XXVII ANNUAL RESEARCH SEMINAR

(30th September & 1st October 2013)

Abstracts

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

Photo credits:

Front cover: Dr. K. Ramesh (Panna Landscape), Dr. J.A. Johnson (Flora), Shri Aseem Shrivastava (Butterfly), Ms. Shruti Sen Gupta (Himalayan Salamander), Dr. K. Ramesh (Western Tragopan), Shri. B. Navaneethan (Guar, Tiger);

Back cover: Dr. S. Sathyakumar (Trans-Himalayan Landscape), Dr. Bivash Pandav (Elephant)

Assessment of cumulative impacts of Hydropower projects on the wildlife values of Alaknanda and Bhagirathi Basins, Uttarakhand

- Asha Rajvanshi, K. Sivakumar & V.B. Mathur

The State of Uttarakhand which is uniquely endowed with glaciers and rain fed rivers along with the altitudinal gradient is developing as the energy capital of the country with a potential to generate 20,000 MW of hydropower. A total of 70 Hydropower projects with a total installed capacity of 9563 MW have been planned in Alaknanda and Bhagirathi river basins. The State is also well known for its rich biodiversity and diverse ecosystems that offer range of ecosystem services for human well-being. These ecosystems additionally support several valued components, both terrestrial and aquatic, many of which harbour rare and threatened plant (*Acer caesium)* and animal species (*Tor putitora, Lutrogale perspicillata, Panthera uncia* and others).

The study aimed to provide a 'risk forecast' for Rare, Endangered and Threatened species and their critical habitats in the event of hydropower projects proceeding as proposed. Although the merits of Cumulative Environmental Assessments (CEA) as a decision support tool for hydropower planning are well acknowledged worldwide, their application for mainstreaming biodiversity issues in India's hydropower planning and policy reforms, is making a new beginning. The CEA of all 70 hydropower projects planned in Alaknanda and Bhagirathi river basins is the first of its kind in India. The focus of the study was to assess the biodiversity issues linked to alteration in environmental flows of river ecosystems, changes in terrestrial habitats and consequent landscape level changes within the zones of influence in the two river basins.

The outputs of the study presented a set of choices of scenarios including suggestions for regulating environmental flows for decision makers to consider development options that could best help in aligning the conservation priorities with present and future hydropower planning in the State.

Project Title	:	Assessment of cumulative impact assessment of Hydropower projects on the wildlife values of Alaknanda and Bhagirathi Basins, Uttarakhand
Project Coordinator:	:	Dr. V.B. Mathur
Principal Investigator(s)	:	Dr. Asha Rajvanshi, Dr.Vinod B. Mathur, Dr. K. Sivakumar, Dr. S. Sathyakumar, Dr. G. S. Rawat, Dr. J. A. Johnson and Dr. K. Ramesh
Project Advisors:	:	Shri B.C. Choudhury, Shri V.K. Uniyal and Dr. V.K. Melkani
Research Personnel:	:	Roshni Arora, Nand K. Dimri, Ajay Maletha and Dr. Manish Khandwal
Funding Agency	:	Ministry of Environment and Forests, Govt. of India
Project Duration	:	December, 2010 - March, 2012

Landscape ecology of large mammals in Terai Arc Landscape: An update

- K. Ramesh

Large mammals continue to occupy central stage in the conservation efforts, on account of their flagship value and sensitivity to changes in habitat caused by natural and anthropogenic factors, and also due to their role in structuring faunal and floral communities. The forests along the Himalayan foothills and Gangetic plains (Shivalik-Terai Landscape or Terai Arc Landscape) are among the unique ecoregions in the world, and support diverse mammalian assemblage, with tiger (*Panthera tigris*) and Asian elephant (*Elephas maximus*) as 'Flagship Species'. Although these species have been the focus of conservation efforts, empirical analyses on the linkages with patch property, permeability of patches for occupancy and movement opportunity, and effect of surrounding matrix on species populations have never been conducted. As populations continue to face challenges due to continuing habitat fragmentation, this project addresses these lacunae by targeting the flagship species in the landscape ecology perspective. On priority, the status of 'tiger and its prey species' are being studied based on occupancy, capture-recapture and distance sampling frameworks across the landscape. Recent estimates of tiger occupancy for the western, central and eastern region of the landscape revealed that tiger occupy 60%, 90% and 40% respectively. Tiger density estimates in selected forest patches in western region ranged from 1.1 to 9.7 tiger / 100 km^2, while in the eastern region it ranged from 1.4 to 6.6 / 100 km^2. Subsequently, these estimates would be related to patch level and landscape matrices to determine the species-habitat relationship at multiple scales. Future efforts would also focus on re-surveying the entire landscape after 10 years in order to provide an update of the status of source habitats and corridors.

Project Title	:	Landscape ecology of large mammals in the Shivalik-Terai Landscape with focus on flagship species and ecosystem services
Principal Investigator(s)	:	Dr. K. Ramesh and Dr. Bivash Pandav
Researcher(s)	:	M. Naveen, SRF
Funding Agency	:	WII, Grand-in-aid
Project Duration	:	August, 2012 - July, 2016

Potential lion habitat and connectivity in Gujarat

- Parabita Basu

We identified potential habitat patches and ecological connectivity for Asiatic lions in Gujarat. Locations of 19 radio collared lions, lion sightings and lion scat locations distributed across the Gir landscape (n > 10,000) were used as presence points in the presence only model along with other ecogeographical variables such as land use/cover, bioclimatic, distance to water, distance to roads, human foot print and topography. All variables were extracted to 1km X 1km grids and analyzed using Environmental Niche Factor Analysis (ENFA). Four geographically distinct potential lion habitat clusters were identified. The ecological connectivity within and among these four clusters was modelled using Circuitscape where the ENFA output was used as permeability with current breeding lion population as focal nodes. To assess the future of these potential connectivities in this rapidly changing agro-pastoral landscape, we studied the corridor landscape between Gir and Girnar. Three land cover maps (1998, 2002 and 2009) were prepared and analyzed to understand the landscape dynamics. Results indicated increase in areas under human settlements and conversion of scrub patches into agricultural, urban land-use which could have substantial impacts on the functionality of dispersal corridor. Vegetative patches declined from 1998 to 2002 (14%) and 2002 to 2009 (57%) with an increase in areas under barren land and settlements (90%) from 1998 to 2009. Land use change along the dispersal corridor was modeled using a Cellular Automata based approach for the year 2015. Projected land cover changes showed a growing tendency in urban land use, threatening areas used by lions as passageways and day refugia. Based on the results of this study, the Gujarat Government has declared the corridor habitat between Gir and Girnar as Ecosensitive.

A perspective on perceptions and factors associated with human-tiger conflict in the Sunderbans

- Dipanjan Naha

On an average 40 to 50 humans were reported to be killed by tigers annually since historic times in the Indian Sunderban. It supports one of the highest human densities with extreme poverty levels. Severity of human-tiger interactions results into a complex web detrimentally affecting lives and livelihood instilling fear. This shapes negative attitudes towards tiger conservation than warranted. We compiled data from concerned departments to evaluate whether human deaths caused by tiger are substantially higher than other major causes of deaths reported from the area between (2006-2010). From an annual average of 30 to 40 human deaths (in 1960-70s) by tigers it has reduced to 7 (SE ± 1.11) per year (2001-2012). Majority of tiger victims were fishermen and crab collectors (82%), followed by honey collectors (5%). April registered the highest frequency of conflict incidents. Annual livestock loss to tiger attacks was 6.4 (SE ± 0.3) for 12 years (1999-2010) in all villages. Semi-structured interviews were conducted for 411 households across 19 peripheral villages to identify major factors shaping negative perception towards tigers. Forty four percent of the respondents interviewed had negative perception and 37% had positive perception about presence of tigers. We modelled ecological landscape level covariates and spatial intensity of human-tiger conflict on secondary data from forest department records (2001-2012) for different administrative blocks in a logistic regression framework. Tiger sign intensity and proportion of channels > 100 m in width were negatively related to intensity of tiger attacks whereas human presence, prey and proportion of channels (30-50 m in width) were positively related to intensity of tiger attacks. Potential conflict zones were predicted using Maximum Entropy modeling approach.

Factors governing spatial distribution and abundance of top carnivores and ungulates in Kanha Tiger Reserve, Madhya Pradesh

- Neha Awasthi

Assessment of distribution and abundance of animals helps in understanding species specific responses towards factors such as habitat features and anthropogenic disturbances. We assessed the abundance and spatial distribution of top carnivores and ungulates in Kanha Tiger Reserve using mark recapture approach through camera traps and systematic stratified distance sampling on 150 line transects. A total of 155 camera trap locations were operated expending an effort of 6,430 camera trap nights with an effective trapping area of 1084.27 km^2 for tiger and 959.2 km^2 for leopard

Population estimated using best fit model M_h Jacknife estimator were 67 (± 6.2) and 96 (± 20.2) for tiger and leopard respectively. Densities of tiger (6.18 ± 0.72) and leopard (10.01 ± 2.40) were estimated using traditional half MMDM approach. Spatially explicit analysis gave a density of 4.59 (± 0.59)/100 km^2 for tiger and 6.14 (± 0.79) /100 km^2 for leopard. Among ungulates, chital 32.90 (±4.47)/ km^2 was most abundant followed by sambar 7.41 (±1.06)/ km^2, wild pig 5.48 (± 0.96) /km^2, gaur 5.2 (±1.57) /km^2 and barking deer 2.36 (±0.26) /km^2.

Factors which were potentially responsible for variation in the abundance and distribution of top carnivore and ungulates were elevation, vegetation type, water availability, prey or predators densities and anthropogenic factor such as distance from villages. We generated surface densities maps using spatially explicit models for top carnivores and ungulates in R packages SPACECAP and DSM respectively. Surface densities were modelled in ordinal regression and GLM framework as response variables. The results and the major factors influencing the distribution and abundance of carnivores and ungulates will be presented and discussed.

Effect of inter-habitat matrix on tropical evergreen forest remnants: An empirical test of matrix-tolerance hypothesis on butterflies in Kodagu region of Western Ghats

- Deepak, C.K.

Recent studies on habitat fragmentation have highlighted the importance of inter-habitat matrix and the need for a shift from traditional binary perspective to a 'matrix composition' perspective for understanding species diversity patterns in human modified landscapes. Matrix-tolerance model provides a simple framework for understanding the sensitivity of species to fragmentation by simultaneous study of native forest patches and surrounding matrix. According to this model, abundance of a species in the matrix is inversely proportional to its vulnerability to fragmentation. This study tested the matrix-tolerance hypothesis on butterflies of tropical evergreen forest remnants, surrounded by a matrix of coffee plantation and paddy field in Kodagu region of Western Ghats. Sampling was carried out in fragments (sacred groves), matrix and a large contiguous forest (Reserved Forest) in Kodagu during January-April, 2013. Fragmentation Vulnerability Index (FVI) was generated for each species using abundance data obtained from time-constrained surveys. Spearman's rank correlation was used to test the association between rank FVI and rank matrix abundance. We found that the relation between abundance of species in the inter-habitat matrix and its vulnerability to fragmentation was positive and significant. Species which are capable of using the matrix are found to be less vulnerable to fragmentation. Some species deviate from the expected model in their response to habitat fragmentation which could possibly be explained by examining species specific traits. Fragment size did not have a significant effect on relation between matrix abundance and fragmentation vulnerability index. The matrix-tolerance model has several implications to conservation and management of biodiversity in fragmented landscapes and its scope can be broadened by incorporating life history traits important in determining sensitivity of species to fragmentation.

Project Title	:	Effect of inter-habitat matrix on tropical evergreen forest remnants: An empirical test of matrix-tolerance hypothesis on butterflies in Kodagu region of Western Ghats
Principal Investigator(s)	:	Dr. Gautam Talukdar, Dr. Bilal Habib and Dr. Krushnamegh Kunte (IISc)
Researcher(s)	:	Deepak, C. K., M.Sc. Student
Funding Agency	:	WII, Grant-in-aid, M.Sc. Programme
Project Duration	:	December, 2012 . June, 2013

Wild animal capture for research and conflict management – Recent efforts

- Dr. Parag Nigam

Wild animals are frequently captured as a part of veterinary interventions of sick and injured animals, conflict resolution, population management *viz* relocation/ translocation/ re-introduction and scientific research. Wildlife capture techniques have evolved over the years. With the advent of new and sophisticated capture methods, physical and chemical restraint procedures can now be performed effectively with predictable outcomes. The selection of the procedure however depends on the species, length of the procedure, degree of stress and safety of both the animal and the investigator.

The principle objective during any capture operation is to inflict minimal amount of stress, pain, apprehension and fear in the animal.

In the last one year, significant efforts have been made on handling tigers, leopard, elephant, sambar and *hangul* facilitated chemical means. The presentation will focus on physical characteristics and response behaviour of these animals during and after capture activities. The presentation highlights the need for proper planning and preparedness prior to any capture and emphasizes the need for better understanding on the species to be handled, environmental conditions, topography, availability of relevant equipments and drugs, their appropriateness, post immobilization monitoring and most importantly professional skills and expertise.

These efforts have significantly contributed towards addressing conflict resolution besides aiding in wildlife research and have demonstrated the benefits of prior planning and preparedness in carrying out wild animal capture.

Project Title	:	WII, Wildlife Health Services
Principal Investigator(s)	:	-
Researcher(s)	:	-
Funding Agency	:	Wildlife Institute of India and State Wildlife Agencies
Project Duration	:	Activity of the Dept. of Wildlife Health Management

Monitoring of reintroduced tigers in Sariska Tiger Reserve, Rajasthan

- Dibyendu Mandal

Ranging pattern, food habits and habitat use pattern of six reintroduced tigers (Male-ST1, ST4 and ST6; female- ST2, ST3, ST5) were studied from July 2008 to February 2013 in Sariska Tiger Reserve, Rajasthan. The radio collared tigers were monitored periodically through ground tracking using ±triangulationq and ±homing inq techniques. A total of 1,218, 3,129, 3,883, 3,031, 2,911 and 2,607 radio locations were recorded for ST1, ST2, ST3, ST4, ST5 and ST6. Seasonal and annual ranging patterns were estimated using Minimum convex Polygon (100% MCP) and Fixed Kernel methods. Average annual home ranges of male and female tigers using 100% MCP were 196±14 and 131±25 respectively during the study period. Average monsoon, summer and winter home range of males were 148±9, 148±16, 138±18 respectively, whereas for females it was 94±14, 85±10 and 90±17 respectively. Food habits and prey selection by tigers were studied through scat analysis and kill data. Analysis of 655 scats and 466 kills revealed sambar was the most preferred prey species. Habitat preference by the tigers was assessed using bonferroni confidence interval method and Ivlev's index. The overall habitat preference was in the following order: Riverine >*Zizyphus* >*Butea* >*Anogeissus* >*Boswellia* >*Acacia* >scrubland. In monsoon, similar habitat preference was observed where as in summer and winter, tigers preferred *Zizyphus* forest over Riverine forest. The mean euclidean distance of the tiger locations from the nearest waterhole was 684±4 m which was less than that from roads (2,000±16 m) and villages (2,309±10 m). In summer, the mean distance to nearest waterhole was less (646±6 m) than that in winter (673±6 m) and monsoon (722±8 m). Results indicate that after exploring new areas the reintroduced tigers established smaller home ranges, avoided human habitation and preferred areas close to water.

Project Title	:	Monitoring of reintroduced tigers in Sariska Tiger Reserve, Rajasthan
Principal Investigator(s)	:	Dr. K. Sankar, Dr. P.K. Malik and Dr. Parag Nigam
Researcher(s)	:	Subhadeep Bhattacharjee, SRF and Dibyendu Mandal, Project Biologist
Funding Agency	:	National Tiger Conservation Authority
Project Duration	:	June, 2008 . March, 2015

Progress and problems in implementation of MSTrIPES

- K. Ashok Kumar

Monitoring System for Tigers: Intensive Patrolling and Ecological Status (MSTrIPES) was proposed as a program to amalgamate research, field survey and conservation policies. MSTrIPES software involves two components namely, patrolling and ecological module that produce spatial and quantitative reports. Implementation of MSTrIPES comprises of four stages a) training b) data collection c) analysis d) reporting and adaptive management. The pilot implementation of the program has commenced in seven tiger reserves (Nagarjunasagar Srisailam TR, Bhadra, Kanha, Sariska, Anamalai, Corbett and Ranthambore TR). The training was provided to 727 frontline staff regarding the data collection at different parks along with the forest department officials.

Researchers were stationed at the different tiger reserves for helping forest department in regularization of MSTrIPES. Daily patrol record was compiled systematically in computer similar to log-book maintained at each forest chowki and basecamps. Data collected through ecological module and routine patrolling is compiled at range level. The trend in ecological status will be incorporated in management decisions as a feed-back. Program is generating management friendly reports and maps so as to assist in adaptive management on quantitative data rather than the subjective opinions. Ground efforts are directly reflecting in all reports, it promotes transparency and authenticity of the data. Changes in field conditions can be integrated in decisions thus channelizing adaptive management.

A major problem encountered in implementing MSTrIPES is the reporting of illegal activities. Forest guard in all seven tiger reserves are reluctant to record and report this data which is vital for mitigation by appropriate management interventions. A major change in attitude and culture of the ground staff is required, and this can be achieved by incentive driven trust building by senior management of tiger reserve.

Correlates of physiological stress in reintroduced tiger: preliminary findings from Sariska and Panna Tiger Reserves

- Manjari Malviya

Tiger (*Panthera tigris*) was reintroduced in Sariska and Panna Tiger Reserves (TRs) during 2008-2012, following its local extinction from these reserves in 2005 and 2009 respectively. The reintroduced founder population (N = 5) in Panna began breeding within a year, with the females yielding multiple litters over the years, while Sariska founder population (N = 8) registered its first and only successful breeding in 2012, after four years of reintroduction. The differential breeding success between these two reserves required scientific explanation and it was hypothesized that stress factors caused by anthropogenic pressures and reproductive health are plausible causes for these variations. This project aims to address this hypothesis. The key life requisites and disturbance factors are subject of comparative analyses and will be linked to the observed pattern of stress and reproductive hormones to explain the breeding success/failure of reintroduced tigers. Hormones were quantified from tiger scat samples. Prey density and disturbance correlates were estimated based on line transect method and circular plots (15 m plots laid at every 400 m on transects) respectively. The preliminary results of hormonal analyses indicated that females in Sariska were cycling and fertile, but had higher stress level as compared to Panna tigers. Line transect results suggested that the overall prey density in Sariska was higher than Panna. Although the number of villages located in the core habitats of tiger in Sariska was disproportionately higher (N = 28) than Panna (N = 3), plot level analyses revealed that the wood cutting was higher in Panna (40%). However, lopping (67%) and weed presence (92%) were higher in Sariska. Further investigations would be made to discern the spatial pattern closely to establish relationships at population and individual levels.

Project Title	:	Evaluation of physiological stress and reproductive potential in reintroduced tiger populations in Sariska Tiger Reserve, Rajasthan and Panna Tiger Reserve, Madhya Pradesh
Principal Investigator(s)	:	Dr. K. Ramesh, Dr. K. Sankar and Dr. G.Umapathy (CCMB)
Researcher(s)	:	Manjari Malviya, JRF
Funding Agency	:	National Tiger Conservation Authority
Project Duration	:	March, 2012 - July, 2014

Scats, information in disguise: Computing biomass consumption from prey occurrences in scats of tropical felids

- Stotra Chakrabarti

Robust understanding of prey composition in carnivore diet provides crucial insights into ecosystem functions and carnivore carrying capacity. But the most commonly used technique based on carnivore scat analysis, could be misleading. Frequency of prey occurrence in scats cannot accurately describe proportional contributions of prey species, since smaller prey have more indigestible matter per unit body mass (due to higher surface-area/volume). Consequently this would positively bias their incidence in scats. To correct for this bias, biomass-consumed per collectable-scat should be calibrated with prey weight through feeding experiments. However, no such relationship exists for Indian felids. This has compelled the use of a similar relationship developed on cougar for diet studies of lion, tiger and leopard. We postulate that predator size difference and ecological contrast between temperate and tropical systems can complicate such transferability of relationship. We developed models from prey incidence in scats to biomass consumed based on feeding trials (n = 44) of Asiatic lion, leopard and jungle cat that adequately represented their entire prey weight ranges. Biomass-consumed per collectable-scat when regressed on prey weight showed asymptotic relationships for all predators. However, carnivore specific models when scaled to their respective body weights did not differ, allowing derivation of a generalized model for all tropical felids. Inferences from these models have strong implications on feeding ecology of tropical felids. Specifically, we demonstrated that medium sized prey contribute more to the diet of large felids than supposed earlier. This revealed higher overlap (than previously estimated) between food niches of sympatric large felids, questioning previous notion of their niche separation. We also showed lower consumption of domestic livestock by large felids than that was estimated in earlier studies, implying that the dependency of large carnivores on livestock has likely been exaggerated till date.

Project Title	:	Computing biomass consumption from prey occurrences in scats of tropical felids
Principal Investigator(s)	:	Dr. Y.V. Jhala, Shri Qamar Qureshi and Shri V.J. Rana
Researcher(s)	:	Stotra Chakrabarti, M.Sc. Student
Funding Agency	:	WII Grant-in-aid, M.Sc. Programme and Ecology of lion project
Project Duration	:	December, 2012 . May, 2013

Comparison of photographic and non-invasive genetic capture mark recapture and assessment of genetic diversity of Greater one-horned rhinoceros (*Rhinoceros unicornis*) in Dudhwa National Park

- Vibhav Srivastava

The Greater one-horned rhinoceros (*Rhinoceros unicornis*) population is largely estimated by labour intensive block count method in which the chances of missing individuals in dense tall grasslands are high. The current study was conducted in power fenced Rhino Reintroduction Area of 27 km^2 located in Dudhwa National Park. The first objective was to evaluate two population estimation techniques with respect to accuracy and precision by using non-invasive faecal DNA and remotely captured photographs in capture-mark-recapture (CMR) framework. DNA was extracted from 140 dung samples, and out of them 27 unique genotypes were identified using rhinoceros specific microsatellite analysis. Capture history was prepared taking 84 occasions in one session and analysed in program MARK to arrive at a population estimate. In photographic CMR, four remotely triggered camera trap units were deployed in six sessions having seven occasions in each session. Between the two techniques, non-invasive faecal DNA based CMR estimated population size (35.10 ± 5.01) closer to the known population size of 32 individuals. Photographic CMR estimated the population size 25.98 (± 4.91) which was lower than the known population size. Further, we also examined genetic structure of this isolated and reintroduced population. With 27 identified unique genotypes and 10 microsatellite markers, the genetic variability in this population was estimated. The mean observed heterozygosity was 0.353 while mean expected heterozygosity was 0.483. The effective number of alleles per loci was 2.069. The inbreeding test revealed that the population show signs of inbreeding ($F_{IS} = 0.39$) and it is likely to increase in future given closure of the population and non-random mating. We suggest that it is necessary to bring variability in gene pool to avoid consequences of inbreeding depression.

Conservation breeding of Western tragopan in Himachal Pradesh: towards establishing a reserve and model population

- Lakshminarasimha, R.

Western Tragopan *Tragopan melanocephalus* is a threatened pheasant species endemic to the north-western Himalaya. A comprehensive project is ongoing to study the biology and reproductive behavior of Western tragopan in wild and captivity. The *ex situ* component focuses on the management and behaviour of the birds housed at a breeding centre for this species at Sarahan, Himachal Pradesh. The captive stock at this centre consists of 23 individuals (11 males and 12 females) and is the only facility in the world for the conservation breeding of this species. During the initial phases, efforts were focused on optimizing housing, diet and breeding conditions, and reduce disturbances to create a biologically relevant captive environment for improved well being and reproduction. A new feeding regime and provision of appropriate conditions for breeding were established. Detailed studies on various behavioural domains such as activity patterns, space-use, foraging and breeding behaviours are being carried out. A total of 12 chicks were born during 2012-13 which were hatched and raised naturally. The decreased proportion of weak-shelled eggs, natural breeding behaviours and females showing breeding activity for the first time are indicative of the positive effects of interventions being done as part of the project. Other positive trends include the increase in number of incubating hens, naturally hatched and reared chicks, low chick mortality rates and improved overall health of the population. The project entails both a general management strategy and scientifically guided efforts to address idiosyncratic causes and arrive at appropriate solutions for the conservation breeding of Western tragopan. The long-term goal is to achieve a sustainably managed viable captive population, which will serve as a reserve and model for reintroduction/reinforcement and research purposes.

Project Title	:	Reproductive biology and behavior of captive and wild populations of Western tragopan in Himachal Pradesh
Principal Investigator(s)	:	Dr. K Ramesh and Dr. Parag Nigam
Researcher(s)	:	Lakshminarasimha, R., SRF and Vipin Upadhyay, JRF
Funding Agency	:	Himachal Pradesh State Forest Department
Project Duration	:	June, 2011 . May, 2014

Evaluating the captive environment of select species housed in Indian zoos for meeting their biological and behavioural requirements

- Sitendu Goswami

Housing and enclosure enrichment practices for 40 native species at select Indian zoos were evaluated through behavioural studies and a preformatted questionnaire was used to score enclosures on their physical attributes (based on existing housing guidelines). The assessments revealed that conspecifics housed in the same enclosure and subjected to similar management practices often displayed widely varying behavioural repertoires. We hypothesized that the personality traits of an animal might play a role in determining the way it interacts with the physical variables of the enclosure.

Most housing and enrichment protocols practiced at Indian zoos are enclosure-centric and do not address the specialized requirements of individuals housed in the enclosures. A study on sloth bear (*Melursus ursinus*) [n=3] and Asiatic black bear (*Ursus thibetans*) [n=2] was carried out at Mahendra Chaudhury Zoological Park, Mohali to understand how animals with different personality traits respond to similar enrichment practices. Personality rating was used to categorize the subjects into receptive and non-receptive individuals. The enclosures were divided into nine unequal zones and instantaneous scan sampling was used to record the behavioural state of the animal and its location (enclosure zone). Baseline information on the time budget and space utilization in both the exhibits was recorded. Enrichment treatments were introduced and the deviation from baseline was noted.

During baseline data collection, we found that receptive individuals showed a higher degree of aberrant behaviours (ARBs) compared to the non-receptive individuals. Following introduction of enrichment treatment, receptive individuals responded faster to enrichment practices than non-receptive individuals. The enrichment protocol was modified to include devices designed for both personality types, which resulted in a marked reduction of ARBs.

Our findings suggest that personality and behavioural assessments should precede enclosure enrichment interventions. Enclosure enrichment treatments targeted at personality types provides animals with the motivation to control and manipulate their environment thereby eliciting more species-typical behaviours.

Identification of two different ancestry of sambar (*Genus: Rusa*) in India through molecular genetics approach

- Sandeep Kumar Gupta

We examined the variations in mtDNA control region cytochrome oxidase subunit *I* (CO*I*) and cytochrome *b* (cyt *b*) in select sambar (*Rusa unicolor*) populations of Southern India (N=22), Central highlands and Gangetic plains (N=37). Based on analysis of mtDNA control region, it was observed that the South Indian population of sambar is distinct from the Central highland and Gangetic plains populations. The South Indian population showed an unambiguous 40 bp insertion in control region.

Morphologically, South Indian population has a sore patch on their neck region which is absent in northern and central populations. The difference in Cyt *b* gene based phylogenetic analysis indicates the presence of two different lineages of sambar in India. The south India lineages is closely relate to the *R. timorensis* of Indonesia, while the Sambar from rest of the India are *R. unicolor*. Therefore, Indian sambar could potentially comprise of two sub species or species; one is the *R. unicolor* and the other likely called *R. indicus*. The *R. unicolor* is widely distributed in North and Central India where as the new Western Ghats lineage (*R. indicus*) is distributed in most part of Southern India. Further studies using molecular phylogeny, ecological and behavioural aspect would be needed to assure separation at species level.

Project Title	:	Phylogenetic Status of Sambar in Western Ghats
Principal Investigator(s)	:	Shri S.K. Gupta
Researcher(s)	:	Nipun Mohan, TA
Funding Agency	:	WII, Grant-in-aid
Project Duration	:	February, 2012 . August, 2013

Status of the Himalayan crocodile salamander (*Tylototriton verrucosus*) in northeast India

- Shruti Sengupta

The Himalayan crocodile salamander was first described in 1871 from western Yunnan, China. Subsequently, the species has been reported from Nepal, Bhutan, India, Myanmar, China, Thailand and Vietnam. This species shows considerable morphological similarity with 13 other known congeneric species from southeast Asia, and is now considered to be a species complex. In India, the distribution of the species is restricted to a few locations from Darjeeling in West Bengal, Ukhrul and Senapati in Manipur, and Gandhigram in Arunachal Pradesh. Morphological comparisons between specimens from three geographically isolated populations, viz. Yunnan, Darjeeling and Manipur based on Discriminant Function Analysis revealed three separate population clusters. Discriminant Function one (Wilk's Lambda=0.010, p<0.001) and two (Wilk's Lambda=0.113, p<0.001) explained 57.4% and 42.6% variations in data. Tail-length, head-width, cranial crest-length, tail-width and snout to vent length were important morphometric characteristics for discriminating between population clusters. This shows that the salamander in India has at least two putative species. A thorough phylogenetic study is required to corroborate these inferences. We also surveyed 20 randomly selected ponds in a Multi-State occupancy framework during June-July 2013 to characterize important salamander breeding habitats in Darjeeling and Kurseong districts, in order to support the *ex-situ* conservation breeding initiative. Our preliminary results suggest that probability of breeding is higher in seasonal ponds. A detailed landscape level survey is required to identify the breeding habitats and the micro-habitat determinants.

Project Title	:	Status survey and conservation of Himalayan Crocodile Salamander (*Tylototriton verrucosus*) in the Eastern Himalayas
Principal Investigator(s)	:	Dr. Karthikeyan Vasudevan and Shri Suresh Kumar
Researcher(s)	:	Shruti Sengupta, JRF
Funding Agency	:	WII, Grant-in-aid
Project Duration	:	February, 2012 . February, 2014

Influence of top predator on space use by ungulates and small Carnivores in Corbett National Park

- Sudip Banerjee

Understanding distribution and abundance of species is important from ecological and conservation point of view. We investigated how ungulates (chital, sambar and barking deer) and small carnivores (jackal, jungle cat) respond to habitat factors and tiger space use in Corbett National Park. We estimated density of tigers in Corbett National Park from 2010 to 2011 under a spatially explicit capture-recapture framework in an area of 480 km^2. Different covariates were collected by carrying out vegetation sampling in ~400m radius around each camera trap, where data on various vegetation characteristics (vegetation type, terrain, canopy cover, understorey), human disturbance and ungulate dung/pellet was recorded. We tested our *a-priori* predictions using the field data in an occupancy framework using PRESENCE 5.5.

For ungulates, habitat use was investigated in a hierarchical framework where large scale covariates were used to explain occupancy in an area of ~1 Km^2 (macro site selection) and small scale variables were used to explain micro-site (~0.1 ha) use. Macro site selection was not related to tiger space use for any ungulate but we observed some evidence of effect of tiger space use on ungulate micro-site selection. Specifically, we found chital avoided undulating terrain at their micro site, while sambar avoided hilly terrain in case of higher tiger use and no such effect was observed in case of barking deer. Our results support earlier studies that report that prey avoid ambush terrain in high predator use areas.

In case of small carnivores, tiger intensity of use had a positive effect on jackal's site occupancy, while its detection probability varied across the two seasons (summer and winter). Jungle cat is an open forest species and thus its occupancy was negatively related to canopy cover and detection probability differed between years.

Project Title	:	Monitoring Source Population of Tigers in Corbett Tiger Reserve, Uttarakhand
Principal Investigator(s)	:	Dr. Y.V. Jhala and Shri Qamar Qureshi
Researcher(s)	:	Shikha Bisht, JRF and Sudip Banerjee, JRF
Funding Agency	:	National Tiger Conservation Authority and Uttarakhand State Forest Department
Project Duration	:	October, 2009 - December, 2013

Patterns in body-size, species co-occurrence and distribution of terrestrial herpetofauna of Andaman and Nicobar Islands

- Harikrishnan, S.

The Andaman and Nicobar Islands are a chain of 556 islands in the Bay of Bengal. We sampled the terrestrial herpetofauna in 30 islands from 2010 to 2013, using visual encounter surveys and quadrat sampling to document species richness, density and distribution, augmented by opportunistic observations. Sixty-two bounded quadrats were sampled in 16 islands. Additionally, species distribution data was collected from 30 islands. Sixty-six species were recorded using all sampling strategies. Body-size measurements were taken from 1,252 individuals of frogs, lizards and snakes. Patterns in body-size, species co-occurrence and distribution were analysed using null models. Body-size distributions of herpetofauna were strongly right-skewed. Size-overlap analysis using body mass of lizards indicated that the observed variance in size-ratios was significantly less than expected by chance (Andaman Islands: $P < 0.001$; Nicobar Islands: $P = 0.01$). Similar results were obtained for frogs and snakes. Species co-occurrence was analysed using C-score. Species co-occurrence patterns of herpetofauna in the Andaman Islands could not be differentiated from null expectation. However, species co-occurrence patterns of herpetofauna from Nicobar Islands were significantly different from null expectation (frogs, $P = 0.001$; lizards, $P < 0.001$; snakes, $P < 0.001$). The relationship between abundance and distribution of species was explored using null models. For frogs, observed dispersion index and regression slope were not significantly different. For lizards, observed dispersion index was not significantly different from expected but, observed regression slope was significantly greater ($P = 0.03$), indicating a positive relationship. For frogs and lizards, boundary and shape tests failed to distinguish observed pattern from a null expectation. Non-endemics had low to medium abundances and were widely distributed, while endemics had high abundances and varied distributions. Based on the information collected during this study, the conservation status of some species of terrestrial herpetofauna in the Andaman and Nicobar Islands is discussed

Project Title	:	Macroecology of terrestrial herpetofauna in Andaman & Nicobar archipelago
Principal Investigator(s)	:	Dr. Karthikeyan Vasudevan, Prof. S. K. Dutta, Prof. Indraneil Das and Shri B. C. Choudhury
Researcher(s)	:	Harikrishnan S., SRF and Sarbani Nag, JRF
Funding Agency	:	Department of Science and Technology, Govt. of India
Project Duration	:	November, 2009 . November, 2013

Demography and dispersal of tigers in Ranthambhore Tiger Reserve

- Ayan Sadhu

Protected areas are the corner stone of conservation. Protection of wide ranging carnivores in these areas is important since they influence long term persistence of the species in landscape level. Long term monitoring of tiger inside the protected areas provides estimates of various demographic parameters which are crucial for conservation of the species. Ranthambhore, the western most source population of Bengal tiger (*Panthera tigris tigris*), is an isolated forest patch in a human dominated landscape. Long term study on tiger (combination of camera trapping, radio telemetry, and intensive monitoring of individual tigers) in Ranthambhore provides us an opportunity to estimate various demographic parameters which are difficult to estimate otherwise. Female age at first reproduction, inter-birth interval and average litter size was estimated as 55.5(±3.69) months, 32.1(±3.55) months, and 2.25(±0.13) respectively. Dispersal distances of male tigers (13.18±2.70) from their natal area are higher than females (6.26±2.89), since male tigers are known to cover long distances to establish territories than females.

Ranthambhore acts as a source population of tiger in western Indian landscape. Surplus tiger population (mostly sub-adults) disperse out of the Reserve and settled down in adjoining sink patches. We have tracked dispersal routes of five individual tigers (4 males and 1 female, from 2010 to 2013) emigrated from Ranthambhore. GPS locations of all confirmed presence points (pugmark, kills and direct sightings) of target animals were recorded (n=119) and used for further analysis in GIS domain. A set of candidate models were prepared by incorporating potential predictor variables which may influence landscape level permeability. Our results revealed tigersq affinity to forest cover, rugged terrain, presence of river/*nullah*, and avoidance towards human disturbance during dispersal. These events manifest the importance of identification of potential corridors to facilitate tiger dispersal, which is crucial for maintaining viable tiger population in the landscape.

Project Title	:	Monitoring Source Population of Tiger in Ranthambhore Tiger Reserve
Principal Investigator(s)	:	Dr. Y.V. Jhala, and Shri Qamar Qureshi
Researcher(s)	:	Ayan Sadhu, JRF
Funding Agency	:	National Tiger Conservation Authority
Project Duration	:	October, 2009 . December, 2013

Ecological aspects of leopard and its prey in Dachigam National Park, Jammu and Kashmir, India

- Zaffar Rais Mir and Athar Noor

Information pertaining to ecological interactions between large carnivores and their prey is generally lacking in the Himalayan ecosystems. We studied some ecological aspects of the leopard (*Panthera pardus*) in the Dachigam National Park. Camera traps (n=12) were deployed to estimate the abundance of leopards based on mark capture-recapture technique. Half Mean Maximum Distance Moved (½ MMDM) density of leopard was estimated at 3.8 ± 2.4 individuals/100 km². Prey abundance was estimated using line transect (n=13) based Distance sampling. Sherman trapping was done to estimate rodent density. Density of *Hangul* (*Cervus elaphus hanglu*) was estimated to be 5.88 ± 0.5/km^2 and that of Himalayan grey langur (*Semnopithecus ajax)* as 19.49 ± 2.2 /km^2. Microhystological analysis of leopard scats (n=714) revealed that rodents contributed maximum (48.77%) to the leopard diet followed by Himalayan gray langur (14.04%), sheep (7.58%) and goat (6.67%). To assess the ranging patterns, three leopards (two females and one male) were fitted with GPS collars. Seasonal variation in the size of home range (100% MCP) was found to have a trend in which maximum size was attained during summer and smallest in winter. Landscape use by collared animals will also be presented and discussed.

Ranging pattern and habitat use of reintroduced gaur (*Bos gaurus gaurus*) in Bandhavgarh Tiger Reserve, Madhya Pradesh.

- B. Navaneethan

Ranging pattern and habitat use of reintroduced gaur were studied in Bandhavgarh Tiger Reserve from January 2011 to July 2013. Of the 50 reintroduced gaur, 27 were radio-collared (six males and 21 females). The radio collared animals were monitored periodically through ground tracking using 'homing in' and 'triangulation' techniques. ArcGIS software 9.2 was used to analyses the home range, ranging pattern and habitat use. Gaur locations were plotted on available vegetation map of the study area to evaluate the habitat use and availability in summer, monsoon and winter. Habitat preference was computed using compositional analysis and Ivlev's electivity index. A total of 1,103, 1,321, 5,711 and 4,029 radio- collared locations were obtained for adult male (AM), sub adult male (SAM) adult female (AF) and sub adult female (SAF) respectively. We estimated home ranges using 100% Minimum Convex Polygon (MCP) and 95% Fixed Kernel Density (FKD) estimators. Using 100% MCP, the estimated overall home range of AM, SAM, AF and SAF were 245 ± 16 km^2, 158 ± 37 km^2, 166 ± 36 km^2 and 145 ± 14 km^2 respectively. The AM overall home range was found to be larger as compared to other age and sex classes. Overall habitat preference by gaur was in the following order: bamboo forest > grassland > riparian > sal > mixed > open mixed forest > agriculture land. In monsoon and winter similar habitat preference was observed, where as in summer the gaur preferred grassland over bamboo forest. Overall gaur preferred flat terrain (58%) followed by gentle slope (29%) and steep slope (13%).

Project Title	:	Monitoring of reintroduced gaur in Bandhavgarh Tiger Reserve, Madhya Pradesh.
Principal Investigator(s)	:	Dr. K. Sankar and Dr. Parag Nigam
Researcher(s)	:	B. Navaneethan, SRF and Manas Manjrekar, JRF
Funding Agency	:	Madhya Pradesh State Forest Department
Project Duration	:	January, 2011 . January, 2015

Reintroduction of tiger in Panna landscape: population status, ranging pattern and associated predators

- Mriganka Shekhar

Reintroduction of tiger in Panna Tiger Reserve, Madhya Pradesh has resulted in a rapid population recovery of the species. The founder population of five animals (one male and four females) introduced in 2009 and 2011 have yielded multiple litters in the last four years producing over 20 cubs, with 100% founder survival and over 75 % cub survival. Currently, the minimum population size of tiger in this reserve is 22 (9 adults + 7 sub-adults + 6 cubs), with male biased sex ratio and moderate heterozygosity. Interestingly, genetic analysis revealed that the reintroduced male did not monopolize the entire reproduction and one of the female (T2) sired cubs from a transient male in first litter and from F1 male in second litter. This offers evidence for clear mate selection strategy by the female, although the female (T2) was within its home range of the male (T3). Home range of the tigers showed dynamic pattern across space and time. Home range of originally dominant male (T3) has been reduced from 309 Km^2 to 124 Km^2, by the competing F1 males which have average home range size of 98 ($\pm$ 14 SD) Km^2. The average home range size of females is 67 ($\pm$ 9 SD) Km^2. The pattern of tiger occupancy was analysed in the context of co-occurrence or avoidance of other large predators, sharing similar resources. Initial analyses revealed that the relationships at spatial scale is less apparent and require further analyses. The emerging ecological insights offer specific basis for population and genetic management of the re-established tiger population and for dealing with future crisis.

Project Title	:	Ecological monitoring of tiger population in Panna Landscape
Principal Investigator(s)	:	Dr. K. Ramesh, Dr. J.A. Johnson and Shri Subharanjan Sen
Researcher(s)	:	Mriganka Shekhar Sarkar, JRF, Sunil K. Bharadwaj, JRF and Sunal K. Roamin, JRF
Funding Agency	:	Madhya Pradesh State Forest Department and National Tiger Conservation Authority
Project Duration	:	February, 2010 . January, 2014