A. Pittet

Final Report for the project:

Application of camera traps for wildlife studies in Bandipur Tiger Reserve

June 2007

Summary

The Nityata Foundation is implementing a project in the Bandipur Tiger reserve since 16 months to asses the suitability of indigenous camera trap systems to carry out wildlife studies. The accent is put on four studies: waterhole usage, elephant herd structure, small and elusive mammals, and human wildlife conflicts.

The project has yielded very good results in the form of more than 18'000 usable photographs and 160 mini videos of approximately 20 seconds each, all classified and tagged with individual GPS locations. In view of the very encouraging results obtained till now, it was decided to carry on with data collection till end of June, which is normally the time of the year by which the forest roads in Bandipur become difficult to use due to the onset of the monsoon.

An initial qualitative assessment of the collection of pictures obtained so far indicates that the material and methodology used were adequate for the first three among the stated project objectives, i.e. waterhole usage, elephant herd structure, and small and elusive mammals. However, the use of camera traps to help in mitigation of the human / wildlife conflicts, was not clearly established.

The project team is now defining further detailed processing of these photographs in order to extract valuable information from these data and answer a number of specific research questions that are expected to contribute to the conservation strategies for the Bandipur national Park. This exercise is done in close collaboration with the Karnataka Forest Department.

Further to these direct outcome, in the process of project deployment, a systematic methodology developed, two field researchers were extensively trained in camera trap usage (planning, methodology, deployment, data collection, interpretation), more than 10 high level forest officers were made aware of the potential of camera trapping and about 30 forest guards were directly exposed to and involved in usage and deployment of camera traps.

Introduction

This document reports the outcome of the project entitled *"An application of information technology in wildlife studies – fauna and their habitat usage survey through inexpensive digital camera traps in Bandipur Tiger Reserve, southern India"*, financially supported by the Rufford Maurice Laing Foundation (UK) under the Rufford Small Grants for Nature Conservation (RSGs). The project is implemented by the Nityata Foundation, Bangalore, India, with support from the Centre for Electronics Design and Technology (CEDT) and the Asian Nature Conservation Foundation (ANCF) at the Indian Institute of Science (IISc), Bangalore, and in very close collaboration with the Karnataka Forest Department (KFD), and more specifically its wildlife wing through the Principal Chief Conservator of Forest (PCCF) Wildlife.

Project Description

The overall of this project can be summarized as: Assessing the suitability of indigenously developed camera traps for various studies of the fauna in the Bandipur Tiger Reserve.

More specifically the project proposes to assess the suitability of camera traps for wildlife studies through four distinct objectives:

- Identifying usage pattern of water holes by different species of animals

- Identifying different age and sex classes of elephants for population structure and dynamic studies of elephants.

- Mapping the status and habitat usage of small, rare, elusive and endangered animals.

- Sharing the knowledge gained through the camera trap technique, with concern forest departments and local human communities who suffer through conflict issues, for a better understanding of the issues involved.

Project timeline

The CEDT has been active in developing camera trap technology since 2002 and has been in constant touch with the Karnataka Forest Department in this regard from then, with a number of joint exercises in deployment of prototypes in various National Parks or Sanctuaries. The project proposal was prepared and submitted by the Nityata Foundation in 2004 and funding was granted by the Rufford Maurice Laing Foundation in June 2005. Detailed discussion about the project implementation authorizations were held with the KFD from August 2005 and the necessary authorization and other documents were signed in October 2005. Following this crucial step, all the required equipment was developed and tested by CEDT during the months of November and December 2005. We had then detailed discussion for planning the deployment and all logistics with the Bandipur Forest Officers in December 2005. This allowed us to start deployment in January 2006. The ongoing field work has been carried out in the Bandipur Tiger Reserve

uninterrupted for 15 months, except for a few weeks when the forests became inaccessible due to heavy rain during the monsoon. We also operated in a "mission mode" for 2 weeks in the Nagarhole National Park adjoining the Bandipur Tiger Reserve, at the request of the Karnataka Forest Department, in the context of a human / tiger conflict.

In view of the very encouraging results obtained, we requested the Rufford Maurice Laing Foundation for the authorisation to carry on with the project till March 2007, which is beyond the initial twelve month project duration. Further, we obtained the authorisation from the Karnataka Forest Department to complete the data collection by continuing the deployment till end of June 2007. We were able to allocate some funds to extend the period of deployment and also continue data processing beyond the project period supported by the Rufford Maurice Laing Foundation. This work is on-going.

The project timeline is summarized in Table 1.

2004	Project proposal prepared and submitted
June 2005	Project funding granted by the Rufford Maurice Laing Foundation
Aug 05:	Discussions with KFD
Oct 05:	MoU and other documents signed with KFD
Nov 05	Equipment. developed & tested by CEDT
Dec 05	Logistics planned with Bandipur DCF
Jan 06:	Field deployment started
Sep 06:	Tiger conflict at Nagarhole
Mar 07:	Closure of the Project funded by the Rufford Maurice Laing Foundation, continuation of field deployment
Jun 07:	Closing of filed work, continuation of data mining
Now	Data mining / processing on-going

Table 1: project timeline

Geographical Coverage and Logistics

In consultation with the concerned officer of the KFD, we identified the following 6 ranges to be covered under the study: Gundre, Begur, Maddur, Moolehole, Bandipur and Moyar (see figure 1). This allows us to cover three broad zones with varied vegetation cover and habitat in the national park. These zones are:

Zone 1: Gundre and Begur Ranges
Zone 2: Bandipur and Moyar Ranges
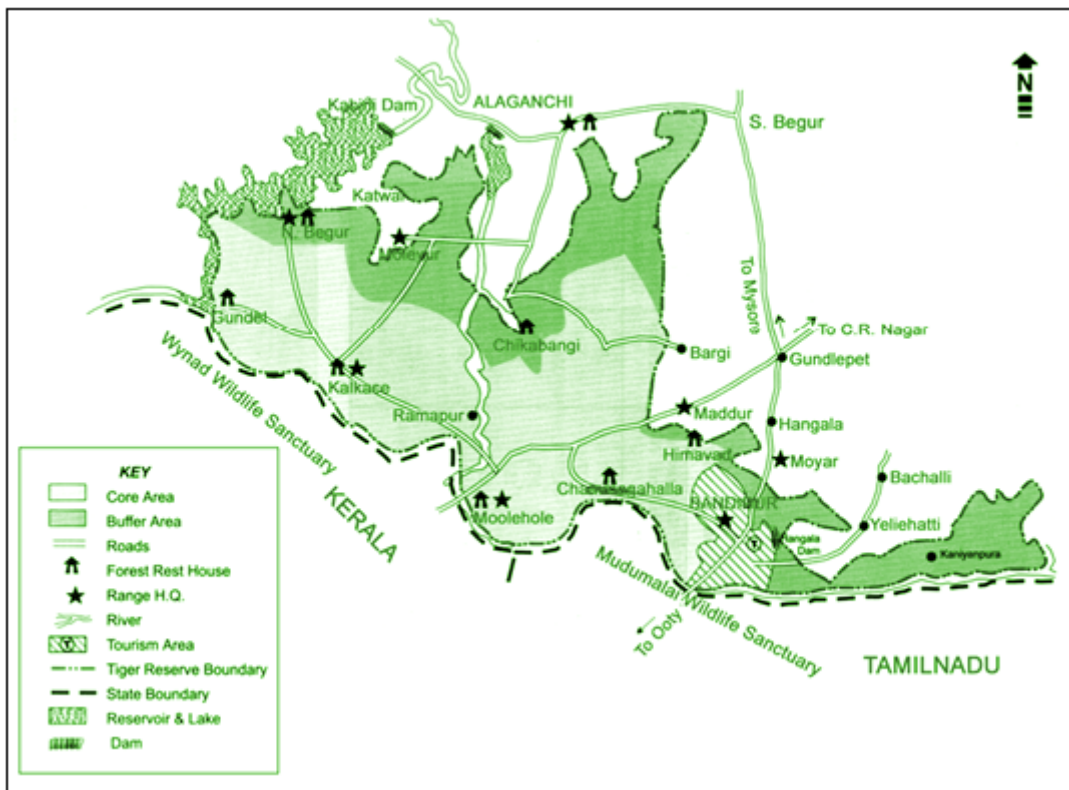Zone 3: Maddur and Moolehole Ranges

Figure 1: map of Bandipur Tiger Reserve

Each zone is covered through camera trap deployment by rotation every three months

We had at any time one or two field researchers based in the Bandipur Tiger Reserve. They worked in close collaboration with the forest department. They had15 locally developed digital camera trap systems and all required accessories at theirs disposal. They also had the required topographic maps, a GPS, a laptop and a cellular phone with GPRS connection. They used a small jeep for field work and have used two base camps to operate from. Both base camps had electricity as they needed to be able to recharge the systems batteries on regular basis.

Methodology

For the first three objectives (water hole utilization, structure of elephant herds and small and elusive mammals) we carry out camera traps deployment in a cyclic manner as follows: out of the identified 6 ranges, one zone of two ranges is covered every month and the process is repeated in the same zone in a 3 months cycle. A total of up to 15 camera traps are deployed simultaneously in the zone under investigation in three phases, each one for addressing one of the specific objectives:

Water hole utilization

In the first phase of deployment camera traps are placed at strategic locations at five randomly selected waterholes in each zone for a period of 96 hours or 4 days to make the sampling pattern stable and comparable. The tracks and signs of various animals that visited the waterhole are recorded before the cameras are placed along with a vegetation

assessment around the waterhole. After 96 hours, the cameras are removed and the tracks and signs of mammals that visited the waterhole are noted (to test the efficiency of the camera traps). This is repeated at the same waterholes after three months.

Structure of elephant herds

The second phase of deployment lasts also approximately 5 days and aims at obtaining pictures of elephant herds to study their structure. Towards this the camera traps are positioned at suitable locations within the ranges under study. To be usable the systems should record adequate sequences of pictures so as to be able to identify the sex and age of most of the individuals in the herd.

Small and elusive mammals

In the third phase of deployment we try to obtain pictures of small elusive mammals. Towards this, the systems are positioned closer to the ground and dispersed over a wider area, trying to identify locations that are likely to be frequented by such mammals. For this we rely significantly on the local knowledge of the forest department field staff.

After completing these three successive deployments within a month, the team moves with the material to the next zone and repeats the operation.

During each phase of deployment, the field researchers and their assistants always record the GPS location of each camera together with a brief descriptive of the surrounding in terms of vegetation, canopy cover, signs of animal presence, etc.

Wildlife / human conflicts

The fourth objective of the study, which relates to wildlife/human conflicts, is taken up on a case to case basis, on request from the forest department. It is in the form of technical support to their intervention towards conflict prevention or mitigation.
In this context, our team has deployed all the available systems for a period of about 15 days in September 2006 in the Nagarhole national Park, at the request of the Karnataka Forest Department. This deployment aimed at collecting data about tiger presence in and around the park, following cases of conflict with the local population.

Picture harvesting

The field deployment has been carried out from January 2006. However the pictures collected during the first round of deployment in zone 1 may not be fully usable as not all required data have been collected by our field researchers. It may be considered as a training / test period. Similarly, we have a discontinuity in data collection during the monsoon, due to unfavourable weather condition making access to the deployment areas difficult or resulting in photos of very poor quality due to rain on the systems.

Till end of March, we had collected more than 25'000 photographs, out of which about 18'000 were found to contain usable data. The remaining pre-processed photographs are mostly the result of false trigger due to hot air convection when the systems were placed in open ground. We also collected approximately 160 mini videos of 20 seconds each. When looking at these figures, it is important to keep in mind that in many cases we have dozens of pictures of the same animal(s).

Through these photographs, we have "captured" more than 30 different species,

Pre-processing

All photographs obtained are pre-processed using the free software Picasa™ . They are first organised into a hierarchy of folders named to reflect the period and zone covered as well as the on-going activity (eg. Round 01, zone 03, waterholes). All photos taken during one setting of a given camera trap system are kept in a folder named according to the system ID and the GPS location also called waypoint (eg. WP320 D34). Once pictures are organised in this way, we attach keywords to each individual picture, describing the species visible on it (elephant, tiger, muntjac, etc), or the reason for triggering (test, people, vehicle, false positive, etc.). This process is carried out using the tools available in Picasa. We then "geotag" each picture, which means that we attach to each picture the longitude and latitude of the location where the camera was setup. This is done using the data collected with the GPS during field deployment and processing it using a combination of 3 softwares: Picasa™, Trackmaker™ and Google Earth™. It is interesting to note that, using Picasa, the keywords as well as geotags are embedded in the EXIF section of each individual picture (jpeg) file. This implies that when copying pictures from one medium to another, or when sending a picture by email to another user, the information is never lost.

Results obtained till now

Usability of camera traps

An initial qualitative assessment of the collection of pictures obtained so far indicates that the material and methodology used were adequate for the first three among the stated project objectives, i.e. waterhole usage, elephant herd structure, and small and elusive mammals. For all three objectives, a large number of photographs were obtained that will provide ample data for further analysis. However, the use of camera traps to help in mitigation of the human / wildlife conflicts was not clearly established, in spite of our involvement in the effort of the forest department to deal with a tiger human conflict in Nagarhole nation Park.
The suitability of the locally developed camera traps for such wildlife studies has been established and the results in terms of number and quality of pictures obtained are very good. The project has allowed us to build a large data base of photographs that may be used to try to answer various questions related to conservation strategies. The value of this project will be know to its full extent only when carrying out further data processing with specific research question in mind.
For now we can only give a few qualitative comments on the results obtained for each objective.

Waterhole usage

On the basis of the pre-processing only, we can see that we have collected significant data for the study of waterhole usage. During this part of the deployment we got two very interesting sequences of wild dog packs hunting. In the first case they hunted down a small group of sambar and killed a young one. This was documented through 2 camera traps and we got a large number of pictures, first of the hunt, and then of the wild dogs

eating their kill and then more than 100 pictures of the vultures coming down to finish the carcass. In the second instance, we have got a few mini video sequences showing a pack of about 15 wild dogs hunting a chital stag at the edge of a waterhole and finally drowning it before eating it.

Elephant herd structure

Here also, we have obtained a good collection of usable pictures and will have now to proceed with proper data processing. In this case, we are looking for sequences of pictures where the herd can be observed moving across the field of view of the camera on a number of photographs. The placement of the camera trap systems should be such that we have a relatively wide angle of view to encompass a significant proportion of the herd on each picture. This fact limits us to use only day time pictures as the flash would not have the required reach at such a distance.

Small and elusive mammals

This part of the study is for sure more difficult and the results obtained confirm the term "elusive" that we used in the project description. Here the main difficulty is the apparent random character of movements of these species. Unlike tigers that make good use of forest roads, or elephants who congregate at waterholes, small mammals may turn up anywhere and do not seem to be very regular in using specific trails. This combined with their relative low density makes it more challenging to capture them on photographs. However we have obtained a decent collection of pictures till now, covering most of the species know to be present in the park.

Wildlife / human conflicts

As mentioned earlier, we deployed our systems in Nagarhole jointly with the Karnataka Forest Department when they were dealing with a critical case involving the presence of a of man eating tiger. During this deployment, a number of tiger pictures were obtained to document their movement in the fringe area of the park, mostly on coffee plantations, where the tension with local population was growing up. Our team, together with the forest officers interacted also very closely with the concerned population and were very active during these two weeks, moving in the affected area to set-up and check the camera traps. In such a critical situation, it is not possible to establish clearly the role and outcome of each of the interventions, but the deployment of camera traps for this specific purpose was certainly a welcome pro-active role taken by the forest department.

Others

We also had the good luck to be able to place camera traps and obtained good photographs of leopards and wild dogs on a cow killed by a leopard. Those show that apparently two different leopards have been feasting on that kill and also a couple of wild dogs have taken opportunity of a few free meals. It was also observed that, even though the wild dogs were only two, they kept at bay a large leopard, which might be the one having done the kill, while they had their meal.
We also got a few pictures and even two short videos of a tiger on a gaur killed near a waterhole. We also obtained a very good collection of photographs of a litter of wild dogs near their den.

Further data processing

With the actual field deployment over by end of June and such a large collection of pictures available with us, we are now entering the phase of actual data processing to extract relevant information from them. Towards this each photograph has to be analysed and relevant data extracted. We are presently working out the exact nature of information we want to obtain, the data required for this and the method by which such data can be extracted from the collection of photographs available. We shall start with a few specific research question related to usage of waterholes; the data processing for this may take a few months before obtaining comprehensive results. The picture database might be used later to answer further research questions related to conservation strategies.

Concluding remarks

This project was for us the first large scale and long duration deployment of camera traps. It aimed at assessing the suitability of a technology for various studies related to wildlife. The technology and methodologies used proved to be effective and gave very good results in the form of a photographic data base with more than 18'000 usable records covering more than 30 different species.

It should be noted that the whole project was and is still implemented as a very close collaboration between biologists, a technical team with serious commitment to wildlife and the Karnataka Forest Department. This collaboration has worked very well all along the project and it appears to confirm our hypothesis that best results for deployment of camera traps are obtained by combining the technical knowledge of the systems with the knowledge of the species and the very specific local knowledge of field staff.

We have now completed the deployment phase and are actively carrying out data mining in the extensive collection of photographs obtained. This work is likely to go on for a few months and we would not be surprised if the database created through this project is used later by other researchers, contributing to answer their own research questions.

Acknowledgements