भारतीय वन्यजीव संस्थान
Wildlife Institute of India

XXXII ANNUAL RESEARCH SEMINAR

19-20 September, 2018

PROGRAMME

Seminar Chairperson: Dr. H. S. Pabla, Chairman, TRAC

INAUGURAL SESSION

0930 – 0935 h Welcome
***Dr. Bitapi Sinha*, Research Coordinator, WII**

0935 – 0940 h Opening Remarks
***Dr. V.B. Mathur*, Director, WII**

0940 – 1000 h Research activities and accomplishments (2017-2018)
***Dr. G.S. Rawat*, Dean, WII**

1000 – 1010 h Inaugural Address
***Dr. S.S. Negi,* Former DGF&SS, MoEF&CC**

1010 – 1020 h **Release of WII Publications**

S.No.	Title of Publication	Released by	Assisted by
1	Manual for Comprehensive Environmental and Socio-economic monitoring in Kailash Sacred Landscape, India	Dr. S.S. Negi, Former DGF&SS, MoEF&CC	Dr. G. S. Rawat, Dean, WII
2	Common Moths of Wildlife Institute of India Campus	Dr. Savita, Director, FRI	Dr. V.P. Uniyal, Scientist-G
3	Ecological Reconnaissance and Conservation Assessment of Avifauna in Sahyadri Tiger Reserve	Dr. Pankaj Srivastava, Director, IIFM	Dr. G.V. Gopi, Scientist-E Dr. V. Clement Ben, Field Director, Sahyadri TR
4	Status of Biodiversity in the River Ganga	Shri Monish Mullick, CWLW, Uttarakhand	Dr. J.A. Johnson, Scientist-E Dr. S.A. Hussain, Scientist-G
5	Our feathered co-inhabitants of Delhi: Coexisting migrant and resident Black kite races in a developing megacity	Dr. H.S. Pabla Chairman, TRAC, WII	Shri Nishant Kumar, SRF Ms. Urvi Gupta, Project Biologist Shri Kiran Srivastava COO, RRCF

TECHNICAL SESSION – I

Species Recovery Programmes

Chair : Shri Vinod Rishi, Former ADG (WL), MoEFCC

Co-Chair(s) : Dr. Rajiv Sinha, Professor, IIT, Kanpur

Dr. Dhananjai Mohan, Addl. PCCF, Uttarakhand

Session Facilitator : Dr. Y.V. Jhala, Scientist-G

1020-1040 Conserving the seagrass sentinels: An update on the Dugong Recovery Program

Anant Pande, Project Scientist

1040-1100 Understanding Distribution, Abundance and Anthropogenic Stressors of Gangetic River Dolphin in Ganga - Brahmaputra System

Dr. Rashid H. Raza, Project Scientist

1100-1120 Road, water, energy and bustard conservation

Dr. Sutirtha Datta*, Scientist-D*

1120-1140 Group photograph and Tea

1140-1200 Implementation of action plan for conservation of Manipur's brow antlered deer or Sangai: An update

Dr. Choungpi Tuboi, Project Scientist

1200-1220 Current status of reintroduced tiger population in Panna Tiger Reserve, Madhya Pradesh

Supratim, Junior Research Fellow

1220-1240 **Discussion and comments of Chair and Co-chairs**

TECHNICAL SESSION – II

Mammalian Ecology

Chair : Shri Monish Mullick, CWLW, Uttarakhand

Co-Chair(s) : Dr. Shomita Mukherjee, Principal Scientist, SACON

Dr. V. Clement Ben, FD, Sahyadri TR

Session Facilitator : Prof. Qamar Qureshi, Scientist-G

1240-1300 Demographic Parameters of Tigers and Implications for their Conservation and Management

Neha Awasthi**,** Senior Research Fellow

1300-1320 Understanding space use and movement of tigers in Eastern Vidarbha Landscape

Zehidul Hussain*,* Project Biologist

1320-1420 Lunch

1420 – 1500 Poster Session

15 Posters

TECHNICAL SESSION – II (Cont'd)

1500-1520 A 'Dhole' Lot Of Movement: Spatial Ecology of Asiatic wild dog in Tadoba Andhari Tiger Reserve, Maharashtra, India

Pallavi Ghaskadbi, Project Biologist

1520-1540 Movement ecology of swamp deer along upper Gangetic plains of north India

Shutarshi Paul, DST INSPIRE SRF

1540-1600 **Discussion and comments of Chair and Co-chairs**

1600-1620 Tea

TECHNICAL SESSION – III

Landscape Management and Climate Change

Chair	**:**	**Dr. Pankaj Srivastava, Director, IIFM**
Co-Chair(s)	**:**	**Shri K. C. Meena, CCF (WL), Rajasthan**
		Dr. Archana Bahuguna, Scientist, ZSI
Session Facilitator	**:**	**Dr. Ruchi Badola, Scientist-G**

1620-1640 National Mission for Clean Ganga – Biodiversity Conservation and Ganga Rejuvenation: Progress

Shivani Barthwal*,* Project Assocciate

1640-1700 Assessment of climate change effects on wildlife species in the Indian Himalayan Region: An initiative in three biotic provinces

Dr. Tapajit Bhattacharya**,** Project Scientist

1700-1720 Spatial pattern analyses and Climate change impact assessment in the Indian Himalayan region

Sujata Upgupta*,* Project Scientist

1720- 1735 Discussion and comments of Chair and Co-chair

Day 2: 20th September, 2018

TECHNICAL SESSION – IV

Human-Wildlife Interface and Invasive Species Ecology

Chair	**:**	**Shri S.P. Tripathi, CWLW, Nagaland**
Co-Chair(s)	**:**	**Shri L. Krishnamoorthy, FD, Kanha TR**
		Dr. Vaibhav Mathur, AIG, NTCA
Session Facilitator	**:**	**Dr. S. Sathyakumar, Scientist-G**

0930-0950 Identifying ecological drivers of human-wildlife conflicts in the Indian Himalayan Region

Dr. Dipanjan Naha, Project Scientist

0950-1010 The enigma of human lion co-existance: Conflict in Greater Gir Landscape

Keshab Gogoi, Junior Research Fellow

1010-1030 Off-road Ecology: combining wildlife roadkill and behavior to understand impacts of roads on wildlife

Akansha Saxena, Junior Research Fellow

1030-1050 Filth, cultural attitudes and urban architecture shape the breeding ecology of urban raptors

Nishant Kumar, Senior Research Fellow

1050-1110 Tea

1110-1130 Friends or foes: Impact of dogs *Canis lupus familiaris* on pastoralists and wildlife in Ladakh

Neeraj Mahar, Senior Research Fellow

1130-1150 What makes *Lantana camara* invasion, a success? Degrading forests and adaptive plasticity!

Ninad Mungi, Senior Research Fellow

1150-1210 Discussion and comments of Chair and Co-chair

TECHNICAL SESSION - V

Tools and Techniques for Wildlife Management

Chair	**:**	**Dr. G.S. Bhardwaj, FD, Sariska TR**
Co-Chair(s)	**:**	**Shri Rajendra Garwad, AIG (South), NTCA**
		Shri Ravi Kiran Govekar, FD Pench TR
Session Facilitator	**:**	**Dr. Pratap Singh, Scientist-G**

1210-1230 E-Bird Technology: Surveillance and Monitoring with drones for Wildlife Management

Shashank Sahwan, Project Engineer

1230-1250 Rapid assessment of channel morphodynamics and its impact on biodiversity of the Ganga River

Dr. Rajiv Sinha, Professor, IIT-K

1250-1310 Assessing tiger dispersal corridor functionality in the Terai-Arc landscape, India

Suvankar Biswas, Junior Research Fellow

1310-1330 A molecular perspective on population structure of dhole across tiger landscapes

Shweta Singh, Senior Research Fellow

1330-1345 Discussion and comments of Chair and Co-chairs

1345-1445 Lunch

TECHNICAL SESSION – VI

Wildlife Monitoring

Chair	**:**	**Shri D.J.N. Anand, CWLW, Manipur**
Co-Chair(s)	**:**	**Shri Nishant Verma, IG, NTCA**
		Shri Ramesh Pandey, FD, Dudhwa TR
Session Facilitator	**:**	**Shri Ajay Srivastav, Scientist-G**

1445-1505 Insights from long term study on Tigers, Co-predators and prey in Tadoba-Andhari Tiger Reserve, Maharashtra

Nilanjan Chatterjee & Lynette Gomes, Junior Research Fellows

1505-1525 Wild denizens of the frozen continent: Long-term monitoring of wildlife in Antarctica

Dr. Manoj V. Nair, Scientist-F

1525-1540 Discussion and comments of Chair and Co-chairs

1540-1600 Tea

CONCLUDING SESSION

Chair : Dr. H. S. Pabla, Chairman, TRAC
Co-Chair : Dr. V.B. Mathur, Director, WII

1600-1630	Comments on the Annual Research Seminar	
1630-1645	Photographic competition Awards	***Dr. Bitapi Sinha, Research Coordinator***
1645-1700	Best Presentation Awards	***Dr. Bitapi Sinha, Research Coordinator***
1700-1725	Concluding remarks	***Dr. H.S. Pabla, Chairman, TRAC*** ***Dr. V.B. Mathur, Director, WII***
1725-1730	Vote of Thanks	***Dr. Bitapi Sinha, Research Coordinator***

****

ARS 2018 – List of e-Posters

S.No.	Title	Presenter
1	A need of harmonized database of genetic markers in wildlife forensics: A case study on tigers	Vinay Kumar
2	Genetic characterization of Himalayan Brown Bear in Jammu and Kashmir, India: Conservation implications	Sujeet Kumar Singh and Shahid A Dar
3	Genetic analyses reveal population structure and demographic decline in leopards (*Panthera pardus fusca*) across Terai-Arc Landscape	Supriya Bhatt
4	Catch me if you can: Does moon illumination influence mammal activity in Manas National Park?	Urjit Bhatt
5	Insight into RhoDIS: A molecular approach for rhino forensic and population managment in India	Tista Ghosh
6	Demographic status of Gharial (*Gavialis gangeticus*) in the National Chambal Sanctuary	Suyash Katdare
7	Preliminary insight into the genetic status of *Gavialis gangeticus* using mitochondrial and microsatellite markers	Surya Prasad Sharma
8	Human-Snake interactions: A study of local perceptions in and around Mudumalai Tiger Reserve, Tamil Nadu	Karthy S
9	How common are the Weavers? - The status of weaver birds in the Terai landscape of Eastern Uttarakhand	Harindra Baraiya
10	Human dimensions and the urban niche of Black Kites *Milvus migrans* in Delhi, India	Urvi Gupta
11	Influence of disturbance factors on tree diversity along the Moyar river valley landscape	Thiru Murugan V
12	Distribution pattern of *Prosopis juliflora* in the three agro-climatic zones of Tamil Nadu	B. Kamalakannan
13	Misty mountain hop: A scoping study in two Protected Areas of Himachal Pradesh, India	Ankita Bhattacharya
14	Monitoring protected areas in the era of climate change	Debanjan Sarkar
15	Ecological assessment along the proposed Nagpur-Mumbai Super Communication Expressway, Maharashtra for wildlife conservation	Yashashree Garge and Bhumika P. Morey

****

Conserving the seagrass sentinels: an update on the dugong recovery program

-Anant Pande

Dugong populations in India are threatened with extinction. Unreliable population estimates, scarce understanding of species distribution, exacerbated loss of seagrass habitats, severe lack of conservation awareness and an untrained frontline forest staff define the challenges for dugong conservation in India. The Dugong Recovery Program was initiated in 2016 to generate baseline data on dugong demography, habitat status, seagrass health parameters and to enhance awareness about the species on a large scale with the involvement of all stakeholders. Another significant goal of the program is to equip the frontline forest staff to document and monitor marine biodiversity and improve their capacity to deal with net entanglements and strandings.

The project has been under implementation at three Dugong range states of the country i.e. Gujarat, Tamil Nadu and Andaman & Nicobar Islands.

In the last two years of the program, we investigated habitat characteristics, conducted outreach programs and organized capacity building trainings in Dugong range states. We conducted intensive Line Intercept Technique surveys (n = 132, comprising 849 quadrates) to understand seagrass meadow characteristics for prioritizing areas for long-term monitoring. Our study revealed presence of 13 species of seagrasses (Andaman Islands = 8, Tamil Nadu = 7 and Gujarat = 6) belonging to 6 genera. Mean seagrass cover was highest at Tamil Nadu (69.47±2.97 %) followed by Gujarat (23.75±2.69 %) and Andaman Islands (21.6±3.54 %). Algal cover showed reverse trend with Andaman Islands consisting of highest cover (28.69±4.77 %). We assessed seagrass associated macrofauna and identified about 59 fish species and 7 taxonomic groups of macrofauna. Through an extensive Dugong Volunteer Network, we reported 19 dugong strandings over last 18 months (16 at Tamil Nadu, 2 at Gujarat and 1 at Andaman Islands). Fishermen and divers reported maximum dugong occurrence information (> 51%) on a regular basis adding up to the primary species distribution data.

With this baseline information from dugong distribution range, an intensive sampling approach for assessing habitat parameters, threat intensity and distribution mapping is the next step for affirmative conservation action. We have standardized protocols and generated enough background data to initiate site-specific population and habitat monitoring for a multi-stakeholder based marine spatial planning of last remaining dugong habitats.

Keywords: Habitat assessment, Stakeholders, Marine Spatial Planning

Project Title	: Recovery of dugongs in India: An integrated participatory approach
Principal Investigator(s)	: K. Sivakumar and J.A. Johnson
Researcher(s)	: Anant Pande (Project Scientist)
Funding Agency	: MoEFCC
Project Duration	: 2016-2021

Understanding distribution, abundance and anthropogenic stressors of Gangetic river dolphin in Ganga - Brahmaputra system

-Dr. Rashid H. Raza

The Endangered Gangetic river dolphin (GRD) *Platanista gangetica gangetica* is distributed in the Ganga-Brahmaputra river system in India. Considering its declining population and iconic status, the CAMPA-Dolphin project was launched to address the conservation challenges by the species. Consolidated project objectives are defined in two broad, synergistic themes;

A: Ecological monitoring

i) To develop a monitoring protocol for Ganges river dolphins and associated riverine fauna.
ii) Quality assessment of river habitat in terms of water quality, anthropogenic pressure and landscape surrounding river scape.

B: Participatory conservation planning and action

iii) Involve stake holders to develop a network which will assist in Ganges river dolphin conservation.

The presentation updates on the studies carried out to fulfil these objectives.

Status surveys in the dry season have been completed in the Ganges-Brahmaputra mainstem and major tributaries of the Brahmaputra (Ganga:Buxar-Farakka-Gangasagar, Least count 1232, Brahmaputra: Sadiya-Dhubri and tributaries, Least count: 821). Most of the survey has used the robust Double observer method. In some segments Single observer surveys have also been used. From mark-recapture based statistics it is estimated that on average 25% of animals are missed by single observer surveys. In order to understand seasonal movement patterns, summer season surveys have been carried out in all major tributaries of the Ganga in Bihar.

Passive Acoustic Monitoring devices have been used to understand the habitat use and activity pattern of the GRD. Week long continuous monitoring in high density areas indicates that dolphins are present throughout the 24 hrs. Extensive spatial deployments indicate continued absence for as long as 6 hrs. Recording and analysis of anthropogenic noise from shipping and other sources have been done to understand the magnitude of noise pollution in the underwater acoustic habitat. Though most of the noise generated by ships are in lower frequency bands, overlap with frequency bands actively used by GRD for echolocation is also present. Advanced instruments have been tested and used for mapping and monitoring of benthic habitat and water quality. A Spatial database from remote sensing has been created to map key elements of river geomorphology important for the dolphins.

Detailed sociological studies have been carried out to assess the perception regarding dolphins so as to address the killing of dolphins.

Project Title	: Development of Conservation Action Plan for Ganges River Dolphin
Principal Investigator(s)	: Prof. Qamar Qureshi, Prof. S. A. Hussain, Dr. Vishnupriya Kolipakkam
Researcher(s)	: Scientist: Wakid A, Rashid, R, Shovna R, Fellows: Anumitra P, Ashwin W, Gargi RC, Kanad R, Leela P, Merin J, Naman G, Rajat R, Sunny D, Genetics: Srinavas Y GIS: Priyamvada B Prj Assistant : Ajay G, Assoc-EcoTox: Vineet S
Funding Agency	: Compensatory Afforestation Fund Management and Planning Authority (CAMPA)
Project Duration	: 2016-2021

Road, water, energy and bustard conservation

-Sutirtha Dutta

Bustard habitats – grasslands and deserts – are historically marginalized as 'wastelands', and are facing an expansion of human footprint, surface water, and electricity network. Understanding how these changes affect ecological processes is pivotal to conserving these ecosystems and the endangered species therein.

As part of Bustard Recovery Program, we assessed: a) relative benefits of surface water to native vs. non-native species using camera-traps at water-points, b) impacts of the introduced free-ranging dogs on native chinkara using radio-tracking, c) long-term population trends of native *vs.* non-native species using occupancy surveys, and d) impact of power-lines on bird mortality using carcass surveys, e) Status of the data-deficient lesser florican under such changes was assessed through range-level population survey. f) The need to commence conservation breeding in light of such catastrophic declines was assessed using multi-criteria decision-analysis.

We found manifold higher visitation rates to water-points of non-native species compared to native species. Free-ranging dog occupancy increased substantially in recent years, and was associated with declining chinkara occupancy. This could be because of dog predation, as results showed 22 (7.6_{SE}) chinkara kills/dog/year or ~33% population offtake. Power-lines resulted in mortality of ~1 lakh birds/year belonging to $\geq$30 species in 4200 km^2 habitat in Thar, including ~18 GIB annually. Similar large-scale habitat changes and neglect have resulted in ~75% decline in florican population over three generations, with 340 ($162\text{-}597_{CI}$) males currently surviving and in urgent need of recovery actions.

Our findings indicated cascading ecological effects of large-scale anthropogenic changes in bustard habitats. We identified power-lines as the most critical threat for bustards, and unravelled hidden costs of 'green energy'. While power agencies were sensitized to mitigate risky power-lines, concerted multi-agency efforts, policy, and legal instruments are required to expedite mitigation. Feasibility of bustard conservation breeding has been questioned in academic circles. However, our reanalysis suggests conservation breeding, supported by sustained *in-situ* measures as the preferred high risk-high gain alternative. It is also the only potential hope for population recovery given the continued population declines, delayed decision-making and delays in *in-situ* implementation partly due to very high costs.

Keywords: Conservation breeding, green energy, habitat restoration, infrastructure, wastelands

Project Title	: Habitat Improvement and Conservation Breeding of Great Indian Bustard: an Integrated Approach
Principal Investigator(s)	: Dr. Y. V. Jhala, Dr. Sutirtha Dutta, Dr. Bilal Habib
Researcher(s)	: Dr. Sujit Narwwade, Dr.Tushna Karkaria, Bipin C.M., Arjun Awasthi, Vineet Singh, Priyamvada Bagaria, Srinivas Yellappu, Mohib Uddin, Devendradutt Pandey, Saurav Supakar, Tanya Gupta, Shaheer Khan
Funding Agency	: National CAMPA Advisory Council
Project Duration	: 2016-2021

Implementation of action plan for conservation of Manipur's brow antlered deer or sangai: An update

-Dr. Chongpi Tuboi

The Sangai (*Rucervus eldii eldii*) occurs as a single, small, isolated population making it vulnerable to extinction. A population of less than 200 breeding individuals and threatened habitat in a single small protected area leave little reason for long-term optimism. Therefore, the Sangai conservation programme aims to (a) Secure the existing population in Keibul Lamjao National Park, (b) Create a second population at the select site and (c) Involve local communities in conservation process.

An integrated management plan of KLNP has been prepared which is under review. Research and habitat monitoring activities are being carried out in the Park. Establishment of the conservation breeding centre is under progress.

To create a second population in the wild, conservation actions have been initiated at the Pumlen Pat and Thongam Mondum Conservation Reserve, Manipur. Intensive lobbying was carried out through meetings, workshops, trust building activities and awareness programmes. A total of two state level workshops, one site level and nine village level meetings have been conducted. During the 6th and 7th State Board for Wildlife meetings in 2017 and 2018 respectively, the Manipur Government has reiterated its commitment for establishment of a second population of Sangai at the proposed site. This area comprising of around 67.8 km^2 has been set aside for declaring the first conservation reserve in Manipur for Sangai conservation and sustainable development of the area.

The people living around Pumlen are dependent on the lake for their livelihood. They are reluctant to forego their activities in the absence of alternate livelihood sources. Sensitization of the local communities and other stakeholders including representatives from government departments, bureaucrats and legislators and trust building exercises is being carried out. In addition, livelihood training camps, exposure visits and awareness programmes are being conducted.

Keywords: Sangai, reintroduction, second home, community participation, advocacy

Project Title	: Conservation action plan for Manipur's Brow-antlered deer or Sangai: an integrated approach
Principal Investigator(s)	: Dr. S. A. Hussain & Dr. Ruchi Badola
Researcher(s)	: Chongpi Tuboi (Project Scientist), M.V. Sharma (Project Associate), Anjali Achom, Ak. Santikumar Singh, S. Rohikanta Sharma, Mirza Ghazanfar Ullah, Sharmila Naosekpam, Y. Neeraj Singh (Project Fellows)
Funding Agency	: Compensatory Afforestation Fund Management and Planning Authority (CAMPA)
Project Duration	: 2016-2021

Current status of reintroduced tiger population in Panna Tiger Reserve, Madhya Pradesh

-Supratim Dutta

Local extinction of large carnivores is an increasing concern across the range countries. Because large carnivores are the apex predators, often representing Umbrella Species conservation concept, conservation intervention relates to not only the species but also the entire ecosystem. Local extinction in 2009 and subsequent successful reintroduction of tiger in Panna Tiger Reserve marks an important conservation model. We present here the current status of tiger population and articulate the future direction.

Panna Tiger Reserve, Madhya Pradesh is situated in Vindyan Hill Range and spreads over Panna and Chhatarpur districts. It encompasses dry deciduous forest, where teak is the most dominating tree species, and Ken River is a perennial river, which flows from south to northward direction within the park with a stretch of 55 km.

Tigers were monitored intensively based on telemetry and camera trapping methods. Nine radio collared tigers were studied to understand the movement patterns and their home-ranges. Camera traps were deployed across the core and buffer areas and monitored the population throughout the year. Data obtained from such continuous camera trapping was also used for inter- and intra-specific temporal activities.

Within the core area, 23 individual tigers were identified with a density of 3.27 ±0.69 per 100 km^2. Annual mean home range of male (n=3) was 200 ± 28.9 km^2 and annual mean home range of female (n=6) was 38.5 ± 7.40. The temporal activity reflected 80% overlap between tigers and leopards, 87% between tigers and hyena, and 71% in between leopard and hyena.

Tiger population in Panna has shown a rapid increase and it reached carrying capacity within short span of five years. Over 10 tigers have already dispersed from Panna landscape. While the population has been consolidated based on conventional and non-conventional methods, the future of the population would rely on the landscape level management and monitoring strategies.

Keywords: Home range, Inter-species interaction, Large carnivore, Activity pattern, Landscape approach

Project Title	: Reintroduction and Recovery Programme of Tigers in Panna Tiger Reserve and Landscape Complex, Madhya Pradesh, Phase II
Principal Investigator(s)	: Dr. K. Ramesh (PI), Dr. J. Antony. Johnson (CI), Dr. Subhranjan Sen (CI)
Researcher(s)	: Manjari Malviya (SRF), Supratim Dutta (JRF), Kamna Pokharia (JRF), Deepti Gupta (Intern)
Funding Agency	: National Tiger Conservation Agency and Madhya Pradesh Forest Department
Project Duration	: 2015/16-2019/20

Demographic parameters of tigers and implications for their conservation and management

-Neha Awasthi

Tigers are threatened across their range by poaching, prey depletion and habitat loss. However, tigers are resilient and if provided protection, exclusive space, and sufficient prey, can recover quickly. An understanding of their demography is essential to manage populations and their habitat.

We studied tiger demography using camera trap-based capture-recapture (CMR) in an open population framework using the robust design in Kanha, Corbett and Ranthambore Tiger Reserves between 2006 to 2017. Radio-telemetry and intensive monitoring of known individual tigers in Ranthambore and Kanha permitted us to estimate survival using known fate models. Tiger and co-predator densities were estimated by spatially explicit capture-mark-recapture approach. We use kill rates determined from continuous monitoring of collared tigers, and from literature for leopards and dhole. Ungulate densities were estimated by distance sampling. Demographic parameters along with ungulate density and kill rates were used to compute carrying capacity.

Tiger density was highest in Corbett (14±3) while Kanha and Ranthambore had similar densities at 6.08± 0.71 and 6.34 ±1.16 respectively. Intrinsic growth rate of tiger population ranged between 0 to 0.09. Sex ratio of tigers was female biased and ranged between 0.80 to 0.75 in the three TR's. Litter size of tigers varied between 2.24 to 3.24. Age of first reproduction for females in Kanha was 3.4 ± 0.19 while in Ranthambore was 4.54 ±0.3. CMR estimates of survival for males and females were 0.68±0.12 & 0.79 ±0.05 for Corbett and 0.76±0.05 & 0.84±0.03 for Kanha. Cub survival was higher in Ranthambore at 85%±02 compared to Kanha 59%±06. Twelve percent of males and 9% of females emigrated from Kanha. Type I survivorship was seen in Kanha females and in both sexes in Ranthambore. Kanha male tigers showed Type II survivorship.

Demographic information has guided the policy of core and buffer strategy implemented by the National Tiger Conservation Authority and has helped establish source populations within each tiger landscape. Understanding of the carrying capacity in a multi-predator, multi-prey system will allow conservation practitioners to better manage tiger populations.

Keywords: Carrying capacity, Demography, Populations, Survival, Survivorship

Project Title	: Intensive monitoring and study of tiger dispersal in Kanha Tiger Reserve (Phase IV)
Principal Investigator(s)	: Dr. Y.V.Jhala, Prof. Q. Qureshi
Researcher(s)	: Ayan Sadhu, Ujjwal Kumar, Shikha Bisht, Sudip Bannerji, Jayant Bora, Shravana Goswami and Neha Awasthi
Funding Agency	: National Tiger Conservation Authority
Project Duration	: 2006-2019

Understanding space use and movement of tigers in eastern Vidarbha landscape

-Zehidul Hussain

Movement is a fundamental characteristic of life which influences population dynamics and genetic diversity. Movement patterns are shaped by animal's interaction with various environmental features. With more than 40% of tigers outside protected area (PA) it is critical to understand tiger movement in a habitat matrix of forest and human-dominated landscape.

This study was carried out in the Eastern Vidarbha Landscape of Maharashtra in four protected areas including Tadoba-Andhari Tiger Reserve, Bor Tiger Reserve, Umred-Karhandla Wildlife Sanctuary, Chaprala Wildlife Sanctuary, and also, the Brahmaputra Forest Division.

Thirteen tigers (8 males and 5 females) of different age and sex classes were identified and fitted with GPS Plus Vectronics collars from 2014 to 2018. We studied the movement patterns and space use of tigers in both protected and outside protected area. We also assessed the proportional use of different landuse categories across the landscape.

We calculated displacement and space-use of tigers using Brownian Bridge Movement Model (BBMM) at multiple temporal and spatial level. Mean home range (95% BBMM) was 61 km^2 (range: 27-118) in protected area and 193 km^2 (range: 59-578) outside protected areas. During pre-dispersal the average home range was 45.4 ±21.2 km2 and 114.1 ±70.5 km2 in post-dispersal phase. Overall average displacement travelled per hour varied between day and night (P=0.04), and both sexes had longer displacement during night outside protected areas. Mean displacement per hour of tigers also varied between pre and post dispersal phase (P=0.03). Movement pattern of individuals tigers were quantified in different dispersal phase. Of the three dispersing individual, cumulative displacement for males was 235km and 978km respectively, while the female travelled 598km before establishing their territories.

Investigating and characterizing the movement pattern is an important step in understanding the species ecology. Using movement analysis to interpret dispersal mechanisms of tigers in human modified landscapes over time aided in the identification of functional corridors or critical areas. The data generated has been applied in management of large ranging carnivores such as identifying road crossing zones and electrocution hotspots across the landscape.

Keywords: Carnivore, displacement, home range, protected area, telemetry

Project Title	: Studying the dispersal of tigers across the Eastern Vidarbha Landscape, Maharashtra, India
Principal Investigator(s)	: Dr. Bilal Habib, Dr. Parag Nigam, APCCF (East) Nagpur
Researcher(s)	: Zehidul Hussain (Project Biologist), Pallavi Ghaskadbi (Project Biologist)
Funding Agency	: Maharashtra State Forest Department
Project Duration	: 2016-2019

A 'dhole' lot of movement: spatial ecology of Asiatic wild dog in Tadoba Andhari Tiger Reserve, Maharashtra, India

-Pallavi Ghaskadbi

The Asiatic wild dog or dhole (*Cuon alpinus*) is one of the top predators in tropical forests of Asia. With recent advances in movement ecology, it is feasible to collect detailed data on where and how animals travel through space; and their interactions with the environment and conspecifics. Our study focuses on understanding movement patterns and space use of this small-bodied, social predator in a dry-deciduous forest with large co-predators.

The study was carried out as a part of a long term monitoring project in Tadoba Andhari Tiger Reserve (TATR), Maharashtra, India. Typical of the Eastern Vidarbha Landscape, TATR is a tropical dry deciduous forest. Despite being an important source site of tiger population, TATR also holds a remnant dhole population in the broader Central Indian Tiger Landscape.

Dhole movement patterns were studied using GPS Plus-Vectronics radio-collars enabled with activity sensor. A total of 5 individuals from 4 different packs across varying age and sex classes were fitted with radio-collars. Additionally, camera traps were deployed in the study area with a grid-size of 2km^2 for monitoring predator and prey species. Movement analyses were conducted in GIS domain using the ArcMet tool. A total of 4457 fixes were used to analyze the movement data of 4 dhole packs. Total displacement of dhole-1(D1) across the habitat was 552.11km(75 days); D2 travelled 849.46km(142days); D3 travelled 328.79km(70days); D4 covered a distance of 133.93km (20days) and D5 travelled 70.29km(20days). Home ranges were estimated using Brownian Bridge Movement Model (BBMM). The average home range (95% BBMM) of dhole packs was 58.66km^2 (±4.07) and the average core area(50% BBMM) was 7.85km^2 (±3.55). The home range shifts in denning season were also studied. Denning home range was 40.54km^2 with a core area of 3.17km^2 and 5 unique den sites. Post-denning home range was 54.17km^2 with 5 core areas of average size of 1.69km^2.

The study enhances our understanding of life history strategies of an endangered canid in a closed forest system using novel movement data along with critical ancillary information like acceleration and proximity parameters.

Keywords: behavioural states, endangered canid, home range, space use

Project Title	: Studying the dispersal of tigers across the Eastern Vidarbha Landscape, Maharashtra
Principal Investigator(s)	: Dr. Bilal Habib, Dr. Parag Nigam
Researcher(s)	: Pallavi Ghaskadbi (Project Biologist), Zehidul Hussain (Project Biologist)
Funding Agency	: Maharashtra State Forest Department
Project Duration	: 2016-2019

Movement ecology of swamp deer along upper Gangetic plains of north India

-Shrutarshi Paul

The swamp deer (*Rucervus duvaucelii*) is the largest grassland-dwelling endemic cervid of the Gangetic plains. Information about its distribution in the upper Gangetic plains was restricted to Jhilmil Jheel Conservation Reserve (JJCR) and Bijnor Barrage area of Hastinapur Wildlife Sanctuary (HWLS) only. Anecdotal reports of their presence outside Jhilmil Jheel and information of their seasonal movements indicate possible presence of the species outside protected areas. Using multidisciplinary approaches, this study aimed at (i) evaluating swamp deer distribution in this landscape; (ii) assessing inbreeding and genetic connectivity status; and iii) analysing swamp deer movement pattern.

The study area encompasses the swampy grasslands along Ganga lying between Jhilmil Jheel Conservation Reserve and Hastinapur Wildlife Sanctuary. The entire study area was divided into 10 survey zones. All grassland patches were digitised and surveyed extensively for swamp deer signs, along with identification of suitable habitats and threats. Biological materials in the form of antlers, pellets and tissues were collected from surveyed areas and individual swamp deer was identified genetically. Subsequently fine-scale analysis of population connectivity and inbreeding status was conducted. Two female swamp deer were satellite radiocollared in Jhilmil Jheel and their movement was intensively monitored.

The survey revealed swamp deer presence in 8 of the surveyed zones with a previously unreported population near Afzalgarh along Ramganga river. Genetic data suggest presence of two distinct lineages that are present across this fragmented landscape indicating connectivity, and overall level of inbreeding was found to be low. Radiotracking analyses showed swamp deer movement downstream of Jhilmil Jheel and extensive usage of non-protected grassland patches along Ganga, confirming the genetic connectivity results in this landscape.

Our study reveals fine-scale presence of swamp deer in fragmented grasslands along Ganga. Genetic and radio-telemetry data suggest extensive movement and resulting connectivity between the fragmented swamp deer habitats. These non-protected grassland patches are home to a number of threatened species and immediate conservation of these critical habitats should be prioritised.

Keywords: Connectivity, radio telemetry, Jhilmil Jheel Conservation Reserve, Hastinapur Wildlife Sanctuary, grassland conservation.

Project Title	: Movement pattern and inbreeding status of swamp deer at Uttarakhand India
Principal Investigator(s)	: Dr. Samrat Mondol, Dr. Bivash Pandav, Dr. Bilal Habib, Dr. Parag Nigam, Dr. Dhananjai Mohan
Researcher(s)	: Shrutarshi Paul (DST-INSPIRE Senior Research Fellow)
Funding Agency	: Uttarakhand Forest Department, Department of Science and Technology
Project Duration	: 2016-2019

National Mission for Clean Ganga – biodiversity conservation and Ganga rejuvenation: Progress

-Shivani Barthwal

The diversity of stakeholders in the Ganga River and the conflicting use of its resources makes it one of the most challenging river systems for conservation planning. Thus, the project aims to prepare a science-based aquatic species restoration program for the Ganga River by involving multiple stakeholders.

The project is being implemented in five Ganga River States viz. Uttarakhand, Uttar Pradesh, Bihar, Jharkhand and West Bengal.

Systematic conservation has been initiated through habitat profiling, rapid biodiversity assessments along 2200 km of the river, intensive monitoring at 32 sites, geo-spatial analysis and genetic and eco-toxicological studies. Rescue and rehabilitation centres have been established, capacity of frontline staff, field veterinarians is being enhanced through trainings. Stakeholder consultations are being held to elicit their participation. Interpretation centres are being established for conservation education.

The Ganga Aqualife Conservation Monitoring Centre has been established at WII, it has initiated conservation planning through extensive review of literature, rapid biodiversity assessments, stakeholder consultations and policy review. The biodiversity profile of 32 sites have been prepared, based on which species restoration plans are being prepared. Spearhead teams, consisting of 36 members and 200 officials and frontline staff from forest departments have been trained. Additionally, about 1500 participants have been trained in 11 training workshops. To handle emergent situations, rescue and rehabilitation centres for higher vertebrates have been established at Sarnath and Narora. 74 field veterinarians in Uttar Pradesh and 60 veterinary officers from Uttrakhand and Uttar Pradesh have been trained on rescue and rehabilitation techniques. Stakeholders of the river have been identified and more than 12000 have been sensitized. To elicit participation of local communities, formal agreements have been signed with 143 village panchayats, more than 200 livelihood assessment cum training workshops have been conducted, 6 skill development centres have been established. A functional cadre of 427 motivated youth as *Ganga Prahari* has been trained. Ecosystem services of the river have been identified and assessment framework has been developed. To foster public awareness for the river ecosystem, nature interpretation centre at Sarnath and Bajda exhibition at Varanasi are being established.

Keywords: Aquatic fauna, Rescue, Rehabilitation, Stakeholders, Sensitization

Project Title	: Biodiversity Conservation and Ganga Rejuvenation
Principal Investigator(s)	: Dr. V.B. Mathur, Dr. G.S. Singh Rawat, Dr. S.A. Hussain, Dr. Ruchi Badola, Dr. Bitapi C. Sinha, Dr. P.K. Malik, Dr. V.P. Uniyal, Dr. Parag Nigam, Dr. B.S. Adhikari, Dr. J.A. Johnson, Dr. S. Gupta, Dr. Gopi G.V., Dr. Suresh Kumar, Dr. G. Talukdar, Dr. Abhijit Das, Dr. Anju Baroth, Dr. Ramesh C.
Researcher(s)	: Shivani Barthwal and Team
Funding Agency	: National Mission for Clean Ganga
Project Duration	: 2016-2018

Assessment of climate change effects on wildlife species in the Indian Himalayan region: An initiative in three biotic provinces

-Tapajit Bhattacharya

The impact of climate change on micro-flora, fauna and their habitats in the Indian Himalayan Region (IHR) is less studied. As a task force under the National Mission for Sustaining the Himalayan Ecosystem, the Wildlife Institute of India is carrying out this study with the objectives such as to assess taxa-specific species diversity, distribution and abundance, and to assess the impacts of climate change on ecosystem services.

The Bhagirathi basin (~7000km^2) in Uttarakhand has been selected as the primary study area in Western Himalaya, other sites in North-Western and Eastern Himalaya are Beas Basin (~ 3,000 km^2, Himachal Pradesh), and Teesta Basin (~ 5,000 km^2, Sikkim).

To obtain fine scale temperature and humidity records, data loggers (n= 111) have been deployed in different Basins covering an elevation gradient from 357m to 5000m. To simulate the warming effects on micro-flora (lichens and soil bacteria) and micro-fauna (soil nematodes), 10 Open Top Chambers (OTC) were deployed inside Gangotri National Park. Inventory and elevation ranges of mammals and Galliformes, herpetofauna, fish and odonates were updated for Bhagirathi Basin and primary information collection for all these taxa are currently going on in other two study areas. Household level questionnaires were completed in Bhagirathi Basin to assess the vulnerability of ecosystem services to climate change in Tehri Garhwal and Uttarkashi Districts.

Presence of 130 lichens, 30 nematode genera, 87 Odonata, 39 aquatic macro-invertebrate genera, 15 fish, 18 reptiles and 12 amphibians, 12 Galliformes and 39 mammal species were confirmed from Bhagirathi Basin. Twenty months of experimental warming (1.8°C) recorded differential species responses in individual OTCs and soil moisture, pH and nutrient contents were found to be important environmental factors influencing soil microbial communities. Predictive species distribution modelling indicated the importance of biotic factors for snow leopard (*Panthera uncia*) but only abiotic factors successfully predicted distributions of one odonate *Aeshna petalura*. Both household and village level vulnerabilities were higher in the villages of Tehri Garhwal compared to Uttarkashi District.

The outputs of this study would provide researched and collated information for use during current negotiations and future strategies in the IHR.

Keywords: Abiotic and Biotic Factors, Bhagirathi, Beas, Species Richness, Teesta, Vulnerability

Project Title	: Assessment and Monitoring of Climate Change Effects on Wildlife Species and Ecosystems for Developing Adaptation and Mitigation Strategies in the Indian Himalayan Region
Principal Investigator(s)	: Dr. V.B. Mathur (PI), Dr. S. Sathyakumar (Nodal Scientist), 11 Co-PI(s)
Researcher(s)	: Tapajit Bhattacharya (Project Scientist)
Funding Agency	: Department of Science and Technology
Project Duration	: 2014-2019

Spatial pattern analyses and climate change impact assessment in the Indian Himalayan region

-Dr. Sujata Upgupta

Managing the impacts of a changing climate on landscapes, land uses and ecosystems and its interaction with society is one of the biggest challenges in the coming decades. Spatial pattern analyses provide essential insights into the interactions between nature and people to derive appropriate scientific strategies for adaptation and mitigation planning. The purpose of this study is to evaluate the landscape dynamics in terms of biodiversity values, pattern changes, factors driving the changes and identify suitable areas for conservation planning. The study was implemented for the entire Indian Himalayan region (IHR) inclusive of all the Himalayan states.

This study used a fusion of geo-spatial analyses along with conventional statistical modelling approach to evaluate the landscape changes. Normalized Difference Vegetation Index (NDVI) of 2000, 2005, 2010 and 2015 at 16x16 km, 4x4 km and 1x1 km grids was used to quantify the changes and identify the driving factors. Pattern of forest cover change was analyzed using Patch Analysis tools. Climate projections from the global climate models were used to analyze changes in future climate. Health of the ecosystems was analyzed in terms of a cumulative health score generated using a composite of systematic indicators.

The results indicate major changes in the landscape showing spatial variations across different scales with sharp increases and decreases in specific areas. There has been a net loss in forest area and the core forests along with an increase in the perforations. Protected areas stay minimally effected. Both climatic and human factors were responsible for the observed changes. Biodiversity values of the IHR varies from near natural to good and is poor in certain restricted pockets. Human influence was significant at larger scales and seasonal extremities at smaller scales. The outcomes of climate projections indicate increase in the mean annual temperature and precipitation patterns across the entire region in the future.

The findings reinstate that appropriate knowledge generation and management response would require multi-scale approach. These outcomes provide a baseline for monitoring future trends and also scope for focusing conservation management on areas under potential threat.

Project Title	: Assessment and Monitoring of Climate Change Effects on Wildlife Species and Ecosystems for Developing Adaptation and Mitigation Strategies in the Indian Himalayan Region
Principal Investigator(s)	: Dr. V.B. Mathur, Dr. S. Sathyakumar
Researcher(s)	: Dr. Sujata Upgupta (Project Scientist)
Funding Agency	: Department of Science & Technology
Project Duration	: 2014-2019

Identifying ecological drivers of human-wildlife conflicts in the Indian Himalayan Region

-Dipanjan Naha

The Indian Himalayan region (IHR) is vast and remote with harsh climate resulting in low agricultural productivity. Livelihood opportunities are limited here and the local communities suffer from periodic losses (livestock depredation, crop and property damage) due to common leopard (mid elevation range i.e. 1000-2000 m) and Asian elephant in the foothills (< 500 m) with occasional fatal attacks on people. This research was undertaken to investigate the ecological aspects of human-killing and injury, spatial characteristic and pattern of such sites, detect changes in major land use patterns and identify conflict hotspots in IHR.

We surveyed two sites in the IHR viz., i) Pauri Garhwal and ii) North Bengal (Dooars), compiled secondary data on human-wildlife conflict records and made field visits to conflict sites. We used a total of 17 predictor variables (open source and remotely sensed data) and conflict locations (N = 164) and (N = 234) as presence locations to model human-leopard and human-elephant conflict risk probabilities using Maxent program. Major land use changes were assessed for this region from 2008 to 2018 using satellite imageries in Arc GIS and ERDAS Imagine.

The average number of injuries and deaths due to leopard attacks in Pauri was estimated to be 11 (SE 1.13) and 3 (SE 0.6) per year between 2006-2016; whereas, in North Bengal it was estimated to be 70 (SE 9.2) and 1.6 (SE 0.3) respectively between 2004-2016. The average annual number of human deaths and injuries to elephants in North Bengal was estimated to be 212 (SE 103) between 2006 to 2016. The predictive risk map revealed a) central and northern regions of Pauri Garhwal and b) protected areas, peripheral areas in Central and western Dooars (North Bengal) as high human-leopard conflict risk zones. There was a gradient in human-elephant conflict risk from being high (east) to low (west), primarily around protected areas, tea plantations and along major riverine corridors of North Bengal.

Our analytical approach can be replicated for other species in sites with similar issues of human-wildlife conflicts.

Keywords: Attacks, elephant, leopard, hotspot, land-use

Project Title	: NMHS-HWC
Principal Investigator(s)	: Dr. G.S. Rawat, Dr. S. Sathyakumar
Researcher(s)	: Dipanjan Naha (Project Associate)
Funding Agency	: MoEFCC
Project Duration	: 2016-2019

The enigma of human lion coexistence: Conflict in greater Gir landscape

-Keshab Gogoi

A major driver for large carnivore extinction has been conflict with human interest. A modern-day conservation success story is that of Asiatic lions that apparently live in harmonious-coexistence with humans in about >13,000 km2 of agro-pastoral landscape of Saurashtra. Here lions along with leopards predate livestock and occasionally kill humans. We attempt to understand this enigma by exploring the magnitude of conflict, its spatio-temporal patterns along with human perceptions and economics.

Data on livestock predation was collected from the Gujarat Forest Department for 2012-2016 where records for compensation were maintained. Records were geo-referenced to villages. Kernel density estimation was used to delineate predation hotspots. Remotely sensed and derived eco-geographical variables were used at the scale of 5km2 for spatial analysis. Interviews were conducted to assess attitudes and perceptions of locals towards large carnivores. Lion density for the landscape was estimated by mark-recapture and telemetry. Distinction between the expected and claimed livestock-predations were made based on continuous monitoring data of collared lions.

Lion and leopard predation showed different spatial patterns. Lion predation was best explained by proportion of suitable-habitat within grids (β= 0.73 SE 0.04) and proximity to such habitat (β= -0.80 SE 0.04). While occurrence of leopard predation was best explained by the proportion of suitable wildlife-habitats in a grid (β= 0.57 SE 0.04), proximity to such habitats (β= -1.02 SE 0.05) and level of urbanization (β= 0.35 SE 0.04). Both lion and leopard predation showed an increasing spatio-temporal trend however, conflict density was increasing for lion but stable for leopard. Communities had more positive attitude towards lions in areas of high-conflict compared to low or no-conflict areas. Pastoralists had the most negative attitude while agriculturists preferred to have lions living in their vicinity.

Currently lions occur at low density and obtain their food from dead or low priced livestock. However, attacks on livestock and humans are on rise with increasing lion density. A policy to legalize revenue from lion associated tourism (with controls), enhancing compensation to include lost opportunity cost, and managing problem individuals swiftly, along with strict law enforcement were ways to maintain the delicate balance of coexistence.

Keywords: Human attitude, leopard, livestock predation hotspots, *Panthera leo persica*.

Project Title	: Reconciling development with conservation: Delineating habitat patches and corridors for Gir lions
Principal Investigator(s)	: Dr. Y.V. Jhala
Researcher(s)	: K. Gogoi, S. Chakrabarty, K. Banerjee, K.S. Chauhan, C. Dave
Funding Agency	: Gujarat Forest Department and WII Grant-in-Aid
Project Duration	: 2017-2019

Off-road Ecology: combining wildlife roadkill and behaviour to understand impacts of roads on wildlife

-Akanksha Saxena

Roadkill data is important for delineating sites for mitigation measures, but is biased due to carcass degradation by traffic and scavengers and imperfect detection by observers. To maintain landscape connectivity, it is important to look beyond roadkill data. Our study aimed at understanding various aspects of roadkill, animal response towards road-related disturbance and effectiveness of roadkill data in identifying spatial locations for mitigation.

Roadkill surveys were conducted on National Highway 44 that cuts through Pench Tiger Reserves, Maharashtra and Madhya Pradesh during May-June 2017 (summer) and June-July 2018 (monsoon).

To evaluate persistence, roadkill were marked and visited every 12 hours for 2 days. Animal decoys were used to estimate roadkill detection probability. Carcass degradation and detection probabilities were estimated through survival analysis and logistic regression.

Camera traps were deployed in 400mx400m grids in forests adjacent to road. Environmental and disturbance variables affecting photocapture rates of major ungulates were analysed. Overlap of ungulate activity patterns with traffic was estimated.

Roadkill (n=86) for three taxa (birds=29, mammals=29, reptiles=28) were found mostly in road sections near deciduous forest (62.79%) followed by agriculture (25.58%). Most roadkill (67.57%) were found in road sections with driver visibility >300 m, and raised (48.78%) and flat roadside topography (34.15%). Roadkill located at the edge of the road has the lowest probability of degradation (28.9%, p=0.003). Probability of reptilian carcass degrading within 12 hours was 66.7% ($p < 0.001$). Probability of missing reptile roadkill (0.97) was higher than that for mammals (0.29). Probability of missing roadkill on the opposite lane of road was 93%. Greater number of chital herd (n=65) using roadside habitat was observed as compared to 2 chital roadkill during the study period.

Capture rates were positively influenced by road proximity for chital and negatively for sambar. The differences in capture rates were significant. Comparisons of activity and traffic patterns showed greater correlation with traffic at increasing distance from road for chital. Gaur and sambar near road were found to be active during low traffic hours.

Owing to imperfect detection and degradation, roadkill data should be interpreted with caution.

Keywords: Roadkill, detectability, persistence, habitat use

Project Title	: Ecological impact assessment of existing and proposed road infrastructure in important wildlife corridors in India for strategic planning of smart green infrastructure
Principal Investigator(s)	: Dr. Bilal Habib, Dr. Y.V. Jhala, Dr. Asha Rajvanshi (Advisor)
Researcher(s)	: Akanksha Saxena (Senior Research Fellow)
Funding Agency	: National Tiger Conservation Authority
Project Duration	: 3 years

Filth, cultural attitudes and urban architecture shape the breeding ecology of urban raptors

-Nishant Kumar

Despite well recognised threats of rapid urbanisation to biodiversity, there remains a paucity of ecological studies from the tropical megacities. Albeit, the behavioural and life history mechanisms of some animal species, in response to frequent proximity to humans, allows them to cope with rapidly expanding urban habitats. Interplay between synurbic animals' habitat selection and human socio-economic aspects mediates their resilience and coexistence with humans. We examined mechanisms of breeding habitat selection by the black kite *Milvus migrans*, in Delhi, where kites mainly subsist on: (1) human refuse and its associated prey-fauna, and (2) ritualised feeding, particularly practised in the historical establishments.

We used mixed effects models to relate urban habitat configuration and human practices with habitat selection, territory occupancy and breeding success, employing a logistic comparison of 154 nests monitored between 2013-16, with 154 random locations. Habitat parameters of nesting pairs were tightly enmeshed with: **a.** high human density, **b.** poor waste management, **c.** road configuration facilitating carcasses and prey **d.** access to ritual subsidies. Furthermore, at 'clean' sites with less human refuse, the proximity to ritual-feeding sites modulated the habitat suitability.

We also examined kites' nest defense against humans to understand the behavioural bottleneck (i.e. conflicting interests) faced by animals in urban environments on modulation of the defence of their offspring against humans, as potential predators. Nest defense levels at 101 territories (n= 657 visits during 2013-16), increased with the number of offspring, and with the progression of the breeding season. Defense also intensified close to ritual-feeding areas and with increasing human waste in the streets, suggesting synergistic effects of food availability, parental investment, personality-boldness and habituation to humans.

Attenuation of fear in the resident kites was attributed to humans affording them with food subsidies, which tied their distribution and behaviour to the history of socio-politico-economics and urban planning at multiple spatio-temporal scales. For synurbic species' adaptation to an urban life, human cultural practices and attitudes define dimensions of their urban niche. After initial urban colonization, animals may continue to adapt to the typically complex, heterogeneous environments of cities through fine-grained behavioural adjustments to human practices and activities.

Key words: Food subsidies, ritual feeding, urbanization, urban ecology, urban predator

Project Title	: Resource Selection by Black Kites
Principal Investigator(s)	: Dr. Y. V, Jhala, Prof. Q. Qureshi, Dr. F. Sergio
Researcher(s)	: Nishant Kumar (Senior Research Fellow), Urvi Gupta (Project Biologist)
Funding Agency	: Raptor Research and Conservation Foundation (RRCF); CSIC, Spain; Microwave, Telemetry; Felix Scholarship Trust, University of Oxford; Somerville College, University of Oxford
Project Duration	: 2013-2018

Friends or foes: Impact of dogs *Canis lupus familiaris* on pastoralists and wildlife in Ladakh

-Neeraj Mahar

Often domesticated species become free-ranging or feral and can be a cause of concern for wildlife conservation. Herein we assessed the impact of dogs on domestic livestock and wildlife in Changthang Wildlife Sanctuary, Ladakh in between 2015-2017.

A combined approach was used to understand impact of dogs a) behavioural observations of dogs using ad-libitum sampling, b) monitored nests to assess breeding success of threatened black-necked crane (BNC) *(Grus nigricollis)*, c) conducted questionnaires of local people to know their perception toward dogs, d) conducted scat analysis to understand dietary pattern of dogs and e) population estimation using block counts (sites n=7) and polygon search method in Spatially Explicit Capture Recapture (SECR) (sites n=3). Analysis was performed in excel and in secr package of R software.

Overall, n=53 direct incidences of disturbance and predation were recorded on birds and mammals by dogs, including range of species from small mammals pika *(Ochotona* spp.*)* to large ungulates Tibetan wild ass *(Equus kiang).* Over the years, breeding failure of BNC was governed by dog predation (33-39%). Pastoralists (40%) were also affected by dogs with 185 livestock predation cases over three years. Respondents (10%) described that dogs were pernicious to wildlife including mammals and breeding waterbirds. Diet analysis of dogs revealed same patterns, about 84**%** of the diet was constituted by livestock and cattle and, 16**%** by wildlife including mammals (10%) and birds (6**%**). Average dog density in Tsokar, Tso Moriri and Hanle was 10 (95% CI 6-19), 61 (48-77), 310 (270-360) individuals/100 sq. km, respectively. Owing to human derived subsidies, population of dogs was influenced by human proximity; mostly recorded near defence installations and hamlets.

Our findings show that dogs are threat to both wildlife and pastoralists. Thus, on priority basis, control of dog population using capture-neuter releases, relocation of dogs in shelters from wildlife habitats and awareness among locals and defence personnel are required.

Keywords: breeding failure, perception, predation, polygon search method, waterbirds

Project Title	: Distribution pattern, habitat use and movement of breeding water birds with respect to Black-necked cranes and Bar-headed geese using telemetry in Changthang cold Desert Sanctuary, Ladakh and Gharana Wetland Conservation Reserve, Jammu & Kashmir
Principal Investigator(s)	: Dr. S. A. Hussain and Dr. Bilal Habib
Researcher(s)	: Neeraj Mahar (Senior Research Fellow)
Funding Agency	: Department of Wildlife Protection, Jammu and Kashmir
Project Duration	: 2012-2019

What makes *Lantana camara* invasion, a success? Degrading forests and adaptive plasticity!

-Ninad Avinash Mungi

While biological invasions are homogenizing the global biota, our knowledge on their spread is often inadequate and subjective. Estimating the distribution of invasive species and understanding the ecological reasons for their success is crucial for their management. Moreover, their ability to invade distinct biogeographic regions in short timespan pose an interesting ecological conundrum. *Lantana camara* (sensu lato), a shrub native to the tropical America, is invasive in more than 60 countries including India, where it has substantially homogenized the forest habitats and is hence of high concern.

We surveyed 2,07,100 km² of Indian tropical forests by sampling 13715, 5x5 km grids each with 1 to 31, 15 m radius plots, to record the abundance of *Lantana*.

We modeled the occurrence of *Lantana* in an occupancy framework that accounts for imperfect detections using covariates on climate, soil, forest and human disturbance. We further modeled its niche in the Maximum Entropy (MaxEnt) framework for understanding the changes in its environmental correlates in analogous areas of its native and invaded range. Subsequently, we compared its physiological correlates in the native range and India.

Lantana occupied 1,54,837 km² of the surveyed area, and 44% of total Indian forests with preference to warm and humid fertile areas, degraded by extractive human use. Areas climatically analogous to the native range of *Lantana* were found in India. Within this area, *Lantana* was found to be more tolerant to higher temperatures, lower fertility and shade as compared to its native range. Moreover, it has expanded by 42% in the novel areas.

Given the history of *Lantana's* selective hybridization since its introduction in India, success of its niche expansion could be attributed to its adaptive plasticity. This, in turn, is suggestive of its contemporary evolution. While identifying countrywide *Lantana* invaded forests, present study also demonstrates how an invasive species might evolve amidst the global changes, taking an advantage of anthropogenic modifications.

Project Title	: All India Tiger Monitoring Project
Principal Investigator(s)	: Dr. Y.V. Jhala, Prof. Qamar Qureshi
Researcher(s)	: Tiger team 2006, 2010, 2014 & 2018
Funding Agency	: National Tiger Conservation Authority
Project Duration	: 2006-2019

E-Bird technology: Surveillance and monitoring with drones for wildlife management

- Shashank Sawan

Unmanned Aerial Vehicle (UAV or popularly known as Drone) can play a major role by providing supplementary tools for the forest management professional. Wildlife Institute of India in collaboration with National Tiger Conservation Authority has initiated this R&D project and aims to support the forest department by providing essential tools and capacity building regarding UAV.

The project has 13 study sites selected from each tiger habitat landscapes across India.

The Phase I of this project has been implemented (2017-2018) in Panna, Sathyamangalam, Kaziranga, and Dudhwa Tiger Reserves and Phase II (2018-2019) soon to be implemented in Corbett, Sundarbans, Melghat, Simlipal, Nagarjunasagar-Srisailam, Bandipur, Parambikulam, Ranthampore, and Namdapha Tiger Reserves.

Delta-wing UAVs (Caipy and Vanguard), fixed Raptor V2 and Quadcopter (customized) are currently being used for surveillance and monitoring purposes. Efforts are being made to develop hybrid aircraft i.e. Raptor V2 with Vertical Take-off and Landing (VTOL) capability and Mutirotors, integrated with thermal imaging sensors and live-streaming. So far, test flying and capacity building of the forest staff have been successfully completed in Panna, Kaziranga, Dudhwa and in Sathyamangalam Tiger Reserves. Documentation of information regarding conflict, poaching, encroachment and fire is in continuation. Along with that maps have been prepared for high conflict and poaching risk areas of Panna Tiger Reserve.

The capacity building program of the forest staff has been successful and they have learned the technology enthusiastically and are currently using it for the monitoring and surveillance purposes. In Panna tiger reserve, the technology proved to be very effective in Tiger, vulture and crocodile monitoring and counting. Detecting and monitoring one horned Rhino in Kaziranga and in Dudhwa Tiger Reserve have been accomplished successfully.

This technology, with the combination of geomatic tools, can help us visualize backgrounds of inaccessible and difficult terrains. Using the high quality cameras and large endurance speed identification of plant species is possible in this new technology. This is likely to open up novel options for field managers and new avenues for business groups, which would further enable development and strengthening of technology based options and solutions for wildlife management in India.

Keywords: Unmanned Aerial Vehicle, Unmanned Aerial System, Wildlife Management, Tiger Reserve

Project Title	: E-bird Technology for Tiger Conservation: Development and Integration of Un-manned Aerial Vehicles as a Surveillance and Monitoring Tool for Protection of Tiger and Capacity Building of Frontline Staff
Principal Investigator(s)	: Dr..K. Ramesh
Researcher(s)	: Shashank Sawan (Project Engineer), Balsher Singh (Project Engineer), T. Krishna Kumar (Project Engineer), Tamali Mondal (Project Biologist), Ritwika Ghosh (Project Biologist)
Funding Agency	: National Tiger Conservation Authority (NTCA)
Project Duration	: 2017- 2020

Rapid assessment of channel morphodynamics and its impact on biodiversity of the Ganga River

-Rajiv Sinha

The ecological condition and biotic associations in a river are significantly influenced by geomorphic condition, and therefore, any anthropogenic intervention on rivers must include assessment of its morphology. The aim of this study was to assess the channel morphodynamics and its impact on the biodiversity of the Ganga River in Varanasi Turtle Sanctuary (VTS), Varanasi, Uttar Pradesh using innovative technology.

Rapid assessment of river morphology using innovative technologies such as remote sensing, drone mapping and Acoustic Doppler Current Profiler (ADCP) was carried out during February-July 2018. Geomorphic mapping of the Ganga River at Varanasi was carried out for the period of 1965 to 2018.

Mapping of the extent of Ganga River from Ramnagar fort to Malviya bridge at Varanasi for the period 1965-2018 shows a fairly stable planform morphology for the last ~50 years. It is evident from the study that there is no significant variation in the width and shape of the channel in this stretch during this period. Cross-sections measured using ADCP in the field accord with the planform mapping. The channels are incised and stable at all transects with relatively small variation in depth near Ganga and Ramnagar bridges. The velocity gradient of the channel cross-sections shows almost similar profile throughout the study reach. The flow velocity is highest in the middle of the channel below the water surface and vanishes as it approaches the riverbed and laterally towards the bank. However, significant morphological changes are observed in reaches downstream of the sanctuary where a large alluvial bar has merged with the floodplain on the northern bank.

The stable planform morphology stretch at Ganga Ghats albeit with minimal natural variability has resulted in a suitable habitat for turtles and other faunal species and their continued survival. Any form of alteration in the existing physical habitat conditions through anthropogenic interventions may not only affect the channel stability but in turn also cause irreparable damage to the sanctuary habitat. The project has also established the protocols for such rapid assessment of morphodynamics that can be replicated in other areas.

Keywords: Channel morphodynamics, geomorphology, Ganga River, Varanasi Turtle Sanctuary.

Project Title	: Rapid assessment of channel morphodynamics and their impact on biodiversity and Manikarnika Ghat at Varanasi using high resolution remote sensing and field surveys
Principal Investigator(s)	: Rajiv Sinha, Kumar Gaurav and Syed Ainul Hussain
Researcher(s)	: -
Funding Agency	: Grant-in-aid, Wildlife Institute of India, Dehra Dun
Project Duration	: February 2018-July 2018

Assessing tiger dispersal corridor functionality in the Terai-Arc landscape, India

-Suvankar Biswas

The Terai-Arc landscape (TAL) is one of the last remaining strongholds of wild tigers, where 22% of the Indian tiger population resides inside ~15000 km^2 of potential tiger habitat. However, this habitat is under serious threat of fragmentation and their future survival is dependent on conservation actions at landscape level. This landscape has 13 identified corridors that are critical for connectivity to maintain tiger metapopulations. We are using a combination of non-invasive conservation genetics and GIS tools to assess the functionality of these corridors with the measure of geneflow and migration across the landscape.

This study was conducted at the Indian part of TAL, covering all potential tiger habitats across the states of Uttarakhand, Uttar Pradesh and Bihar.

We surveyed ~13000 km^2 of tiger habitat and collected 1608 large carnivore faeces from the entire landscape. In the laboratory, we used species-specific assays to ascertain tiger faeces. Further, we identified unique individual tigers using 13 microsatellite loci and used the genetic data to assess population structure as a proxy of corridor connectivity.

We ascertained 743 genetically confirmed tiger scats and identified 219 individual tigers across TAL. The markers were polymorphic with high allelic richness (14.46±2.67), allelic size range (45.38±10.96) and observed heterozygosity (0.33±0.1), and provided a cumulative $P_{ID(sibs)}$ value was $2.42X10^{-6}$. About 45% of the total tiger population have been covered in this study. Subsequent genetic analyses revealed that western, central and eastern parts of TAL form three genetic tiger subpopulations, with some genetic similarity between the western and central populations.

This study generated probably the most fine-scale genetic information of wild tigers at a landscape level. Our results suggest that eastern TAL tiger population is genetically more isolated from the rest, and major tiger corridors in the other two populations are functional. Our results reveal one new functional corridor that facilitates tiger dispersal to potential sink habitats. The future of tiger conservation in this landscape will depend on careful management of these corridors and maintain source-sink dynamics.

Keywords: Genetic structure, metapopulation, migration, non-invasive genetics, non-protected area.

Project Title	: Metapopulation dynamics of tiger in the Terai-Arc landscape, India
Principal Investigator(s)	: Dr. Samrat Mondol, Dr. Bivash Pandav and Dr. Gautam Talukdar
Researcher(s)	: Suvankar Biswas, Junior Research Fellow
Funding Agency	: Wildlife Conservation Trust-Panthera Global Cat Alliance Grants and Department of Science and Technology, Government of India
Project Duration	: 2015-2019

A molecular perspective on population structure of dhole across tiger landscapes

-Shweta Singh

Understanding genetic structure of carnivore populations is necessary for assessing metapopulation function and gene flow at a landscape or regional scale. Canids represent the most diverse group of carnivores, with 36 taxa represented in 13 genera distributed throughout the world. The Asiatic wild dog or dhole (*Cuon alpinus*) is the only member in its genera *Cuon.* The present distribution of dholes across Asia has primarily reduced due to habitat fragmentation, decline in prey, and persecution by humans. The aim of the study was to investigate the population genetic structure of present dhole populations across India.

Scats samples were collected from all major Dhole occupied landscapes across India between 2016-2018. DNA was extracted from putative dhole scats A species-specific primer was designed to differentiate dhole scats from other sympatric carnivore scats.

DNA was isolated from a total of 700 scat samples, and using the dhole specific marker, 391 scat samples were identified of Dholes. A panel of twelve polymorphic markers was used to identify individual dholes from these dhole positive scats. The probability of identity (P_{ID}), which determines the power of these microsatellite markers to differentiate between individuals, was $1.296x10^{-19}$ and PID-sib was $1.32X10^{-6}$ · The Mean number of alleles was found to be highest in Central India (14.58+/-4.14), and the highest genetic diversity was found in North-Eastern populations (0.66+/- 0.34). The observed heterozygosity for all landscapes was found to be significantly lower than the expected heterozygosity, indicating sub-structure within each landscape. Using Bayesian model-based clustering algorithm, three major clusters, were identified across India; North-Eastern, Central Indian and Western Ghats. Northern-Western Ghat populations showed affinity to Central Indian populations, and North-East populations were distinct from the rest of the Indian dhole populations. While there are sampling gaps, current results of population structuring support biogeographic understanding of Dhole distribution.

Keywords: Carnivore, Non invasive, Population Structure, Genetic sampling.

Project Title	: Genetic connectivity at landscape scales for large carnivore populations in tiger habitats
Principal Investigator(s)	: Dr. Y.V. Jhala, Prof Qamar Qureshi, Dr Vishnupriya Kolipakam
Researcher(s)	: Shweta Singh (Senior Project Fellow)
Funding Agency	: NTCA
Project Duration	: 2016-2019

Insights from long term study on Tigers, Co-predators and prey in Tadoba-Andhari Tiger Reserve, Maharashtra

-Nilanjan Chatterjee

Long-term studies are fundamental to achieve an integrated understanding of how components of ecosystems interact as well as to test ecological theory over broad spatial and temporal scales. These studies significantly advance understanding of the dynamics of populations, communities and ecosystems. Integrated long term studies contribute developing knowledge base informing policy and improved management decisions. Herein we summarise the results of monitoring tigers, co-predators and prey in Tadoba-Andheri Tiger Reserve (TATR) between 2013 to 2017.

TATR in Chandrapur district of eastern Maharashtra spreads over an area of 1700 sq. km. with moderately undulating terrain. TATR is a tropical dry deciduous forest with Bamboo (*Dendocalamus strictus*) and Teak (*Tectona grandis*) being the dominant species, which provides suitable habitat for a wide array of faunal species.

Intensive camera-trapping was carried out in core and buffer areas of the tiger reserve by placing a pair of motion-sensored camera traps in grid of 1.42x1.42 km. Tiger and leopard population was estimated using spatial capture-recapture. Distance sampling was used to estimate the density of prey species. Four tigers and three leopards were radio-collared to understand their space use and movement. One ha enclosures were set up at relocated sites to study the effect of grazing on vegetation recovery. A total of 60 (1m x 1m) plots were sampled to evaluate species diversity and density across all relocated village sites. We used power analysis to derive optimal sampling design with number of sampling sites for different mammals captured in camera-trap.

We photo-captured 113 tigers and 172 leopards during the study. Tiger density varied from 5.29 ±1.12 individual/100 km^2 to 5.82±0.68 individual/100 km^2 whereas, Leopard density varied from 4.17±0.89 individual/100 km^2 to 6.29±1.26 individual/100 km^2. Tiger males exhibited larger home-range than females. Radio-collaring of tigers revealed a dispersal of more than 100 kilometres. We found no significant change in major prey species density across years as it varied from 31-33 individuals/km^2. Vegetation plots showed a decreasing species richness with time since relocation year increases. Power of occupancy estimate increased with number of sampling sites for all species, though the change was not significant for species with higher occupancy or detection probability.

The stable prey-predator population signifies the equilibrium in the trophic system. This will aid in better understanding of species interaction and dynamics of the ecosystem. The outcomes implemented with better management policies can be used for effective species conservation.

Keywords: Camera-trap, Conservation, Occupancy modelling, Prey-predator interaction, Village relocation

Project Title	: Long-term monitoring of Tigers, Co-predators and Prey species in Tadoba-Andhari Tiger Reserve and adjoining landscapes, Maharashtra
Principal Investigator(s)	: Dr. Bilal Habib, Dr. Parag Nigam
Researcher(s)	: Nilanjan Chatterjee (Junior Research Fellow), Lynette Gomes (Junior Research Fellow)
Funding Agency	: Maharashtra Forest Department and National Tiger Conservation Authority
Project Duration	: 2013-2019

Wild denizens of the frozen continent: Long-term monitoring of wildlife in Antarctica

-Dr. Manoj V Nair

In this epoch of Anthropocene, with global climate change unleashing unprecedented changes on wildlife and their habitats, the remote wilderness of Antarctica is perhaps the most ideal area to investigate its likely impacts. This necessitates sustained studies, a challenge to which WII has responded by undertaking long-term monitoring of wildlife in the Southern Ocean and the Indian area of operation in Antarctica, since the early 1990s.This study (January to April 2018), during the 37th Indian Scientific Expedition, furthers the same.

Methods include vessel-based surveys to estimate abundance and distribution of seabirds, on-foot surveys to monitor pre-marked bird nests earlier studied using sensor-based camera traps, aerial surveys to estimate abundance of seals and penguins, drone-based exploratory surveys and *ad libitum* observations on cetaceans.

Of forty-seven avian, six pinnipedian and six cetacean species seen, seven bird, one seal and one whale species were hitherto unrecorded. Aerial transects revealed relative abundance of seals comparable with that of earlier studies. Visit to unsurveyed areas, *viz.* Stornes Peninsula Antarctic Special Protected Area (ASPA) and McLeod island yielded two unknown nesting colonies of Snow Petrels and moulting sites of Adelie Penguins. Aerial survey of Amanda Bay ASPA indicated that nesting activity of Emperor Penguins had concluded. In contrast, a 3-island cluster east of Broknes peninsula had active Adelie rookeries numbering thousands. Two nests of South Polar Skua and an Adelie rookery of 420 nests were enumerated during a day-long survey of Svenner-II island.

Biological samples (n=47) of Weddell's Seal, Adelie Penguin, Snow Petrel and Wilson's Storm Petrel were collected for further analysis. Use of Drone was pioneered and was effective for surveys of penguins and seals. Popular talks aimed at promoting participatory monitoring among station inmates were well-received. As a corollary, a 'Field Guide to Antarctic Wildlife' is under preparation.

This study adds to the long-term data set of WII on select Antarctic wildlife, a detailed analysis of which is likely to provide interesting insights into patterns of climate-change driven shifts in species abundance/distribution.

Keywords: Pelagic birds, cetaceans, pinnipeds, rookery, drone, ASPA, climate change

Project Title	: Long-term monitoring of Wildlife and its habitats in Antarctica and Southern Indian Ocean
Principal Investigator(s)	: Dr. K.Sivakumar, Dr. S.Sathyakumar, Dr. Samrat Mondol, Dr. Manoj V.Nair, Mr. Anant Pande
Researcher(s)	: -
Funding Agency	: WII (Grant in aid)
Project Duration	: Long Term

A need of harmonized database of genetic markers in wildlife forensics: A case study on tigers

-Vinay Kumar

Recent development in the protocols for forensic identification has enabled tracking poaching of endangered species to its geographic origin but requires harmonized genetic database across species' range. Tiger (*Panthera tigris tigris*) is endangered and have conservation importance in India. We observed complete incompatibility of genetic markers used in tiger study across tiger range countries (TRCs) which complicates comparisons and only 2 to 3 microsatellite markers were common. A project titled "*Panthera tigris* genome: Implication in wildlife forensics" was initiated, to establish the harmonized genetic database of tigers based on mtDNA (1kb) and multilocus genotype markers for identifying the geographic origin of seized parts. We established genetic database for northern, peninsular and Sundarbans tiger populations. Phase-II of the project is aimed to extend the database for remaining populations and screen a few candidate markers (mtDNA and microsatellite) of different bioclimatic zones.

Tiger reserves of Southern and north-eastern tiger states.

We used 3.6 kb data (1kb of Phase –I and 2.6 kb in phase-II) of the seven different mtDNA genes i.e. subunits of NADH dehydrogenase subunit 1, 2, 5 & 6 (ND1, ND2, ND5, ND6), 12s ribosomal RNA, cytochrome b and control region). 26 microsatellite markers were also screened and applied for genotyping of reference samples (70 tissues and 600 scats) and seized body parts (n=24). Multilocus genotype data were analyzed by different Bayesian and non-Bayesian methods to see the level of population structure and assignment of seized body parts of tiger (n=24).

Fixed state SNPs were identified which defined five different geographical regions. Among 26 markers applied for the amplification nine markers were amplified with 190 unique individuals from 10 different tiger Reserve. The mean observed heterozygosity ranged from 0.28 to 0.69. Fst values indicate a population differentiation from moderate to high among examined populations. These observed values (Fst>0.033) are suitable for Bayesian-based population assignment. 30 % cases were assigned to the origin populations and 70% showed mix ancestry and remained unassigned.

Fixed state SNPs defined at least five zones without any ambiguity in India. Uses of multi locus data indicate the presence of mixed ancestry of individuals. Therefore, there is a need of the increasing multilocus markers and use of some other analytical tools to assign source of origin.

Project Title	: *Panthera tigris* genome: Implications in forensics and conservation. Phase II –DNA profiling of tiger populations from southern, eastern and northeast India
Principal Investigator(s)	: Dr. Parag Nigam, Dr. S.P. Goyal
Researcher(s)	: Vinay Kumar (Project Biologist)
Funding Agency	: WII-Grant in Aid
Project Duration	: 2017-2019

Genetic characterization of Himalayan brown bear in Jammu and Kashmir, India: Conservation implications

-Dr. Sujeet Kumar Singh and Shahid A Dar

Himalayan brown bear (*Ursus arctos isabellinus*) (HBB) has patchy distribution from Gobi desert to western Himalaya in India and categorized as endangered in the IUCN red list. Studies reported reduced genetic variation in brown bear due to anthropogenic pressure and poaching. Very little information on distribution and no information on genetic status exist in India. Therefore, we aimed to determine the level of genetic diversity, direction and rate of gene flow and effect of evolutionary forces on the population dynamics of brown bear in Jammu and Kashmir (J&K), India.

This study was conducted in Jammu and Kashmir.

We extracted DNA from n= 420 field collected scat samples from J&K and amplified 18 microsatellite markers. Genetic diversity indices, inbreeding (Fis) and the genetic signal of population bottleneck was estimated and compared with other brown bear populations. Pairwise Fst and contemporary migration rate were calculated to see the level of gene flow between the populations. To check the population subdivision between different HBB sub-populations of J&K, AMOVA, Bayesian and non-Bayesian based structure analysis were used. Among 18 markers tested, 14 markers were successfully amplified with 218 scat samples having <10% gaps/loci. Among 218 amplified samples, we found 187 unique genotypes that were used in further analysis. Moderate level of genetic diversity observed in the J&K population (He=0.54) which is similar to the HBB populations of Pakistan (He=0.55) and higher than Gobi (He=0.29). Positive Fis value suggested J&K population is inbred. We reveal the presence of weak genetic structuring with three genetic clusters identified and among that Hirpora region of J&K showing distinct genetic cluster. Reduction in genetic variation and population structuring in J&K population might be due the habitat fragmentation, poaching and non-random or skewed mating of a few individuals. Significant pairwise Fst and positive inbreeding coefficient suggested genetic drift playing the considerable role in reduction of genetic variability in the fragmented population. We suggest appropriate conservation strategies to manage Himalayan brown bear as panmictic population.

Keywords: Western Himalaya, population genetics, Inbreeding.

Project Title	: Population genetic structure and gene flow in brown bear (*Ursus arctos isabellinus*) populations in India (Jammu and Kashmir, Himachal Pradesh and Uttarakhand) , assess extent of gene flow between populations of India and Pakistan: Conservation and Forensic Implications.
Principal Investigator(s)	: Dr. S. Sathyakuamr, Dr. S.P. Goyal
Researcher(s)	: Dr. Sujeet Kumar Singh (Research Biologist), Shahid Dar (Project biologist) and Vinay Kumar (Technical Assistant)
Funding Agency	: Department of Science and Technology (DST)
Project Duration	: 2015-2018

Genetic analyses reveal population structure and demographic decline in leopards (*Panthera pardus fusca*) across Terai-Arc Landscape

-Supriya Bhatt

The leopard, *Panthera pardus*, is probably the most widely distributed and adaptable large carnivore that still persists in most of it's historic range. However, we lack population and landscape-level information from existing leopard populations across their distribution. In this study, we used non-invasive samples to investigate leopard genetic variation and population structure across the Terai-Arc Landscape (TAL).

The study area includes the Indian part of Terai-Arc Landscape (TAL), covering tiger habitats of Uttarakhand, Uttar Pradesh and Bihar.

We conducted intensive field surveys to collect fresh large feline faecal samples from the entire landscape. In the laboratory, we used DNA-based approaches to identify leopard faecal samples. Further, we identified unique individual leopards using a panel of 12 microsatellite loci. The entire data was used to assess population structure and genetic variation in this landscape.

We ascertained 490 genetically confirmed leopard scats for individual identification from the entire landscape, and identified 141 unique leopards with multiple genetic recaptures from field-collected leopard faeces. Overall, the markers were found to be polymorphic with high values of allelic richness (10.083±2.139), allelic size range (26.667±7.409) and observed heterozygosity (0.40328±0.14181). The cumulative PID_{sibs} value was $9.6X10^{-6}$ suggesting high statistical support in unambiguous individual identification. The population structure analyses indicated two distinct genetic subpopulations of leopards in TAL with the hilly terrain and flat Gangetic plains as the approximately boundary between them. Genetic differentiation (F_{st}) value between two populations was found to be 0.18. Demography analyses indicated signals of population decline in both populations.

Our results suggest two genetic subpopulations in leopards of Terai-Arc landscape, with signatures of population decline in this widely distributed, adaptable large carnivore. We recommend detailed, landscape-level ecological studies on leopard populations in this landscape for future conservation efforts.

Keywords: carnivore conservation, genetic differentiation, non-invasive samples

Project Title	: Understanding metapopulation dynamics of tigers in Terai-Arc landscape, India
Principal Investigator(s)	: Dr. Samrat Mondol, Dr. Bivash Pandav, Dr, Gautam Talukdar
Researcher(s)	: Supriya Bhatt (Project Biologist), Suvankar Biswas (Junior Research Fellow)
Funding Agency	: Department of Science and Technology, Government of India, Wildlife Conservation Trust - Panthera Global Cat Alliance Grants
Project Duration	: 2016-2018

Catch me if you can: Does moon illumination influence mammal activity in Manas National Park?

-Urjit Bhatt

Species interaction plays a vital role in structuring communities by stimulating behavioral responses in temporal niche, there by affecting the sympatric associations and prey-predator relationships. We determined relative abundance indices (RAI) and activity periods of each species to understand temporal overlaps between sympatric species and moonlight influence on mammalian activity, through camera-traps.

The study was carried out in tropical semi-evergreen forests of Manas National Park (MNP).

Camera traps (n=241) in a 1□x1 grid were deployed from April 2017 to May 2018. The RAI was calculated as the summed of all detections for each species from all camera-traps, divided by the total number of trap nights. Activity periods were classified as diurnal, nocturnal, crepuscular, and cathemeral. Activity patterns and temporal overlap were determined using kernel density estimation. Moon phases were classified as new, waxing, full & waning. *One-way ANOVA*, *Tukey HSD* for *Post-Hoc*, and *partial correlation* tests were conducted to measure the degree of association and pairwise comparisons among records of predator-prey in each moon phase.

A total of 35 species were recorded with 16,214 independent records over 7337 trap nights. A high degree of temporal overlap [Δ4 = 0.82 (± 0.05)] with varying activity peaks were foundamong most sympatric species pairs. Moon phase did not have any correlation with activity of large carnivores and large prey. Small carnivore activity was influenced negatively by moonlight ($_{\text{partial correlation}}$ r = -0.221, p<0.01). Medium to small carnivores were nocturnal (clouded leopard, leopard cat, and civets) or diurnal (yellow-throated marten and mongooses). Large carnivores were cathemeral (tiger, leopard, black bear), and diurnal (dhole).

The result suggests that large carnivores were active non-differentially across moon phases; however, small carnivores showed significantly high activity in darker nights. These patterns indicate that small or meso predators may differ their activity temporally possibly as an anti-predator strategy or otherwise to increase their foraging efficiency.

Keywords: Tropical forest, moon phase, prey-predator relationship, niche-overlaps

Project Title	: Ecology of clouded leopard (*Neofelis nebulosa*) in an east Himalayan biodiversity hotspot.
Principal Investigator(s)	: Prof. Salvador Lyngdoh, Dr. Bilal Habib
Researcher(s)	: Urjit Bhatt (Junior Research Fellow)
Funding Agency	: Department of Science & Technology, Govt. of India
Project Duration	: 2016-2019

Insight into RhoDIS: A molecular approach for rhino forensic and population managment in India

-Tista Ghosh

With a current population of ~3300 wild individuals, the remaining populations of greater one-horned rhinoceros (*Rhinoceros unicornis*) face severe pressures of habitat loss and poaching. The major aim of the Rhino DNA Indexing System or RhODIS is to build a DNA database of the existing populations to facilitate (1) matching of confiscated rhino contraband with existing database as a scientific evidence of poaching involvent in the court for prosecution; and (2) understanding genetic status of existing populations to aid their management.

This study is focused on rhino-bearing areas of Assam, Uttar Pradesh and West Bengal.

At the initial phase of the project, we focused on selecting and standardizing a set of microsatellite markers to generate forensic quality data from different rhino samples. From an initial set of 35 markers we finalized a panel of 14 microsatellites for unambiguous individual identification. These marekrs were tested with 53 tissue samples from Assam. In addition, we have collected 375 fresh rhino dung samples from Manas NP, Pabitora WLS and Dudhwa NP, and standardized individual identification using samples from Dudhwa NP (n=90). The individual level data from Kaziranga NP and Dudhwa NP were used to assess marker polymorphism and genetic differentiation between these two populations. Our standardized panel of 14 microsatellite loci produced a cumulative PIDsibs and PIDunbiased values of 1.5x 10-4 and 4.7 x 10-10, respectively for Kaziranga tissue samples. Similarly, the Dudhwa NP dung DNA samples showed a cumulative PIDsibs and PIDunbiased values of 3.4x 10-3 and 2.3x 10-6 respectively. The Fst Value between Kaziranga and Dudhwa was found to be 0.11. The genotyping matching approach has helped in solving four rhino poaching cases from Assam and West Bengal.

We standardized a panel of markers and developed forensic quality information from various types of rhino biological samples. These genetic data will help in solving rhino poaching cases and generate population level data from remaining rhino populations. Such information will be critical in developing management plans for this endangered species.

Keywords: One-horned Rhinoceros, Microsatellite markers, Dung, Wildlife forensics, Population management

Project Title	: Implementing rhino DNA indexing system (RhoDIS) to counter rhino poaching threat and aid population management in India
Principal Investigator(s)	: Dr. Samrat Mondol
Researcher(s)	: Tista Ghosh (Junior Research Fellow)
Funding Agency	: WWF India
Project Duration	: 2017-2020

Demographic status of Gharial (*Gavialis gangeticus*) in the National Chambal Sanctuary

-Suyash Katdare

Models and indices help in identifying trends within a population. Here, we have used a stage (size class) based population model and nest counts to determine the status the critically endangered Gharial (*Gavialis gangeticus*) in the National Chambal Sanctuary.

Total counts of gharial were conducted in February by surveying the river during daylight hours, on consecutive days, using a motor boar. The nest count was conducted during the post hatching season. Observations on nest loss due to predation and disturbance to the nest site were recorded by regular monitoring of nest sites. A stage structured model based on the Lefkovitch matrix was used to carry out demographic analyses. We used surrogate values of vital demographic rates from the Australian Freshwater crocodile *Crocodylus johnstoni*, which is ecologically similar to the gharial with respect to life history events.

Encounter rate of the entire population was 3.85 individuals/km. The projected population showed near stability (ë=0.99). The total nest count for this year was 429 in the NCS, 27 more than in 2017. The nest loss was 27.6%, compared to 12.4% from 2017. Nest loss was caused mainly by predation, where some communal nesting sites experienced 100% predation. Thus, the breeding population is at least 508 individuals, including 79 males (counted during the survey) and 429 females.

Current observations show that the population is increasing, whereas the projection using the surrogate indices shows that the population has attained stability. The population growth rate (ë) is most sensitive to changes in the juvenile and adult size classes. The NCS population has been supplemented with juveniles under the rear and release program, hence determining the vital demographic rates is necessary to understand the future trend of this population.

Keywords: Nest loss, population projection, stage structured model

Project Title	: Ecological Monitoring of Chambal River basin with special reference to water requirement of key aquatic species
Principal Investigator(s)	: Dr. S. A Hussain, Dr. Ruchi Badola, Dr. S. K. Gupta
Researcher(s)	: Suyash Katdare (Senior Research Fellow)
Funding Agency	: Grant-in-aid (WII)
Project Duration	: 2016-19

Preliminary insight into the genetic status of *Gavialis gangeticus* using mitochondrial and microsatellite markers

-Surya P Sharma

The gharial *Gavialis gangeticus* underwent a substantial population declination owing to illegal fishing, hunting and habitat loss. The population has recovered through concentrated conservation intervention. However, the patterns and trends in genetic diversity of the present populations are not known. The present study aims at determining the current genetic variation in gharial using mitochondrial and microsatellite markers.

The samples for the study were collected form National Chambal Sanctuary (NCS) and Katarniaghat Wildlife Sanctuary (KWS).

Non-invasive biological samples (NCS=850 and KWS=128) including eggshells membrane/extra-embryonic membrane and tissue from dead hatchlings were collected. Total genomic DNA (n=350) were extracted using Phenol-Chloroform method. Partial fragment of mtDNA COI region was amplified (n= 158) samples and 583 bp sequences were generated for these samples. The sequences were aligned using BioEdit. Number of haplotypes (h), haplotype diversity (hd) and nucleotide diversity (π) were calculated using DnaSP 5.10.01. A panel of 14 microsatellite locus was screened and genotyping was performed for n=62 samples. Microsatellite loci alleles were scored using GeneMarker 2.7.4. Heterozygosity (H), mean number of allele and polymorphic information content (PIC) was calculated using CERVUS 3.0.7.

Examination of the 583 bp COI region from 146 individuals revealed two haplotypes characterized by one polymorphic site in NCS population and 12 individuals from KWS population revealed only one haplotype. The haplotype (hd) and nucleotide (π) diversities are (hd = 0.301, π = 0.00054) for NCS. However, KWS population showed no variation. Of the 14 microsatellite evaluated, eight loci were successfully amplified in gharial. Only five loci were polymorphic for which observed heterozygosity ranged from H_O=0.145 to 0.758, expected heterozygosity ranged from H_E=0.163 to 0.516, mean number of allele per locus was 1.875, PIC ranged from 0.149 to 0.421 and $P_{(ID)sib}$ was 0.24.

The low heterozygosity, mean allele per locus and PIC indicate low genetic diversity in sampled population. The low level of genetic diversity and no genetic differentiation among populations could be due to reintroduction from same stock population, population bottlenecks orfounder effects. Further, it highlight the need for detailed insights into the genetic status of the extant gharial population.

Keywords: Exploitation, reintroduction, heterozygosity, haplotype

Project Title	: Ecological Monitoring of Chambal River basin with special reference to water requirement of key aquatic species
Principal Investigator(s)	: Dr. S. A Hussain, Dr. Ruchi Badola, Dr. S. K. Gupta
Researcher(s)	: Surya P. Sharma (Junior Research Fellow)
Funding Agency	: Grant-in-aid (WII)
Project Duration	: 3 years

Human-Snake interactions: A study of local perceptions in and around Mudumalai Tiger Reserve, Tamil Nadu

-S Karthy

India has one of the highest numbers of snake bite related mortality N=~50000/year) in the world. This is more than just a health problem–it is also a great conservation challenge. There are misconceptions and lack of knowledge on snakes among the people resulting in undesirable consequences to both humans and snakes. However, this lack of awareness receives little attention from policy makers and public administration. This study aims to generate information on people's perception about snakes around Mudumalai Tiger Reserve, Tamil Nadu

A questionnaire survey consisting of 25 easy to answer questions that range from how often a snake has been seen where and what a person's response was to the event. Data was collected from 30% of the households (**n=493**) from 15 villages between June 2018 and August 2018.

People's fear of snakes did not vary among different population ($F=4.48$; $p = <0.05$) and age groups ($x^2 = 1.946$; $p = 0.962$). Most of the people were aware about venomous snakes in their locality yet they felt threatened by non-venomous snakes. Of the responses collected so far, 44% people are aware that killing certain snakes was against the law; nevertheless ~50% people did kill snakes that they encountered. Survey revealed that, out of five at least one person was bitten by venomous snakes. Most people (90%) realized the importance of allopathic treatment due high recovery rates and close proximity of hospitals. However still 10% of tribals depend upon traditional treatment. Further, 22% people reported loss of livestock due to pythons and other snakes.

It is difficult to initiate a conversation about conservation of snakes as they are mostly perceived as a threat to human lives. Outcome of this study will help the managers to prepare effective management protocols for efficient mitigation measures, create awareness among the public and will help farmers to understand ways to avoid/minimize interactions with snakes.

Keywords: Conflict-mitigation; Snake-bite; Neglected tropical disease

Project Title	: Spatio-temporal and thermal ecology of Indian Python *(Python molurus molurus*, Linn 1758) in Moyar river valley, Tamil Nadu
Principal Investigator(s)	: Dr. Ramesh C, Dr. Abhijit Das, Dr. Gautam Talukdar
Researcher(s)	: S Karthy (Project Assistant), Thirumurugan V (Project assistant); Vishnu C S (Junior Research Fellow)
Funding Agency	: Science and Engineering Research Board- Department of Science and Technology (EMR/2016/003963)
Project Duration	: 2017-2020

How common are the Weavers? - The status of weaver birds in the Terai landscape of Eastern Uttarakhand

-Harindra Baraiya

Weaver birds in the Indian region once regarded as common are now thought to be undergoing drastic population decline. Four species of weaver birds occur in the Indian subcontinent that include the widely distributed Baya weaver *Ploceus philippinus*, Streaked weaver *Ploceus manyar*, Black-throated weaver *Ploceus benghalensis* and the globally threatened Yellow Weaver *Ploceus megarhynchus*. The terai landscape of eastern Uttarakhand is unique in having all of the four species and this study is the first systematic effort to document the status of weaver birds in the area.

This study was carried out from May to November 2017, and again in May 2018. A total of 80 days was spent searching for weaver birds during which only three of the four species were recorded in the area with Baya weaver being relatively common. No evidence of Yellow weaver in the region could be found. A total of 146 nesting colonies of Baya weaver were located and in all 1908 nests that included 909 complete and 999 incomplete nests were recorded. In addition, a total of 710 adult males were observed at the nesting colonies. Baya nests were found mainly on *Phoenix dactylifera* (20%) and *Senegalia catechu* (15%), and 16 % of nests recorded were on power lines. Black-breasted and Streaked weaver being primarily associated with water bodies were found nesting largely (80%) on *Saccharum spontaneum*. Unlike the Baya weaver the nesting of Black-breasted and Streaked were in clusters and a total of 35 and 18 such clusters having 142 and 53 nests respectively were recorded in the area.

Habitat conversion and degradation across the terai landscape of our study primarily due to urbanization and setting up of industrial parks is likely to be impacting weaver bird occurrence. Extraction and removal of reeds from water bodies in the area for water chestnut cultivation is likely to be affecting Streaked and Black-breasted weaver nesting. Additionally, collection for pet trade as reported in literature may also be impacting weaver bird populations, specifically of Yellow weaver in the region.

Project Title	: A rapid status survey for the globally threatened Yellow Weaver *Ploceus megarhynchus* in Uttarakhand with special emphasis on its conservation requirements
Principal Investigator(s)	: Dr. Suresh Kumar, Dr. Manoj V. Nair, Dr. Malvika Onial, Dr. Dhananjai Mohan
Researcher(s)	: Harindra Baraiya (Intern), Sarabjeet Kaur, P.K. Jain (Intern), Karthik Nandu (Intern), Ankita Bhatt (Iintern)
Funding Agency	: Uttarakhand State Forest Department
Project Duration	: 1 Year

Human dimensions and the urban niche of Black Kites *Milvus migrans* in Delhi, India

-Urvi Gupta

Though urbanization is well known as one of the major threats to biodiversity, certain species have adapted to the human dominated ecosystems, reaping benefits as *anthropo-dependent* commensals. One such species, the black kite *Milvus migrans* is a facultative scavenger, arguably dwelling at its highest breeding density within Delhi.

Our study on the resident kites (*Milvus m. govinda*) employs nest surveys in 40 sampling plots of 1 km^2, distributed throughout the city along the gradients of urbanisation. A sample of ~150 nests are checked annually to record breeding ecology parameters, nesting success and diet. Kites, currently existing at temporally stable breeding densities (since 1960s), have adapted to nest in fully urban conditions in South Asia and mainly subsist on: (1) human refuse and its associated prey-fauna, e.g., pigeons and rats, and (2) ritualised meat feeding, particularly practiced by the residents of historical colonies in Delhi. Their resilience and coexistence with humans is mediated by the interplay between their habitat selection and human socio-economic aspects, and human activities facilitating these scavengers with prey.

We also use cutting edge GPS-telemetry (n= 22) with the latest accelerometry technology to understand how kites move and forage within the city, how they select urban sites for foraging and how this varies along the urbanization gradient. Tagged *M. m. lineatus* kites, who breed in Central Asian Steppes, form enormous gregarious flocks largely associated with predictable foraging opportunities at the sanitary landfill sites. They regularly used the same city park or woodlots in vicinity, roosting communally. The resident kites, on the other hand, regularly made temporally predictable and direct movements from their nests to the hotspots of ritualised meat feeding.

Thus, we showcase the seeding of a long-term research, studying the urban adaptability to set basic sampling protocols i.e. monitoring nesting density, nest ecology, and physiological effects of anthropogenic foraging. Over the longer-term, we will also examine how two black kite sub-species co-occur by differential exploitation of an urban environment. Such data will aid in understanding the effects of changing urban resources, socio-economics, and micro-climatic factors on kite ecology.

Keywords: Food subsidies, ritual feeding, synurbic, trans-Himalayan migration, urbanization, urban ecology

Project Title	: Resource Selection by Black Kites
Principal Investigator(s)	: Dr. Y. V, Jhala, Prof. Q. Qureshi, Dr. F. Sergio
Researcher(s)	: Urvi Gupta (Project Biologist); Nishant Kumar (Senior Research Fellow)
Funding Agency	: Raptor Research and Conservation Foundation (RRCF); CSIC, Spain; Microwave, Telemetry; Felix Scholarship Trust; Somerville College, Oxford
Project Duration	: 2013-2018

Influence of disturbance factors on tree diversity along the Moyar river valley landscape

-Thiru Murugan V

Species diversity and forest structure indicate the health of an ecosystem. Multiple disturbances are known to have a negative influence on forests. Detail information on disturbances due to anthropogenic and biological factors on Tropical forest are lacking. This study evaluates various disturbances influences on tree species diversity and forest structure

Moyar river valley landscape (MRVL) a part of Nilgiri Biosphere Reserve, traverses through Mudumalai and Sathyamangalam Tiger Reserves, Tamil Nadu. It is the transition zone that connects the Western Ghats and Eastern Ghats. MRVL consist of five major vegetation types, namely Riparian, Southern Thorn, Southern Scrub, Tropical Dry deciduous and Tropical Moist deciduous Forest. The elevation ranges 250-1266m above sea level with the average annual rainfall 600-1000mm and average mean temperature 21°C-28°C.

One km transect (n=49) consist of ten equally distanced 10m x 10m plots (n=490) were laid randomly in five forest types (10 transects for each forest type, except Moist deciduous forest with nine transects). All the trees (≥10cm Girth at breast height) were enumerated from the plots. Disturbance intensity, such as human access, invasive species, fuel-wood collection, NTFP, logging and Cattle grazing were quantitatively assessed (1-minimum to 10-maximum). Species diversity and tree density were correlated with the disturbance level using spearman rank correlation. A total 181 tree species and 2653 trees were enumerated. Among five vegetation types, moist deciduous forest had highest species diversity (5.13±2.38/plot) and stem density (9.98±6.16/plot). Meanwhile, scrub forest had least species diversity (2.52±1.68/plot) and tree density (3.64±2.79/plot). Species diversity and stem density were negatively correlated with disturbance (r= -0.07 – -0.27 & -0.06 – -0.26), except for scrub forest (r = 0.04 & 0.12).

Developmental activities, expansion of agricultural fields, Invasive species and other biological disturbance affecting the forest structure in MRVL. Immediate management intervention required to control the invasive species spread and reduce the anthropogenic pressure in MRVL.

Keywords: Vegetation classification, Forest–environment relationships, species richness, anthropogenic impact

Project Title	: Spatio-temporal and Thermal Ecology of Indian Python (*Python molurus molurus* Linn.1758) in Moyar River Valley, Tamil Nadu
Principal Investigator(s)	: Dr. Ramesh C, Dr. Gautam Talukdar, Dr. Abhijit Das
Researcher(s)	: Thiru Murugan V (Project Assistant) Karthy S (Project Assistant), Vishnu CS (Junior Research Fellow)
Funding Agency	: Science and Engineering Research Board - Department of Science and Technology (EMR/2016/003963)
Project Duration	: 2017-2020

Distribution pattern of *Prosopis juliflora* in the three agro-climatic zones of Tamil Nadu

-Kamalakannan B

Prosopis juliflora is an invasive, drought resistant, evergreen fast growing Phreatophyte widely distributed in India and other tropical regions of the world. It is believed to be one of the worst invaders affecting natural and man-made ecosystems in Tamil Nadu. This study aims to assess the distribution pattern of *P. juliflora* and its impacts on three different agro-climatic zones of Tamil Nadu.

The study was conducted in three agro-climatic zones (Western zone, Cauvery delta zone and Southern zone) of Tamil Nadu.

Permanent sampling plots were laid in randomly selected sites at three agro-climatic zones to assess the status and distribution pattern of *P. juliflora* covering various seasons. Six plots of 15 m radius were laid in 2 km transects and a total of 20 such 2 km transects were laid randomly in three agro-climatic zones of Tamil Nadu. Data were analysed for density, abundance, frequency (%), relative density and relative frequency of plants. Other ecological variable such as % cover of grasses, herbs, shrubs and abundance of animal pellets were recorded within belt transects to assess the relative use of habitat by domestic and wild ungulates.

Among three agro-climatic regions, southern zone (Ramanathapuram district) exhibited the highest density of *P. juliflora* ($F = 34.35$, $P < 0.05$). Density and frequency occurrence (%) of *P. juliflora* were also higher in southern zone (followed by western zone and Cauvery delta zone. Maximum frequency class 'E' (81-100%) was observed in all three zones whereas minimum frequency class 'A' (1-20%) was observed in western zone and Cauvery delta zone. Southern zone covers 79.4% of *Prosopis juliflora*then western zone (46%), and in Cauvery delta zone (32%). Native species abundance and diversity of other species was higher in western zone followed by Cauvery delta zone and southern zone. In western zone supports more ungulates than Cauvery delta zone. Driest environment settings of southern zone favoured more *P. juliflora*than other two agro-zones that are comparatively wet.

Distribution and impacts of invasive *Prosopis juliflora* was higher in drier zone than the wet regions. Our preliminary result shows that both Cauvery delta and western zone invasive *Prosopis juliflora* supports to native herbs, shrubs, grass and also it support herbivores like chital, black buck, hare and cattle populations.

Keywords: Ecological variables, transects, southern zone, frequency class

Project Title	: Study on Ecological & Socio-economic impact of invasive species, *Prosopis juliflora* and *Lantana camara*, and their removal from forest, common and fallow land of Tamil Nadu.
Principal Investigator(s)	: Dr. G.S. Rawat, Dr. K. Sivakumar, Dr. R. Badola, Dr. B.S. Adhikari
Researcher(s)	: Kamalakannan, B. (Project Biologist)
Funding Agency	: State Forest Research Institute (SFRI), Tamil Nadu Forest Department
Project Duration	: 2 years

Misty mountain hop: A scoping study in two protected areas of Himachal Pradesh, India

-Ankita Bhattacharya

Proper biodiversity assessment of protected areas (PAs) through participatory interventions in mountainous landscapes provides information to guide conservation action and helps in capacity building. Our study aimed to assess faunal status of four PAs in Himachal Pradesh.

Reconnaissance survey of two PAs namely Daranghati (~183km^2) and Lippa-Asrang (~34km^2) wildlife sanctuaries was carried out (May–July, 2018). These PAs fall in the Greater Himalayan range and landscape adjoining the Trans-Himalaya in eastern part of Himachal Pradesh.

Prior to field work, training session with forest staff was conducted for different sampling methodologies. 52 camera traps were deployed involving forest staff and locals in Daranghati (n=44, session=35 days) and Lippa Asrang (n=8, session=30 days). Alongside, sign surveys, bird and butterfly counts in pre-existing trails (n=16; 3-10km) were conducted in Daranghati. Light trapping exercise for moths was done at night at different elevations. Analysis was done using 'camtrapR' and 'rich' package in software R.

Camera trap data revealed first photographic record of Snow Leopard (3938m) and Himalayan Brown Bear (3287m) from Lippa-Asrang. In Daranghati, 10 mammal and 4 Galliformes species were photo-captured. 50 bird species were listed from Lippa-Asrang and 74 birds, 23 butterflies and 132 moth species from Daranghati. Highest photo-capture rate was of Himalayan black bear, followed by Rhesus macaque, Himalayan goral and Himalayan monal. Activity pattern of Black Bear was diurnal. Goral activity showed unimodal pattern (early morning) which was non-overlapping with humans. Red fox, Yellow-throated marten, Leopard cat and Common leopard were also recorded from Daranghati. Species richness (mammals and birds) reached asymptote with 20 camera traps.

The reconnaissance study helped to understand sampling feasibility and species status in parts of the study area. This would help in developing a robust methodology for future sampling in all the PAs. The study also introduced forest staff with modern sampling techniques and helped in facilitating capacity building. Baseline information on presence of rare and threatened faunal species generated from the study would be vital to formulate Management Plan of the PAs.

Keywords: Camera-trapping, Capacity-building, Fauna, First record, Himalaya

Project Title	: Assessment of Biodiversity and Ecotourism Potential of Four Protected Areas in Himachal Pradesh, India.
Principal Investigator(s)	: Dr. Bilal Habib, Dr. Bitapi C. Sinha
Researcher(s)	: Ankita Bhattacharya (Senior Project Biologist), Shivam Shrotriya (Senior Project Biologist)
Funding Agency	: Himachal Pradesh State Forest Department
Project Duration	: 8 months

Monitoring protected areas in the era of climate change

-Debanjan Sarkar

Protected areas are recognised as decisive tools for sustainable development and the fight against climate change. Beyond conserving species and ecosystems, protected areas provide essential ecosystem services. In this study, we aim to investigate the response of different protected areas towards climate change and identify vulnerable protected areas towards climate variability.

The analysis will be focused on National Park and Wildlife sanctuaries of India for which boundaries are available. For current status modelling, we will use Moderate-resolution imaging spectroradiometer (MODIS) monthly time series data on the four key ecosystem and climate variables, i.e., enhanced vegetation index (EVI) and three climatic variables driving vegetation productivity (air temperature, water availability and cloud cover) to identify protected areas sensitive to climate variability over the past 17 (2000-2017) years. Based on the mentioned inputs, a Vegetation sensitivity index (VSI) will be developed. For future scenario, we will use IPCC's data on the projections of future climate change (Surface temperature, precipitation changes). For area boundaries and Biogeographic zones of India, Wildlife Institute of India's data on protected area network will be used. The Vegetation sensitivity index (VSI) will be demonstrating responses of the vegetation of protected area towards changing climatic conditions.

The outputs will be crucial in determining the protected areas which have shown higher sensitivity towards climate change over the past years and the climatic factors that have influenced this condition. The output will be a baseline database for protected area managers and policymakers in determining the suggestive mitigation/adaptation strategy for those protected areas.

Keywords: Climate Change, IPCC scenario, Protected areas of India, Vegetation sensitivity

Project Title	: Linking protected area networks and near real-time 'rain bird' locations with IBIN
Principal Investigator(s)	: Dr. Gautam Talukdar, Dr. R. Suresh Kumar
Researcher(s)	: Debanjan Sarkar, Junior Research Fellow
Funding Agency	: Ministry of Science and Technology, Department of Biotechnology
Project Duration	: 3 years

Ecological assessment along the proposed Nagpur-Mumbai super communication expressway, Maharashtra for wildlife conservation

-Yashashree Garge and Bhumika P. Morey

Maharashtra State Road Development Corporation proposes to build a smart green expressway connecting Nagpur to Mumbai with an aim to strengthen the rural agriculture sector while enhancing mobility. The proposed alignment doesn't traverse any existing Protected Areas (PAs). The objective of this ecological assessment is to help Government of Maharashtra upscale ecological concerns at the earliest stage of highway planning, even beyond PA network.

The study area is along the proposed alignment (710 km) of Nagpur-Mumbai expressway, Maharashtra, India.

We reviewed secondary data documenting flora and fauna of area traversed by the highway. We mapped land use and vegetation classes within 10 km buffer of the proposed alignment covering an area of 16,045 km^2. Literature was reviewed for understanding existing best practices that can be applied to this highway for appropriately mitigating potential impacts on wildlife values.

Proposed highway spans across ecological zones of Western Ghats (221 km), Central Highlands (188 km) and Vidarbha (347 km). Study area comprises of mainly agriculture (73.64%), wasteland/grassland (10.95%) and forest (9.06%) etc. We identified approximately 488 avian and 91 mammalian species (54 threatened species listed in IUCN Redlist and 33 endemic species), 76 reptilian species, 19 amphibian species and 600 plant species. *Tectona-Terminalia-Diospyros, Boswellia, Zizyphus, Acacia, Cymbopogon, Ischemum, Dichanthium-Sehima* are dominant plant communities. Ecologically important mammals in the area include tiger, Indian wolf, blackbuck, chinkara, Indian giant squirrel, Indian pangolin and gaur as well as avian species such as great Indian bustard, forest owlet and sociable lapwing.

Based on available information on land use/cover and habitat specific wildlife values which include protected, rare, endemic and threatened flora and fauna, we plan to prepare detailed maps of each highway segment (5 km long, 20 km wide), with the road as a median. This pre-feasibility study enabled delineation of prioritized ecologically sensitive sites requiring a detailed survey to suggest mitigation measures for habitat specific wildlife and plausible sustainability strategies for optimizing resource efficiency, preserve ecosystem services and achieve carbon neutral functioning of the expressway.

Keywords: Mitigation measures, Road ecology, Samruddhi expressway, Sustainable development, Tiger corridor

Project Title	: Assessment of impacts of the proposed Nagpur-Mumbai Super Communication Expressway, Maharashtra, Samruddhi Corridor on wildlife values and measures recommended mitigating negative impacts.
Principal Investigator(s)	: Dr. V.B. Mathur, Dr. Bilal Habib, Dr. G.S. Rawat, Dr. Gautam Talukdar, Dr. Abhijit Das, Dr. Navendu Page, Dr. S.P. Goyal (Subject Matter Specialist), Dr. Asha Rajvanshi (Advisor)
Researcher(s)	: Indranil Mondal (Project Scientist), Shivam Shrotriya (Project Scientist), Bhumika Morey (Project Fellow), Kunjan Joshi (Project Fellow), Pandurang Pawar (Project Fellow), Vidhi Modi (Project Fellow), Yashashree Garge (Project Fellow)
Funding Agency	: Maharashtra State Road Development Corporation
Project Duration	: July, 2018-July, 2021