

## Estimation of Wildlife Populations

# 3

### 3.1 Introduction

Wildlife managers have used a range of methods for counting herbivore and carnivore populations. For tiger and leopard, the traditionally used method of the '*pugmark census*', was relied upon by Indian wildlife managers for over three decades. However, this method has been criticized by several scientists for giving inaccurate and often inflated estimates of tiger and leopard population in a given area. Since 2002, the PTD and the WII have been working on a revised methodology for assessment of tiger habitats and numbers and the new system will be implemented in the national tiger estimation exercises to be carried out from November, 2005 onwards. In recent times in certain protected areas reliable estimates of tiger/leopard populations have been obtained using '*Camera Traps*' in the '*Capture-Recapture*' framework. The WII employed this method in an ISA of 140.81km<sup>2</sup> in RNP during May - June 2005 at the request of the SEC. In addition to this, the SEC agreed to the proposal of the WPSI to use the technique of '*Digital Imaging of Pugmarks*' for estimating tiger abundance in RNP. The FD carried out the traditional pugmark cast method of estimating tiger abundance in RTR and for leopard in STR. The reason for employing a range of methods as indicated above was to take into account their relative strengths and also the feasibility of their field implementation.

Like many protected areas in India, Sariska and Ranthambhore Tiger Reserves also conduct 'waterhole counts' for estimating animal abundance. Since this method is based on several 'untested' assumptions, the SEC decided to discontinue this method for the 2005 census and requested the WII to employ a more scientific animal estimation methodology. Accordingly, the WII under the guidance of the SEC planned the 'transect count' for estimating herbivore abundance in Ranthambhore and Sariska Tiger Reserves. A spatial database in GIS domain was developed by WII to align the transects in all the forest beats in STR and the existing census units in RTR. These transects were then marked permanently by the frontline staff. Seventy three line transects covering all four ranges in STR were walked upto eight times by the frontline staff and a total transect length of 1148 km was covered. Similarly in RTR 89 transects totaling 1119 km were walked. It is stated that it is for the first time an exercise of such a magnitude has been undertaken in any protected area of this country. The very high domestic livestock numbers indicated through the transect count exercise in both RTR and STR are a matter of great concern that needs to be addressed immediately as these numbers are detrimental to both the tigers future and its prey species.

## 3.2 Sariska Tiger Reserve

### 3.2.1 Pugmark method

The leopard population estimation using traditional pugmark technique was carried out in STR from 16<sup>th</sup> May 2005 to 30<sup>th</sup> May 2005. A total of 1205 plaster casts were obtained (Talvriksh 153; Akbarpur 257; Sariska 606 and Tehla 189). Out of 1205 plaster casts only 537 were subjected to further analysis by a team of wildlife managers. Based on this analysis it is estimated that the leopard population in STR ranges from 51 to 55 individuals. The report "Analysis of Pugmark of Leopard population in STR" is placed as **Annexure 3.1**.

### 3.2.2 Camera trap method

Camera trapping for estimating leopard abundance in STR was carried out in an Intensive Study Area (ISA) of 23.75 sq km. A total of 10 camera trapping sites were chosen in the ISA and camera traps were placed for 10 days during June 2005. The total effort thus realized was 100 trap days. A total of 22 leopard photographs were obtained with 12 left flank photographs belonging to 9 individuals and 10 right flank photographs of 8 individuals. The effective sampled area amounted to 68 sq km. The density estimates arrived at using closed population estimator of capture-recapture analysis based on selected model (Mo) was  $23.5 \pm 8.12$  (Left flank) and  $25 \pm 9.03$  (Right flank) per 100 sq

km. Density estimates determined either from left or right flanks were similar. The best estimate derived using model M(o) of program CAPTURE using left flank data ( $D = 23.5 \pm 8.12$  leopards per 100 sq km) was relatively precise with lower Standard Error. Thus the mean estimated population in the effective sampled area of 68 sq km was  $16 \pm 6.85$  individual leopards. Estimated leopard population in ISA of STR is relatively very high in comparison to the reported estimates ranging from 0.11 to 20 individual/100 km<sup>2</sup> in other parts of the world. The report “Estimating Leopard Population Using Camera Traps In Sariska Tiger Reserve” prepared by WII is placed as **Annexure 3.2**.

### 3.2.3 Transect method

The report “Estimating Herbivore Abundance using Line Transect Method in Sariska Tiger Reserve” prepared by the WII is placed as **Annexure 3.3**.

A spatial database of STR was created in the GIS domain. The thematic layers viz. Contours and Spot Heights, Drainage, Compartment Boundary, Village Locations and Roads were overlaid on the Forest Beat boundaries, which were considered as the basic census units.

The frontline staff were trained in marking of the transects and recording animal sightings. The range-wise transect details are given in **Table 3.1**.

**Table 3.1 Range-wise transect details in Sariska Tiger Reserve**

Range	No. of Transects	Total Walks	Mean Transect length (km)	Minimum length (km)	Maximum length (km)	Total (km)
Talvirksh	13	86	3.67	1.90	5.00	316.40
Akbarpur	16	103	2.83	1.40	4.30	292.41
Sariska	20	126	2.57	1.50	4.70	324.60
Tehla	24	65	3.30	2.10	4.50	215.00
<b>Total</b>	<b>73</b>	<b>380</b>	<b>3.02</b>	<b>1.40</b>	<b>5.00</b>	<b>1148.41</b>

Range-wise Encounter Rates (ER) (No. /km) were calculated which indicates that Chital, Sambar and Langur ER are highest in Sariska Range while Nilgai ER is highest in Tehla Range. Density (No./ km<sup>2</sup>) estimates for wild herbivore species are Chital (10.33/ km<sup>2</sup>), Sambar (13.34/ km<sup>2</sup>), Nilgai (23.56/ km<sup>2</sup>) and Wild pig (4.11/ km<sup>2</sup>) and the estimated population in Sariska Tiger Reserve is Chital (12408), Sambar (14901), Nilgai (22853) and Wild Pig (4177). A high population of domestic livestock viz., Buffalo (3180), Cow (2968), Sheep (688) and Goat (19418) has also been estimated in STR.

### 3.3 Ranthambhore Tiger Reserve

#### 3.3.1 Pugmark method

The abundance estimation of tiger in RTR using conventional pugmark method was carried out from 6<sup>th</sup> May 2005 to 20<sup>th</sup> May 2005. In all 337 plaster casts were obtained and were subjected to pugmark analysis by a team of wildlife managers and based on this analysis an estimate of 31 tigers (9 male, 17 female, 5 cubs) was made. The report “Analysis of Pugmark Census conducted from 6/5/05 to 20/05/05 in RTR” is placed as **Annexure 3.4**.

In addition to the above the WII photographed the Pugmark casts in order to subject them to statistical analysis. 341 photographs of pugmarks were taken of which 269 were of left hind foot. Since there was a variation in the quality of the pugmark casts, these were classified into good (n=51), moderate (n=90) and poor (n=120). 21 variables on the calibrated image using SigmaScan Pro-4<sup>TM</sup> software were measured. Preliminary analysis based on Hierarchical Cluster Analysis of the measurements indicated the presence of at least 12 different individual tigers in 51 casts. This study has indicated that obtaining good quality pugmark casts is absolutely critical for individual tiger identification using the Cluster Analysis and Discriminate Function Analysis. The report ‘Estimating Tiger (*Panthera tigris*) Population using pugmark casts obtained in Ranthambhore National Park’ prepared by WII is placed as **Annexure 3.5**.

#### 3.3.2 Camera trap method

Reliable estimates of populations are critical for the conservation of large terrestrial carnivores as they play an important role in evaluating the effectiveness of conservation efforts and also provide benchmark data for future management decisions. Camera trapping was carried out in an ISA of 140.81 sq km in RNP. A total of 30 camera trapping sites were chosen in the ISA in three phases with 10 camera traps placed in each phase for 9 – 15 days during April-May, 2005. The total effort thus realized was 358 trap days. A total of 31 tiger photographs were obtained with 17 left flank photographs belonging to 13 individuals and 14 right flank photographs of 10 individuals. Closed population estimator was used for estimating the population size. The effective area covered amounted to 360.22 sq km which is ca. 91 per cent of RNP and contiguous forest (ca.400 km<sup>2</sup>). Density estimates ranged from 4.72 to 5.83 tigers per 100 sq km. However, the best estimate derived was based on left flank using model M(h) of program CAPTURE ( $D = 5.83 \pm 2.01$  tigers per 100 sq km). This is because of the relatively higher left flank captures. The mean estimated population in the effective sampled area of 360.22 sq km. is  $21 \pm 6.1$

individual tigers and range is between 15 and 27 individuals. The report “Estimating Tiger Population Using Camera Traps In Ranthambhore National Park” prepared by the WII is placed as **Annexure 3.6**.

### 3.3.3 Digital Analysis of Pugmarks

For estimating the tiger population in RTR the Digital Pugmark Technique using the software PUGMARK 1.0 was employed by the WPSI from 6<sup>th</sup> to 20<sup>th</sup> May 2005. In all 200 pugmark sets were collected by five teams over a period of fifteen days. For the final analysis 140 pugmark sets, chosen on the basis of quality of pugmarks and minimum number of pugmarks per set were used. Ten predictor variables from the pugmarks and two additional variables namely stride and straddle were used to determine the tiger abundance. Based on the statistical analysis it was found that there were a total of 26 tigers in RTR – 6 males, 15 females and 5 cubs. Except for two individual tigers, that were probably transients, pugmark sets of all the other individuals were recaptured on more than three occasions on different days. The GPS locations associated with each individually identified pugmark set were plotted in order to delineate the individual tiger distribution across RTR. The profiles of 26 tigers identified in RTR using the Digital Pugmark Technique are given in **Table 3.2**.

**Table 3.2: Profile of Tigers found in Ranthambhore (May2005)**

Tiger ID	Gender	Name	Area Occupied
001 M	Male	Berda male	Berda village, Berda water hole, Berda tiraha, Lahpur road, Chiroli, Kalakhet
002 M	Male	Chiroli male	Naya road, Chiroli, Bakola, Phuta kot, Rani deh, Purana pani, Bagdah, Ama Ghati, Peepli deh
003 F	Female	Berda female	Berda, Bhanwarda, Kachida, Bakola, Bagdah, Bhootkhorra
004 F	Female	Bakola female	Bakola, Bagda, Semli tiraha, Durrah anicut
005 F	Female	Dhakada female	Dhakda
006 F	Female	Ranideh female	Ranideh, Chor gali, Lalghati, Anatpura waterhole, Bagdah, Durrah anicut
007 M	Male	Lakarda male	Lakarda High Point, Jhalra, Kukraj top, Jhokha, Bhoot khorra, Gurla tiraha
008 F	Female	Lahpur female	Lahpur khet, Circular road, Chindawali tiraha
009 F	Female	Odikho female	Odikho, Chindawali tiraha, Chindawali ghatee
010 F	Female	Chindawali female	Chindawali tiraha, chindawali ghatee
011 M	Male	Indala male	Indala, Peeli talai
012 F	Female	Jhalra female	Jhalra, Milik talao, Bada gate, Chhota gate, Jogi Mahal, Nalghati
013 C		Jhalra cub 1	Jhalra, Milik talao, Bada gate, Chhota gate, Jogi Mahal, Nalghati
014 C		Jhalra cub 2	Jhalra, Milik talao, Bada gate, Chhota gate, Jogi Mahal, Nalghati
015 F	Female	Guda female	Guda trijunction, Guda, Soleshwar

016 C		Guda cub 1	Guda trijunction, Guda, Soleshwar
017 C		Guda cub 2	Guda trijunction, Guda, Soleshwar
018 F	Female	Sultanpur female	Jagner, Phootakot, Sultanpur
019 C		Sultanpur cub	Jagner, Phootakot, Sultanpur
020 F	Female	Tambakhan female	Tambakhan, Milik talao, Singhdwar
021 F	Female	Thumka female	Thumka, Thumka top, Preet deh, Jharna mahadev, Mayee dang
022 F	Female	Preetdeh female 1	Sarkari talai, Preet deh, Thumka gate, Thumka top, Jaikho, Galai Sagar, Neela patta, Lahpur khet
023 F	Female	Preetdeh female 2	Preetdeh, Sarkari talai, Berda triangle
024 F	Female	Transient female	Sarkari talai
025 M	Male	Sarkari talai male	Sarkari talai, Preet deh, Sukhna, Khara chatta, Dholi bawali, Phirozpur talai
026 M	Male	Rawara dang male	Balaji, Mayee ghati, Macch ghati, Rawara dang

The report “Monitoring Tigers in Ranthambhore National Park using the Digital Pugmark Technique” prepared by WPSI is placed as **Annexure 3.7**.

### 3.3.4 Transect method

The report “Estimating Herbivore Abundance using Line Transect Method in Ranthambhore Tiger Reserve” prepared by the WII is placed as **Annexure 3.8**.

A spatial database of RTR was created in the GIS domain. The thematic layers viz. Contours and Spot Heights, Drainage, Compartment Boundary, Village Locations and Roads were overlaid on the existing census units.

The frontline staff were trained in marking of the transects and recording animal sightings. The range-wise transect details are given in **Table 3.3**.

**Table 3.3: Range-wise transect details in Ranthambhore Tiger Reserve**

Range	No. of Transects	Walks	Mean Transect Length (km)	Minimum Length	Maximum Length	Total(km)
Kundera	12	60	2.47	1	7	148.38
Khandhar	11	54	2.68	0.5	3.2	144.88
Project	12	61	2.44	1.75	3	148.95
Baler	7	38	2.84	1.8	3.6	107.8
Mandryal	10	57	2.79	2	3.6	158.9
Keladevi	14	62	2.77	1.7	4	171.55
Karanpur	9	52	2.79	2.3	3.2	144.9
Sawai Mansingh	14	40	2.35	1.2	4.5	94.00
<b>Total</b>	<b>89</b>	<b>424</b>	<b>2.64</b>	<b>0.5</b>	<b>7</b>	<b>1119.36</b>

Range-wise Encounter Rates (ER) (No. /km) were calculated which indicates that Chital, Sambar Chinkara ER were highest in Kundera, Khandhar and Project Range. Density (No./ km<sup>2</sup>) estimates for wild herbivore species were Chital (13.43/ km<sup>2</sup>), Sambar (8.61/ km<sup>2</sup>), Nilgai (6.98/ km<sup>2</sup>), Chinkara (1.73/km<sup>2</sup>) and Wild pig (2.27/ km<sup>2</sup>) and the estimated population in RTR was Chital (16527), Sambar (9770), Nilgai (9560), Chinkara (2166) and Wild Pig (2660). A high population of domestic livestock viz., Buffalo (10178) and Goat (52510) has also been estimated in RTR in the exercise.

## 3.4 Recommendations

### **Camera Trap method**

- *The camera trap method in RNP has given a good indication of the tiger abundance in RNP. However, a high Standard Error obtained indicates the high variability in the density estimates. There is hence the need to increase the sampling effort and get greater area coverage for securing greater precision in abundance estimation. The ongoing WII study in RNP which also includes developing molecular markers for individual identification of tigers based on scat analysis is expected to provide more precise estimates in future.*
- *In the case of STR the camera trap method has indicated a high abundance of leopards in the relatively small intensive study area. Here again the associated Standard Errors with the density estimates are high and hence there is a need to increase the sampling effort and greater area coverage for securing greater precision in abundance estimation. The STR management would need to initiate a long term camera trap study in collaboration with a scientific organization.*

### **Transect method**

- *There is a need to determine site and species-specific 'Effective Strip Widths' in order to make reliable extrapolations of the density estimates. This can be done by the park management in collaboration with a scientific institution.*
- *There is also a need for skill enhancement of the frontline staff and improvement in the field operations. Intensive training of all the staff concerned with regard to use of compass, GPS, distance and sighting angle*

*estimation and recording of information on to the data sheets in order to bring a more rigorous and scientific approach to the estimation exercise.*

- *The spatial database generated as part of this exercise needs to be constantly updated along with the maintenance of the permanent transects. Increased involvement of university and college departments, scientific institutions and members of civil society will enhance the quality of outputs and ensure transparency as well.*

### **Digital Pugmark method**

- *Since this method requires good infrastructure namely equipment, mobility and wireless communication backed by trained and motivated manpower its future application would depend upon the availability of the above.*
- *Rigorous statistical testing and development of the analytical software PUGMARK 1.0 is needed in order to enhance the reliability of the results.*

### **Traditional Pugmark method**

- *This method is highly dependent on the quality of plaster cast obtained initially (as indicated in the current WII study (see **Annexure 3.5**)), which in turn is a function of a range of variables (terrain, skills, integrity etc.) and is also prone to a number of subjective assessments during the analytical phase. It is therefore recommended that this method be used only for ascertaining habitat occupancy and not for arriving at precise numbers as is presently the case.*