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sent on July 19, 2005.

Comments on *Monitoring Tiger Status and Habita,*
Technical Note by Project Tiger Directorate (2005).

The comments are as follows:

Use of beats for monitoring tiger occurrence/abundance with the help of Forest Guards: This may be the long lasting way of monitoring tiger status in the country. But the problems with this method are beats may not exist in some parts of our tiger habitats as in Western Ghats and north-east India and there is no guarantee that the guards would go and check the beats when they are far off. The plan to have the data collected once a year is also debatable. In areas like Western Ghats and north-east India it is proposed to have $20km^2$ blocks where tiger and prey signs will be counted. Identification of these blocks on the toposheets may be easier but locating them in the field and reaching them on time to do proper surveys and counts will be extremely difficult. Involvement of numerous un-trained and not-so motivated staff can also lead to enormous problems related to observer bias and data quality. Having dedicated teams to verify whether the surveys are being done properly or not will also be a monumental task. Counter checking for data quality and correction mechanism for a protected area may be feasible but it will be difficult for a vast landscape and country. The idea to have this programme going for ever will also have lots of problems as a result of frequent transfer and turnover of staff. It will not be possible to put in **equal level of search effort in all the beats due to variations in terrain and the density of vegetation. Even if successful this approach would be useful only for understanding spatial use.**

Estimation of tiger population : Till date, methods used for **estimating relative abundance and population of** elusive larger cats and other carnivores all over the world include use of camera traps, **radio telemetry** and DNA based techniques using scats and hair. In India so far the 'census' of tiger population has been done largely by the use of pug marks.

A. Pugmarks:

Pugmarks have been widely used over the years to estimate tiger numbers in India. In some places to bring in consistency in pugmark shape and structure Pugmark Impression Pads have been introduced and plaster casts of the pugmarks are also made. Pugmarks observed in field have been traced using "Pugmark Tracer" and recently use of digital cameras to photograph the pugmark tracings is being promoted. The use of digital cameras to photograph the cast is also encouraged. The idea behind this exercise is that the photographs of the tracings and casts can be subjected to Computer-aided analysis for identifying individual tigers based on various measurements.

Problems: One of the vital requirements for using Computer aided analysis is that the data that come out of pugmarks should be of quality and **requires validation of its**

accuracy with respect to identity of individual tigers under field situation. Based on our experiences in Panna, Ranthombhore, Sariska TRs and other tiger habitats we would say that the availability of good quality of pugmarks in the field suitable for such measurements is not more than 20 to 25 per cent. In many places like Western Ghats, north-east India and even in Corbett TR there are problems such as dense vegetation, leaf-litter and rocky nature of the terrain even to see pugmarks. So far, by and large, estimations based on pugmark tracings have led to over estimations. Among the three ways of using pugmarks i.e. tracings, photographs and casts, the cast seems to be better as it would allow one to make decisions on the quality of pugmarks. Errors arising as a result of the inefficiency of the field staff would also be the least. The primary requirement for this method is to have a good quality of Track Plot or Pugmark Impression Pad for obtaining usable casts. Geology and type of soil may allow us to practice this technique in central India but definitely not every where.

B. Camera Traps:

Remotely triggered cameras (Camera traps) have been widely used all over the world for survey of elusive carnivores and estimating populations. By having sufficient number of camera traps at the appropriate places it is possible to get an estimate of the number, based on widely used Mark-Recapture model, with a low Coefficient of Variation, ca. 10%. Recently we have successfully used camera traps in Chilla Range ($150km^2$) in Rajaji National Park (ca. $800km^2$) and we have estimated the number with a low CV ca. 10%. Twenty camera trap sets (total US $ 9000 or Rs. 4.1 lakhs) would be needed to get a reliable estimate of the numbers in a Reserve within a period of three months. Several other valuable information such as the sex of the animal and if it is a female whether it is pregnant, whether it has littered can also be collected. With the help of trained staff such sets can be made use of for long term monitoring of key areas within tiger reserves. Camera traps can be used in high tiger density areas where theft of cameras can be avoided.

C. Non-invasive DNA based Techniques using Scats:

During last few years, tremendous development has taken place in the field of Molecular Scatology and scats have been widely used for identifying individuals based on genotyping and subsequently using data in Mark-Re-Capture model for estimating population. This method has been tested for a number of species like bears, mountain lions, and coyotes etc. Initiative has already been taken at Wildlife Institute of India to develop protocols and estimate tiger population in Ranthambhore Tiger Reserve. This technique can be used for all the tiger reserves and has great opportunities for application in difficult habitats like Sunderbans TR. The problem with this method right now is it is very expensive.

Any plan to estimate tiger numbers in the country should try to use a combination of methods depending upon factors such as the nature of the substrate, leaf litter, density of vegetation, law and order situation and density of tigers.

Estimation of ungulate populations based on visibility and encounter rates.
This method may work in even terrain and in dry deciduous tracts but not every where. Better not to promote this method based on an unpublished master's dissertation (Mitra 2004).

In summary, we suggest that:

more emphasis should be given for the use of camera traps in high density tiger habitats which has less bias and has been validated as a technique for estimating the population of carnivores all over the world,
DNA based technique using scats has also been widely validated for estimating the population of carnivores and needed support and encouragement should be given to this method, and the use of
Pug marks for population estimation, which can lead to enormous errors, should be avoided. Pug marks can be used as an index to gather occurrence/abundance information.