms pathogenesis and pathology, diagnosis, immunity. Dynamic differences between predation and parasitism, basic parameters of epidemiology, determinants of spread, transspecies infection. Effects of disease on wildlife growth, reproduction, fitness, and survival. Wildlife as disease vector. Heterogeneity in macro-parasite infection, parasites and host population dynamics. Micro parasite transmission and persistence. Ecology of tick-borne infections in wildlife reservoirs. Role of pathogens in biological conservation. Methodologies to identify and study wildlife diseases in the field and laboratory. Public health concerns and control of infectious diseases in wildlife, including zoonotic diseases and those threatening endangered species.

Books Recommended

- 1) Arora, B.M. 1994. Wildlife Diseases in India: Infectious and Parasitic Diseases of Mammals, Reptiles and Amphibians. 183 p. , 30 col.
- 2) Caughley, G and Anthony R.E. Sinclair, 1994. Wildlife ecology and management. Blackwell science publication.334 p.
- 3) Friend, M. 1987. Field Guide to Wildlife Diseases: General Field Procedures and Diseases of Migratory Birds. Bernan Associates.
- 4) Hudson, P. J. 2002. The Ecology of Wildlife Diseases. Oxford University Press
- 5) Majumdar, S. K. 2005. Wildlife Diseases: Landscape Epidemiology, Spatial Distribution and Utilization of Remote Pennsylvania Academy of Science.

WL-725	Museum Science	3(2-2)
---------------	-----------------------	---------------

Theory

Principles and significance of preserving and presenting biological specimens for research, teaching and display. Faunal collection techniques; mammals, birds, reptiles, amphibian, fish, invertebrates. Taxidermy techniques; Animal (mammals, birds, amphibians, reptiles & fish) mounting for display. Diorama making techniques, fiberglass, gyps and wax replica techniques.

Practical

- Field Collection of vertebrate specimens, preservation, taxidermy, mounting and display.

Books Recommended

- 1) Anderson, R. M. 1965. Method of Collecting and Preserving Vertebrate Animals. Bull. No.69. Biological Series No.18. National Museum of Canada.

- 2) Matcalf, J.C. 1981. Taxidermy. A Complete Manual. Gerald Duckworth and Co. Ltd. UK.
- 3) Wagstaffe, R. and Fidler, N. J. 1968. The Preservation of Natural History Specimens, Vol.2. Welwyn Garden City, Germany.

WL-726	Essentials of Wildlife Conservation-National Perspectives 3(3-0)
---------------	---

Theory

National wildlife policy of Pakistan. Introduction and history of wildlife legislation in Pakistan. Provincial/territorial wildlife acts/ordinances. Concept of threatened species. IUCN Red list of threatened species. In-situ and Ex-situ conservation of wildlife. Protected Areas system (PAs) and categories in Pakistan. IUCN categories of PAs. Institutional structure for wildlife management in Pakistan: Federal & provincial public organizations, NGOs, research institutes, academic institutions related to wildlife. International Conventions related to wildlife i.e. Convention on International Trade of Endangered Species of Flora & Fauna (CITES), Convention on Migratory Species (CMS), International Convention on Wetlands/Ramsar Convention, Convention on Biological Diversity (CBD); their objectives, obligations and implementation in Pakistan. Current developments in wildlife conservation in Pakistan, Major conservation projects.

Books Recommended

1. Anwar, M. 2007. Review of protected areas management and performance effectiveness in Pakistan. IUCN/Ministry of Environment. 78pp.
2. GOP. 2005. Proceedings of the national consultative workshop on the implementation of CBD, CMS and Ramsar Convention in Pakistan. Ministry of Environment/UNEP/IUCN, Islamabad. 136pp.
3. GOP, 2005. National Environmental Policy of Pakistan. Ministry of Environment, Islamabad.
4. IUCN. 2000. Pakistan Protected Areas System Review and Action Plan. IUCN-Pakistan. 45pp.
5. Khurshid, M. 2004. Environmental initiatives; Global and Nation perspectives. Ministry of Environment, Islamabad. 161pp.
6. Shafiq, M. (ed.) 2005. Wildlife Acts and Rules of Pakistan. Pakistan Forest Institute, Peshawar. 297pp.
7. UNEP. 2005. Selected texts of legal instruments in international environmental law. United Nations Environment Program. Nairobi. Kenya. 734 pp.
8. WWF. 2002. Workshop Report: Development of performance indicators for the management of protected areas of Pakistan. WWF/World Bank 116 pp.

WL-727 Capture, Care and Transportation of Wildlife	3(2-2)
--	---------------

Theory:

Principles of physical and chemical immobilization. Basic pharmacology of immobilising drugs. Types and safe usage of wildlife capture equipment. Principles of safe handling of mammalian, avian and reptile species. Anaesthesiology of wildlife species. Handling and care of wildlife species under physical and chemical immobilization. Problems associated with animal capture, sample taking and data collection. Mass capture techniques. Transportation of wild animals/birds. Management of released wild animals. Occupational health, practical training in approaching dangerous animals.

Practical:

Live trappings of representative mammalian, avian and reptilian species; immobilizing with appropriate doses of selected immobilizing drugs; observation of recovery periods after injecting an appropriate dose. Determination of effective doses (per unit body weight) of immobilizing drugs to anesthetize a representative animal from major wildlife groups i.e. mammal, birds, reptiles etc.

Recommended Books:

1. Fowler, M. E. Restraint and handling of wild and domestic animals. Wiley-Blackwell publisher.
2. Jordan, W. J. and J. Hughes. 1991. Care of the wild: first aid for all wild creatures. The University of Wisconsin Press. 240 pp.
3. Rollin, B. E. and M. L. Kesel. 1995. The Experimental Animal in Biomedical Research: Care, husbandry, and well-being; an overview by species. 560 pp.
4. Setchell, J. M. and D. J. Curtis. 2003 Field and laboratory methods in primatology: a practical guide. Cambridge University Press.

WL-728	Wildlife Policy, Legislation and International Conventions	3(3-0)
---------------	---	---------------

Theory

Introduction and history of wildlife legislation in Pakistan. National wildlife/forest/conservation policies of Pakistan. Provincial wildlife acts/ordinances. Organizations, authority and administration of public and private organizations concerned with wildlife conservation at the federal and provincial level. Current wildlife administration and enforcement practices in Pakistan. National and international agencies involved in wildlife conservation. Biodiversity Action Plan for Pakistan. International environmental agreements/conventions (such as CITES, CMS, Ramsar, CBD, UNFCCC, etc.): background, objectives, obligations and institutional arrangements to implement the conventions/agreements in Pakistan. Gaps in the implementation of international conventions.

Books Recommended

- 1) GOP. 1999. Biodiversity Action Plan for Pakistan. Ministry of Environment/IUCN-P/WWF-P. 79pp
- 2) GOP. 2002. National Action Programme to Combat Desertification in Pakistan. Ministry of Environment/ PARC/ UNESCAP. 268pp
- 3) GOP. 2005. Proceedings of the national consultative workshop on the implementation of CBD, CMS and Ramsar Convention in Pakistan. Ministry of Environment/ UNEP/ IUCN, Islamabad. 136pp.
- 4) IUCN. 1993. Biodiversity Conservation and the Laws. Environmental Policy and law paper No. 29. 292 pp.
- 5) Khurshid, M. 2004. Environmental initiatives; Global and Nation perspectives. Ministry of Environment, Islamabad. 161pp.
- 6) McNeely, J. 1997. Conservation and the future Trends and options towards the year 2025. IUCN H.Q. 119 pp.
- 7) UNEP. 2005. Selected texts of legal instruments in international environmental law. United Nations Environment Program. Nairobi. Kenya. 734.
- 8) Shafiq, M. (eds.) 2005. Wildlife Acts and Rules of Pakistan. Pakistan Forest Institute, Peshawar. 297pp.

Theory:

Origin and evolution; Biogeography; Systems (Integumentary, sensory, communication and reproduction); Development and morphology of tadpole; Thermoregulation; Dormancy; Enemies and defense; Behavioral ecology; Reptile toxinology; Prevention and treatment of envenomation; Zoogeographical affinities and herpetological habitat types in Pakistan. Values for ecosystems and society; Global population trend; Threatened species (IUCN Red List); Major threats (climate change, habitat fragmentation, pollution, invasive species, illegal trade); Herpetoculture as a tool for ex-situ conservation; Action plans for threatened species.

Practical:

Classification, taxonomy and diversity based on museum specimens; Field and Lab. studies of tadpoles (morphology and staging); Study visits for habitat description, survey methods (species identification, population estimation), traps and trapping methods.

Books Recommended

1. Ferri, V. 2002. Turtles and tortoises. Firefly Books. 256 pp.
2. IUCN. 2009 a. The IUCN Red List of Threatened Species. Reptiles Facts. IUCN, Glands, Switzerland.
3. IUCN. 2009 b. The IUCN Red List of Threatened Species. Amphibian Facts. IUCN, Glands, Switzerland.
4. Khan, M.S. 2006. Amphibians and reptiles of Pakistan. Krieger Publishing Company, Florida, USA. 311 pp.
5. Pianka, E.R. 2006. Lizards: Window to the evolution of diversity. University of California Press, California, USA. 348 pp.
6. Pough, F.H., Andrews, R.M., Cadle, J.E., Crump, M.L., Savitsky, A.H. and Wells, K.D. 2004. Herpetology (3rd Ed.). Benjamin Cummings, USA. 736 pp.
7. Siegel, R.A., Collins, J.T. and Novak, S.S. 2002. Snakes: Ecology and evolutionary biology. The Blackburn Press. 529 pp.
8. Vitt and J.P. Caldwell. 2013. Herpetology: An Introductory Biology of Amphibians and Reptiles (Fourth Ed.). Academic Press, USA. 720 pp.
9. Wells, K.D. 2007. The ecology and behavior of amphibians. University of Chicago Press, Chicago, USA. 1400 pp.

Theory

Introduction to ex situ conservation concepts; Philosophical and ethical concerns on assisted reproduction/captive breeding; Role of Zoos/wildlife parks in ex-situ conservation; Factors affecting male fertility in wild populations; Enhancing female fertility in captivity; Non-invasive endocrine measures of reproduction and stress on wild animals in captivity. Introduction to Assisted Reproductive Techniques (ARTs); Methodology and applications of Artificial Insemination, Embryo Transfer Technology. *In-vitro* fertilization, Intra-Cytoplasmic Sperm Injection, Sperm Sexing, Genome Resource Banking, Semen Banking, Embryo Banking, Oocyte Banking, Tissue Graft Bank, and Cloning in wildlife. Controlling of oestrous cycle and ovulation; Control of seasonal breeding; Control of multiple births and litter sizes.

Practical:

Morphological study of sperm and ova, collection and cryo-preservation of sperm and ova. Demonstration of Artificial Insemination Technique, Motility assessment of male gametes, Staining of live and dead male gametes. Acrosomal analysis of sperm.

Books Recommended:

1. Gordon, I. R. 2005. Reproductive Technologies in Farm Animals. Cabi Publishing. ISBN 0-85199-862-3. Comwell Press, Trowbridge. 332 pp.
2. Ryan, M. A. 2001. Ethics and economics of Assisted Reproduction. George Town, University Press, Washington D.C., USA. 183 pp.
3. Robert, S.W. 1995. Assisted Reproduction Progress in research and practice. Parathon Publishing Group Limited, UK. 156 pp.
4. William, V. H., R. Amanada., J. R. Ricakard and D. E. Wildit. 2003. Reproductive Science and Integrated conservation. Cambridge University Press. The Zoological Society of London. 409 pp.

WL-731	Wildlife Farming and Ranching	3(3-0)
---------------	--------------------------------------	---------------

Theory

Background to wildlife farming and ranching, principles and guidelines; laws and regulations governing wildlife farming and ranching in Pakistan and their enforcement; types and purposes of farms; critical issues in wildlife farming; diseases and parasites on a farms; species of interest for wildlife farming; management of wildlife farm. Types of ranches; planning a wildlife ranch: ecological capacity, designing a stocking program, expected harvest, infrastructure and equipment; establishing wildlife populations; management of wildlife populations; habitat/vegetation management; diseases and parasites on a ranch; options for wildlife utilization; economics of wildlife ranching; wildlife vs livestock. Marketing of farm and ranch products; record keeping. Contribution of wildlife farms and ranches to conservation goals; contribution of wildlife farms and ranches to community development.

Books Recommended:

1. Clifford, W., F. L. Frye, and J. B. Murphy. 1995. Health and welfare of captive reptiles. Chapman and Hall , London 350 pp.
2. Gibbons, E. F., B. S. Durrant and J. Demarest. 1995. Conservation of endangered species in captivity: an interdisciplinary approach. State university of New York Press 181 pp.
3. Hafez, E. S. E. and B. Hafez. 2000. Reproduction in Farm Animals. John Wiley and Sons Inc.
4. Olney, P. J. S, A. Feistner and G. M. Mace. 1994. Creative Conservation: Interactive Management of Wild and Captive Animals. Springerlink publishers.
5. William, W. 2007. From wilderness vision to farm invasions: conservation & development in James Currey Publishers 290 pp.

WL-732	Wildlife Data Analysis	3(1-4)
---------------	-------------------------------	---------------

Theory:

Introduction to wildlife data analysis softwares (Distance, EstimateS, Presence and BiodiversityR); Diversity Indices; Species richness estimators; Distance sampling; Occupancy and detection probabilities; Variables and covarites; Introduction to geographic information systems (GIS)/ remote sensing (RS) technologies and their application in wildlife management, Active and passive remote sensing, Coordinate systems, Geo-referencing, Map

projections, GPS (global positioning system), Spatial data analysis; GIS softwares: ArcGIS software and Introduction to Geospatial Environment Modelling; Quantum GIS.

Practical:

EstimateS: Data entry/preparing input file, Loading input data, Diversity settings, Computation, Interpretation of output file, Plotting and visualizing the results; **Presence:** Data entry in spreadsheet, Loading input file, Using built-in models, Creating new models, Interpretation of results; **Distance:** Data entry/preparing input file, Loading input data, Exploratory data analysis, Model selection (key functions, adjustments), Final analysis and Inference; **BiodiversityR:** Installation of supporting packages, Data entry in spreadsheets, Loading the input file, Settings, Selecting the analysis (species richness, diversity, presence/absence of species, ecological distance by clustering, ecological distance by ordination), Interpretation of results; **GIS softwares:** Mapping GIS data, Displaying data, Basic editing, Querying data, Analyzing data, Presenting data.

Books Recommended

1. Buckland, S.T., Anderson, D.R., Burnham, K.P. and Laake, J.L. 1993. Distance Sampling: Estimating abundance of biological populations. Chapman & Hall, London.
2. Kindt, R. and Coe, R. 2005. Tree diversity analysis. A manual and software for common statistical methods for ecological and biodiversity studies. Nairobi: World Agroforestry Centre (ICRAF). pp 207.
3. MacKenzie, D., Nichols, J., Royale, J., Pollock, K., Bailey, L., Hines, J. 2005. Occupancy estimation and modeling. Academic Press. USA. pp 344.
4. The *EstimateS* website contains more extensive help files and descriptions of the program, as well as an extensive bibliography and links to copies of many articles in PDF format: <http://purl.oclc.org/estimates> or <http://viceroy.eeb.uconn.edu/estimates>