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Research Article

Monitoring of reintroduced tigers in Sariska Tiger Reserve, Western India: preliminary findings on home range, prey selection and food habits

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Abstract

Home range and food habits of tigers (*Panthera tigris tigris*) were studied in Sariska Tiger Reserve from July 2008 to June 2009. Three tigers (one male and two females) were radio-collared and reintroduced in Sariska Tiger Reserve from Ranthambhore Tiger Reserve, Western India during 2008-2009. The reintroduced tigers were monitored periodically through ground tracking using "triangulation and homing in techniques." The estimated annual home ranges were 168.6 km^2 and 181.4 km^2 for tiger and tigress-1 respectively. The estimated summer home range of tigress-2 was 223.4 km^2. In total, 115 kills and 103 scats of tigers were collected to study the food habits. The line transect method was used to estimate the prey availability. The density of peafowl (*Pavo cristatus*) was found to be highest (125.2 ± 15.3/ km^2) in Sariska followed by livestock (*Bubalis bubalis* and *Bos indicus*) (59.9 ± 22.3/ km^2), chital (*Axis axis*) (46.7 ± 9.5/ km^2), sambar (*Rusa unicolor*) (26.2 ± 4.9/ km^2), common langur (*Semnopithecus entellus*) (22.8 ± 6.5/ km^2), nilgai (*Boselaphus tragocamelus*) (19.5 ± 3.3/ km^2) and wild pig (*Sus scrofa*) (15.4 ± 4.4/ km^2). Tigers fed on seven prey species as shown by kill data. Tigers' scat analysis revealed the presence of five prey species. Prey selection by tigers based on scat analysis was in the following order: sambar> chital> nilgai> livestock> common langur. It is proposed to restock the tiger population initially with five tigers in Sariska and subsequent supplementation of two tigers every three years for a period of six years, which will allow the population to achieve demographic viability. Removal of anthropogenic pressure from the national park will be crucial for the long term survival of tigers in Sariska.

Keywords Food habits, home range, reintroduction, Sariska, tiger.

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Introduction

Reintroductions have proved to be a valuable tool for the recovery of species that have become either globally or locally extinct in the wild [1]. Reintroducing species to parts of their former range where they have become locally exterminated is one of the last measures that can be employed to conserve the threatened species in the concerned habitat. Reintroductions can also give us an insight into the reasons for disappearance of a species from the areas where they formerly occurred. Therefore, it is required to be genuinely experimental and properly monitored [2]. Reintroduction of large predators had a poor success rate in the past [3-5] and the overall conservation benefits in the long term are questionable [6-7]. Since the reintroduction programs are expensive and time-consuming, and corresponding success rates are low, it is difficult to justify spending precious conservation money in these activities as against other *in situ* conservation measures [8]. Therefore it becomes highly imperative that reintroductions should be based on sound scientific principles and methodology so that the success rates will be high and the efforts fruitful enough. The reintroduction and recovery of the Florida Panther (*Puma concolor coryi*) in Florida, USA, during 1981 and reintroduction of the African wild dog (*Lycaon pictus*) in Africa in the 1990s are two such instances, among others, that have enriched our knowledge about the science and management of carnivore reintroductions. It was reported [5] that there is a dearth of published studies documenting the reintroduction of large predators in Africa. In a series of 30 events of large carnivore reintroduction reported from Africa, the final outcome was known only from nine which were considered successful [7]. However, translocation events of large carnivores are a common practice in Africa [9-11] although seldom published in literature. In most of the projects, post-release monitoring rarely occurred and the results of the rest did not suggest a high success rate, with the causes of failures poorly analyzed [12].

A few incidents of translocation of wild tigers have been reported from the Indian subcontinent and the Russian Far East [13-15]. In such events the conflict tigers were captured and released in the wild and the post-release monitoring or rather fate of the translocated animals was reported only in two cases [14-15]. After the extermination of tigers (*Panthera tigris tigris*) in Sariska Tiger Reserve (Sariska), western India in 2004 due to poaching, reintroduction of tigers from Ranthambhore Tiger Reserve (Ranthambhore) was envisaged by translocating an initial population of five tigers (two males and three females), with a supplementation of two tigers (male and female) in every three years for a period of six years [16]. The simulations showed the probability of tiger survival as 0.9620 (0.0086 SE). The disappearance of tigers in Sariska during 2004 illustrates the threat that exists to isolated tiger populations in many parts of the country. Based on the past trends and experiences, it is presumed that such losses and local extinctions in future will be more frequent and there is a need to undertake immediate reintroduction and species recovery programs to save the large cat in the wild. It is perhaps not an isolated situation, and the recent national scale assessment reported that tigers had gone locally extinct from 97 districts in India in the last 150 years [17]. Thus a study was envisaged to reintroduce tigers in Sariska in a phased manner, and home range, prey selection, and food habits of the reintroduced tigers were studied from July 2008 to June 2009.

Methods

Study Area

The Sariska Tiger Reserve (76°17' E to 76°34'E and 27°5 to 27° 33 N) is situated in the Aravalli Hill Range and lies in the semi-arid part of Rajasthan [3]. The total area of the Tiger Reserve is 881 km^2, with 274 km^2 as notified national park. The terrain is undulating to hilly in nature and has numerous narrow valleys, two large plateaus (Kiraska and Kankwari), and two large lakes (Mansarovar and Somasagar). The altitude of Sariska ranges from 540 to 777 m. There are two state highways: the

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Alwar-Thanagazhi-Jaipur and the Sariska-Kalighati-Tehla, which are over 44 km in length and traverse the heart of the notified national park. The vegetation of Sariska corresponds to northern tropical dry deciduous forests and northern tropical thorn forest [18]. Apart from reintroduced tigers, other carnivores present are leopard *(Panthera pardus),* striped hyena *(Hyaena hyaena)*, jackal *(Canis aureus)*, jungle cat (*Felis chaus*), common mongoose *(Herpestes edwardsi*), small Indian mongoose (*H. auropunctatus*), ruddy mongoose (*H. smithi*) palm civet (*Paradoxurus hermaphroditus*), small Indian civet (*Viverricula indica*), and ratel (*Mellivora camensis*). Chital (*Axis axis*), sambar (*Rusa unicolor*), nilgai (*Boselaphus tragocamelus*), and wild pig (*Sus scrofa*) are the wild ungulates found in Sariska. Other wild prey species found are common langur (*Semnopithecus entellus*), rhesus macaque (*Macaca mulatta*), porcupine (*Hystrix indica*), rufous tailed hare (*Lepus nigricollis ruficaudatus*), and Indian peafowl (*Pavo cristatus*) [19].

Thirty-two villages are located inside the Tiger Reserve, of which 10 are in the notified national park and have been due for relocation since 1984. One village, Bhagani, was relocated during November 2007 from the notified National Park. The majority of the population (87%) inhabiting the villages in Sariska belongs to the *Gujjar* community who are traditionally pastoralists and practice animal husbandry. The estimated livestock population for the entire tiger reserve was 19,132 individuals with 12,098 goats, 5,079 buffaloes, 1,528 cattle and 1,528 sheep [16].

The capture and translocation of tigers

Five adult tigers (3 females and 2 males) were chemically immobilized and radio-collared (VHF-Argos-Satellite) in Ranthambhore from June 23 to July 4, 2008. A mixture of Xylazine and Ketamine (500 mg + 400 mg, HBM) was used as 2.5 ml for females and 3.2-3.5 ml for males. A 250 kg container (length 5' 11", breadth 3' 6.5" and height 3' 10") was fabricated with non-slip wooden planks on the bottom and angle iron frames on sides and top for the transport of the animals. Two small windows were kept on the top of the container and also on two sides of the container for monitoring the animal during transportation and injection of medicaments if needed. Ventilation holes of 25 mm were created at regular intervals all over the container for proper ventilation. Care was taken to keep the container dark from inside so that the animal would remain calm during the transport. A small truck was used to transport the tiger in its container from the site of immobilization to the helipad inside Ranthambhore. An Indian Air Force helicopter (MI-17) was used to transport the tiger from Ranthambhore to Sariska (see photos in section on Implications for conservation).

Among the five tigers immobilized and radio-collared, one adult male and one adult female were selected to be shifted to Sariska. The selected candidates were chemically immobilized in Ranthambhore on June 28 and July 4, 2008, respectively. The captured tigers were kept under sedated condition in a container, and transported to Sariska by helicopter. The air journey from Ranthambhore to Sariska took 45 minutes for both the animals. In Sariska the tiger and tigress were released into a 1 ha enclosure on June 28 and July 4, 2008 respectively. A visual barrier of 2.5 m height was fixed along the enclosure to minimize any stress to the tigers due to movement of people around the enclosure. The tiger was released into the wild after eight days of observation, on July 6, 2008, and the tigress was released into the wild on July 8, 2008, after three days of observation. Thereafter on Feb. 25, 2009, another tigress was chemically immobilized and fitted with VHF radio-collar in Ranthambhore. She was then airlifted and brought to Sariska by Indian Air force MI-17 helicopter following the precautionary protocols as taken for the first two individuals. After arriving at Sariska she was kept inside the 1 ha enclosure for two days. On Feb. 27, this tigress was released into the wild.

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Home range of the re-introduced tigers

The radio-collared tigers were monitored periodically through ground tracking using "homing in" and "triangulation" techniques [20-22]. The satellite data up-linking in both the radio-collars stopped functioning by mid-September, 2008. Thereafter the tigers were tracked only by VHF signals (ground tracking). The Minimum Convex Polygon (MCP) technique was used for home-range calculation [23-25]. The interpretation and comparison of home-range size was also measured by 100% MCP. The use of MCPs was justified because of the sample size in the one-year study period and the temporally clustered nature of fixes that resulted in autocorrelation of results [26]. Accurate analyses using Kernel methods would not be suitable within this data set because it generally requires larger samples with a more even distribution of the locations to maintain accuracy [27]. At the same time the MCP technique is one of the oldest techniques for home-range estimation, comparable between species globally, and its inclusion as one or more methods of range calculation is therefore valuable.

Estimation of prey abundance

Prey species abundance in the study area was estimated by the line transect method under the distance sampling technique [28]. This method has been widely applied to estimate densities of prey species in different forests of the Indian subcontinent [29-34]. In total, 32 line transects varying in length from 1.6 km to 2 km were laid covering 160 km^2 area in tiger- occupied landscapes. The total transects length of 60.4 km were walked three times in early morning resulting in a total effort of 181.2 km. On each sighting of potential prey species on line transects, the total number of individuals, animal bearing, and angular sighting distance were recorded. Program DISTANCE 5 [35] was used to estimate the density of prey species. Prey biomass availability was estimated by multiplying densities of each prey species with their respective body weights [31-33].

Food habits

Diet and food preferences of tigers can be estimated from scat analysis as well as from kills [36-37, 32-34]. Tiger scats were collected whenever encountered during the study period. All the scats were washed, oven-dried and subsequently preserved for future analysis. Micro-histological structures of hairs were used to identify the prey species [32-34, 37, 38-41]. Tiger kills were recorded whenever encountered. The biomass and number of individuals of the prey consumed by tigers was estimated using Ackerman's equation [42] to get a more accurate estimate of prey consumption [31-34]. The assumption for extrapolating of the above equation was that the tigers and cougars (*Felis concolor concolor*) had similar utilization and digestibility [31]. It was also presumed that the scats containing various prey items had similar decay rates and that their detection was equally probable and subject to the same formula as mentioned above [42] to estimate the prey consumption by tigers. Prey selectivity by tigers was estimated for each prey species by comparing their availability and utilization data. The expected proportion of scats in the environment (i.e. availability) was calculated using the following equation [30]: $fi = [(di /dt) * \lambda i]/ \Sigma [(di/dt) * \lambda i]$, where fi= expected scat proportion in the environment, di= density of i^{th} species, dt = sum of density of all species, $\lambda i = X/Y$ = the average number of collectible scats produced by leopards from an individual of i^{th} prey species, X = average body weight of the species, and $Y = 1.980 + 0.035 X$ [42]. Percentage biomass consumption and percentage individual consumption were also estimated using the parameters of percentage occurrence of the prey species in the scats, Ackerman's correction factor, and average body weight of the prey species. The prey selection was also determined by using Ivelev's index [43], $E = (u – a) / (u + a)$, where, 'u' was observed relative frequency occurrence of prey items in predator scats and 'a' was expected scat proportion in the environment.

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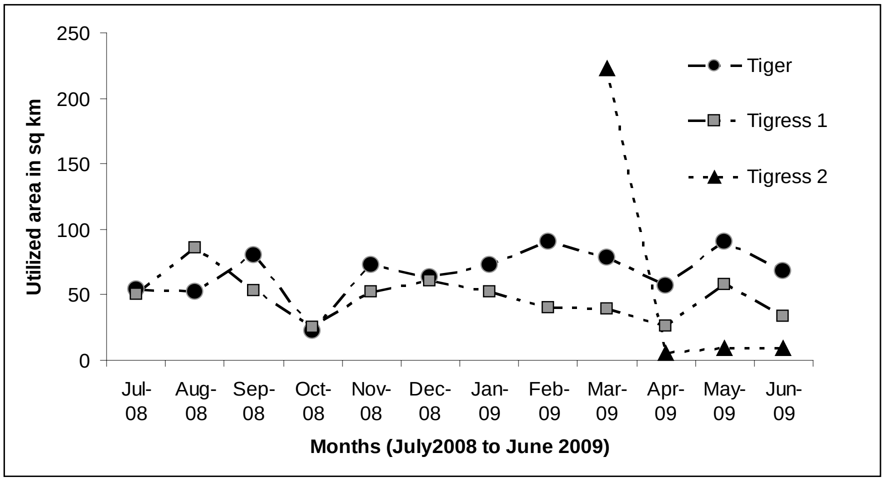

Fig. 1. Month-wise area of utilization of reintroduced tigers in Sariska Tiger Reserve (July 2008 to June 2009). Tigress-2 was reintroduced in March 2009. The tiger utilized a larger area all through the year. Tigress-1 and Tigress-2 utilized large areas soon after reintroduction, but subsequently their home ranges stabilized.

Results

Home range of tigers

It was observed that the tiger and tigress moved in two different directions (tiger toward the south and the tigress toward the north) soon after release into wild. They occupied different areas and did not meet each other till September 2008. In total, 437 locations for tiger, 463 locations for tigress-1, and 229 locations for tigress-2 were obtained using a hand-held Global Positioning System (GPS) (July 2008 to June 2009). These positions were later transferred into the Sariska beat map required for home-range estimation. The utilized areas (in km^2) by the reintroduced tigers month-wise is given in Fig. 1. It was found that all three individuals initially explored large areas soon after their release into the wild, followed by settling down in smaller areas after 2 to 3 months. The monsoon (July 2008 to October 2008) home ranges of the tiger and the tigress-1 were 133.8 km^2 and 151.3 km^2, respectively, and the home-range overlap was 59.4 km^2 (Fig. 2). In winter (November 2008 to February 2009), the home ranges of the tiger and tigress-1 were estimated to be 107.1 km^2 and 81.4 km^2, respectively, with an overlapped home range of 79.9 km^2 (Fig. 3). After having surveyed the new areas in monsoon, the tiger and tigress were settled in the best available habitats in winter with adequate prey base, water availability, and less anthropogenic pressure. The high home-range overlap (79.9 km^2) in winter between the tiger and tigress-1 may be attributed to their pairing and courtship observed periodically. The estimated home ranges in summer (March 2009 to June 2009) of the three tigers were 101.3 km^2 (tiger), 67.2 km^2 (tigress-1), and 223.4 km^2 (tigress-2) (Fig. 4). The largest home range of tigress-2 (223.4 km^2) was attributed to exploration of areas soon after her release into the wild. The home-range overlap between the tiger and tigress-1 in summer was estimated as 67.1 km^2, whereas the overlap between the tiger and tigress-2 was 83.6 km^2. Similarly, the estimated overlapped area between tigress-1 and tigress-2 was 54 km^2. During the first week of April 2009 the tiger located tigress-2 for the first time since its reintroduction and mated with her. The estimated annual home ranges (from July 2008 to June 2009) were 168.6 km^2 and 181.4 km^2 for tiger and tigress-1, respectively, with an overlapped area of 99.04 km^2 (Fig. 5).

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Fig. 2

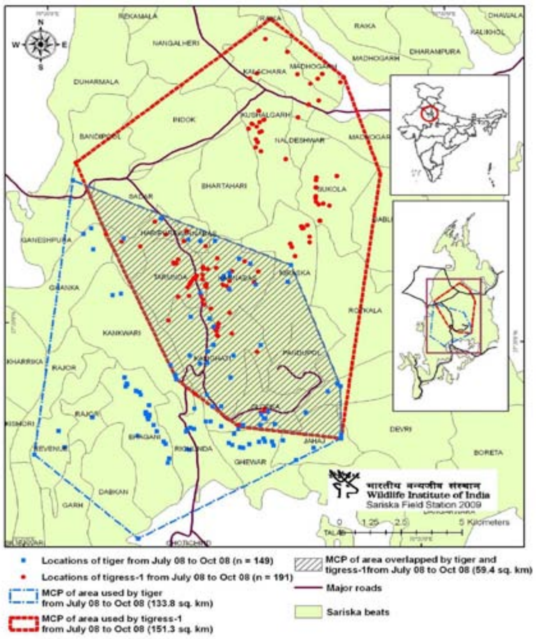

Fig. 3

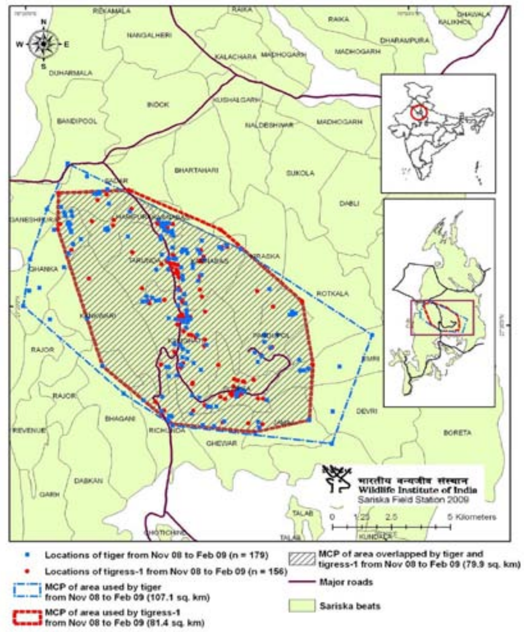

Fig. 4

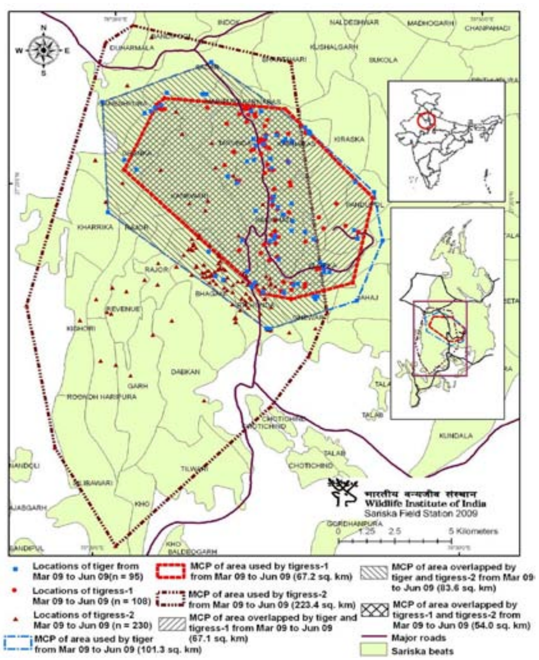

Fig. 5

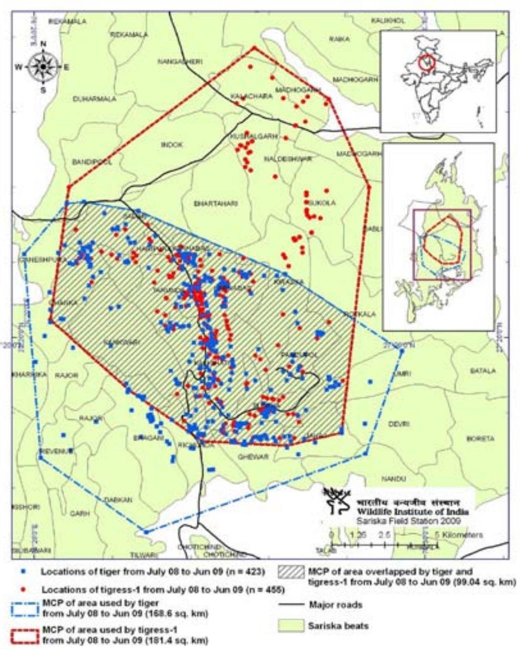

Fig. 2. Monsoon (July 2008 to October 2008) home range of reintroduced tigers in Sariska Tiger Reserve with shaded part showing the overlapped area between the tiger and tigress-1. New habitats were explored by them during monsoon. Fig. 3. Winter (November 2008 to February 2009) home range of reintroduced tigers in Sariska Tiger Reserve. The complete overlap of tigress-1 home range by the tiger was due to pairing and courtship during winter. Fig. 4. Summer (March 2009 to June 2009) home range of reintroduced tigers in Sariska Tiger Reserve. Tigress-2 explored new areas during this period and hence had a larger home range as compared to the other tigers. Fig. 5. Annual home range of reintroduced tigers in Sariska Tiger Reserve (July 2008 to June 2009) with shaded part showing the overlapped area between the tiger and tigress-1.

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Prey abundance

The individual prey densities and mean group size were estimated for all prey species (Appendix 1). The half-normal key function with cosine adjustment was the best-fitted model for density estimation of all prey species. This was selected on the basis of the lowest Akaike Information Criteria (AIC) [28, 45]. The study area was found to harbor a high ungulate density of 107.8 animals/ km^2. The total prey density excluding peafowl was estimated to be 190.5 animals/ km^2. The density of peafowl was found to be the highest among all the prey species (125.2 ± 15.3/ km^2) followed by livestock (buffalo and brahminy cattle) (59.9 ± 22.3/ km^2), chital (46.7 ± 9.5/ km^2), sambar (26.2 ± 4.9/ km^2), common langur (22.8 ± 6.5/ km^2), nilgai (19.5 ± 3.3/ km^2), and wild pig (15.4 ± 4.4/ km^2) (Appendix 1). The total ungulate biomass was estimated to be 10072.8 kg/ km^2. The estimated total biomass of all the potential prey species, including livestock and peafowl was 21618.1 kg/ km^2 (Appendix 1).

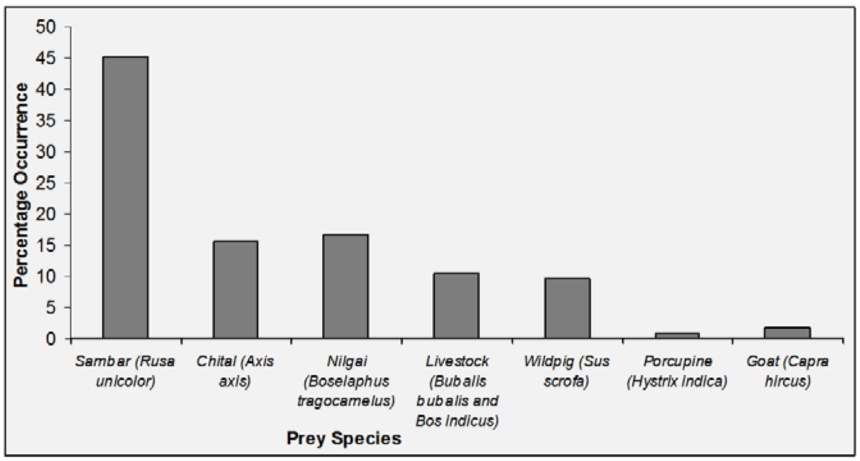

Fig. 6. Percentage occurrence of prey species in tiger diet based on kill data in Sariska Tiger Reserve (n=115)

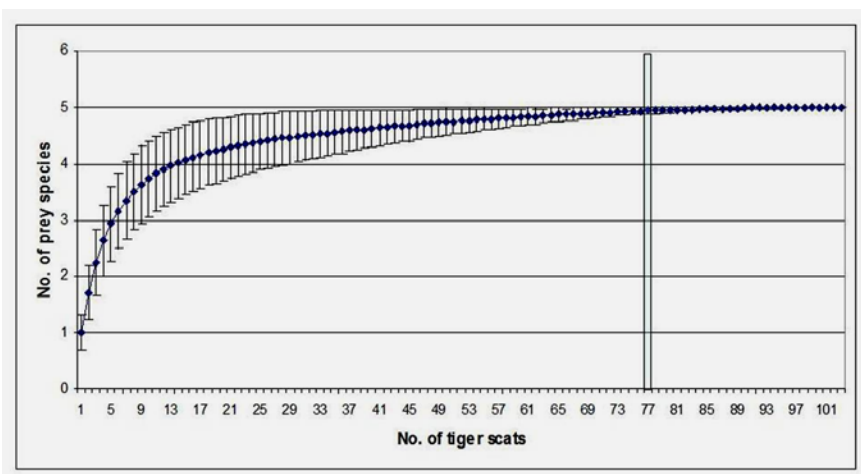

Fig. 7. Scat sample stabilization curve for the reintroduced tigers in Sariska Tiger Reserve.

Food Habits

In total, 115 kills of tigers were recorded. Sambar was found to be the most consumed prey species (45.2%) followed by nilgai (16.5%), chital (15.7%), livestock (buffalo and cattle) (10.4%), wild pig (9.6%), goat (1.7%), and porcupine (0.9%) (Fig. 6). A total of 103 scats of tigers were collected and analyzed during the study period. Presence of five prey species was revealed through the scat analysis. Analysis of 75 to 80 tiger scats was found adequate to stabilize the dietary spectrum of the reintroduced tigers

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in Sariska [EstimateS, 46] (Fig. 7). Scat analysis also revealed that sambar (41.7%) remained as the major prey species for tigers followed by chital (26.3%), livestock (buffalo and cattle) (19.4%), nilgai (10.7%), and common langur (1.9%) (Appendix 2). Although wild pig, porcupine and goat kills by tigers were recorded in the study area, no remains of these species were found in tiger scats. The peafowl density was found to be the highest among the potential prey species in the study area, but their remains were not found in tiger scats. Sambar and chital were the major prey species of the tigers in Sariska before the local extermination of tigers [33, 47]. A similar finding of the dietary pattern of tigers was reported from Kanha [38], Bandipur [40], Rajaji National Park [48], and Ranthambhore [34].

Based on availability of prey species obtained from distance sampling and utilization based on scat analysis, it was found that sambar and chital were preferred prey species by tigers (Appendix 2). The order of prey selection by tiger at the individual species level was in the following order: sambar> chital> nilgai> livestock> common langur. In terms of percentage biomass consumption of prey species by tigers, a similar trend was observed, i.e., sambar was consumed the most followed by livestock, chital, nilgai, and common langur (Appendix 3).

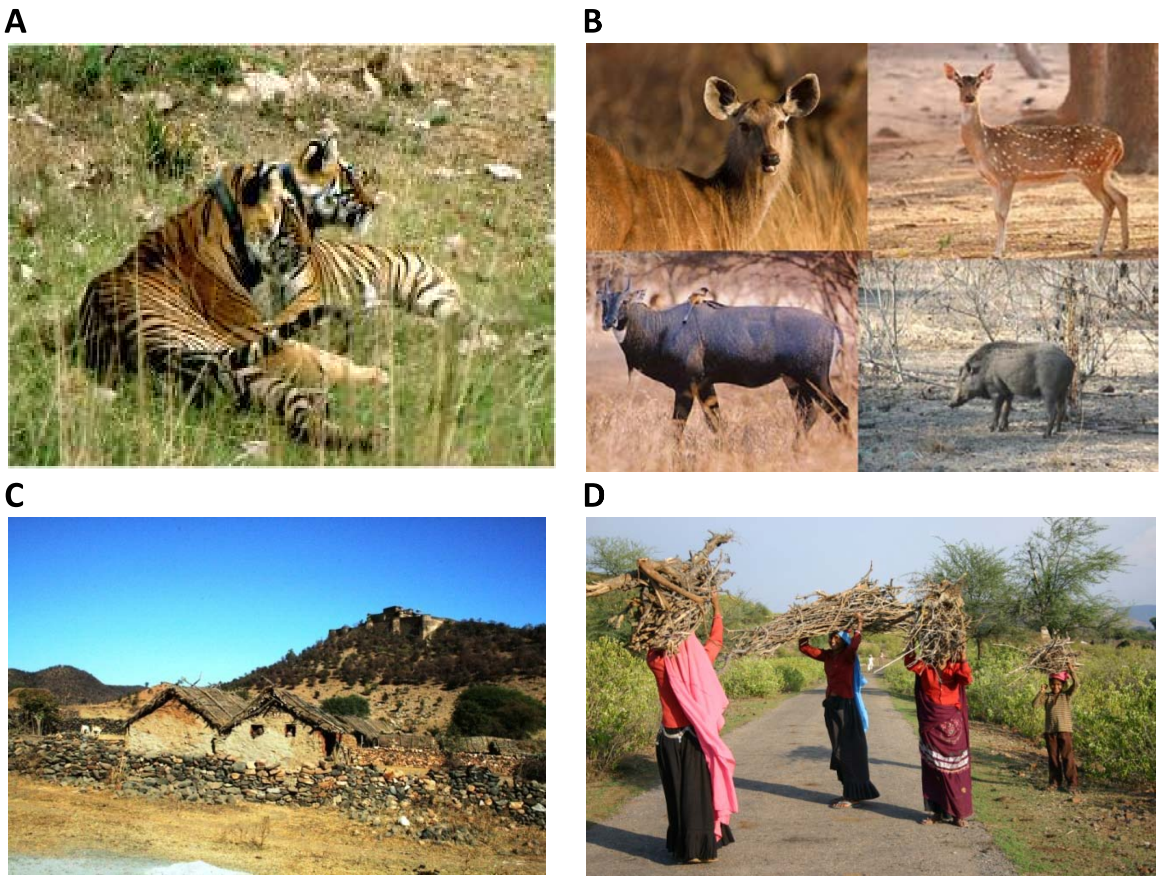

Fig.8. The free ranging tigers (A), wild ungulates (B), Kankwari, one of the villages to be relocated (C) and fuel wood collection by villagers in Sariska Tiger Reserve.

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Discussion

It was observed that all three tigers utilized larger areas, up to 220 km^2 initially soon after the reintroduction (Fig. 8). The reported high annual home range of tigers in Sariska as compared to other studies in the Indian sub-continent [13, 38, 44] (Appendix 4) may be attributed to their initial habitat exploration after reintroduction.

It was [49] reported that the non-sustainable extraction of fuel wood and fodder in Sariska may lead to forest degradation (Fig. 8). Rapid population growth and resultant human activities increase pressures and competition on the limited resources, thus exacerbating conflicts between local communities and the government [50-52], and the resulting conflicts are the biggest hindrances to conservation efforts [53]. A questionnaire survey conducted in all villages in Sariska during 2006-2007 [54] after the tiger extermination revealed that the proposal to reintroduce tigers into the area was found well supported by a majority of respondents from the national park (98%) and the sanctuary (81%). Fifty-eight percent of the national park inhabitants were found readily willing to relocate anytime from the area, contrary to the remaining 42% who were ready to do so only if assured by attractive packages of land, money, and accessibility to basic amenities. Nearly the entire community believed that the tigers play a significant role in the grazing economy through their livestock depredations as they tend to kill the weaker individuals from the stock, thus preventing the spread of diseases among the entire population. Though the present study revealed that domestic livestock (buffalo and cattle) formed a substantial portion (<20%) in the tigers' diet, tigers were not observed killing livestock close to village premises. Only unguarded livestock were killed by tigers in Sariska.

It seems that carnivores are closely tied with prey size, prey biomass, and disturbance factors [55-57]. Prey density is critical for the maintenance of large carnivore populations. Looking at the current socio-political scenario, it is important to maintain core-breeding areas for tigers at landscape level. In any given national park, it is important to maintain mini-cores as a source area for tigers and their prey. In Sariska Tiger Reserve, the Sariska-Pandupole valley and adjoining hills (ca. 100 km^2) is the only area that can be considered as mini-core. The Sariska notified national park (274 km^2) could possibly support 15 tigers (95% confidence interval: 10 to 21) based on the tiger-prey equation [16, 55]. The present wild prey density (Fig. 8) and biomass in Sariska was high and comparable with other tiger reserves such as Ranthambhore, Pench, Nagarhole, Bandipur, and Mudumalai [32, 34, 40-41]. The 10 villages from the notified national park, once relocated, may make a 274 km^2 area available free from biotic interference which can support at least 15 adult tigers [16]. The estimated mean livestock grazing distance from different villages of the national park and the sanctuary was 3.3 km and 3.1 km, respectively, thus leaving only 15% of the area in the whole tiger reserve as undisturbed wildlife habitat [54]. The future of Sariska lies in successful relocation of the remaining 10 villages from the national park (Fig. 8). The successful relocation of *Bhagani* village can set as an example to expedite the entire relocation process. In contrast, the relocation of national park villages, though not easy and even if accomplished in a given time span, does not provide Sariska with a safe and undisturbed wildlife habitat all alone, since the sanctuary villages are much more populated than those of the national park and will continue to exploit the forest resources. To achieve success in making people less dependent on forest resources, implementation of eco-development programs in and around the tiger reserve with the involvement of Non-Governmental Organizations (NGOs) is recommended.

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Fig. 9. Tiger darted at Ranthambhore Tiger Reserve (A), radio-collaring operation at Ranthambhore Tiger Reserve (B), translocation of tiger by helicopter (C) and the tiger released in an enclosure at Sariska Tiger Reserve.

Implications for conservation

As per the proposed plan, two more tigers (male and female) were reintroduced in Sariska during July 2010 for establishing the initial population of five tigers (Fig. 9). The proposed supplementation of three tigers (one male and two females) in every two years for a period of six years and removal of anthropogenic pressure from the national park will be crucial for the long-term survival of tigers in Sariska.

Since the tiger population in the wild is dwindling drastically in its entire distribution range, and since Sariska, which had the western-most distribution of tigers, has seen their complete extinction once, it has grown even more necessary to monitor and study the relevant ecological aspects such as ranging pattern with regard to anthropogenic pressure, food habits, and prey selection of the reintroduced

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tigers. Therefore the outcome of long-term monitoring studies on tigers will be helpful for the park administration to manage this top-most predator and it habitats, and as a whole the complete ecosystem, more effectively.

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Appendix 1. Encounter rate, density, and group size of prey species estimated by line transect sampling in Sariska Tiger Reserve.

Species	Number of animals encountered	Encounter rate/ km	SE	Density/ km^2	SE	Mean group size	SE
Chital (*Axis axis*)	414	0.37	0.06	46.7	9.5	6.02	0.7
Sambar (*Rusa unicolor*)	217	0.44	0.07	26.2	4.9	2.8	0.2
Nilgai (*Boselaphus tragocamelus*)	191	0.41	0.05	19.5	3.3	2.4	0.2
Common langur (*Semnopithecus entellus*)	183	0.11	0.02	22.8	6.5	10.3	1.3
Livestock (*Bubalis bubalis* and *Bos indicus*)	613	0.23	0.06	59.9	22.3	13.5	3.0
Wild pig (*Sus scrofa*)	140	0.14	0.03	15.4	4.4	5.4	1.0
Peafowl (*Pavo cristatus*)	1137	1.23	0.10	125.2	15.3	5.3	0.4

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Appendix 2. Prey selectivity of the reintroduced tigers in Sariska Tiger Reserve, Rajasthan

Species	Observed frequency of occurrence in scats	Density in the wild/ km^2	Ackerman's correction factor	Expected frequency	Ivlev's index (u-a/u+a)
Chital (*Axis axis*)	26.3	46.7 ± 9.5	3.555	15.52	0.26
Sambar (*Rusa unicolor*)	41.7	26.2 ± 4.9	6.355	15.91	0.44
Nilgai (*Boselaphus tragocamelus*)	10.7	19.5 ± 3.3	8.42	15.69	- 0.19
Common langur (***Semnopithecus entellus***)	1.9	22.8 ± 6.5	2.47	5.38	- 0.49
Livestock (*Bubalis bubalis* and *Bos indicus*)	19.4	59.9 ± 22.3	8.28	47.39	- 0.42

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Appendix 3. Biomass and individual prey consumption of the reintroduced tigers in Sariska Tiger Reserve, Rajasthan.

Species	Observed frequency of occurrence in scats	Average body weight (kg)	Percentage biomass consumption	Percentage individual consumption
Chital (*Axis axis*)	26.3	45	15.18	35.03
Sambar (*Rusa unicolor*)	41.7	125	43.19	35.88
Nilgai (*Boselaphus tragocamelus*)	10.7	180	14.68	8.28
Common langur (*Semnopithecus entellus*)	1.9	8	0.76	5.67
Livestock (*Bubalis bubalis* and *Bos indicus*)	19.4	180	26.18	15.10

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Appendix 4. Home ranges of tigers estimated in different protected areas of Indian subcontinent.

Study area	Home Range of tiger				Reference
	Male		Female		
	ID	Area (km^2)	ID	Area (km^2)	
Sariska Tiger Reserve, Rajasthan, Western India	Tiger	168.6	Tigress-1	181.4	Present study (2008-09)
			Tigress-2	223.4	
Kanha National Park, Madhya Pradesh, Central India	-	-	-	65	Schaller (1967)
Royal Chitwan National Park, Nepal	-	-	-	9.3	Seidensticker (1976)
Panna Tiger Reserve, Madhya Pradesh, Central India	M-91	98.25	F-111	50.9	Chundawat (2001)
			F-113	67.5	
			F-118	31.3	
			F-120	35.7	
Pench Tiger Reserve, Madhya Pradesh, Central India	-	-	F1	17	Sankar pers.comm. (2008-2009) (ongoing study)
			F2	27	

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