Monitoring tigers, co-predators, prey and their habitat in India: observer report by Luigi Boitani

In 2005, the Government of India launched the "National Tiger Habitat and Population Evaluation System", an ambitious program aimed at developing a permanent system to monitor trends in the populations of tigers and their prey, and in habitat quality. Purposes, objectives, rational and methods of the exercise have been extensively discussed through several technical meetings of a large network of experts and a detailed description of the field techniques have been made available to all interested parties (Jhala, Qureshi, Gopal 2005).

In the history of the past 30 years of tiger conservation, this is the first attempt to survey all India in a standardized scientific approach aimed at setting the baseline for a permanent monitoring system. The key questions are (in order of importance):

- State of tiger habitat
- Population trend of tigers
- Areas where tigers are decreasing & why
- Status of tiger's wild prey
- Where are the source populations (breeding units)
- Spacing and connectivity of populations
- How many tigers

The project will be implemented through 4 main phases (cfr. Jhala, Qureshi, Gopal 2005 for full description):

Phase 1: Spatial mapping and monitoring of tigers, prey and habitat. This stage consists of mapping a) tiger presence and relative abundance; b) tiger prey presence and relative abundance and c) habitat quality and anthropogenic pressures at a high spatial resolution of 15-20 km2.

Phase 2: Spatial and attribute data. This stage aims at modeling tiger presence through several habitat suitability models using many environmental parameters and including the development of a new broad vegetation map.

Phase 3: Estimating the population of tigers and its prey. This stage aims at answering the question of how many tigers and ungulates are there. Tigers numbers will be obtained through extrapolation of actual tiger densities obtained in three-five replicates of sufficient size (50-200 sq km) in each of three strata defined by low, medium and high density of tiger signs. Prey numbers will be estimated through the Distance Sampling method applied to data collected during Phase 1.

Phase 4: Intensive monitoring of source populations. A variety of techniques will be applied to intensive monitoring of tiger numbers in all tiger reserves and protected areas.

On invitation of the Government of India, I traveled to India from February 21 – March 3 to provide an external review of the field work implemented during Phase I and comment on the general design of the program. The detailed Terms of Reference for my short visit were:

(i) To observe the field procedure of primary data collection in selected areas of their choice,

(ii) Overseeing and observing compliance of prescribed procedures for data collection,

(iii) Overseeing and observing data compilation at field unit/district/conservancy/state levels,
(iv) Overseeing/observing the inference at the national level,
(v) Authentication of datasheets, apart from making observations, if any.

In the short time available, I have been able to visit/meet:
- Project Tiger Directorate in New Delhi (Dr. R. Gopal, Director)
- Wildlife Institute of India in Dehradun (Dr. P.R. Sinha, Director; Dr. Y.V. Jhala)
- Rajiji National Park, Uttaranchal, where both Phase 1 and Phase 3 were under way
- Thundathil Forest Range, Kerala, a non-protected area where Phase 1 was under way
- Periyar Tiger Reserve, Kerala (C.A. A. Bashir, and several officers of the reserve), during the last days of Phase 1.

During my travel, I also had the opportunity to meet and discuss the program with:
- Dr. Chris Carbone (Zoological Society of London), international observer
- Prof. Sukumar (Bangalore), national observer

General comments:

In general, I have been very positively impressed by program and the way it has been designed through a combination of updated science and extensive consultation with the best tiger experts of India. The rational for and the structure of 4 phases appear to be the best possible compromise to leverage on the exceptional opportunity to use an existing system of sampling units (beats, about 10-20 km2 each) and a network of largely equally capable field personnel.

The overall design is based on a few critical assumptions that may deserve further attention and discussion (see below), especially for the implementation of Phases 3.

Phase 1 is the critical stage of the program as data obtained at this stage will determine the quality of all following steps. I was impressed by the high level of coordination and participation of a huge number of field personnel (more than 100.000 foresters covering all tiger habitats of India at the same time and within few weeks). Great care has been given to capacity building and training of the Forest staff. The methodology has been tested in a pilot study and the sampling protocols are very detailed to ensure the best possible data quality and consistency over the entire range of the operations. The design of Phase 1 allows for the application of the most recent methods to calculate the probability of presence/absence and this results would provide a very significant improvement of the estimates of tiger ranges, numbers and trends. Prey abundance are calculated using the distant sampling approach and this method should greatly improve the estimates. The foresters will help building the first ever broad vegetation map of a significant portion of India and this layer will provide an invaluable support to much of the modeling efforts and other broad habitat-based analyses.

I found great enthusiasm everywhere, good knowledge of the methods and the assigned areas, excellent implementation of the given protocols. Objective data collected in the field were rigorously separated from personal interpretation and judgment. I like to highlight that all personnel I met had a strong sense of ownership of this work and expressed obvious pride for contributing to an important national goal.

Specific comments:

1. The Field Guide is excellent, clear and concise. It is in English and Hindi. However, it is possible that local foresters do not read either language. In Kerala, with support from the Periyar Foundation, the Field Guide has been translated to local language, edited to make it slimmer and simpler, supplemented by an attachment that explain in more detail (figures and schemes) some of the sampling procedures, and personalized by the logo of the Foundation. Two copies of the booklet are given to each field personnel, one to be filled and returned to the Kerala Forest & Wildlife Department, the other to be kept by the forester: this approach is likely to increases dramatically the sense of participation and ownership of the program. It is suggested to consider the same approach for the next all-India survey.

2. In Data Sheet 1, the column "Forest types" and "Terrain types" leave it to the compiler to fill in whatever he/she feels appropriate. This may be the source of problems when analyzing the data. It is suggested to provide an Authority List to choose from in order to reduce the potential variation of types.

3. The raw data of the sheets is the primary data of the program and all effort should be put to maintain their integrity. The program expects that the data will be transferred onto Excel files without any manipulation; in fact it is expected that helpers without understanding of the data will enter them to the Excel files. However, this may not be the case everywhere: the Forest & Wildlife Department of Kerala, for example, plans to collect all data sheets and check for consistency before entering the data and transferring them to the Wildlife Institute. While this is done with positive intentions (correct/translate the names of plants, insert GPS points, correct errors), it may also be the opportunity for involuntary data "adjustments". It is suggested that the WII maintain access to at least a random selection of the original data-sheets in order to check if any significant change of the original field data has occurred.

4. Most of the beats are traditional areas that have been maintained unchanged for many decades and are well known to the local authorities. The boundaries of the beats are normally well marked on topographical maps of suitable scale. A possible source of error, however, is in the transfer of these boundaries to a GIS. The transfer of all beats to a GIS is a formidable task and it is not clear who will do it and how the work will be validated. An accurate GIS map of all sampling units is the fundamental tool for all analyses planned by the program and in particular to build the broad vegetation map, to calibrate the remote sensing data, to correlate tiger signs and habitat types.

5. There are local situations (e.g. Thundathil Forest Range, and possibly many other) where the beats have been re-arranged for the Tiger Survey (small beats have been merged into new sample areas in order to have a more uniform area size across the region): it is not clear who and how will be able to capture this information into the national GIS system. It is suggested that this issue be immediately considered and solved through extensive exchange of information with the authorities of each State.

6. The current protocol for sampling carnivore (tiger) signs in each beat dictates that the beat should be surveyed opportunistically by checking all sites where signs and tracks can be

found and the data sheets report only the final number of tracks and signs encountered for each species and the searching effort (time spent in the search and the length of the trail searched). However, the effort may be significantly different depending on the number of searchers (which currently varies substantially among beats), the detectability of tracks and signs which depends on the nature of and the availability of suitable substrate. Failure to account for these factors may substantially reduce the robustness of the index. It is suggested to try to capture these information in the data sheets (number of searchers and, as surrogate for detectability, the type/quantity of ground cover).

7. Phase 2 of the program is dedicated to the development of habitat suitability models to be used as surrogates for tiger presence/absence. As the program will produce a great amount of good quality data on presence, it is suggested to apply habitat models based on presence only data. These types of models (Mahalanobis distance, ENFA, GARP, etc.) appear to be more robust when the quality of the absence data cannot be assessed and may be able to perform more safely that the logistic regression-based models. Even though the program will likely produce an assessment of the probability of absence/presence for a good portion of the distribution area, it will not be easy to include these probabilities in the modeling exercise. It seems unlikely that any model could be developed to model real tiger densities.

8. Phase 3 is a fundamental stage toward an estimate of tiger numbers. It is based on two methodological steps, stratification and estimate of tiger numbers in selected areas in each stratum.
   a) Stratification based only on density of signs does not account for the variation in sign detectability which might be substantial until proven irrelevant. Assuming equal detectability on the basis of the broad scale of the exercise might introduce an unverifiable bias that could significantly weaken the results. It is suggested that this assumption and its implication on the goodness of the results are at least extensively discussed. A more complex stratification scheme will increase the work in estimating tiger numbers in selected areas, but it might also help reducing the variance of the estimates. Type of forest or terrain might be tested as indicators of differential detectability. A potential solution to be explored could be a stratification that combines density of signs and broad geographical/ecological regions.
   b) The process by which the number and location of the areas where the number of tigers will be estimated needs to be explained with more detail. The current protocol indicates 3-5 replicates as the expected sampling effort but there is no sufficient justification for this number. It is suggested that this part of the method is scrutinized in detail to evaluate the expected power of the sampling scheme. The biological and statistical justification for the extrapolation of density within the selected areas\to the whole strata is probably the most troublesome step in the whole program and it is suggested to submit it to the critique and consensus of the broadest possible group of experts.
   c) The genetic analyses of DNA obtained from scats are indicated as one of the main method to estimate tiger numbers in the selected areas. While the method is certainly central to any attempt to estimate numbers, it is suggested to be cautious on its effectiveness at least until it is sufficiently clear a) the genetic variation of the tiger populations, b) the probability of individual identification (allele dropout), c) the heterogeneity of data (which will determine its utilization in CMR models).

d) The CMR models applied to the genetic data are likely to produce estimates with an large CI if the sampling is not able to ensure a minimum number of recaptures of a substantial proportion of the existing population. Until this is proven possible, it is suggested to lower the expectations from this technique.

9. The program will produce a great number of good spatial data on the presence/absence of tigers and associated carnivores and prey and on habitat features, including human presence and disturbance. These data offer a great opportunity for analyses under a systematic conservation planning approach that takes in account the irreplaceability and vulnerability of sites and the cost of conservation action. These techniques could be a very useful tool to explore the optimal network of protected areas to maintain tiger populations, the patterns of human-tiger conflicts, the costs associated with multiple use of land. It is suggested to add this component to Phase 4 of the program.