COUNTING TIGERS.....by Machine Learning

ALL INDIA TIGER ESTIMATION 2018

NATIONAL TIGER CONSERVATION AUTHORITY

Ministry of Environment, Forest and Climate Change
Government of India

INTRODUCTION

The Tiger Task Force (TTF) appointed by the Prime Minister of India realized that it is imperative to have a credible scientific national monitoring protocol that would inform policy makers and wildlife managers on;

a) Spatial extent and population size of individual tiger populations in India,

b) Welfare factors in these and neighbouring habitat (prey status, human pressures, other wildlife species status, and habitat conditions),

c) Trends in the population and area occupied overtime

After discussions and consultations with national and international experts, a decision was made to mandate the Wildlife Institute of India (WII), Dehradun with the task of developing and implementing this status assessment every 4 years under direction of the NTCAand in collaboration with State Forest Departments and civil society NGO's.

This decision was based on a pilot study conducted by the WII in a large landscape (Satpura-Maikal> 20,000 sq. km in MP) wherein they had developed protocols that combine simple yet scientifically robust protocols for data collection by field forest staff in combination with rigorous statistically sound methods like camera trap based capture-mark-recapture models implemented simultaneously by trained wildlife biologists. This approach was found to be best suited for Indian field conditions wherein the field staffs provide a large manpower for survey across the 400,000 sq. km of tiger bearing forests in 18 Indian States. It was hypothesized that tiger population distribution and abundance would be determined by;

1. Habitat characteristics
2. Prey availability
3. Anthropogenic pressures

Three cycles of national tiger status assessments (2006, 2010, and 2014) have already been conducted and the results have been wildly publicized by media, used by scientists and incorporated into conservation policy and management actions. The national status assessment exercise has successfully addressed all of the objectives listed above and provides details of tiger population size, extent, covariates of prey, co-predators, habitat and human impacts. The tiger population in India has been observed to increase at a rate of about 5.8% per year since 2006.

Though the conceptual methodology has remained the same since 2006, the NTCAand WII have kept pace with latest scientific developments in the field of animal abundance estimation and used the best available science to evaluate tiger status. For the national status assessment 2014, Spatially Explicit Capture Recapture (SECR) in a joint distribution likelihood approach with ecologically relevant covariates was used.

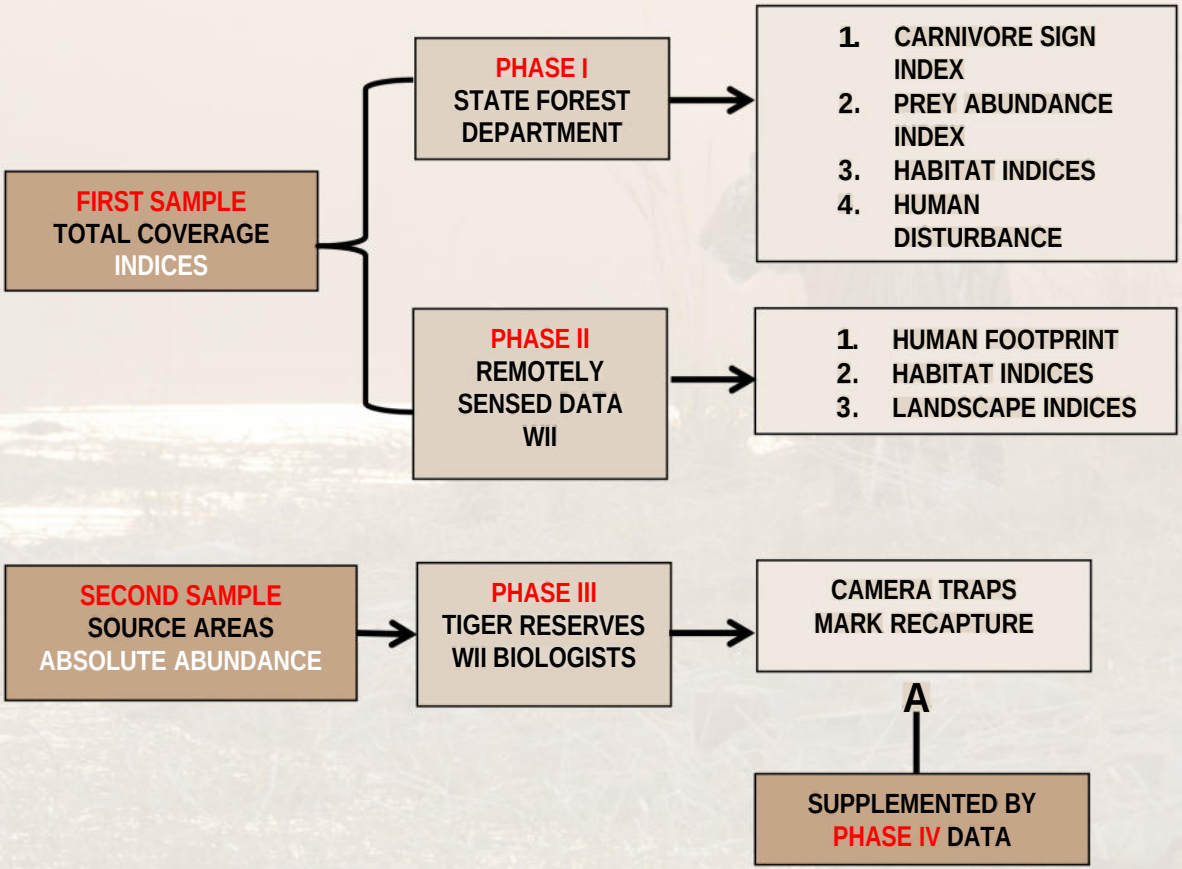
This approach consist of two samples, the first sample is collected by the forest staff of 18 tiger states and is constituted by structured protocols that are easy and economical to generate information on tiger presence and relative abundance, along with information on prey, co-predators, habitat and human impacts. The second sample is carried out by trained wildlife biologists who collect information using camera traps on tiger, leopard and prey abundance using SECR and Distance sampling. Individual tigers and leopards are identified using customized software that uses the stripe and spot patterns (akin to human fingerprints) to identify individuals.

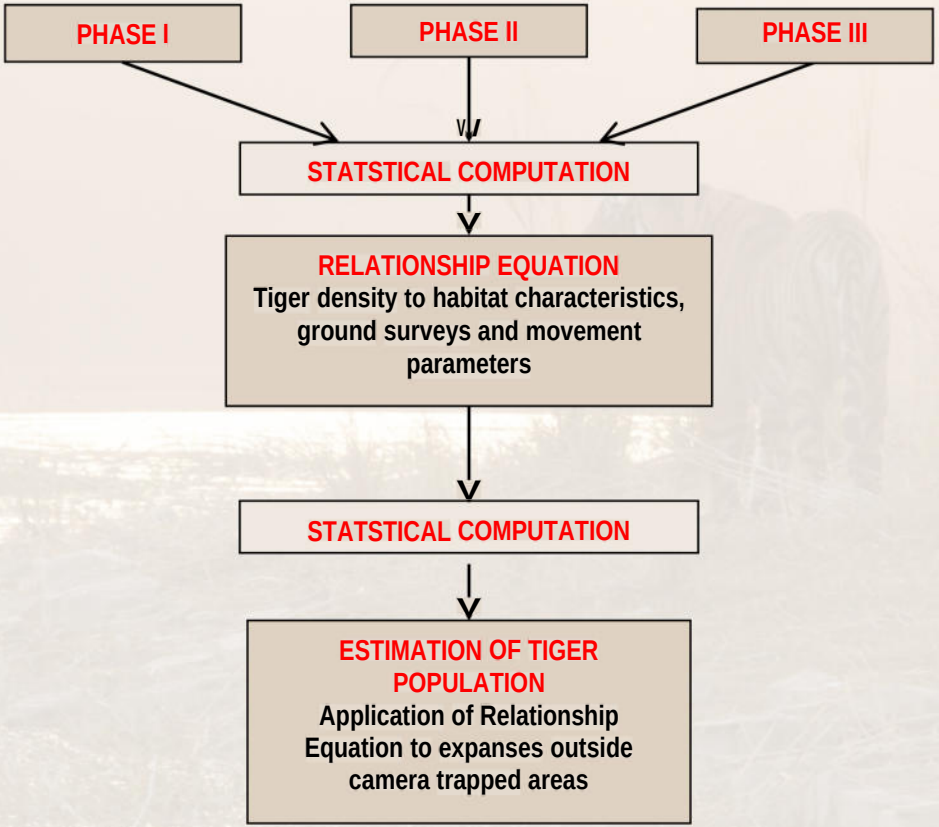
There has been an organic evolution to adopting the Spatially Explicit Capture Recapture (SECR) protocol, from ad hoc approaches like the half MMDM (mean of maximum distance moved) method, wherein tiger density was calculated by dividing the estimated population size by the effective trapping area which in turn was estimated by adding a buffer strip of half the mean maximum distance moved by recaptured tigers to the trapping grid.

In 2014, over 70% of the estimated tiger population was through camera trapping where photographs of 1686 individual tigers were obtained. The remaining 30% of the tigers from areas that had tigers but were not camera trapped were estimated by using models in Spatially Explicit Capture Recapture (SECR) where ecological covariates of prey, habitat, and human impacts along with movement parameter of tigers were used in a joint likelihood framework. This has enabled India to obtain tiger reserve/source area specific tiger densities.

The double sampling approach has proven its worth on account of its robustness as it incorporates ground reality (anthropogenic influences on tiger, co-predator, and prey and habitat status), its uniformity across landscapes, its amenability to temporal comparison, besides being based on primary data collected from the field unlike theoretical spatial models. The All India Tiger Estimation involves application of field craft and science for easy field practice by frontline forest personnel.

OUTLINE OF THE DOUBLE SAMPLING FRAMEWORK




PHASE I
PHASE II
PHASE III
STATSTICAL COMPUTATION
RELATIONSHIP EQUATION
Tiger density to habitat characteristics, ground surveys and movement parameters
STATSTICAL COMPUTATION
ESTIMATION OF TIGER POPULATION
Application of Relationship Equation to expanses outside camera trapped areas

PHASE - II

In this phase, following remotely sensed data are collected by the NTCA Tiger Cell from which secondary information is derived for landscape characterization.

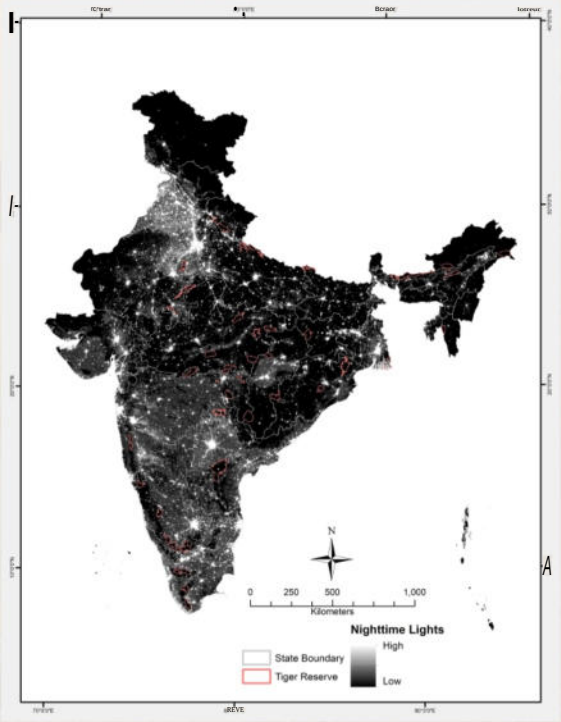
Primary data;

1. Human footprint Data from SEDAC (Socioeconomic data and applications Centre) is utilized
2. NDVI (Normalized Difference Vegetation Index) from MODIS (Moderate Resolution Imaging Spectroradiometer)
3. Forest cover maps from Forest Survey of India (FSI)
4. Digital elevation model derived from Shuttle Radar Topographic Mission (SRTM)
5. Human and livestock population data from Census department, Ministry of Home Affairs
6. Road network map of India from Survey of India
7. Drainage data (rivers and water bodies) from Survey of India

Secondary data;

1. Distance from human settlement/ night lights
2. Forest patch area calculation
3. Distance from inviolate areas like PAs

Software used for the above GIS analysis includes Arc GIS, QGIS, Fragstats, Geo Spatial Modelling Environment, besides others.



This information is extracted to beat and grid level in GIS domain by the NTCA Tiger Cell at WII.

PHASE - III/IV

Phase III and IV involve intensive camera trapping, carried out as follows;

1. Based on tiger signs obtained during the carnivore sign survey, camera traps are placed in the field in a grid of 2 sq kms for a period of 25 days (closure period). In this regard, Phase IV exercise (of 2017-2018) shall be merged with the All India Tiger Estimation, as per protocol decided.
2. Individual tigers are identified using software Extract-Compare.
3. Tiger abundance is estimated using mark recapture framework, where,

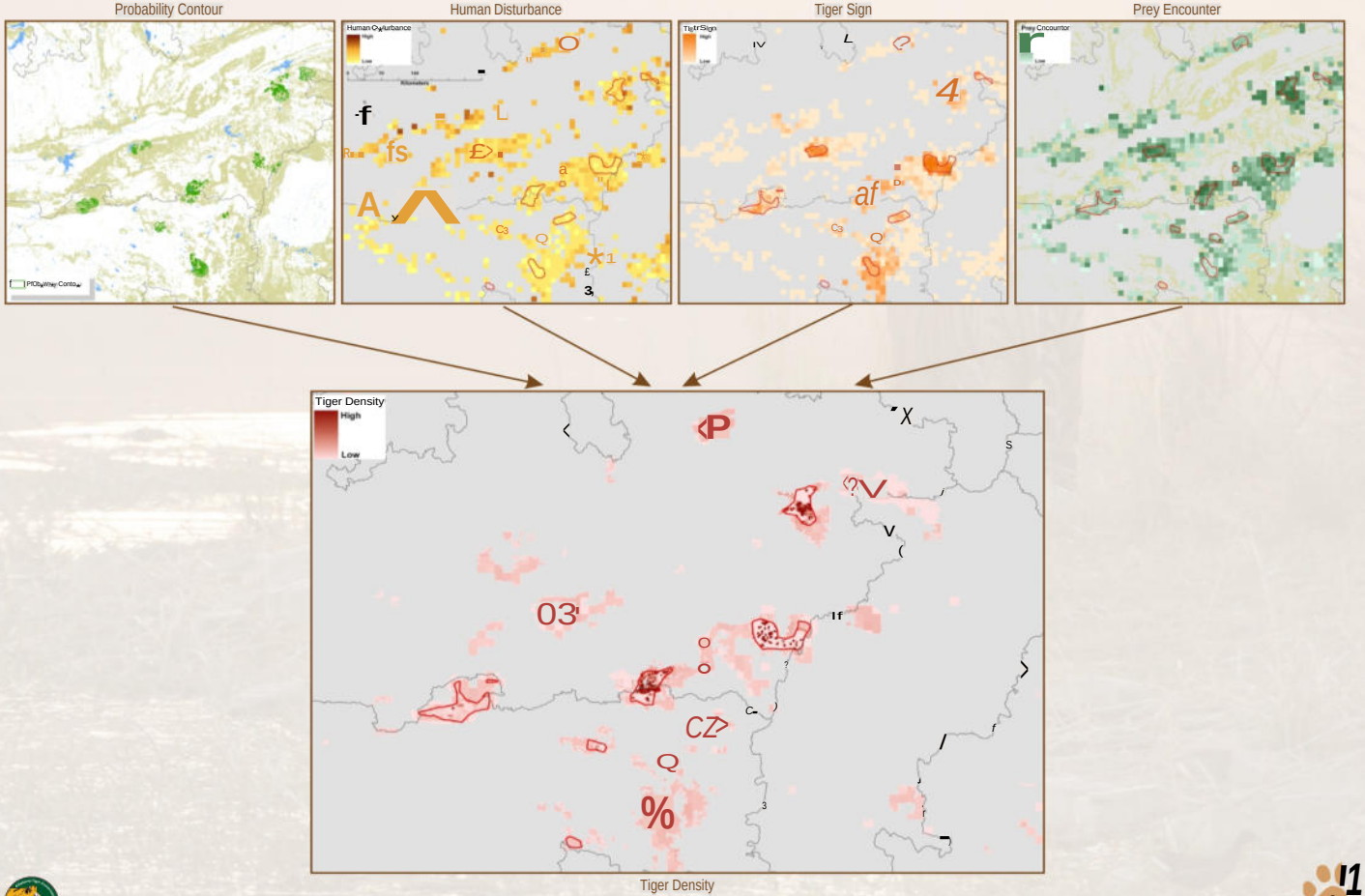
N (Tiger population) =c (Unique individuals captured)/ p (Detection probability)



Courtesy : Field Director, Navegaon - Nagzira

4. Since, the 2010 estimation, Spatially Explicit Capture Recapture (SECR) models are being used for precise estimation of tiger densities in program R.
5. In areas where it is not possible to undertake camera trapping, due to very low tiger number or unfavourable law and order conditions, scat samples of tigers and other carnivores are collected in expedition mode to estimate minimum numbers through genetic analysis. This information can be used along with opportunistic camera trap photos to model suitable tiger habitat using program MaxEnt (Maximum Entropy models)
6. In areas like the Sundarbans, the traditional camera trap based mark-recpature is tailored to local conditions by making use of lures and ensuring geographical closure of the sampled area by channels wider than 1 km as tigers have shown avoidance for the same.

JOINT DISTRIBUTION LIKELIHOOD MODEL

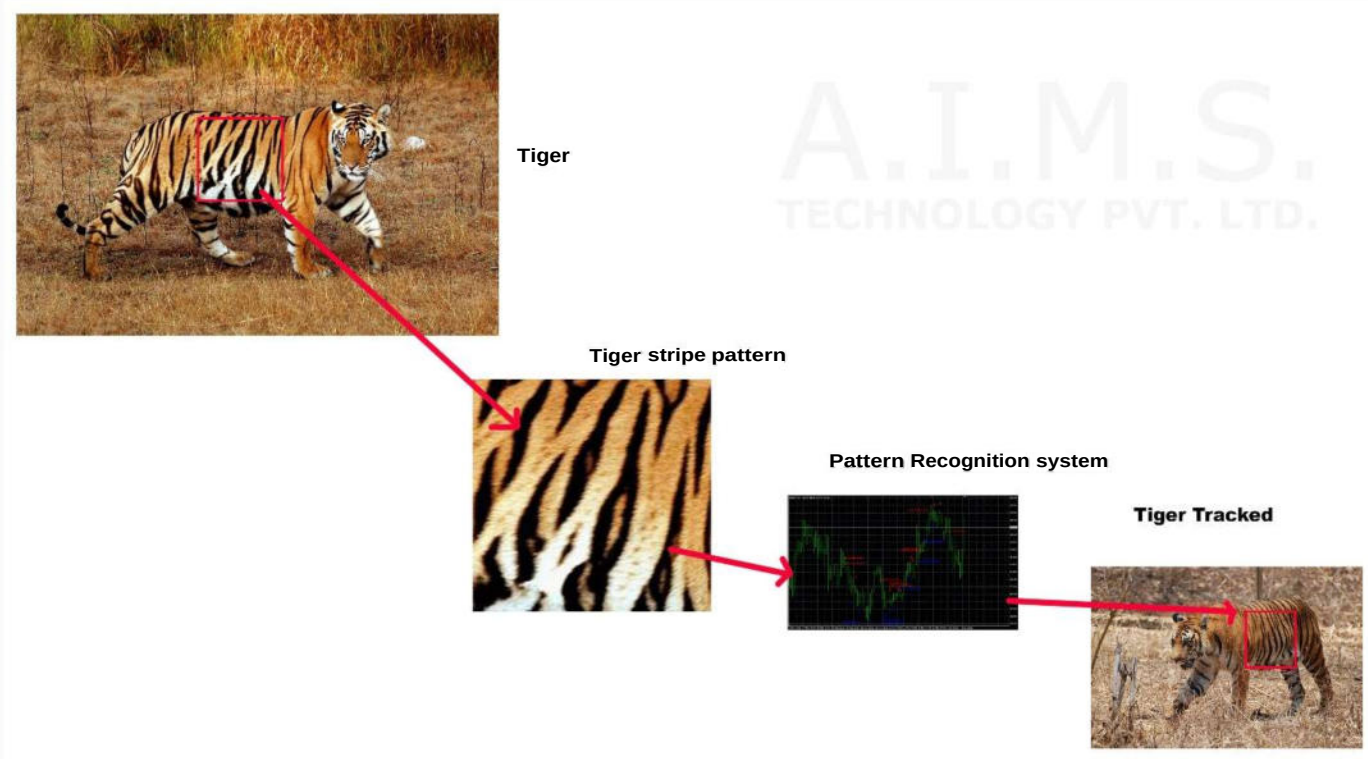


Why Not Use Pattern Recognition System to Track Endanger Species?

on Tuesday, 21 November 2017. Posted in Artificial Intelligence

Several times, we hear the news about the tiger found dead. We all are aware of this beautiful and ferocious animal. Once, forest used to hear the roar of this animal, but now this scenario is rare. Due to illegal poaching and various diseases, we are losing this alluring animal. Basic problem is keeping an eye on the population of this endangered animal and poaching. Artificial intelligence has a solution to any problem. Yes, I am talking about using a **pattern recognition** system for keeping track of these endangered species.

Even, there are various other species like Royal Bengal Tiger, Rhinoceros, Asian Elephant, Asian lion, Blue whale, Chimpanzee, Snow Leopard, Siberian Tiger and many more. The list is endless.



Just think, how difficult it is, for human to keep track of all such an endangered species. So, **why not use pattern recognition system to track endangered species?** I wonder, if **pattern recognition** can work for human fingerprints; then why not give a try for animals.

When we look at the endangered animals, they seem similar or almost indistinguishable. But still there exists a difference between the two individuals of the same species. Take an example of Tiger. There are strips on the body of this animal. The tigers have a specific pattern of the strips.

Taking another example of Blue whales. They have a certain variety in the patterns available on their body. Just think about our fingerprints. Each fingerprint differs from one another. Same is the case with whales and other animals as mention above.When I am saying about **pattern recognition system**, it will be using machine learning techniques.

How can we design the system?
Firstly, the question arises “what we require for building such system?” Well, the answer is simple. We will require the differentiating patterns of the animals, we want to track. Take an example of the tiger.

As I have mentioned above, tigers have various strip patterns that can help in differentiating them from one another. Then we have to decide a region where the animal of that pattern mostly occurs. Actually, tigers have their own marked territory. So, it’s quite easy to track it in a particular region.

Finally, by using the concepts of **pattern matching** and machine learning, we can construct a machine which is having the patterns of the animal and we can install it in the jungle in a particular place.

Now, whenever the animal gets encountered, the system will track it and record it. If anything goes unusual, then reports can be generated and the problem can get resolved.

Conclusion:
Reason for my writing is to improve the system for tracking the endangered species. Artificial intelligence has a solution for the tracking of animals. If such system is used for the tracking of the endangered species, then it will be helpful in efficiently tracking the animals. This will be easier for the tracking of animals and even help in checking the number of the species.

If such system gets installed in the forest, then we can track many species and can save them for our future generation. This will reduce the humans and animal conflicts and also make the tracking easier.

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Camera traps capture exciting animal behaviour across India

iQHVHWla

POSTED ON
22 May 20U

The utility of camera traps

Camera traps are invaluable, non-invasive and coal effective tools that provide wildlife researchers with photographic data that can be used Io estimate density and abundance Of a specific species, proof of presence of a species in an area and trends in population change due to anthropogenic pressures, among other data. Such data derived from the systematic end scientific use of camera traps help conservationists in taking management and policy decisions.

In India, camera traps are well known as the tools used for the science based All India Tiger Estimation Exercise conducted by NTCA/WII with support from WWF and other NGGs. What is not so well known though is that camera traps are also very good at offering Insights into the behaviour of wild animals and revealing now distribution records lor a species.

Ajtf Crıs Uitf / tWrf

Enlarge

WWF-Ifidia's use of camera traps across India

Over the past few years, WWF-IndSa in partnership with NTCA end different Stale forest departments has been deploying camera traps across India towards estimating tiger numbers, estimating the presence of specific species, and understanding human-wildlife conflict.

These camera reaps used in varied and diverse habitats, from the forbidding heights of Kargll to the dense forests of Western Ghats, have raveled hitherto seldom seen behaviour and activity of wild animals.

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Enlarge

Leopard-Hyena fight

For the pas! one and half years, WWF-Jndla has been monitoring cattle kills by large carnivores In the critics! Kanha Pencil corridor forests ol Central India using camera traps as part of a project to provide intnnm relief Io local communities Io reduce retaliatory poisoning of tigers and lleopards.

These camera traps captured a rarety seen and iperhaps never before photographed scene in India – a hyena *(Hyaena hyaena)* and a leopard *(Panihera pardits fusee)* fighting over a cattle kill, probably made by a tiger. The photograph provides an insight into the complex ecological interactions between carnivores and shows how scavengers utilize a kill made by a laroe carnivore, signifying the Intricate food chain.

Changeable Hawk-Eagle (Dark morph)

Moving eastwards, camera traps setup near a waterhole In the Sunderbans forests captured an uncommon dark morph variant of the Changeable Hawk-Eagle fSpizeefr/s *ctrrftatus)* VMile the eigle is easily seen across Indie's forests the dark morph has very scarce sightings

© WW -India/Sunderbans r oror aA\£ni#jg# *Dx01*

Fishing cat with prey

A camera trap in Ihe KazEranga National Park in Assam captured one night a fishing cat *fPnm®iiurvs ivierrmuB}* coming back from a successful hunl with its favourite prey - a fish The fishing cal, as their name suggests, are skilled swimmers and excellent at catching fish and this capture aptly confirms their nocturnal hunting abilities

Clouded leopard

Elsewhere in Assam, earnera traps photographed one ol the lesser-known members of ihe cat family, the clouded leopard *(NeofeiiS nebutosa)* in Manas National Park The camera traps documented a good density of these cats hom this perk a density exceeding that of the tigers in Manas!

Eurasian magpies

The far north of India, Kargil to be more precise, Is snow leopard country This mysterious denizen of Ihe heights sometimes comes down during the lean winter months from his high attitude haunts to hunt livestock The kill after the snow leopard has had Its till and loft eftacts a host of scavengers like the Eurasian magpies (Pice *pica)* This capture from Kargil shows a flock of these magpies congregating at the site of the kill (not visible In photo) to feed on the careen demonsirating the complex food web that interlinks large carnivores and birds In such high altitude areas where food sources can be scarea during winters

ft+VW ftiMtfliam FOTMT Dwr Enlarge

Asiatic black bear

The Senchal Wildlife Sanctuary located In Darjeeling is home to a sizable population of the Asiatic black bear *tUraua tnibetatnis)* The aim of ihe camera napping exercise here was to study the distribution patterns of the Asiatic black bear and analyse Its habitat as well as determine the scale and tendency of human-bear conflict The distribution patterns of the bears determined from the camera trap captures would help In reducing human-beer conflict In the area by undertaking plantation of more fruiting trees in areas known to bo frequented by these bears, thereby reducing diances of them venturing out ol the sanctuary Into human areas in seaich of food Tills capture shows a Asiatic black bear and her cub foraging for food inside ihe Sanctuary indicating that heatthy breeding is taking place in the Sanctuary

Rusty-spotted cat

The camera trapping exercise in the forests of PHlbhtt revealed a completely new distribution record for the rusty spotied cat *(Prm&ktw njtogirmM)* in the Terai Arc landscape The previously known distribution record loi this cat is from the stales of south and central India and parts of western India In this case, the camera traps discovered a hitherto unknown distribution record for the smallest wild cat.

© WWF-India/Assam Ft*a Enlarge *Ox pt*

Hyena hill

This camera trap shows a Hyena scavenging a chllaf probably a kill made by ■ larger carnivoie. Captured in Ihe Sathyamangalam forests of Tamil Nadu an area proposed to be declared a ijgei reserve, this photo is indicalive o! the good denilly of hyenas found In this region Overall, one of the best populations of hyena In India It found In this region a crucial connecting link between the Eastern and Western Ghats

As these captures amply demonstrate camera traps can apart from generating baseline data about presence and abundance of wildlife, also provide valuable Insights to wildlife researchers about the behaviour of wild animals and