

Preliminary findings on the causes of diversity gradients in the old world flycatchers along the Himalayas

- Suresh Kumar Rana

Aim: A series of studies on Himalayan avifauna had reported a strong gradient in bird species diversity from eastern to western Himalayas. Along elevational gradient, mid-elevation peak in species diversity in the east, while in the west plateau in species diversity was recorded at lower elevations. Studies on 10 species of Old World leaf warblers that range across the Himalayas demonstrated that factors such as history, competition, filtering and lower resource diversity drives reduced species numbers from eastern to western Himalayas. We initiated a study to investigate the causes of avian diversity gradients in two phylogenetically coherent groups of flycatchers representing *Ficedula/Muscicapella* and *Niltava/Cyornis* genus. The study aims to understand elevational distributions, densities, habitat associations, vocalization and genetic differentiation of flycatchers in the eastern and western Himalayas.

Study Area: The study area includes elevational gradients in North Bengal along eastern Himalayas and Jammu-Srinagar axis in J&K along western Himalayas. The elevational gradients cover the complete habitats of flycatchers from foothills to treeline in undisturbed forest patches usually in protected areas.

Methods: Here we report on the two months field work (May-June 2014) carried out at select sites in the eastern Himalayas, involving spot mapping of singing males of flycatchers and quantification of habitat correlates within two 5-ha plots.

Results: It was found that 12 out of 16 species of flycatchers breed in the 1000 to 2000 m range showing a mid-elevational peak similar to that of other passerine birds. Analysis of vegetation data specifically tree diversity where all trees within the 5 ha plots were marked had 72 species in the foothill plot, while only 38 species were found in the 2000 m plot. On the other hand, tree density was 327/ha with basal area 47.26 m²/ha at 2000 m, while in the foothill plot it was 247/ha and basal area of 31.38 m²/ha.

Conclusion: Our preliminary findings suggest that breeding bird diversity is opposite to tree diversity, while plant productivity possibly plays an important role. Vegetation sampling in the western Himalayas along with flycatcher songs and genetic differentiation across the Himalayas are currently being investigated.

Key words: Eastern Himalayas, Mid-elevation peak, Spot-mapping, Tree diversity, Plant productivity

Project Title	: Causes of avian diversity gradients along the Himalayas.
Principal Investigator(s)	: Sh. R. Suresh Kumar, Sh. Pratap Singh, Sh.S.K. Gupta, Dr. Dhananjai Mohan and Dr. Trevor Price
Researcher(s)	: Mr. Suresh Kumar Rana and Mr. Ashutosh Singh, Junior Research Fellows
Funding Agency	: Dept. of Science and Technology, Govt. of India
Project Duration	: 19.08.2013 to 18.08.2016

Corridors, bottlenecks and conflict: Tiger habitat connectivity around Tadoba Andhari Tiger Reserve, Maharashtra, India

- Indranil Mondal

Aim: Human dominated landscapes form a sea of matrix around islands of protected areas which harbours the majority of the biodiversity in our country. When wildlife becomes abundant in such small pockets of favourable habitats, they spill over into human dominated areas causing conflict. This is especially true for large carnivores like tigers, and stands as a major barrier against its conservation. Under such circumstances, studying how such dispersing/ exploring tigers use the landscape, becomes very important.

Location: After studying various cases of human-tiger conflict from dispersing/ exploring individuals from all over the country, we zeroed in on the landscape around the Tadoba Andhari Tiger Reserve (TATR), in Chandrapur, Maharashtra.

Methods: We analyzed tiger presence and human-tiger conflict locations from around TATR, and regressed them against habitat features such as land use, vegetation type and distance metrics from human habitation, roads and source of water to calculate co-efficient to be used to define the cost surface for connectivity analysis. We mapped bottlenecks using centrality analysis and investigated the coincidence of conflict with occurrence of bottlenecks.

Results: Analysis suggested presence of drainage network and small forest patches as cues for delineating movement corridors in the human dominated landscapes. We believe crop type can also influence delineation of corridors along agricultural landscapes. Interestingly on many cases we found tigers preferring areas near human habitation for refuge or movement, which is probably true during the night. We found an overlap of bottlenecks in corridors and conflict incidents.

Conclusion: The corridors delineated using conflict locations, extends beyond that given by non-conflict presence data. So we see that bold tigers venturing into human dominated areas are actually using wider corridors, or ones that were not known to exist earlier. In that case there are chances of overlap with new human dominated pockets and therefore more conflict. So we recommend prioritization, to select such predicted conflict hotspots and apply focused restoration and management in order to prevent or mitigate conflict in the future.

Keywords: Habitat connectivity, tiger, conflict, bottleneck, restoration.

Project Title	: Evaluating pattern of landscape use by dispersing tigers (stray) and modelling potential connectivity bottlenecks.
Principal Investigator(s)	: Dr. Bilal Habib; Dr Parag Nigam and Dr. Gautam Talukdar
Researcher(s)	: Mr. Indranil Mondal, Project Biologist
Funding Agency	: National Tiger Conservation Authority
Project Duration	: 19.08.2013 to 18.08.2014

A preliminary study on the fishes of upper Subansiri river basin, Arunachal Pradesh

- Sutanu Satpathy

Aim: Subansiri River is one of the major tributaries of the Brahmaputra; it originates from the Tibetan plateau and flows through Arunachal Pradesh. This river basin is under tremendous pressure from various hydro-electric projects and other developmental endeavours. Although Subansiri is an important Biogeographic unit for aquatic diversity, fishes of this system are relatively poorly studied. With this background, a reconnaissance survey was carried out in the upper Subansiri River during April and May 2014 to understand fish species assemblages.

Methodology: As part of the preliminary study, a total of nine streams were surveyed for fish and other aquatic habitat characteristics. At each site, 100m stretch of stream was selected for habitat characterization. Some key habitat variables such as altitude, riparian cover, major substrate type and, land use pattern were assessed; while water quality parameters such as temperature, dissolved oxygen and, conductivity were recorded. Fish sampling was carried out using different fishing gears such as gill nets, cast nets and drag nets, and the species were confirmed using standard ichthyologic literature.

Results: A total of 22 species of fish belonging to 9 genera and 5 families were recorded. Among the species, *Devario reio* was the most common and dominant species in the explored area. Interestingly, a rare and endemic fish, *Psilorhynchus arunachalensis* was also recorded in one of the streams. High species richness was recorded in Sigin stream.

Conclusion: This preliminary finding suggests that streams of the Subansiri river basin are quite diverse in habitat as well as species richness.

Key words: fish assemblage, aquatic habitat, streams, species richness, *Psilorhynchu*

Project Title	: Ecology, taxonomy and conservation of fish diversity in Subansiri river basin of Arunachal Pradesh, North East India
Principal Investigator(s)	: Dr. J. A. Johnson, Dr. K. Sivakumar and Dr. Gopi G. V
Researcher(s)	: Mr. Sutanu Satpathy, Junior Research Fellow
Funding Agency	: Dept. of Science and Technology, Govt. of India
Project Duration	: 03.03.2014 to 02.03.2017

Where to BEE? Diversity patterns of bees in agro-ecosystems along varying distances from forest in Doon Valley

- Preeti Shirish Virkar

Aim: Pollination is an essential ecosystem service by pollinators to natural and agro-ecosystems. The recent world over decline of pollinators can have important negative consequences on wild plant diversity, ecosystem balance and crops ultimately affecting food security and natural resources. This is mainly due to the habitat loss and modern agricultural interventions. Considering the key role of pollinators, a study was initiated in Doon Valley with the objective to assess the diversity of pollinators in different agro-ecosystems and forest types. In the present study, we investigate the effects of forest habitat on bee diversity patterns in agro-ecosystems at increasing distance from forest. Forests act as reserves of pollinators. Thus, we test our hypothesis that agro-ecosystems at increasing distance from forests show lower bee diversity.

Study Area: Agro-ecosystems and forest habitats in Doon Valley, Uttarakhand, India.

Methodology: Stratified random sampling was used to sample bees in sampling units (5m x 5m quadrats) in agro-ecosystems along a gradient of increasing distance from forest (250m, 500, 750, 1000m). Bee diversity was recorded based on the passive coloured (yellow, blue and green) pan trap data observations.

Result: A total of 23 bee species belonging to four families Megachilidae, Apidae, Andrenidae and Halictidae were recorded. Agro-ecosystems in close proximity to forests showed higher bee diversity (H' for <100m= 2.077385) compared to those further away (H' for 1000m= 0.500402).

Conclusion: Findings of investigation emphasizes importance of forest as potential refuge for pollinators as they provide nesting, off seasonal foraging and breeding sites. Wilderness in or near agro-ecosystems support higher bee diversity.

Key Words: pollinator, decline, wilderness, refuge, gradient

Project Title	: Assessment of pollinators in different agro-ecosystems and forest types around Dehradun.
Principal Investigator(s)	: Dr. V.P. Uniyal
Researcher(s)	: Ms. Preeti Shirish Virkar, Senior Research Fellow
Funding Agency	: Dept. of Biotechnology, Govt. of Uttarakhand
Project Duration	: 01.02.2012 to 31.01.2015

Monitoring the abundance of breeding Lesser Florican *Sypheotides indica* in the agriculture fields of Rajasthan and Madhya Pradesh

- Dr. K. Sivakumar

Aim: Lesser Florican (*Sypheotides indica*), an endemic species to Indian subcontinent, is seen during monsoon season in the north-western India, where it breeds. Its population and range is continuously decreasing at an alarming rate due to breeding habitat loss and certain threats prevailing in the non-breeding habitats. This project aims to study the ecology and migration pattern of Lesser florican using the satellite tracking techniques to find out their non-breeding habitats, and also to assess the current status and distribution in the north-western India.

Study area: Entire breeding range of Lesser florican in western India but more focus was given to Ajmer District in 2013.

Methods: Entire breeding range of Lesser florican in western India was stratified into 1 km² grids. Grids that represented the potential habitat of floricans were randomly surveyed for their population distribution.

Results: In 2013, a total of 224 male Lesser floricans were found in the agricultures fields in and around Ajmer, Rajasthan. So far, this is the largest population of lesser florican recorded in a single district in India. It was also found that the florican population was widely dispersed in the form of lekking clusters and spread into the neighbouring districts of Tonk, Bhilwara and Beawar. In Madhya Pradesh, 26 floricans were found in different districts in 2013. Due to late arrival of monsoon, there was no florican sighted in Ajmer till 28th July 2014, except one sighting in Sailana WLS and one in Dadri (near Ghaziabad).

Conclusion: Population of Lesser floricans in the western India is seems to be more or less stable in last three years. However, increasing sightings of these birds in the agriculture landscape is cause of concern that may not be good for the long term conservation of this species due to various threats prevailing in this landscape.

Project Title	: A study on the ecology and migration pattern of the Lesser Florican <i>Sypheotides indica</i> in Western India using satellite tracking techniques.
Principal Investigator(s)	: Dr. K. Sivakumar, Dr. Y.V. Jhala and Dr. Gobind Sagar Bhardwaj
Researcher(s)	: Mr. Anthragam Mohan , Junior Research Fellow
Funding Agency	: Grant in-aid
Project Duration	: March, 2012 to February, 2015

Preliminary results from satellite tracked Black-necked Cranes and Bar-headed Geese in Jammu and Kashmir, India

- Neeraj Mahar

Aim: Understanding of migration routes and use of stop over sites is critical for long term conservation of migratory birds. To understand this we intend to study movement pattern of Black-necked Cranes (BNCs) and Bar-headed Geese (BHG) in J & K.

Location: Gharana Wetland Conservation Reserve, Jammu and Changthang Cold Desert Wildlife Sanctuary, Ladakh.

Methods: We captured and fitted Platform Transmitter Terminals (PTTs) on four BHGs (two each in Gharana and Changthang) and two BNCs (in Changthang). Two BHGs were fitted with conventional neck bands in Changthang. ARGOS provided locations with different accuracy (high accuracy location classes- 3, 2, 1, & 0; low accuracy classes- A, B & Z). We used high class locations in R software for spatial analysis.

Results: During late September to early December, 2013, BNCs moved 279 km and 329 km around their capture sites in Changthang. Besides, PTT fitted BHGs in Gharana, the home range of BHG (ID 111847) was 52.60 sq. km (85% MCP) and core was 7 sq. km (50% MCP), while second BHG (ID 111848) had home range of 29.68 sq. km (85% MCP) with a core of 2 sq. km (50% MCP). The BHG (111847) used 431 km stretch of the Tawi flood plains while BHG (111848) used only 54 km stretch. While BHGs in Changthang moved 361 km (130046) and 945 km (130044). Additionally, neck bands fitted BHGs (ID K24 & K27) migrated to Gharana from Chushul via Pong Dam.

Conclusion: Contrary to the expectation of BHGs migrating to central Asia, the PTT fitted BHGs in Gharana used Tawi flood plains. However, the PTT tagged BHG in Changthang moved close to Himachal Pradesh border from Chushul. The study tracked migration of BHG from Ladakh to Jammu probably via Himachal (Pong Dam). A larger sample size may yield further information on their migration pattern. The BNC showed lateral migration from west to east.

Key Words: Telemetry, migration, home range, Platform Transmitter Terminal (PTT), Ladakh.

Project Title	A study of the distribution pattern, habitat use and movement of breeding waterbirds with special reference to Black-necked Cranes and Bar-headed Geese using Satellite telemetry in Changthang Cold Desert Wildlife Sanctuary, Ladakh and Gharana Wetland Conservation Reserve, Jammu & Kashmir
Principal Investigator(s)	: Dr. S. A Hussain, Dr. Bilal habib, Dr. Gopi, G. V., Sh. Tahir Shawl , Sh. Intesar Suhail and Sh. Jigmet Takpa
Researcher(s)	: Mr. Neeraj Mahar, Junior Research Fellow
Funding Agency	: Dept. of Wildlife Protection, Govt. of Jammu and Kashmir
Project Duration	: 30.07.2012 to 29.07.2015

Breeding ecology of an urban raptor, Black Kite (*Milvus migrans govinda*), in Delhi

- Nishant Kumar

Aim: Some species in human modified landscapes have adapted and thrive on opportunistic availability of resources. Black Kite, a medium sized raptor, is a typical example which exploits the super abundance of garbage based food in the towns and cities of the Old World. We studied the density, phenology, breeding success and diet of Black kites in a changing urban landscape.

Location: Delhi NCR. During 2013-2014, our survey effort extended in an area of 1500 km², pertaining to the city of Delhi, India. The overall city comprises both urban and semi-urban areas under poor solid waste management, which affords plenty of food to Black Kites in the form of rubbish, carrion and remains from slaughterhouses. The city, with patches of tropical thorn forest, has semi-arid climate and receives 64 cm of annual precipitation.

Methods: Black Kite nests were surveyed through a network of 32 plots of 1km² distributed on the gradient of urbanization throughout the city. A sample of 150 nests was checked every few days to collect data on laying date, breeding success and diet.

Results: The average density was 15.1±7.9 nests/km². The majority of nests were on trees (91%) and the rest on artificial structures. Mean laying date was 31st January and the laying season was protracted over four months. Mean number of fledged young was 0.73, 1.09 and 1.53 per territorial, breeding and successful pair. Breeding success was 48% in 2013 and 55.56% in 2014. Diet was dominated by scavenged meat and by rats, pigeons and doves abundant in the city.

Conclusion: Density has been stable since 1960. 1970s and probably represents the highest ever recorded for a raptor. This is probably promoted by a combination of (i) availability of rubbish, (ii) few predators and (iii) high tolerance by people. The conservation status of this raptor seems satisfactory, but removal of mature trees for rapid development may result in local declines or re-distributions, suggesting the need for continued monitoring.

Key Words: Urban, Scavenging, Resource, Phenology

Project Title	: A study of resource selection by Black Kites.
Principal Investigator(s)	: Dr. Y. V. Jhala and Sh. Qamar Qureshi
Researcher(s)	: Mr. Nishant Kumar, Junior Research Fellow
Funding Agency	: Raptor Research & Conservation Foundation, Mumbai
Project Duration	: 15.01.2014 to 14.01.2015

When Less is Good: traditional land use aides Great Indian Bustard Conservation

- *Vaijayanti, V.*

Aim: Despite the establishment of protected areas for the conservation of Great Indian Bustards (*Ardeotis Nigriceps*, hereafter GIB), decline in their numbers continue. In contrast, GIBs have been observed in human dominated landscapes, outside protected areas in Maharashtra. We explored the possible reasons for the continued presence of GIBs in this landscape.

Study Area: The study area includes four villages in Warora Taluka of Chandrapur District, in eastern Maharashtra. The temperatures reach 47°C during summers and the monsoons bring 1336 mm rainfall per year.

Methodology: In order to understand the traditional land use pattern, we carried out a questionnaire survey with 47 villagers. This was followed by characterization of GIB habitat using crop type, height and interspacing between crops, neighbouring crops, use of manure, size of grasslands, distance to village/road and aspirations of the people as parameters. These habitats were identified by direct sighting, telemetry and secondary data.

Results: Traditional land use pattern in Warora (as realized through the questionnaire) is a mosaic of rainfed and small patches of grasslands left fallow by people. Spared by farmers, as grazing areas, are the edges of crops that mark the borders of fields. GIB was sighted in and around crops of varying heights and intercrop spacing. It was observed on the edges of tall (>80cm) crops and short (<80cm) and well-spaced (within and between) (>30cm) crops/grasslands. On crop harvest and temperature rise GIBs were not sighted. Their return coincided with the advent of the monsoons and presence of cover.

Conclusion: The traditional land use practice, low rainfall and economic status of Warora farmers seems to be conducive for GIB during the breeding season. The strong adherence of farmers towards the traditional cropping pattern protects the current GIB habitat from any major changes in land use. Thus, GIB presence in Warora maybe a result of having just the bare necessities. Identification of similar pockets of GIB habitat and promoting the traditional land use practice may help in conserving GIBs beyond protected areas.

Keywords: traditional land use practice, Great Indian Bustards, agricultural lands

Project Title	: Tracking the Great Indian Bustards and mapping its potential habitat across the Deccan landscape, Maharashtra, India.
Principal Investigator(s)	: Dr. Bilal Habib, Dr. Gautam Talukdar, Sh. R. Suresh Kumar and Sh. Mukul Trivedi
Researcher(s)	: Ms. Vaijayanti, V, Junior Research Fellow
Funding Agency	: Maharashtra Forest Department
Project Duration	: 17.01.2014 to 16.01.2016

Prioritizing, planning and assessing the recovery of bustards

- *Sutirtha Dutta*

Aim: Bustards play iconic and indicator roles for conservation of agro-grassland systems. To inform national recovery plans for this endangered taxa, our project aims at prioritizing conservation areas, planning landuses based on habitat-relationships, and subsequently assessing their recovery status.

Location: Extensive surveys in Rajasthan, Gujarat, Maharashtra, Karnataka, Andhra Pradesh and Madhya Pradesh; intensive research in Kachchh (Gujarat) and Thar (western Rajasthan)

Methods: For prioritizing landscapes, Great Indian Bustard (GIB) occurrence was assessed using ground surveys and modeled on eco-geographical variables to generate habitat-suitability maps. Their local extinction was assessed from literature and e-questionnaires, and modeled on socio-ecological variables to generate extinction-risk maps. Cells with high suitability and persistence-probability were prioritized for conservation. For landuse planning, we modeled lesser florican abundance on landuse-related variables and predicted their status under simulated scenarios of agricultural growth and allocation. To assess recovery status, we developed occupancy and distance sampling based population and habitat assessment protocol.

Results: Conservation prioritization analysis showed that sites with semiarid bioclimate, open-habitat, less crop-cover and fewer anthropogenic pressures were suitable for GIB; while, their local extinction was related to loss of open-habitat and landuse intensification. Thar and Kachchh were identified as priority landscapes. Species-landuse analysis showed that florican abundance responded unimodally to herbaceous biomass, peaking at optimal combinations of grass- cover and height. Managing florican habitat as grassland interspersed with croplands and pastures spared rotationally reconciled conservation vs. livelihood goals under low production-level. However, population decline was inevitable under increased production. Implementing our status assessment protocol in Thar, we demonstrated GIB density of 0.58(SE0.36)/100km² with distribution largely outside Protected Areas and limited by disturbances.

Conclusion: We recommend maintaining landuses below species-tolerance thresholds by harnessing schemes (e.g., food bill) to compensate for production deficit; investing on such activities in research-prioritized landscapes; and adapting them based on periodic assessment of recovery status.

Keywords: conservation modeling, habitat suitability, extinction-risk map, land sparing vs. sharing, monitoring protocol

Project Title	: Conserving Great Indian Bustard occupied landscapes through scientific understanding and participatory planning.
Principal Investigator(s)	: Dr. Y. V. Jhala
Researcher(s)	: Dr. Sutirtha Dutta, Research Affiliate
Funding Agency	: USFWS Assistance Award, Grant-in-aid, MBZ Species Conservation Fund, National Geographic Conservation Trust & Ravi Sankaran Fellowship Program
Project Duration	: April, 2014 to March, 2017

Evaluation of methods to estimate Wild Ass population in Rann of Kutch, Gujarat

- Qamar Qureshi

Aim: To evaluate various approaches of population estimation for long term monitoring of *Khur* (*Equus hemionus khur*) distributed in large multiple use landscape.

Study Area: *Khur* or Indian wild ass population is distributed largely over 10,000 sq. km. in the arid saline desert interspersed with crop fields and saltpans in Little and Great Rann of Kutch (Gujarat).

Methods: *Khur* is highly endangered wild equid with its range restricted now to single locality in India. We evaluated distance based sampling using three different means i.e. foot, vehicle, and aerial (airplane and Unmanned Aerial Vehicle, UAV) transects. Foot transects were systematically spread across Eastern and Southern fringe with random start. Total of 74 foot transects have been laid covering 370 km. We also collected habitat and observer related variables to evaluate their effects on detection of animals. The Aerial survey was conducted using fixed wing Cessna aircraft covering 413 km. We evaluated observer fatigue, observer variability, aircraft height and habitat types for their effect on detection probability. Abundance data was analysed using Distance based estimators and Horvitz-Thompson like estimator was used for covariate based estimates. The issue of availability bias in aerial surveys has not been addressed so far, this study has initiated process of incorporating availability bias.

Results: Density of *Khur* based on foot transect was estimated to be 6.99 ± 1.16 (SE) in Southern fringe (winter) and 2.3 ± 0.5 in Eastern fringe (summer). Aerial transect based density in winter was 2.5 ± 0.5 . The aerial survey standardization protocols indicate effect of observer fatigue and height, and estimates were corrected for the same.

Conclusion: The choice of method depends on technical capability of team and cost. The use of complicated methods increases complexity of analysis and may not improve the precision of estimate. The current density estimates from aerial survey and foot transect are not comparable due to design issue. The work is in progress and will be able to address the current design issues.

Key words: *Khur*, Line transect, Monitoring, Aerial survey, Horvitz-Thompson estimator.

Project Title	: Evaluation of methods to estimate Wild Ass population in Rann of Kutch, Gujarat.
Principal Investigator(s)	: Sh. Qamar Qureshi and Dr. Nita V. Shah
Researcher(s)	: -
Funding Agency	: Grant-in-aid
Project Duration	: 04.02.2012 to 31.06.2016

A new home for lions?

- *Stotra Chakrabarti*

Aim: Reintroducing Asiatic lions at alternative sites is essential to insure against environmental stochasticity and extinction of the species. We assessed ecological and social potential of Barda Sanctuary for developing strategies for lion reintroduction.

Study Area: Barda hills (215 km²) in western Saurashtra, Gujarat, are a dry deciduous forest tract, of which 192.3 km² is the sanctuary.

Methods: We used spatially explicit capture-recapture (n = 1,856 camera trap nights) and Distance sampling (n = 27 line transects) framework for estimating abundance of predators and prey respectively. Potential habitat corridors between Gir and Barda were delineated using lion habitat-suitability models and Circuitscape. Social perceptions about lion reintroduction were quantified through questionnaire surveys (n = 90 respondents). We used information on lion habitat use, home range and prey availability from eastern Gir (habitat similar to Barda) to estimate lion carrying capacity of Barda landscape.

Results: Barda landscape (410 km²) was estimated to support 26 - 35 lions. Wild prey density of Barda sanctuary was low, nilgai (0.3±0.02 km⁻²) and wild pig (3.4±2.8 km⁻²) being the only wild ungulates recorded on transects. Currently, reintroduced lions cannot be sustained exclusively by wild prey, leading to predation on livestock present in Barda. Existing connectivity between Gir and Barda was found to be extremely tenuous and unfavourable for regular lion movements. Majority (98%) of the pastoralists living inside Barda were willing to resettle outside.

Conclusion: Soft release of few lions concurrent with incentive-driven voluntary resettlement of pastoralists from inside Barda to create inviolate area, restocking of prey-base and managing conflicts with appropriate compensation was considered to be a feasible strategy for making Barda a potential new home for lions. Restoring habitat corridors might require extensive investments and policy change and desirable only if Barda was to be managed as a natural metapopulation with Gir landscape.

Key Words: Barda, carnivore, conflict, corridor, reintroduction

Project Title	: Ecology of the endangered Asiatic lion using satellite and GPS telemetry.
Principal Investigator(s)	: Dr. Y.V. Jhala
Researcher(s)	: Dr. Kausik Banerjee, Research Associate and Mr. Stotra Chakrabarti , Junior Research Fellow
Funding Agency	: Dept. of Science and Technology, Govt. of India and Gujarat Forest Department
Project Duration	: 09.10.2013 to 08.10.2016

Abundance and distribution pattern of tigers in Pench Tiger Reserve, Madhya Pradesh

- Anindita Bidisha Chatterjee

Aim: Tiger (*Panthera tigris*) acts as a flagship species in most of the forested tracts of Asia. In spite, they have gone through major shrinkage in its range. So this study aims at looking at the abundance and distribution pattern of tigers for long term conservation and management interventions.

Location: Pench Tiger Reserve Madhya Pradesh, lies in central India with a total area of 410 km² which includes Pench National Park (292 km²) and Pench Mowgli Sanctuary (118 km²).

Methods: Photographic capture-recapture framework was used to evaluate tiger abundance. A total of 83 grids, each four km² in size, were sampled using a pair of camera traps for each grid. Encounter rate of 12 potential prey species was assessed using line-transect based distance sampling method (n=56 transects, total effort=259 km). Tiger abundance was estimated using Spatially-Explicit-Capture-Recapture (SECR) model in software DENSITY 5.0. Tiger capture rate and encounter rate of principle prey (chital, sambar and wild pig) were computed for each four km² grid. Relationships of tiger space use (capture rate) with principle prey species encounter rate, forest cover density and distance to human settlements were examined using correlation analysis.

Results: Based on 2472 photographs belonging to 44 individual tigers the estimated density was 4.53 (SE 0.73)/100 km². The encounter rate of chital, sambar and wild pig were estimated at 21.72/km, 2.42/km and 0.9/km respectively. The overall encounter rate of these major prey species was 24.95/km. The forest cover density (>55%) and distance to human settlements showed influence on tiger space use.

Conclusion: The results showed a marginal increase in the density of tigers in Pench as compared to the previous years (2006 to 2013). The dense forest cover influenced 15% of the space use and the distance to villages influenced 17% of the tiger space use in the study area.

Keywords: Capture-Recapture Framework, Space Use Pattern, Forest Cover, Human Settlements, Prey encounter rate

Project Title	: Ecology of Tigers in Pench Tiger Reserve, Madhya Pradesh, Phase . II.
Principal Investigator(s)	: Dr. K. Sankar, Sh. Qamar Qureshi, Dr. Y.V. Jhala, Dr. Rajesh Gopal and Sh. Alok Kumar
Researcher(s)	: Ms. Anindita Bidisha Chatterjee, Junior Research Fellow
Funding Agency	: Grant-in-aid
Project Duration	: 01.04.2013 to 31.03.2016

Population Illusion: Tiger and leopard numbers from Tadoba-Andhari Tiger Reserves and the adjoining Landscape

- Nilanjan Chatterjee

Aim: As a part of the long term monitoring project on Tigers, co-predators in Tadoba-Andhari Tiger Reserve and the adjoining landscape, we estimated the population of tigers, leopards and dholes present in TATR. This was the first attempt to study the population dynamics of three predators in the landscape.

Study area: The study was carried out in Tadoba-Andhari Tiger Reserve in Chandrapur District of Eastern Maharashtra. Mainly a tropical dry deciduous forest dominated by Bamboo (*Dendrocalamus strictus*) and Teak (*Tectona grandis*), the reserve spread across over an area of 1700 km².

Methods: We used spatially-explicit capture recapture model to estimate the population of tiger and leopards in the reserve. We used hierarchical classification to enumerate the number of dhole packs present in the area based on number of individuals captured in each or series of photographs captured in a short time interval. The data presented is based on three sessions of camera-trapping (~20 days each session) spread over an area of 1700 km² with an overall effort of ~8000 trap nights during the year 2014.

Results: The population estimate (N) for 2014 camera trapping season was 60(SE 5.8) for tiger based on the 56 adult individuals identified from the photographs. From 43(N=49(4.6)) in 2012, the tiger population in 2013 was 50(N=51(7.5)), showing an increase in the tiger population and a turnover rate of ~25%. We identified 32 leopard individuals from the camera-trap, which showed a steep increase from 17 in 2013. We estimated 7 dhole packs in the tiger reserve with an average pack size of 6.2(SE 1.4).

Conclusion: The large turnover rates in big-cat population indicates its connectivity with other protected areas. Long-term survival of this predator guild will depend on functional connectivity of TATR with adjoining protected areas. We also developed method for estimating population of social carnivores using camera-traps.

Key words: camera trap, spatially explicit capture-recapture, hierarchical clustering, dhole, tadoba

Project Title	: Long term monitoring of tigers, co-predators and prey-species in Tadoba-Andhari Tiger Reserve and the adjoining landscape.
Principal Investigator(s)	: Dr. Bilal Habib, Dr. Parag Nigam, Sh. Mukul Trivedi, Dr. V. K. Sinha and Sh. G. P. Garad
Researcher(s)	: Mr. Nilanjan Chatterjee , Ms. Madhura Davate and Mr. Anil K. Dashahare; Junior Research Fellows
Funding Agency	: Maharashtra Forest Department and National Tiger Conservation Authority
Project Duration	: 04.04.2013 to 03.04.2018

Prey density, food habits and population density of leopard (*Panthera pardus*) in Sariska Tiger Reserve, Rajasthan

- Dibyadeep Chatterjee

Aim: The leopard (*Panthera pardus*), an endangered species is the most successful predator among big cats and its size gives the ability to feed on a variety of prey species ranging from young domestic cattle to smallest rodent. Inadequate prey base affects reproductive success and survival of leopard. Hence, prey density, food habits and population density of leopard in Sariska Tiger Reserve, Rajasthan, were investigated from April 2013 to March 2014.

Study Area: Sariska Tiger Reserve, lies in the State of Rajasthan, Western India (N27°05' to N27°45' and E76°15' to E76°35'). The total area of the Tiger Reserve is 881 km², of which 400 km² is the notified National Park.

Methods: Prey species availability was estimated using line transect method (total effort = 115 km and 134 km during summer 2013 and winter 2013-2014 respectively) in the intensive study area of 274 km², that comes under notified National Park. Based on scat analysis (N = 398), the proportion of different prey species consumed by leopard was estimated. Camera trap based mark-recapture framework was used to estimate density of leopard.

Results: In summer, peafowl was found to be the most abundant (120.29 ± 10.88 SE/km²) prey species in the study area followed by common langur (31.96 ± 12 SE/km²), nilgai (25.19 ± 4.52 SE/km²), livestock (15.21 ± 5.21 SE/km²), grey francolin (14.13 ± 3.79 SE/km²), chital (13.67 ± 4.52 SE/km²), sambar (10.6 ± 4.46 SE/km²), wild pig (8.44 ± 2.65 SE/km²) and hare (1.99 ± 0.66 SE/km²). In winter, peafowl was found to be the most abundant (138.35 ± 18.71 SE/km²) prey species followed by livestock (51.69 ± 9.55 SE/km²), nilgai (28.59 ± 4.93 SE/km²), chital (24.26 ± 5.5 SE/km²), sambar (12.42 ± 2.69 SE/km²), wild pig (12 ± 3.4 SE/km²), grey francolin (9.24 ± 2.28 SE/km²) and hare (0.43 ± 0.5 SE/km²). Nine prey species were identified in leopard scats. Sambar contributed maximum in leopard's diet followed by chital, nilgai, cattle, rodent, common langur, bird (peafowl and grey francolin), hare and wild pig. The overall density of leopard in the study area was estimated as 15.63 ± 1.77 SE individuals/100 km².

Conclusion: Though peafowl was the most abundant prey species in Sariska, sambar contributed maximum to the leopard's diet as revealed by scat analysis, which was similar to the previous findings in the same study area. Slight decrease in the leopard density was observed during the present study as compared to the previous findings.

Keywords: line transect, scat analysis, camera trapping

Project Title	: Ecology of Leopard (<i>Panthera pardus</i>) in Sariska Tiger Reserve, Rajasthan, Phase-II.
Principal Investigator(s)	: Dr. K. Sankar and Sh. Qamar Qureshi
Researcher(s)	: Mr. Dibyadeep Chatterjee, Junior Research Fellow
Funding Agency	: Grant-in-aid
Project Duration	: 01.04.2013 to 31.03.2016

Variation in group size, age-sex structure, genetic diversity and establishing genetic identity of crop raiding Asian elephants in and around Rajaji National Park, Uttarakhand

- Rahul De

Aim: Habitat fragmentation, degradation and land use changes impact Asian elephant populations and cause elephants to stray out of the forests, crop raiding, human deaths and retaliatory killing of elephants. The present project aims to gain understanding of crop raiding patterns, population genetics, gene flow and socio-biology of elephants of north-west Indian population.

Location: Rajaji National Park, Uttarakhand and adjoining elephant habitat.

Methods: Geo-referenced faecal samples (n=783) were collected, both opportunistically and by following elephants, as source of DNA. Sex and group composition were recorded upon encounters. Classification into age groups was done based on relative height and morphological characteristics. Baseline reference data on frequency of 88 identified alleles in a panel of 12 microsatellite loci in the population was generated using high quality tissue and blood samples (n=111) which would be used to eliminate false alleles while amplifying relatively inferior quality faecal DNA samples. Faecal samples (n=20) collected from crop raiding events (n=4) were used for genetic identity and we discuss any recurrent patterns of raids.

Results: Out of 122 sightings, group size ranged from two individuals to a herd of 20 individuals. There were 24 encounters (19.6%) of solitary animals (100% males). Female individuals constituted 59.5% samples, 14.7% were from male individuals and sex was unknown for 25.8% samples including samples from calves. Proportion of sampled adult, sub-adult, calves and old animals were 51.8%, 7.2%, 5.7% and 10.3% respectively. We observed mean expected heterozygosity ($H_E=0.663\pm0.039$), mean unbiased expected heterozygosity ($uH_E=0.667\pm0.039$), mean observed heterozygosity ($H_O=0.504\pm0.032$) and mean fixation index ($F_{IS}=0.237\pm0.033$) across 12 loci.

Conclusion: Group sizes >4 were 66.1% whereas group size of five to seven were most frequent (21%). Sex ratio was skewed towards females (1:2.5). Ratio of sampled adult, sub-adult and calves were 10.9:1.3:1. Low positive value of F_{IS} suggests heterozygote deficiency and non-random mating or biased sampling.

Keywords: *Elephas*, non-invasive, heterozygosity, F_{IS} , Non-random mating.

Project Title	: Patterns of spatial and temporal habitat occupancy in relation to crop raiding behaviour and genetic variation of free-ranging Asian elephants (<i>Elephas maximus</i>) in north-west India using non-invasive genetic sampling.
Principal Investigator(s)	: Dr. S.P Goyal, Sh. Qamar Qureshi, Dr. Parag Nigam and Dr. A.C. Williams
Researcher(s)	: Rahul De, Junior Research Fellow (UGC-NET)
Funding Agency	: Project Elephant, MoEF, Govt. of India, WWF-Asian Rhino and Elephant Action Strategy, University Grants Commission, Operation Eye of the Tiger, India
Project Duration	: 01.10.2012 to 30.09.2015

Species identification through non-invasive genetic methods: Preliminary results from Khangchendzonga Biosphere Reserve, Sikkim

- *Suvankar Biswas*

Aim: Identification of species using non-invasive genetic methods. Field surveys in Khangchendzonga Biosphere Reserve (BR) usually result in substantial encounters of wildlife faeces. However, visual encounters were very rare as most of the wildlife species are nocturnal or crepuscular as confirmed by the results obtained from camera trapping.

Study area: The Khangchendzonga BR in Sikkim is a large landscape that encompasses rich and diverse intricate habitats that are home to several wildlife species.

Methods: In order to identify wildlife species through non-invasive genetic methods, an attempt was made to analyse the faecal samples (n=94) collected from field. In-house methods and Qiagen DNA stool Kit were used for DNA extraction from faeces (scat/pellet groups). The DNA templates were used for amplification of a fragment of mitochondrial DNA Cyt *b* gene.

Results: DNA was extracted from 35 samples only and thereafter, these samples were attempted for PCR amplification of Cyt *b* gene and amplification was possible from four samples only. All the PCR amplified fragments generated unambiguous sequences. The amplified PCR products were subjected to DNA sequencing using standard protocol. Sequencher programme was used for post cleaning and validating the ambiguous nucleotides. Short sequences of 146 bp for carnivore samples and 381 bp of ungulate sample were generated. The BLAST tool of NCBI database was used for similarity search and blue sheep (*Pseudois nayaur*), red fox (*Vulpes vulpes*), snow leopard (*Panthera uncia*) and leopard cat (*Prionailurus bengalensis*) were identified.

Conclusion: The probable cause of getting less success in PCR amplification and subsequent DNA sequencing were due to degradation of stored samples that were collected during rainy and humid conditions. Therefore, it is proposed to modify sample collection and storage protocol.

Project Title	: Monitoring Land Use by Wildlife, Livestock and Humans in Khangchendzonga Biosphere Reserve.
Principal Investigator(s)	: Dr. S. Sathyakumar and Sh. S.K. Gupta
Researcher(s)	: Mr. Suvankar Biswas and Mr. Sandhi Mitra; Junior Research Fellows
Funding Agency	: Ministry of Environment, Forests and Climate Change
Project Duration	: 22.06.2011 to 21.06.2014

Capacity Building in Biodiversity Informatics to support evidence based decisions in conservation.

- Rupa

Title: Capacity Building in Biodiversity Informatics to support evidence based decisions in conservation.

Aim: Biodiversity informatics is an emerging tool dealing with improved management, presentation, discovery, exploration and analysis of biodiversity information based on taxonomic, biogeographic or ecological information stored in digital form. The aim of this project is to enhance the capacity in field of Biodiversity Informatics for evidence-based decision for conservation through mobilizing and publishing of camera trap data.

Study Area: The Rajaji National Park (RNP) (820 sq km) in Uttarakhand was chosen as a pilot site as camera trapping exercise has been systematically carried out from the year 2004 to 2012.

Methods: 305 Digital camera trap images were downloaded from SD cards and were geo-tagged using GeoSetter software. The metadata of these images was extracted by using freeware program BR's EXIFextractor. To obtain a standardized metadata of camera trap images a pre-configured Excel spreadsheet file in Audubon Core data template was used, using standardized terms. The metadata and camera trap images were then hosted on Open Geospatial Consortium (OGC) compliant Web GIS Portal deployed for interoperability/exchange of data. A three tier security (Administrator, User and Guest) user roles were defined as well as the Unified Threat Management (UTM) system was employed on Web Portal to ensure cyber security compliance.

Results : As a result of this exercise, a web portal with 305 standardised camera trap photographs has been developed, which is accessible at <http://129.168.206.51/wii-ct-client/LoginForm.aspx> . The geolocation of camera trap data was degraded and then hosted on Web Portal as there are security issues associated with tiger data. A Best Practice Guide (BPG) has also been developed so as to streamline the process of multimedia data cataloging and publishing.

Conclusion : The pilot project has demonstrated publishing and open access to camera trap data which assists in evidence based decision making. It can be upscaled to host different types of multimedia data.

Key Words : Camera trap, Audubon core, Geotagging, Metadata, Multimedia.

Project Title	: GBIF project - Capacity Building in Biodiversity Informatics
Principal Investigator(s)	: Dr. V.B. Mathur, Dr. S. Sathyakumar, Dr. Bivash Pandav and Dr. Gautam Talukdar
Researcher(s)	: Ms. Rupa, Senior Project Associate
Funding Agency	: NINA, Norway
Project Duration	: 21.10.2013 to 20.10.2014

Conservation and development in Kailash Sacred Landscape (KSL) - a new initiative

- Dr. Arti Kala

Aim: Initiative seeks solutions to reconcile tradeoffs between conservation and development in KSL. The implementation plan aims to accomplish harmony between the objectives of biodiversity conservation, productivity enhancement, and livelihood improvement.

Study Area: A transboundary area (31, 375 km²) in China, India, and Nepal well-known for its cultural, geo-hydrological, and biodiversity values delineated is marked by the Mount Kailash. KSL-India (7,120 km²) predominantly lying in Pithoragarh district, Uttarakhand forming catchment of Kali River and incorporating Askot Sanctuary is the focused area for the paper.

Methods: The 18-month preparatory phase resulted into the preparation of Feasibility Report, Conservation Strategy, and Comprehensive Environmental Monitoring Plan besides the Regional Implementation Plan which incorporates a synthesis of proposed activities under the five major components. Current focus being on the Ecosystem management for sustaining servicesq assessments on landscape characterization, ecosystem diversity, distribution and status of RET species, and sustainable livelihoods were initiated by a multidisciplinary team. Broadly, a hierarchical, consultative, participatory, rapid, and intensive approach for reconnaissance and field assessments addressing requirements of various activities has been adopted. Using conventional methods, assessments in community forests of 15 Van Panchayats relevant to horizontal transectq were also undertaken. Pilot trial using camera traps for ascertaining the distribution and status of faunal species was undertaken. Workshops on stakeholder consultation and capacity building were also organized.

Results: Team efforts helped in establishing linkages with the stakeholders, reconnaissance, preliminary field level assessments and an insight on diversity of ecosystems and associated species, socio-economic situation, conservation challenges, and identification of potential sites for future intensive studies and participatory natural resource management planning. Development of a GIS database was successfully initiated.

Conclusion: Major pilot project visualizes enormous challenges as well as opportunities. It has set the right tone for accomplishment of its twin goals.

Keywords: Transboundary landscape, Ecosystem management, Biodiversity, Community forest, Participatory planning.

Project Title	: Execution of Implementation Plan of the Kailash Sacred Landscape Conservation and Development Initiative.
Principal Investigator(s)	: Dr. P.K. Mathur, Dr. B.S. Adhikari, Dr. S. Sathyakumar, Dr. V. P. Uniyal, Dr. K. Sivakumar, Sh. Mukul Trivedi and Dr. Gopi, G.V.
Researcher(s)	: Dr. Arti Kala, Research Associate
Funding Agency	: ICIMOD, Kathmandu, Nepal
Project Duration	: Five years (2013-2017)

Landscape characterization, spatial heterogeneity, and community forests in Kailash Sacred Landscape (KSL)-India

- Sweta Singh

Aim: Present study aimed to characterize the KSL-India and develop understanding on spatial heterogeneity of landscape for twin goals i.e. conservation and development. In addition, an insight on community forests and their surrounding lands forming a matrix was also developed.

Study Area: Study was carried out in KSL-India encompassing 7,120 km² covering major part of Pithoragarh district and a small portion of adjacent Bageshwar district, Uttarakhand State.

Methods: Land Use/Land Cover (LULC) map in GIS domain was generated for entire landscape. For this, necessary data from multiple government agencies was obtained, digitized, rectified, and extracted specifically for landscape, sub-watersheds, and forest Ranges. GPS locations collected during field assessments in different forests were used for validation. Software FRAGSTATS v.4.2 was used for quantifying landscape structure and computing various metrics. Computed metrics/indices characterized the landscape mosaic as a whole, patch type (class), and each patch type. Comparisons amongst different sub-watersheds and Ranges were also made. Spatial heterogeneity was also assessed for the predetermined Horizontal Transect (running west to east in lower latitudes) and its surrounding area.

Results: Preliminary findings provided an insight for the landscape, sub-watersheds, and forest Ranges. Pithoragarh and Bageshwar districts constituted 96% and 4% area of the landscape, respectively. 41.5% area of the landscape in the northern part was snowbound. Glaciers constituted the second largest category of land cover representing 10.77% area of the landscape. Human and agro-ecosystem dominated matrix contributed 17.6% area of KSL-India. 18 different forest types covering 2,127.27 km² area represented nearly 30% of the landscape. Three Oak (*Quercus* spp.) forest types occupied 1,064.16 km² area and represented almost half of the forested tract. The study also discusses spatial heterogeneity on the basis of 9,392 patches under 22 LULC categories deciphered.

Conclusion: Study could characterize the heterogeneity of the landscape.

Key words: LULC, watersheds, matrix, FRAGSTATS, forest types

Project Title	: Execution of Implementation Plan of the Kailash Sacred Landscape Conservation and Development Initiative.
Principal Investigator(s)	: Dr. P.K. Mathur, Dr. B.S. Adhikari, Dr. S. Sathyakumar, Dr. V. P. Uniyal, Dr. K. Sivakumar, Sh. Mukul Trivedi and Dr. Gopi, G.V.
Researcher(s)	: Ms. Sweta Singh, Project Biologist
Funding Agency	: ICIMOD, Kathmandu, Nepal
Project Duration	: Five years (2013-2017)

Spatial heterogeneity and its implications on mammalian diversity and its distribution in Kailash Sacred Landscape (KSL)-India

- Ajaz Hussain

Aim: Being a spatially heterogeneous landscape owing to variety of causes including the environment, biotic interactions, disturbance, and succession, study aims to assess and understand the influence of such spatial patterns on mammalian diversity, its distribution, and status for effective conservation planning.

Study Area: Last one year efforts were primarily made in 15 community forests relevant to horizontal Transect selected for various studies in KSL-India. For pilot study on the use of camera traps, two sub-watersheds namely Jhulaghat and Ramganga Purvi were selected.

Methods: Initial efforts for assessing mammalian diversity and their status were made in 15 select community forests. Conventional field method i.e. trail transects of 1 km in different forest patches was adopted for recording direct sightings and indirect evidences. A pilot trial on use of camera traps in two select sub-watersheds was carried out by adopting grids of 2kmx2km i.e. 4 km² area. Altogether, 17 grids were sampled. Each grid had 8 camera traps for three consecutive nights which resulted into a total of 408 camera trap nights during May-June, 2014. Data was analyzed in terms of photo capture rate (PCR).

Results: The trail transect data collected in 15 community forests is being analyzed. A total of 12 mammalian species and four bird species were captured during the pilot trial on camera traps. Barking deer was most captured species followed by wild boar. Other species captured based on PCR and relative per cent occurrence were: Indian Crested Porcupine, Common Leopard, Kalij Pheasant, Indian Hare, Himalayan Palm Civet, Asiatic Black Bear, Hanuman Langur, White Crested Laughingthrush, Rusty Cheeked Scimitar Babbler, Yellow Throated Marten, Golden Jackal, Leopard Cat, Grey Winged Black-bird, and Grey Francolin accordingly.

Conclusion- Initial efforts have provided understanding on mammalian diversity and distribution and way forward for planning future study.

Keywords: Landscape, Community Forests, Sub-watersheds, Camera Traps, Photo Capture Rate

Project Title	: Execution of Implementation Plan of the Kailash Sacred Landscape Conservation and Development Initiative.
Principal Investigator(s)	: Dr. P.K. Mathur, Dr. B.S. Adhikari, Dr. S. Sathyakumar, Dr. V. P. Uniyal, Dr. K. Sivakumar, Sh. Mukul Trivedi and Dr. Gopi, G.V.
Researcher(s)	: Mr. Ajaz Hussain, Project Biologist
Funding Agency	: ICIMOD, Kathmandu, Nepal
Project Duration	: Five years (2013-2017)

Bird diversity in community forest of Kailash Sacred Landscape (KSL) - India

- Sumit Kumar Arya

Aim: Study aimed to assess diversity of avifauna in \pm an Panchayats , those find a special place in the landscape. They represent one of the largest, oldest, democratic autonomous local institution in devolved common property management ever developed by community in collaboration with the State.

Study Area: KSL-India forms the study area covering an altitudinal gradient from 350m to 7,000m asl. Current preliminary study focused on lower latitudinal ridges of the landscape and assessment of avifauna was carried out in 13 Van Panchayats.

Methods: Fixed radius point count method at the regular interval of 100m was used on transects laid in each habitat of the community forest including adjacent agro-ecosystems during the month of September-November, 2013 and February-May, 2014. At each point, 10-15 min was spent on observations on birds. One transect was laid for every 8 ha. Each transect had 06-10 sample points. Eight habitat types were categorized in four altitudinal categories. Past 3x software used for computing Shannon diversity and Margalef richness values. Bird density was also computed.

Results: Altogether 418 point counts were sampled on 46 transects in eight habitats. In all, 114 species belonging to nine Orders and 43 Families were recorded. Total 2,065 individuals were recorded during field assessment. The birds belonging to families Muscicapidae, Columbidae, Corvidae and Picidae were most abundant. Maximum diversity (1.11 ± 0.1) and richness (1.49 ± 0.14) were obtained in the case of Deodar forest whereas highest density (33.73 ± 2.66 birds/ha) was recorded in the Agro-ecosystem. Himalayan bulbul registered highest density in Deodar, Mixed and Shrubland habitats whereas Common myna, Grey hooded-warbler, Long tailed-minivet, White capped-redstart and Great tit recorded highest values in Agro-ecosystem, Oak, Pine, Riverine and Sal habitats, respectively.

Conclusion: Study has provided preliminary insight on patterns of diversity and distribution of avifauna in different habitats.

Keywords: Avifauna, Diversity, Richness, Van Panchayat, Point count

Project Title	: Execution of Implementation Plan of the Kailash Sacred Landscape Conservation and Development Initiative.
Principal Investigator(s)	: Dr. P.K. Mathur, Dr. B.S. Adhikari, Dr. S. Sathyakumar, Dr. V. P. Uniyal, Dr. K. Sivakumar, Sh. Mukul Trivedi and Dr. Gopi, G.V.
Researcher(s)	: Mr. Sumit Kumar Arya, Project Biologist
Funding Agency	: ICIMOD, Kathmandu, Nepal
Project Duration	: Five years (2013-2017)

Forest fragmentation and its impact on wild ungulates in Kailash Sacred Landscape (KSL)- India.

- Rohit Chaudhary

Aim: Ongoing study aims to assess the impact of forest fragmentation on distribution and status of wild ungulates.

Study Area: KSL-India (7,120 km²) in Pithoragarh and Bageshwar districts of Uttarakhand is the study area. KSL-India once predominated by native forests has witnessed widespread forest fragmentation and other biotic influences. Presently, KSL-India depicts mosaic of fragmented forests in a human dominated landscape.

Methods: First step would be to assess and understand the nature and extent of forest fragmentation in KSL-India. Secondly, the focus would be to assess the effect of size, shape, edge, proximity, and connectivity amongst forest fragments on the distribution and status of wild ungulates in different forest types and in relation to surrounding matrix. Conventional methods viz. trail walk, sign survey, and transects will be used besides camera traps would be deployed for assessing distribution and abundance of wild ungulates. Patch quality in terms of habitat, topographical and disturbance variables would be determined. Radio/satellite telemetry studies are being planned on selected ungulates to get a greater insight on spatial and temporal use of forest patches. The expected output will ultimately help in effective conservation planning, management and also contribute as vital baseline information for the purpose of long term ecological monitoring as envisaged in KSLCDI.

Results: In a brief period of four months, reconnaissance visit was undertaken. Familiarity of the area and preliminary understanding on forest diversity and the process of forest fragmentation were developed. Pilot trial on the use of camera traps was attempted in select sub-watersheds.

Conclusion: Study area provides enormous opportunity to assess the impact of fragmentation on wild ungulates owing to long history and varied forest management regimes besides all-round rapid development taking place.

Keywords: Forest patches, Forest diversity, sub-watersheds, Matrix, Long term ecological monitoring

Project Title	: Execution of Implementation Plan of the Kailash Sacred Landscape Conservation and Development Initiative
Principal Investigator(s)	: Dr. P.K. Mathur, Dr. B.S. Adhikari, Dr. S. Sathyakumar, Dr. V. P. Uniyal, Dr. K. Sivakumar, Sh. Mukul Trivedi and Dr. Gopi G.V.
Researcher(s)	: Mr. Rohit Chaudhary, Project Biologist
Funding Agency	: ICIMOD, Kathmandu, Nepal
Project Duration	: Five years (2013-2017)

Ecological mapping of Askot landscape

- Parisha Bankhwal

Aim: Ecological mapping aims to identify areas of high biodiversity value, resources dependencies and threats in order to define targeted interventions for improving conservation outcomes and community livelihoods. Species Distribution Maps and Resource Extraction Maps will be prepared. This will enable modeling areas of high biodiversity and pressure zones within the landscape.

Location: The Askot landscape is located in the Eastern Kumaon, in the state of Uttarakhand. It extends over Dharchula and Munsyari tehsils of Pithoragarh district covering an area of 4494.49 km². The Kali river forms the boundary in the south-east till Jauljibi, forming the border of India and Nepal. The western and north - western boundary runs along the true left bank of the Gori River.

Methods: The land use land cover was prepared from IRS LISS III satellite data for the year 2011. Based on the element of visual interpretation an interpretation key was prepared and land use land cover categories were delineated at 1:50000 scale using onscreen visual interpretation technique.

Results: Twenty one classes including eleven different vegetation types were mapped. In the landscape, forested area is 20.87%, non-forested area is 73.98% and grassy slopes constitute 5.15%. Intensive ground truthing was done through field survey and involved collection of 1068 GPS points in different sites for various categories. 3229 photographs were taken in each of the four cardinal directions (north, south, east and west) and geotagged. Spatial layers like drainage, road and settlement were prepared from secondary sources. Respective datasheets were created for plants, fishes, insects, birds and mammal taxa. Species point location for plants, fishes, birds and mammals were also plotted for Gori sub watershed.

Conclusion: The geospatial database will enable us to model high biodiversity areas and high pressure zones, which can then be used for prioritizing conservation and management of biodiversity rich areas.

Keywords: Biodiversity, Land Use/Land Cover, Species Distribution Maps, Resource Extraction

Project Title	: Biodiversity Conservation and Rural Livelihoods Improvement Programme.
Principal Investigator(s)	: Sh. V.K. Uniyal, Sh. Qamar Qureshi and Dr. Gautam Talukdar
Researcher(s)	: Ms. Parisha Bankhwal, Project Assistant
Funding Agency	: World Bank
Project Duration	: 1.9.2011 to 30.9.2017

Distribution and identification of indicator fish species for monitoring stream ecosystem in Askot landscape, Uttarakhand

- Vandana Rajput

Aim: Fishes are the best known group of aquatic vertebrates live near or top of the aquatic food chain. They response quickly to any change in the environmental conditions so they are considered as indicators for the aquatic ecosystem. This study aimed to investigate the fish distribution pattern in Askot landscape and also to identify indicator species for monitoring the aquatic habitat.

Study Area: Askot landscape covers the huge altitudinal range from 560m to 7434m in the Eastern Kumaon of Western Himalayas having three river basins- Gori, Kali and Dhaulti Ganga. Of these streams, 18 were selected for the present investigation and field work was conducted between February 2013 and May 2014.

Methods: At each stream 100m section of stream was selected for fish species inventory, assessment of habitat variable and human interaction. Fish sampling was performed using cast net, monofilamentous gill net and drag net covering different seasons which includes intermediate season (January-March), summer season (April-June) and post monsoon (September-October). Habitat variables such as riparian cover, water temperature, altitude, stream order, major substrate type and land use pattern were recorded at each site along with various human interactions such as water diversion, destructive fishing and sand mining.

Results: Total of 12 fish species belonging to two orders, three families and nine genera were recorded from the study area. Among them, *Schizothorax richardsonii* and *Puntius chelynooides* were commonly distributed species in the landscape. A very rare and highly specialized catfish *Parachilognis hodgarti* was recorded in four streams. High diversity of fishes was observed in Rautis and Ghatya streams during summer season (Shannon diversity index 0.664 and 0.448 respectively). Based on the information on human interaction, a matrix was prepared against species distribution and human disturbance for identification of indicator species.

Conclusion: On the basis of the analysis, two species namely *Schizothorax richardsonii* and *Puntius chelynooides* were selected for monitoring aquatic habitat with reference to human disturbance.

Key Words: fish diversity, Shannon diversity, habitat, human interaction, habitat assessment

Project Title	: Biodiversity Conservation and Rural Livelihoods Improvement Programme.
Principal Investigator(s)	: Dr. J.A.Johnson
Researcher(s)	: Ms. Vandana Rajput, Project Assistant
Funding Agency	: World Bank
Project Duration	: 1.9.2011 to 30.9.2017

Understanding of forest resource availability in Askot Landscape: A case study of Gori Valley

- Soni Bisht

Aim: The study aimed to document the status and distribution of forest resource availability in Gori Valley

Study area: Gori valley forms one of the major watersheds of river Kali in Askot landscape, located in the Eastern part of Kumaon region in Pithoragarh district of Uttarakhand.

Method: Gori Valley was divided into eight bins (sampling units) and in each bin 5 transects (3.5 km long trail from the village) were laid. In each transect at a distance of 500, 1000, 1500, 2500 and 3500 m, points were selected for laying plots (3 plots, each 200 m apart, 10 m radius circular plots for trees; 5 m plots for shrubs, climbers and saplings of trees; and 4, 1x1 m quadrats for herbs) for data collection. GPS locations, slope, aspect, canopy cover and disturbance (logging, logging, grazing and fire) were recorded for each plot. The use of natural resources viz., fodder, fuel wood, timber and medicinal plants by the locals of 8 villages was done through questionnaire. The analysis was done following Misra (1968) and plant identification by Osmaston (1928).

Results: Thirty nine transects (117 sampling plots) provided a record of 566 species (116 trees, 142 shrubs, 24 climbers, 35 orchids and 249 herbs) in Gori valley. The density and total basal area (TBA) of trees were highest in north and east, while regeneration in north-west facing slopes between 1900-2200 m. The density and TBA of *Alnus nepalensis* were highest in NW, *Q. glauca* in N and *P. roxburghii* in NE facing slopes. In all, *Machilus duthie* and *Lyonia ovalifolia* had maximum density among trees, *Inula cappa* and *Sarcococca saligna* among shrubs. The maximum dependency of locals was on broadleaved evergreen species for fodder; *Lyonia ovalifolia*, *Rhododendron arboreum*, *Q. leucotrichophora*, *Woodfordia fruticosa* and *Pinus roxburghii* for fuelwood; and *Shorea robusta*, *Alnus nepalensis* and *Pinus roxburghii* for timber. High value yielding medicinal plants are being extracted by the locals from the valley.

Conclusion: Gori valley harbours 22% plant wealth of the total Askot landscape. North and east facing slopes support maximum density and TBA of trees, while regeneration between 1900-2200 m in north-west slopes. The dependency of local community is largely on oak species.

Keywords: Elevation gradient, Fodder, Fuel wood, Medicinal plants, Total basal area

Project Title	: Biodiversity Conservation and Rural Livelihoods Improvement Programme.
Principal Investigator(s)	: Dr. B.S. Adhikari
Researcher(s)	: Ms. Soni Bisht, Project Assistant
Funding Agency	: World Bank
Project Duration	: 1.9.2011 to 30.9.2017

Developing habitat suitability maps for key mammalian species for Askot landscape, Uttarakhand

- Ankita Bhattacharya

Aim: Use of statistical and spatial models to predict potential distribution of a species is helpful for application and implementation of landscape level conservation. In the present study, we developed habitat suitability maps for some key mammalian species to identify and prioritize landscape for monitoring under BCRLI project.

Location: The study area is Askot landscape, Uttarakhand, located in eastern Kumaun, encompassing an area of 4463 sq. km. The altitude ranges from about 600 m to above 5500m. The vegetation comprises subtropical, tropical, subalpine and alpine types.

Methods: We used latitudinal gradient directed transects (gradsects) as our extensive sampling method. We divided the study area into nine sampling units where 40 gradsects were laid and 118 plots were sampled. We collected information on presence/absence of some mammals along with habitat variables, topographic factors and disturbance parameters. We used logistic regression to find the predicted probabilities of occurrence for each species. These were interpolated across the landscape and were used to spatially predict the distribution probability of selected mammal species across the landscape.

Results: Goral, Barking deer, Wild pig and Leopard showed positive response to distance (settlements, road) and negative response to disturbance parameters. Goral showed a positive response for Banj-oak forest ($p=0.060$), Mixed forests ($p=0.066$), Scrub ($p=0.013$) and North east aspect ($p=0.139$); Wild pig showed positive response towards Shrub and Herbaceous vegetation ($p=0.018$); Leopard showed a positive response to Goral presence ($p=0.118$) and Shrub cover ($p=0.131$).

Conclusion: We find that mammals show a positive response to habitats suitable to them and with increase in disturbance, their predicted probabilities of occurrence decreases. We produced potential maps showing areas with habitats which are suitable for each species. The habitat suitability maps generated from this study will be used for prioritization of sub watersheds of landscape for future monitoring strategies.

Keywords: Askot, Habitat Suitability Modelling, Monitoring, Landscape, Mammals

Project Title	: Biodiversity Conservation and Rural Livelihoods Improvement Programme.
Principal Investigator(s)	: Dr. Bilal Habib and Sh. R. Suresh Kumar
Researcher(s)	: Ms. Ankita Bhattacharya, Project Assistant
Funding Agency	: World Bank
Project Duration	: 1.9.2011 to 30.9.2017

An assessment of the socio-economic status of local communities for conservation planning - A case study of Gori valley, Askot Landscape, Uttarakhand

- Amrita Laha

Aim: Biodiversity Conservation and Rural livelihood Improvement Project (BCRLIP) significantly depends on the social factors that shape human interactions with the environment and choices to exploit or conserve biodiversity. The preliminary aim of this study has been to assess the socio-economic status of the local people and the extent of their dependence on natural resources.

Location: Gori valley, Askot Landscape, Uttarakhand

Methods: Based on stratified cluster sampling of 37 village Van Panchayats (VVP), using census of India, 2001 and 2011, three clusters of villages were identified. This was followed by 340 questionnaire survey conducted in 18 (49%) VVP selected through non-random sampling along with 75 individual interviews with people across age classes and 8 forest department staff for perception analysis.

Results: An array of livelihood options were delineated out of which most people were engaged in labour work [72%] and *Cordyseps* extraction [59%]. Data reveals the average monthly income of every household to be Rs 638. The cluster wise per capita resource dependency on fuel wood, fodder, dwarf bamboo, and medicinal plants has been estimated along with a graphical representation of *Cordyseps spp.* extraction. Data reveals high dependency on natural resources of villages located above 2500m. Though *Cordyseps* emerge as an important income supplementary source, data instructs that it is highly inconsistent and unreliable. However it has led to discernible changes in agricultural practices. In addition to it, farmers incur huge amount of crop loss owing to wild animals (89%), birds (69%), lack of rain (64%) and irrigation (33%), hail (49%) and feral cattle (32%). Reports also indicate steady emigration (29%) of the male working class [15-59] for the purpose of employment and education .

Conclusion: Issues that pose a hindrance to the success of a project such as BCRLIP are multi tiered and require careful understanding for developing livelihood supplements.

Key words: Biodiversity conservation; Ecosystem management; Local communities; Socioeconomic profile; Livelihood options; Landscape management; Askot landscape

Project Title	: Biodiversity Conservation and Rural Livelihoods Improvement Programme.
Principal Investigator(s)	: Dr. S.A. Hussain, Dr. Ruchi Badola and Sh.V.K. Uniyal
Researcher(s)	: Ms. Amrita Laha, Project Assistant
Funding Agency	: World Bank
Project Duration	: 1.9.2011 to 30.9.2017

Public perception towards wildlife in wolf landscape, Ladakh, Jammu and Kashmir, India

- Hussain, S. R.

Aim: Effective implementation of conservation policies to foster co-existence depends upon better understanding of attitudes of local people towards wildlife. We intended to understand the pattern of public perception towards carnivore and ungulate species and carnivore-human conflict in a wolf-landscape.

Location Villages around Leh, Ladakh region of the Western Indian Trans-Himalaya, India.

Methods We conducted questionnaire surveys in the villages around Leh city (headquarter of Ladakh region). We sampled 20-30 % households per village. The households were selected by stratified sampling method to represent different cultural and economical classes. A total of 250 interviews were conducted in 14 villages during summer of 2014. Questionnaires were designed in semi-structured type with most of the questions obtaining quantitative data, and a few questions including open-ended answers. Interviews were conducted by visiting houses and taking notes. Perceptions were recorded for attitude, knowledge and effect on livelihood on a rubric scale of 1-5 for different carnivores and ungulates. Data is summarized for different socio-economic classes to see the pattern of perception.

Results A cumulative livestock loss of 6, 22,000 rupees monetary value was reported by the sampled households in last one year, out of which 34.57 % was due to natural death and diseases and rest was caused by carnivores. However, among carnivores feral dogs were the most damaging causing 39. 23 % of loss while wolf and snow leopard caused 15.6 % and 10.61 % loss respectively. Public attitude for co-existence with different carnivores did not vary much across farmers vs non-farmers, educated vs illiterate and female vs male. Average attitude for co-existence score was 2 showing agreement for co-existence. When asked for the importance of different species, average answers ranged from 2.5 to 3.5 showing a neutral response.

Conclusion: Compared to our baseline survey of year 2011 in Ladakh, conflict with feral dogs has increased significantly, which demands a strong management policy to regulate and monitor feral dogs. Quantification of public perception should range more and show a pattern with increase in sample size.

Keyword Conflict, livestock loss, feral dogs, co-existence, wildlife management

Project Title	: Ecology and conservation of the Himalayan wolf.
Principal Investigator(s)	: Dr. Bilal habib, Dr. Y. V. Jhala and Sh. Salvador Lyngdoh
Researcher(s)	: Mr. Shivam Shrotriya, Senior Research Fellow and Mr. Hussain, S. R., Junior Research Fellow
Funding Agency	: Grant-in-aid
Project Duration	: 23.08.2010 to 05.02.2017

Economics of living in the wild: cost-benefit analysis for the forest corridor linking the Rajaji-Corbett National Parks

- Pariva Dobriyal

Aim: Understanding the spatial distribution of costs and benefits along the human landscape of Rajaji-Corbett forest corridor and estimating the costs of conservation in terms of human wildlife conflict (HWC)

Location: Forest corridor linking Rajaji and Corbett Tiger Reserve, Uttarakhand

Methodology: The Landsat MSS, TM and ETM images for the years 1972, 1990 and 2010 were used to analyze the changing aspects of land use and land cover over a 38 years period. Supervised classification was done to prepare the land use maps. To study the demographic and infrastructural changes and human census data was collected for the years 1971, 1981, 1991 and 2001 for the region. Villages were selected through Hierarchical Cluster Analysis to study the socioeconomic profile, literacy rates, occupational pattern, access to basic facilities, forest dependence and intensity of HWC. Interview based questionnaire was used to survey randomly selected households.

Results: The study revealed that from 1972 to 1990, there is a decrease in the dense forest cover (1.8%) and open forest area (8.7%) while between 1990 to 2010 dense and open forest cover have decreased by 4.5% and 3.1% respectively. At the expense of dense forest and open forest, area under moderate dense forest (1972 to 1990- 10.9%; 1990 to 2010- 2.4%) and settlement (1972 to 1990- 3.1%; 1990 to 2010-2.3%) have increased. Both demographical and infrastructural variables showed increase which indicates that disturbance regimes in the forest corridor may be increasing affecting the forest connectivity, resources and species that inhabit the corridor which is resulting in situation of HWC. About 50% of the households reported loss of cash crops due to wild animals. Livestock loss was reported by the 23% of the households while attack on human was reported by 10% of households. Information on the socio economic condition of the people, type and quantity of use values derived and human wildlife conflict for more villages, is being collected.

Keywords: Human wildlife conflict, land use land cover, socio-economic status, household survey

Project Title	: Economics of living in the wild: cost-benefit analysis for the forest corridor linking the Rajaji-Corbett National Parks.
Principal Investigator(s)	: Dr. Ruchi Badola and Dr. S.A. Hussain
Researcher(s)	: Ms. Pariva Dobriyal, Senior Research Fellow, Mr. Tanveer Ahmad and Mr. Goura Chandra Das; Technical Assistants
Funding Agency	: The South Asian Network for Development and Environmental Economics
Project Duration	: 01.10.2012 to 30.09.2015

An assessment of socio-economic status and resource dependency of local communities living around Kedarnath Wildlife Sanctuary for developing alternative livelihood options

- Upma Manral

Aim: Forests of Indian Himalayan Region are surrounded by various land use types and human population that derives many direct and indirect benefits from these forests. Previous studies have evidenced habitat destruction and successional changes in the region because of ongoing unsustainable harvesting and logging practices. Thus, it becomes imperative to study phyto-resource dependency and livelihood strategies of rural communities and explore the alternatives for livelihood generation to better manage and conserve natural wealth of the region particularly of protected areas.

Location: Madhmaheshwer and Kalimath valleys, Kedarnath Wildlife Sanctuary, Uttarakhand

Methods: Hierarchical Cluster Analysis was conducted to select study villages for sampling. Household level questionnaire survey was conducted using semi-structured questionnaire with both open and close-ended questions on socio-economic profile, resource use pattern, human wildlife conflict and participation in community based activities and local level institutions.

Results: 390 households (25% of total) were surveyed in 15 villages. Primary occupation for majority of households was daily wage work with armed forces being major employer from government sector. Fuelwood was primary source of energy and on an average 25-30 kg/day/household of fuelwood was collected for about 180 days/year. *Quercus leucotrichophora* was the most preferred leaf fodder brought from forests (35-40 kg/household/day) primarily from October to May. Leaf litter was collected primarily for keeping livestock warm in cowsheds during winter months (40kg/household/day for 60 days/year) which was later used as manure in fields. Collection of tree branches more than 2 m in length and hill bamboo (*Thamnocalamus spathiflorus* and *Arundinaria falcata*) in May and June to support Rajma plants put extra burden on forests (150 ±30 kg woody biomass for a field of 60 m² in area). As traditional agricultural practices in the region are closer to organic farming thus option of organic certification for Amaranths, Kidney beans and citrus fruits was explored for augmenting income of locals. Also, 120 members of 50 functional and 30 inactive SHGs were interviewed. These SHGs focused on savings, with members pooling financial resources and making small interest by bearing loans among themselves. The functional SHGs had better co-operation among members and had visibly strong leadership and resulted in economic independence of its members.

Key words: Protected area, livelihood strategies, local institutions, household survey, human wildlife conflict

Project Title	: Promoting livelihood security and community participation in forest conservation in fringes of Kedarnath Wildlife Sanctuary, Western Himalaya.
Principal Investigator(s)	: Dr. Ruchi Badola and Dr. S.A. Hussain
Researcher(s)	: Ms. Upma Manral, Senior Research Fellow
Funding Agency	: Uttarakhand State Council for Science & Technology
Project Duration	: 20.05.2013 to 19.05.2015

Comparative status of large mammals and their habitats in Shivalik-Terai Landscape between 2003 and 2013

- M. Naveen

Aim: Status of large mammals and their habitats in the Shivalik-Terai Landscape was documented ten years ago. Given this baseline, this study was aimed at understanding comparative status of these species and their habitats between 2002-03 and 2013-14.

Location: The landscape covers an area of 42,700km² between Yamuna River in the west and Valmiki Tiger Reserve in the east, and spreads across five states *viz.* Himachal Pradesh, Haryana, Uttrakhand, Uttar Pradesh and Bihar.

Methods: Sampling protocol remained the same as was followed during 2002-2003 and surveys were repeated in the same sampling units across the landscape. Presence/absence of target species and habitat correlates were recorded in 237 survey routes covering 951km. Data was analyzed based on frequency of occurrence and was compared between two sampling periods. Further, satellite data for these two time scales were processed and compared to discern the broad scale pattern of landscape change.

Results: It was found that the overall status of tiger remained stable, while there has been marginal increase in the occupancy of leopard, but such pattern was not consistent across the habitat blocks. Significantly, prey species appears to show positive trend in the occupancy pattern across the landscape. Although presence of cattle and domestic dog in the forest areas has shown declining trend, lopping incidents have increased. However, change detection analyses revealed that some of the important corridors/habitat connectivity have been lost in the last ten years.

Conclusion: Biological value of the landscape is responding positively to management and conservation interventions at local scales, while the landscape has undergone definitive fragmentation due to loss of habitat connectivity at landscape scale. Conservation inputs including to address the lopping and fragmentation issues at various habitat blocks would strength the conservation trajectory of the landscape.

Key Words: Large Carnivores; Occupancy Sampling; Habitat Assessment; Image Processing; Fragmentation.

Project Title	: Landscape ecology of large mammals in the Shivalik- Terai landscape with focus on flagship species and ecosystem services.
Principal Investigator(s)	: Dr.K.Ramesh and Dr.Bivash Pandav
Researcher(s)	: Mr. M. Naveen, Senior Research Fellow
Funding Agency	: Grant-in-aid
Project Duration	: 04.02.2012 to 03.02.2016

River habitat survey: vegetation, birds and landscape change in upper Ganges, Uttarakhand

- Ankita Sinha

Aim: The study aims to address the current scenario of the structural integrity of the riverine forests in the context of vegetation characteristics, obligate species and climate change in the upper Ganges.

Location: The study area is the Bhagirathi basin encompassing the area between Rhishikesh and Gangotri in the state of Uttarakhand.

Methods: Species assemblages comprising the riverine forest stands were identified based on field surveys and the riverine vegetation was classified according to the Champion and Seth classification system. Mapping of riverine vegetation was carried out within a buffer along the river in Erdas13.1 and Arc Map 10.1 software. The occupancy pattern of the major riverine bird species of the basin was studied and the patterns of distribution were accounted for with the associated habitat parameters seen on ground. Change detection analysis was done to discern land cover and land use changes across the river basin between two decades (1993-2003 and 2003-2013) using Markov and Change Vector Analyses in Idrisi software.

Results: Bhagirathi catchment was found to consist of four forest types according to Champion and Seth Classification of forests: Tropical moist deciduous forests, Tropical dry deciduous forests, Himalayan sub tropical Pine forests and Himalayan moist temperate forests. There were over 13 species of riverine birds distributed along the river, with varying occupancy and abundance patterns. The distribution of the riverine birds was found to be associated with elevation, flow of river, presence of boulders and vegetation cover. The change detection analysis suggests that the basin has lost almost 625 sq km of forested area in 20 years.

Conclusion: The study area is under major influence of the anthropogenic activities as the forest cover is drastically decreasing while barren land is increasing. The baseline that would be established by this study would be useful to recognize the priority areas for devising adaptive strategy towards climate change.

Keywords: Bhagirathi, landscape change, riverine birds, species-habitat relationships

Project Title	: Effects of climate change on riverine forests and indicator species along river Ganga in Uttarakhand: a multi-scale approach.
Principal Investigator(s)	: Dr. K. Ramesh and Dr. B.S.Adhikari
Researcher(s)	: Ms. Ankita Sinha, Junior Research Fellow
Funding Agency	: Dept. of Science and Technology, Govt. of India
Project Duration	: 25.03.2013 to 24.03.2016

Preliminary analysis on ecological status of mangroves and their associated species in the Godavari Estuarine Region

- Giridhar Malla and Paromita Ray

Aim: East Godavari River Estuarine Ecosystem (EGREE) constitutes the second largest mangroves along the east coast of India. It provides significant ecological and economic benefits and livelihood services to the local community. Climate change is expected to rapidly affect the biodiversity and socio-economic condition of EGREE.

Study Area: EGREE, located in Andhra Pradesh, at the confluence of Gouthami-Godavari River with Bay of Bengal is an extensive river estuarine ecosystem.

Methods: After a reconnaissance survey, the entire area of EGREE was stratified and a grid map of 1x1 km was prepared. 40 grids have been chosen randomly to study the ecology of mangroves and selected associates.

Similarly, 45 grids have been chosen to study the distribution and habitat ecology of aquatic species especially fishes and planktons.

Further, a land cover/land use map for the region was also prepared based on Supervised Classification, using a 2013 LISS III image.

Results: The salinity varied from 7 to 34 ppm in the study area. Diversity of the mangroves was higher in brackish water area than in highly saline water. Preliminary analysis of two seasonal data reveals that there were minimum of 24 species of mangroves, dominated by *Avicennia marina* (IVI = 42.152), *Excoecaria agallocha* (IVI = 20.731) and *Aegiceras corniculatum* (IVI = 10.363).

A total of 14 species of mammals and 186 species of birds were recorded from EGREE. So far, we could record 65 species of fishes (11 families) in EGREE, dominated by Perciformes. Shanon-Weiner Index (H) = 0-2.51.

Of the 189 sq. km of mangroves area, 18 sq.km is already degraded and further 20 sq.km is at risk of degradation due to poor land-use pattern.

Conclusion: From the current study, it is evident that the species composition of flora and fauna are changing with the changes in salinity across the study area.

Key words: EGREE, Mangrove, Estuarine, Fishes, Godavari

Project Title	: Establishment of knowledge management system for East Godavari River Estuarine Ecosystem, Andhra Pradesh.
Principal Investigator(s)	: Dr. K. Sivakumar, Dr. J. A. Johnson, Dr. Gopi G. V., Dr. Panna Lal, Ritesh Kumar, P.S. Rajasekhar , P. Bhadury and S. Kulkarni
Researcher(s)	: Ms. Priyamvada Bagaria, Ms. Paromita Ray and Mr. Giridhar Malla; Junior Research Fellows
Funding Agency	: India GEF Coastal and Marine Programme of United Nations Development Programme, Ministry of Environment, Forests & Climate Change
Project Duration	: Nov. 2012 to Nov. 2016

Plant species composition and biomass production by flood plains in differential inundation regime

- Dr. Gopi, G.V.

Aim: Biomass productivity of wet grasslands is influenced by hydrologic conditions. This study addresses the quantity of herbaceous biomass produced by plant communities in different hydrologic regime in Brahmaputra flood plains.

Location: Kaziranga Tiger Reserve (KTR), Nagaon and Golaghat districts, Assam.

Methods: We used IRS LISS IV remote sensing data to prepare a land use - land cover map of the KTR and the inundation regime of the area was mapped based on discernable plant communities. Fifteen enclosures of 10 x 10 were constructed in different inundation regime. Within these enclosures, vegetation was clipped from 1 m x 1 m plots in three replicates; oven dried and weighed to derive the biomass production during January . April 2014.

Results: The areas of inundation for >21 days but <6 months and for >6 months and regularly inundated had discernable tall and short grass communities. These areas represented 24.4%, 2.2% and 1.9% of the Reserve respectively. A total of 73 plant species were recorded within the enclosures, of which 31 species were in short grasslands and 21 species in tall grasslands and 17 species were common to both the habitats. Overall, Poaceae was dominant, followed by Asteraceae and Polygonaceae. The Shannon's Diversity index for tall and short grasslands was 1.15 and 0.73 respectively. During January-April, four plant communities were recorded in areas with differential inundation regime. The above ground biomass productivity of the area inundated for >21 days to 6 months was 512.27 ±58.41 g m², for the area inundated for >6 months it was 328.08 ±46.31 g m² and overall it was 401.76 g m².

Conclusion: It appears that the areas inundated for longer period yield greater species richness but lower productivity than the areas inundated for shorter period.

Key words: Flood plains; inundation regime; plant species composition; plant community; above ground biomass production.

Project Title	: Patterns of biomass production by wetlands and its use by wild ungulates in Kaziranga landscape.
Principal Investigator(s)	: Dr. S.A. Hussain, Dr. Ruchi Badola and Dr. Gopi G.V.
Researcher(s)	: Dr. Chongpi Tuboi, Senior Research Fellow
Funding Agency	: Dept. of Science and Technology (DST), Govt of India
Project Duration	: 20.05.2013 to 19.05.2015

Monitoring birds and mammals in Southern ocean and Antarctica: Preliminary results and challenges

- *Anant Pande*

Aim: Present study was conducted during the 33rd Indian Antarctic Expedition as part of the long-term monitoring program of wildlife in Antarctica. The objectives of the study were to understand the distribution pattern and community structure of pelagic seabirds in Southern ocean and Antarctica; evaluate the habitat use of birds and mammals in Antarctica and identify key threats; and monitor indicator species such as penguins and seals in the Indian sector of operation in Antarctica. This presentation gives an overview of the preliminary results and the challenges faced during the study.

Location: Southern Indian Ocean; Larsemann Hills and India bay, Antarctica

Methods: Ship-based observations were carried out to record the pelagic seabirds during the voyage from Cape Town, South Africa to Antarctica. Aerial transects were conducted onboard a Bell-type helicopter to count the seals and penguins. On-foot surveys were done at the islands of Larsemann hills to determine presence of any animal use.

Results: 45 species of seabirds were recorded during the voyage in a total count of 7133 birds. Species richness peaked in the mid-latitudes while species abundance showed a steady increase over increasing latitudes. The observations were dominated by the planktivorous species in the lower latitudes replaced by mixed prey dependent species in the higher latitudes. 848 individuals of 6 species were counted in the aerial surveys dominated by Weddell Seal (42.5%) and Adelie penguins (25.1%). Out of 13 islands surveyed for the presence of any animal use, nesting of birds was found to occur in 12 islands.

Conclusion: Observed changes in the abundance and distribution of seabirds and mammals in the study areas as compared from previous surveys could be attributed to marked differences in sampling effort resulting from adverse weather and limited logistics. Advanced monitoring methods are proposed to assist existing methodologies to come up with robust estimates.

Project Title	: Long-term monitoring of Antarctic wildlife and their habitats in Antarctica.
Principal Investigator(s)	: Dr. K. Sivakumar and Dr. S.Sathyakumar
Researcher(s)	: Mr. Anant Pande, Senior Research Fellow
Funding Agency	: Grant-in-aid & Ministry of Earth Sciences
Project Duration	: December 2013 to April 2014

Spatial distribution and abundance of ungulate community in relation to habitat correlates in Kanha Tiger Reserve

- Neha Awasthi

Aim: Understanding the influence of natural factors and anthropogenic impacts on population of ungulates is of fundamental importance to their management. Here, we estimate spatially explicit densities of ungulates covering the study area of 917 km² to evaluate the relationship between abundance and habitat covariates.

Location: Kanha Tiger Reserve, Madhya Pradesh. The reserve has an excellent interspersed of the Dadars (flat hill tops) and valleys constituted by grassland, moist sal forest and miscellaneous forest habitat.

Methods: We used systematic stratified distance sampling on 150 line transects with an effort of 900 km walk. Density surface modelling (DSM) approach using line transect survey data was used to estimate the population density as well as depict the spatial distribution of ungulate species in different habitat types. We generated surface density maps using spatially explicit models for ungulates in R (package dsm).

Results: Individual ungulate species attained different abundances in different habitats. Habitat specific density estimates were more ecologically meaningful as well as relevant for management. Among ungulates, chital was most abundant species throughout the study area with a density of 63.24 (SE 14.12) /km² followed by gaur 7.95 (SE 2.39)/km² in grassland habitat whereas miscellaneous habitat with bamboo and sal patch held the highest densities for sambar 9.05 (SE 1.27)/km² and barking deer 2.57 (SE 0.31)/km². Variables like distance to village was the most important factor influencing chital abundance while terrain features were the most influential determinant of gaur and sambar abundances.

Conclusion: Spatial models using covariates addresses the challenge of providing site and habitat specific density which is the primary requirement for conservation management.

Key words: Line transects, spatially explicit, covariates, density surface modeling

Project Title	: Monitoring source population of tiger in Kanha Tiger Reserve.
Principal Investigator(s)	: Dr. Y.V.Jhala and Sh. Qamar Qureshi
Researcher(s)	: Mr. Ujjwal Kumar and Ms. Neha Awasthi; Junior Research Fellows
Funding Agency	: National Tiger Conservation Authority
Project Duration	: 10.06.2009 to 31.12.2014

Monitoring source population of tiger (*Panthera tigris*) in Ranthambhore

- Ayan Sadhu

Aim: Ranthambhore is the westernmost source population which holds the hope for long term persistence of tigers in the western-Indian landscape. Hence in 2007, this study was initiated to monitor the source population of tigers, and to identify potential dispersal routes. Aim of the present study was to estimate the density and abundance of tigers and its prey species in Ranthambhore.

Study area: Ranthambhore Tiger Reserve

Methods: In 2013 (April to June), the intensive study area (465km²) was sampled by 76 pairs of camera traps (4180 trap-nights) deployed in a systematic manner. Abundance was estimated using close population capture-recapture framework (considering time, behaviour and individual heterogeneity) and best fit model was selected on the basis of AIC_c value. Density of tigers was estimated by spatially-explicit capture-recaptures (SECR) models. Estimation of tiger-prey was carried out by using line transects (n=60) placed in all major habitat types in the study area.

Results: Abundance and density of tigers was estimated at 31.0(±0.01) and 6.11(±0.01) tigers/100km² respectively. Habitat mask was used to eliminate non-habitat areas from sampling area. Combined density of major prey species (Chital, Sambar, Nilgai, Wildpig, Chinkara and Langur) was 51.4±7.03/km² while individual density of Chital (26.3±4.7/ km²), Sambar (8.4±1.6 /km²), Nilgai (3.5±0.9/km²), and Langur (11.94±4.96/km²) were estimated. Due to insufficient samples size (<20) individual estimates were not possible for Langur, Chinkara and Wildpig.

Conclusion: During the period of study a surplus population of sub-adult individuals were present in the study area which are likely to be dispersed from their natal area. Due to this abundance has significantly increased from the previous year estimates (2012: 22±0.1, 2013: 31.0±0.01)

Key-words: Abundance, Density, SECR, Line-transect

Project Title	: Monitoring source population of tiger in Ranthambhore Tiger Reserve, Rajasthan.
Principal Investigator(s)	: Dr. Y. V. Jhala and Sh. Qamar Qureshi
Researcher(s)	: Mr. Ayan Sadhu, Junior Research Fellow
Funding Agency	: National Tiger Conservation Authority
Project Duration	: 05.09.2011 to 04.09.2014

Monitoring tigers in Sundarbans

- Manjari Roy

Aim: Sundarbans, subjected to constant tidal phenomena coupled with the ever present threat from tigers on humans, has deterred rigorous scientific research. In light of current conservation context, we have been using standard camera trap based photographic capture recapture technique to successfully monitor tiger population of Sundarbans for three years.

Study area: The study was carried out in the National Park West Range of the Sundarbans Tiger Reserve, covering an area of 327 sq.km in 2010 and 558 sq.km in 2012.

Methods: We used camera trap based photographic capture recapture analysis to estimate tiger population parameters. We estimated population abundance within the trapped area using Program MARK. The conventional population density was estimated for the effective trapping area by adding a buffer width around the concave polygon joining outermost camera traps. We also estimated tiger density using spatially explicit capture recapture analysis in program SPACECAP.

Results: M_{t+1} was 10 individuals in 2010 and 22 individuals in 2012. We selected the combined effects of individual heterogeneity and differential behavioural response to trap response in different years (M_{bhy}). The effective trapping area of 327 sq.km. and 558 sq. km. in the two years gave tiger densities at 4.2 tigers per 100 sq. km. (SE 3.6) in 2010 and 4.2 tigers per 100 sq. km. (SE 1.03) in 2012. The density estimates using SPACECAP were 4.15 tigers/ 100 sq. km (SD 1.13) in 2010 and 4.14 tigers/ 100 sq. km (SD 0.49) in 2012. Analysis of the 2014 dataset is still in progress.

Conclusion: We believe that the density estimates obtained by us using CMR are robust and in consonance with prey availability in the Sunderban habitat. Extrapolating this density to tiger occupied area (1646 km²) of the Sundarbans Tiger Reserve provides us with a population estimate of 64 to 90 tigers.

Keywords: mangrove, camera trapping, tiger, density, abundance

Project Title	: Population Estimation and Ecology of the tiger in Sundarbans Tiger Reserve.
Principal Investigator(s)	: Dr. Y.V. Jhala and Sh. Q. Qureshi
Researcher(s)	: Ms. Manjari Roy and Mr. Dipanjan Naha; Junior Research Fellows
Funding Agency	: National Tiger Conservation Authority
Project Duration	: 05.10.2009 to 31.12.2014

Activity patterns and food habits of reintroduced gaur (*Bos gaurus*) in Bandhavgarh Tiger Reserve, Madhya Pradesh

- Manas P. Manjrekar

Aim: The study of different ecological aspects of reintroduced animals gives an insight into their response towards the new environment. Hence activity patterns and food habits of the reintroduced gaur (*Bos gaurus*) were studied in Bandhavgarh Tiger Reserve from March 2012 to June 2014.

Study area: Bandhavgarh Tiger Reserve (1,536.7 km²) lies on the north-eastern boundary of Madhya Pradesh state in central India having a monsoonal climate and a moist deciduous type of vegetation.

Methods: Scan sampling technique was used to collect data on the activity pattern of gaur. Thirty six food plants and 168 gaur dung samples were collected for three seasons viz. summer 2012, monsoon 2012 and winter 2012-13. The food plant samples were analysed for nutritional contents and the dung samples for percentage frequency occurrence of monocot and dicot plant fragments.

Results: The annual activity budget of gaur showed that the time spent on feeding was the highest (39.8%, SE=0.76) followed by moving (22.7%, SE=0.56) and resting (21.6%, SE=0.76). Gaur showed significant seasonal differences in time spent on feeding ($X^2=14.603$, $p<0.05$), moving ($X^2=82.146$, $p<0.05$) and resting ($X^2=43.250$, $p<0.05$). The percentage time spent feeding on grasses (*Saccharum*, *Vetiveria* and *Phragmites*) was highest in summer (48.4%, SE=3.91) and on *Dendrocalamus strictus* leaves was highest in winter (63.9%, SE=3.96). The estimated crude protein content was highest in *Butea superba* leaves (11.6%) in monsoon and lowest in *Eragrostis spp.* (1.2%) in summer. The estimated fibre content was highest in *Chlorozylon sweteina* leaves (69.7%) in winter and lowest in *Phyllanthus emblica* leaves (33.8%) in summer. The overall percentage of monocot plant fragments in gaur dung was high (90.3%, SE=1.57) compared to dicot plant fragments (1.3%, SE=0.67).

Conclusion: As grasses constituted a major component of the gaur diet, effective management of grasslands will play a significant role in the long term conservation of this reintroduced population in Bandhavgarh.

Key words: Activity patterns, Food habits, Bandhavgarh Tiger Reserve, Scan sampling, Nutritional analysis

Project Title	: Monitoring reintroduced gaur (<i>Bos gaurus gaurus</i>) in Bandhavgarh Tiger Reserve, Madhya Pradesh.
Principal Investigator(s)	: Dr. K. Sankar and Dr. Parag Nigam
Researcher(s)	: B. Navneethan and Manas P. Manjrekar; Senior Research Fellows
Funding Agency	: Madhya Pradesh Forest Department
Project Duration	: 14.01.2011 to 31.12.2014

Founder influences on the viability of captive carnivores population

- Dr. Anupam Srivastav

Aim: *Ex-situ* management of threatened species is emerging as an important conservation tool. However, these populations lose genetic variability at faster rates being initiated with small number of founders and limited subsequent supplementation; resulting in reduced individual fitness, resistance to diseases and environmental adaptability. We discuss the effect of founders on the viability of captive populations.

Study Species: We selected threatened carnivore species namely; Asiatic lion (*Panthera leo persica*), Indian Tiger (*Panthera tigris tigris*), Dhole (*Cuon alpinus*) and Red panda (*Ailurus fulgens fulgens*) for this study from 25, 75, 7 and 4 Indian Zoos respectively.

Methods: Pedigree databases of the selected species were recorded and analyzed for their genetic and demographic status using SPARKS 1.66 (Single Population Record Keeping Software) (ISIS 2004) and PMx v 1.2 (Ballou *et al.* 2010). Various attributes including total number of animals, founder size, founder genome equivalents and genetic diversity (GD) across time were analyzed for their influence on the viability of populations.

Results: Lion and tiger captive populations were characterized by their large size (current $N > 100$), long history in captivity, and continued founder inclusion over time, whereas Dhole and Red panda were characterized by the converse. Measures of genetic viability of individual populations revealed higher levels of GD retained in the former ($GD > 0.9$) and lower values ($GD < 0.9$) in later. Strong association between total number of animals and measures of genetic viability were recorded for lion and tiger populations (Founders $N > 20$) using Pearson's correlation coefficient significant at 0.01 levels and weak associations for later (Founders $N < 10$).

Conclusion: The study revealed that founder size and supplementation of founders over time were crucial in determining the viability of captive populations; necessitating appropriate management interventions addressing inclusion of adequate unrelated founders with equitable representation.

Key words: - *Ex-situ* conservation, founders, captive population, viability, genetic diversity

Project Title	: Development and maintenance of studbooks of selected endangered faunal types in Indian zoos.
Principal Investigator(s)	: Dr. Parag Nigam and Sh. P. C. Tyagi
Researcher(s)	: Ms. Nilofer Begum , Junior Research Fellow and Dr. Anupam Srivastav, Project Consultant
Funding Agency	: Central Zoo Authority
Project Duration	: 15.11.2012 to 14.11.2014

Conservation-breeding of Western tragopan (*Tragopan melanocephalus*) : the principle of naturalism and model population

- Lakshminarasimha R

Aim: The Himachal Pradesh Forest Department have initiated a breeding program for the *ex-situ* conservation of the threatened Western tragopan. The said project aimed to provide scientific inputs towards enhancing the outcome of the Western tragopan conservation breeding program. It also focused on establishing a %reserve+ and %model+ population of the species in captivity and support *in-situ* conservation efforts including reintroduction and population reinforcement.

Study Site: The study was carried out at Sarahan pheasantry, situated in Shimla, Himachal Pradesh. Significantly, the pheasantry is the only captive facility in the world for conservation breeding of this species.

Methods: The %principle of naturalism+ was followed to develop a keeping system based on ecological requirement of the species. The changes in the husbandry regimes were also supported by behaviour-based management to ensure expression and retention of species-typical behavioural traits. The status of the captive population and the specific strategies for the future management of the stock and reintroduction options were analysed.

Results: The present captive population of the species consists of 34 individuals (28 adults and 6 juveniles) including seven wild-born founders. An average of six births per year has been recorded, reaching the maximum capacity of the captive centre this year. Pedigree analysis revealed a high degree of relatedness among descendants due to disproportionate breeding among the founder individuals. Conservation-oriented management options proposed for the captive population to address these issues include (a) further expansion accompanied by population sub-division, (b) establishment of new pairing system, (d) training the population managers, and (e) identification of priority individuals for the conservation breeding program.

Conclusion: The results emphasized the importance of (i) diverse captive habitat to the extent compatible with the species needs in captive breeding programs and (ii) an integrated conservation-based approach for establishing viable captive population in the Indian zoo context.

Project Title	: Reproductive biology and behaviour of captive and wild populations of Western tragopan in Himachal Pradesh.
Principal Investigator(s)	: Dr. K. Ramesh and Dr. Parag Nigam
Researcher(s)	: Mr. Lakshminarasimha R, Senior Research Fellow and Mr. Vipin Upadhyaya, Junior Research Fellow
Funding Agency	: Himachal Pradesh Forest Department
Project Duration	: 01.06.2011 to 31.08.2014

Genetic assessment to determine extent of introgression in wild pigs: A case study in and around Ranthambhore National Park

- Puneet Pandey

Aim: Wild pig (*Sus scrofa cristatus*) has the widest geographical range among all ungulates in the Indian subcontinent and forms an important prey-base for large carnivores. Though variations in chromosome number have been recorded between wild (n=36) and domestic pigs (n=38), the duo can produce fertile hybrids with morphological attributes similar to wild pigs. Such events can seriously impact wild populations by introgression of alien alleles thereby affecting the genetic fitness and overall immune response. The present study was undertaken to evaluate the genetic diversity and hybridization in wild pigs using mitochondrial and microsatellite markers.

Study area: The study was carried out by sampling wild and domestic pigs in and around Ranthambhore National Park (RNP), Rajasthan.

Methods: A total of 71 blood samples collected from wild and domestic pigs were subjected to genetic analysis using mitochondrial (control region; 650 bp) and microsatellite (10 loci) markers. Faecal (n=26) and hair samples (n=34) of wild pigs were also tested for amplification success rate using different size range markers (100 bp to 650 bp).

Results: Two haplotypes with one segregation site (haplotype diversity= 0.6 ± 0.13) and thirteen haplotype with twenty four segregation sites (haplotype diversity= 0.79 ± 0.04) were recorded in wild and domestic pigs respectively. Analysis of polymorphic microsatellite markers revealed high observed (0.74 and 0.72) and expected (0.71 and 0.86) heterozygosity in wild and domestic pigs respectively. Common haplotype was not found in samples of the two subspecies; suggesting absence of mitochondrial genetic introgression. Bayesian approach for analysis of microsatellite results however could identify one hybrid in the wild population.

Conclusion: The study revealed presence of nuclear genetic introgression in one wild pig from RNP population and necessitates appropriate management interventions towards preventing hybridization of domestic and wild stocks.

Keywords: *Sus scrofa cristatus*, hybridization, non-invasive, control region, microsatellite

Project Title	: Study of genetic diversity in wild (<i>Sus scrofa cristatus</i>) and domestic (<i>Sus scrofa domestica</i>) pigs to find level of hybridization between them in the vicinity of Ranthambhore National Park.
Principal Investigator(s)	: Dr. S.P. Goyal, Dr. Parag Nigam and Dr. N.P.S. Chauhan
Researcher(s)	: Mr. Puneet Pandey, Junior Research Fellow
Funding Agency	: Grant-in-aid
Project Duration	: 04.02.2012 to 31.08.2014

Assessment of genetic variations and amplification of MHC class-I gene from the tiger (*Panthera tigris*) scat samples

- Ajit Kumar

Aim: Tiger (*Panthera tigris*) populations in India have been exposed to various anthropogenic influences potentially affecting their genetic structure. Small population always faces an uncertain future from the impact of a variety of potential threats, including climate change, human encroachment (habitat degradation) and the infectious diseases. Our preliminary study based on microsatellite markers indicated lower genetic diversity in tiger population of Ranthambore Tiger Reserve (RTR). However, ecologically this population is doing well. Therefore, MHC gene variability can be used as a tool to gauge a population's ability to adapt to changing environmental conditions. Hence, this study was focused to compare genetic variability at microsatellite and MHC gene loci.

Study Site: This study was carried out in Badhavgarh Tiger Reserve (BTR) and Ranthambore Tiger Reserve (RTR).

Methods: A total of 46 (RTR=29 and BTR=17) scat samples were examined in this study. Nine polymorphic microsatellite loci and MHC Class-I gene (exon 2 and exon 3) were used for assessment of genetic variation from the DNA extracted from scat samples.

Results: It was observed that 30-50 ng/ μ l DNA extracted from scats having OD260/OD280 ratio between 1.75 to 1.90 can significantly increase the PCR success rate. We detected significant difference in expected and observed heterozygosity, which was 0.61 and 0.47, respectively in RTR's tiger population. However, in BTR's tiger population, the expected and observed heterozygosity was comparable. The mean polymorphic information content (PIC) value of the microsatellite loci (n=9) was 0.50. Direct sequencing of amplified PCR product of polymorphic MHC gene indicated the multiple heterozygous SNPs in single samples.

Conclusion: It was indicated from sequencing data that positive amplicons need to be cloned prior to sequencing to obtain unambiguous nucleotide sequences. Removal of putatively false and spurious nucleotides from the sequence will provide clear estimation of MHC gene diversity among tiger populations.

Key words: *Panthera tigris*, non-invasive samples, MHC gene, Heterozygosity.

Project Title	: Evaluation of MHC Heterozygosity in isolated tiger population.
Principal Investigator(s)	: Sh. S. K. Gupta
Researcher(s)	: Mr. Ajit Kumar, Senior Research Fellow
Funding Agency	: Grant-in-aid
Project Duration	: 04.02.2012 to 03.02.2015

Traditional knowledge on the use of medicinal plants by indigenous ethnic community in Nanda Devi Biosphere Reserve, Western Himalaya

- Amit Kumar

Aim: Rapid changes in socio-economic conditions result in loss of traditional knowledge, which play an important role in subsistence and survival of local communities. Therefore, the study aimed to document the traditional knowledge among local community on ethnomedicinal plants.

Study area: The study area, Upper Dhauri Valley (728 km²) is located in the buffer zone of Nanda Devi Biosphere Reserve, consists of three sub-watersheds viz., Amrit Ganga, Ganesh Ganga and Satya Gad with an elevation gradient between 3000 to 4500m asl.

Methods: Reconnaissance surveys followed by extensive floristic surveys were carried out in three sub-watersheds of the valley. We used semi-structured questionnaires during interviews in seven villages inhabited by *Bhotiya* community for ethnomedicinal study and compared it with the available medicinal plants in Upper Dhauri Valley.

Results: Extensive floristic surveys accounted a total of 310 plant species belonging to 203 genera and 61 families. Of these, 189 plants (61%) were cited as medicinal, in the literature from Uttarakhand state. The highest medicinal plant species richness was recorded in Amrit Ganga (62 species) followed by Ganesh Ganga (54 species) and Satya Gad (42 species). The ethnomedicinal study revealed 37 medicinal plants belonging to 23 families and 31 genera, being used by locals to cure 22 human ailments. Of which, eighteen species were found threatened under various threat categories of CAMP. Most of the plant species were reported to cure rheumatism followed by stomachache, cold and cough, fever and headache.

Conclusion: The study provides ethnomedicinal use of 37 plant species by indigenous ethnic community, of which 50% are under various threat categories.

Keywords: *Bhotiyas*, Biosphere Reserve, Ethnomedicinal, Traditional knowledge, Trans-Himalaya

Project Title	: Structural and functional attributes of plant communities in Cold Arid Region of Nanda Devi Biosphere Reserve, Uttarakhand in relation to resource use pattern.
Principal Investigator(s)	: Dr. B.S. Adhikari and Dr. G.S. Rawat
Researcher(s)	: Ms. Monideepa Mitra and Mr. Amit Kumar; Junior Research Fellows
Funding Agency	: Ministry of Environment, Forests & Climate Change
Project Duration	: 01.06.2011 to 31.05.2014

Ecology and, conservation status of House Sparrow in Uttarakhand

- Jiju, J. S.

Aim: The study aimed to gather information on the ecology and current status of House Sparrows in Uttarakhand. In this presentation we highlight the density and distribution of house sparrows in urban and rural regions of Uttarakhand.

Location: During the present study period districts Dehradun, Bageshwar, Rudraprayag and Chamoli were sampled during December 2012 to May 2013.

Methods: Tehsil was selected as the smallest sampling unit for the study. Line transects and point count methods were adopted to survey the different habitats viz. rural, urban, forest and agrarian ecosystems in Uttarakhand. Line transects of 1km length were laid in various habitats with five point counts done at an interval of 200m along the transect. Five transects were laid randomly in each tehsil and were walked thrice during morning and evening hours. Ten tehsils in four different districts of Uttarakhand were surveyed from December 2012 to May 2013 resulting in an effort of 105 km. Artificial nest boxes were installed in different areas of Dehradun and Chamoli. Different aspects like presence/absence, people's attitude towards House Sparrow and Threats were covered in the questionnaire survey, conducted in Dehradun district.

Results: Out of 35 transects, House Sparrow were seen in 24 transects. The flock size varied from 1 to 30 throughout the survey. Thirty individuals of House Sparrow were seen in Rishikesh in flock. Maximum sightings were encountered in Rishikesh tehsil whereas the least was encountered in Rudraprayag. The average ($CI_{95\%}$) encounter rate, flock/cluster size, individual density and flock density was 1.11(0.81-1.50), 4.30(3.68-5.03), 171.24(118.2-247.9)/hectre, and 1.71/hectre respectively. Out of six nest boxes that were installed, two were occupied by House Sparrow. Questionnaire surveys suggest that people perceive house sparrows to be quite common in their vicinity though there is much ambiguity in the results as very few can differentiate between House Sparrows and Russet Sparrows.

Conclusion: House Sparrow was widely distributed in all the tehsils surveyed. From the questionnaire survey, people's attitude towards House Sparrow was positive and majority of them are aware that the population of House Sparrow is declining.

Key words- Line transect, Uttarakhand, tehsil, distribution, nest boxes

Project Title	: Ecology, conservation and status of House Sparrow in Uttarakhand.
Principal Investigator(s)	: Dr. V.P. Uniyal
Researcher(s)	: Mr. Jiju, J. S., Junior Research Fellow
Funding Agency	: Uttarakhand State Council for Science & Technology
Project Duration	: 2012 to 2014

Bird Surveys in the Western Trans-Himalayas

- Subharanjan Sen

Title: Bird Surveys in the Western Trans-Himalayas

Aim: Avifaunal survey of the Western Trans Himalayas and status and adequacy of the present IBAs.

Study Area: Trans-Himalayan regions of Jammu & Kashmir and Himachal Pradesh. The study area included eight IBAs. These include Chushul Marshes, Hanle plains, Hemis NP, Pangong Tso, Tso Kar Basin, Tso Morari, Kibber WLS and Pin Valley. Also included were areas like the Nubra and Suru Valleys.

Methods: We used vehicular road transects, foot transects and point counts. A total of more than 6000 kilometers was traversed in the trans-Himalayas during the surveys from September 2011 to June 2014. A total of about 50 transects were walked totaling about 70 kilometers. In addition about 30 point counts were made.

Results: A total of 147 bird species were encountered during the surveys (N=37,931). The birds belonged to 32 families and 89 genera. The most well represented family was Fringillidae followed by Corvida and Passeridae. The most common guild were Granivores followed by ground insectivores and omnivores. The least represented guilds included bark feeders and scavengers. The bird species most common was the House Sparrows followed by Twite and Horned Lark with relative frequencies of 10.4, 8.25 and 7.39 respectively.

Conclusion: The Harong wetlands, parts of the Suru and Nubra valleys hold several important globally threatened, restricted range and biome restricted bird species that warrant their addition to the IBA list. New agricultural and especially horticultural practices are leading to rapid changes in bird communities, especially in Himachal Pradesh. Shifting of herding practices in Ladakh in favour of Pashmina goats and an increase of livestock threaten several IBAs. Border road constrictions and the menace of dogs and unregulated tourism in some areas continue to be major problems. There is also the need to rationalise the notified boundaries of several PAs.

Project Title	: A survey of the avifauna in the Important Bird Areas (IBAs) of the Trans-Himalayan region.
Principal Investigator(s)	: Sh. Subharanjan Sen and Dr. Gobind Sagar Bhardwaj
Researcher(s)	: Mr. Suresh Pawan Kumar, Junior Research Fellow
Funding Agency	: Grant- in- aid
Project Duration	: 04.02.2012 to 03.02.2015

Diversity patterns of moth assemblages (*Lepidoptera:Heterocera*) in Nanda Devi Biosphere Reserve, the Western Himalayas

- Pritha Dey

Aim: Natural populations of moths display strong association with the vegetation, its depletion and subsequent regeneration and are negatively affected by degradation of their habitat by anthropogenic activities. We studied the pattern in species composition and diversity.

Location: Nanda Devi Biosphere Reserve with an area of 6403 sq.km and elevation ranges from 1800-7817m asl. It represents the typical attributes of the Western Himalayas.

Methods: Sample collection was done at two locations across 32 sites, at every 200m within an elevation range of 2000m-3800m, for 3-4hours starting from dusk. Sites were selected randomly across four forest types (Pine, Oak, Deodar and Birch forest). Hourly variations in temperature, relative humidity and wind speed were noted with thermohygrometer and anemometer respectively. Presence of anthropogenic disturbance signs such as logging, lopping and grazing was also noted along 50m transects around the site of collection. Vegetation sampling was done in nested method in circular plots (20m radius plots for tree species, 10m radius plots for shrub species and four 1x1m random plots for herb species) within 50m radius of the site. The observed individuals were sorted into families and morphospecies.

Results: The observations highlighted the Geometridae family, which were most abundant in all the sites with 475 individuals recorded. The number of morphospecies and individuals at trap sites were negatively correlated with elevation and positively correlated temperature.

Project Title	: Diversity of moth assemblages (<i>Lepidoptera: Heterocera</i>) and their potential role as a conservation tool in different protected areas of Uttarakhand.
Principal Investigator(s)	: Dr. V.P. Uniyal
Researcher(s)	: Ms. Pritha Dey, Junior Research Fellow
Funding Agency	: Dept. of Science and Technology, Govt. of India
Project Duration	: 26.11.2012 to 25.11.2014