Home range and resource selection of 'problem' leopards trans-located to forested habitat

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To understand the home range and resource selection of trans-located leopards, two male leopards were captured from conflict areas and released in the Sariska Tiger Reserve, western India (March 2009–August 2010). Both the leopards were fitted with VHF radio-collar, and 148 locations were collected from the first leopard (SP1) and 268 locations from the second (SP2). Third-order resource selection function (resource selection of the individual animal within its home range) was estimated from trans-located leopards using generalized linear mixed effect model with data on vegetation types, elevation, encounter rate of prey species and presence of tiger. With 100% minimum convex polygon (MCP), the estimated home range of SP1 and SP2 was 84.3 and 63.2 km^2 respectively. Both the leopards established their home ranges in and around the Sariska Tiger Reserve. The resource use of these trans-located leopards increased with increasing area of *Zizyphus* mixed forest and *Acacia* mixed forest, and decreased with increasing area of *Anogeissus*-dominated forest. Similarly, they selected habitats with higher encounter rate of wild pig and nilgai, and used less the habitats with high encounter rate of chital and common langur. Finally, it was observed that the 'problem' leopards in this study showed significant positive selectivity to the available natural vegetation types and wild-prey abundance, rather than degraded habitats and domestic prey species.

Keywords: Home range, human–leopard conflict, *Panthera pardus*, radio-telemetry, resource selection.

THE leopard (*Panthera pardus*) is a wide-ranging large carnivore that is less susceptible to disturbance, is a generalist with respect to habitat requirements and can survive on a wide range of prey species[1], yet the species is vulnerable to habitat loss and fragmentation. Unlike the tiger, which needs a high biomass of large-sized prey[2], the leopard has been known to survive on domestic dogs and rodents in the absence of wild-prey populations[3]. Very little information is available on the leopard populations in India by studying their ranging pattern and resource selection for understanding their ecology, behaviour and social aspects as well as their responses to changes in land use and land cover[4].

In the last few decades severe leopard–human conflicts have been reported from different regions of India such as Maharashtra[3,5–7], Gujarat[8], West Bengal–northern part[9] and Himalayan region of Pauri-Garhwal, Uttarakhand[10]. Leopards are also widely distributed in both protected areas and human-dominated landscapes in the Indian subcontinent. They can persist near human settlements by feeding on livestock and domestic dogs[5,11]. According to Athreya *et al.*[5], high tolerance of the people to the presence of large, wild and potentially dangerous animals[12,13] makes it possible for species such as leopards to come close to human settlements to prey on domestic animals. Athreya *et al.*[14] have stated that various reasons have been put forward to explain the increase in man–leopard conflict intensity, such as depletion of the natural prey base and degradation or fragmentation of natural habitat. Beside this, man-made modification of the landscape results in suitable habitat formation for the leopard (e.g. sugarcane, tea plantations; tall crops) and increase in local leopard populations[14]. The leopard–human conflict not only affects humans or livestock, but the leopard population also. The leopard is a Schedule I animal in Wildlife (Protection) Act, 1972, which provides it highest protection in India. Still the killing and illegal trade of body parts of leopard are being reported at a high intensity compared to tiger or other large felids[14].

Several factors like habitat degradation, presence of domestic dogs, non-availability of electricity in rural areas and distance to forest from the villages have been identified as the indicators of conflict in Pauri Garhwal, Himalaya[10]. During a two-year study in Bandipur Tiger Reserve, India, 26% of the leopard kill comprised of domestic cattle and dog[15]. In Majhtal Wildlife Sanctuary, Western Himalayas, leopard largely predated on domestic species (> 50%) despite presence of wild prey species[16]. Leopard is known to feed on carcasses and return to kill made by them, which makes them more susceptible to being poisoned[17]. The present study shows that translocation of leopards from human-dominated areas to forested

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areas could be a better management strategy to mitigate leopard–human conflict. Considering the fact that Sariska Tiger Reserve (STR), Rajasthan holds very high prey base, two leopards were trans-located from conflict areas to STR. Earlier it was reported that Sariska National Park (SNP) area (~ 274 km^2) can support 10–12 tigers[18]. During the present study, there were only five tigers and an established population of 14 leopards in and around SNP area (~ 400 km^2)[19]. Hence, it was assumed that some areas were available for accommodating the trans-located leopards. Leopard–human conflict has been reported throughout South Asia and the 'problem' leopards were rescued from the conflict areas and released back in forested areas in many cases. But, no information is available on habitat use or resource selection of those trans-located leopards after release. In the present study, two leopards were captured from the conflict areas, radio-collared and released in forested areas of STR and an endeavour was undertaken to study their resource selection after release.

Study area

The study was carried out at STR (27°05′–27°45′N and 76°15′–76°35′E) from January 2009 to August 2010. The total area of the Reserve is 881 km^2, of which 273.8 km^2 is a notified National Park. According to Champion and Seth[20], the vegetation of this region falls under tropical dry deciduous forest and tropical thorn forest. The climate is subtropical, characterized by a distinct winter (November–February), summer (March–June), monsoon (July–August) and post-monsoon (September–October). The average annual rainfall is 700 mm, occurring mostly during July–September. The wild ungulates found in Sariska are chital (*Axis axis*), sambar (*Rusa unicolor*), nilgai (*Boselaphus tragocamelus*) and wild pig (*Sus scorfa*). Apart from leopards, other carnivores present are tiger (*Pathera tigris*) and striped hyaena (*Hyaena hyaena*). Small carnivores found are jackal (*Canis aureus*), jungle cat (*Felis chaus*), desert cat (*Felis silvestris*), common mongoose (*Herpestes edwardse*), small Indian mongoose (*H. auropunctatus*), palm civet (*Paradoxurus hermaphroditus*), small Indian civet (*Viverricula indica*) and Ratel (*Mellivora capensis*). Rhesus monkey (*Macaca mulatta*) and common langur (*Semnopithecus entellus*) are the two primates found. Porcupine (*Hystrix indica*) and rufous tailed hare (*Lepus nigricollis ruficaudatus*) are also found in Sariska[18].

There are 32 villages within the Reserve of which 10 are located in the SNP area. In the entire STR, the human population is around 6000 and the livestock population is more than 20,000 (ref. 18). There were 14 major villages inside the home ranges of two trans-located leopards with approximate human population of 8400 and livestock population of 13,500.

Materials and methods

Home range of trans-located leopards

Radio-telemetry technique was used to estimate the home range and habitat use of trans-located leopards. Two male leopards were captured from conflict areas outside the Reserve and released in the forested area of STR to study their home range and resource selection.

The first male leopard (SP1) was captured from a village near Shahpura, 50 km away from STR (Figure 1). On 24 December 2008, the animal strayed into that village probably to kill a goat but got trapped in a small house. The animal was immobilized using N-45 tranquilizing equipment and a HBM mixture of xylazine and ketamine. After capturing, the animal was kept in Jaipur Zoo for three months for treatment. On 27 March 2009, SP1 was again immobilized using the same drug, fitted with Telonics-made VHF radio-collar and released in the study area. The weight of SP1 was 40 kg and estimated age was 2 years 6 months at the time of collaring. The second male leopard (SP2) was rescued from a 96 ft deep dry well in Madhogarh Fort around 100 km from STR[21] (Figure 1). This animal strayed to Madhogarh village from Jamwa Ramgarh Wildlife Sanctuary, which is adjacent to STR. Being chased away by the villagers, it took shelter in Madhogarh Fort inside the village and fell down into an old dry well. After a long effort of 50 h, the animal was rescued from the well by immobilizing using Dist-Inject tranquilizing equipment and a HBM mixture of xylazine and ketamine. The animal (SP2) was fitted with Telonics-made VHF radio-collar and released in the study area on 28 October 2010. The weight of SP2 was around 65 kg and estimated age was 4 years at the time of collaring.

Radio-locations of each collared animal were determined by ground tracking through VHF signal following 'homing in' and 'triangulation' techniques[22]. Four to six locations every week per collared animal were recorded at different times of the day. SP1 was monitored from 27 March to 18 December 2009 (266 days) till the animal died due to unknown liver–lung infection. In total, 148 locations were collected from it. SP2 was monitored from 28 October 2009 to 18 August 2010 (292 days) till the animal was lost due to malfunctioning of radio-collar. In total, 268 locations were collected from it.

Coordinates for all the radio-location points were determined with the help of global positioning system (GPS) and later plotted in Mapsource[23] and ArcGIS 9.2 (ref. 24) to estimate the home range. Two methods of home range analysis were used, i.e. minimum convex polygon method[25] and kernel method[26]. As both the animals were captured outside STR and later released in the study area, they took around two months to explore the area and establish their home ranges in STR. Hence, the locations of initial two months were excluded from the home-range analysis.

Figure 1. The sites of capture of two male leopards (SP1 and SP2) and the site of release in Sariska Tiger Reserve, Rajasthan.

CALHOME[27] and ArcGIS 9.2 (ref. 24) with Hawth's tool[28] and HRT tool[29] were used to estimate the home ranges.

Resource selection of trans-located leopards

Resource selection of trans-located leopards was studied between March 2009 and August 2010 based on their home ranges. The home ranges of each leopard were divided into 2 km × 2 km grids. The percentage available area of different vegetation types, and mean and variance of elevation were extracted from each grid cell (2 km × 2 km) using the land-use/land-cover and SRTM (Shuttle Radar Topography Mission) maps of STR. A multispectral (Landsat 7 ETM+), high-resolution (28.5 m) satellite imagery from the Global Land Cover Facility (http://glcf.umiacs.umd.edu/), NASA, USA, was used to generate a land-use/land-cover map of the study area, which was later validated through ground truth method in various vegetation points along the line transects. One pair of camera traps was placed in each 2 km × 2 km grid to obtain photo-capture rate of other competitor species, i.e. tigers in each grid in the study area. The cameras were operated continuously for 24 h during the entire study period. Twenty-six line transects were laid covering home ranges of both the leopards and walked thrice in summer and winter seasons. The length of the line transects varied from 1.6 km to 2 km and the total effort was 138.6 km each in summer and winter. Encounter rate of prey species in the study area was estimated by line transect method under distance sampling technique and then extracted from each grid (2 km × 2 km). Thus, the data on available vegetation types, elevation, encounter rate of prey species and the presence of tiger were obtained from each grid and based on these data third-order resource selection of trans-located leopards was studied[30].

The third-order resource selection (resource selection of the individual leopard within its home range) of trans-located leopards was estimated through generalized linear mixed effect model (GLMM)[31,32]. All the resource parameters (vegetation types, elevation, encounter rate of prey species and presence of tiger) were chosen as fixed effects and individual leopards were chosen as the random effect for GLMM models. Poisson distribution and log link function were selected based on the number of locations of each individual leopard in each grid for the analysis. The data were analysed in *R* environment using lme4 (ref. 33) and MuMin[34] packages.

Results

Home range of trans-located leopards

As both the male leopards were rescued from outside STR and released inside the Reserve, initially they explored larger areas to establish their new home ranges.

Both the animals took nearly one and half months (45 days) to explore the habitat and settle down (Figure 2). SP1 explored around 96.7 km^2 in the first 45 days after release; similarly, SP2 explored around 223.8 km^2 in the first 40 days after release. Therefore, the locations for initial 45 days were excluded from home-range analysis.

The estimated home range of SP1 with 100% minimum complex polygon (MCP) was 84.3 km^2 and that of SP2 was 63.2 km^2 (Figure 3). The estimation of home ranges with 95% MCP was 66.3 and 42.1 km^2 for SP1 and SP2 respectively. With 95% kernel, the estimated home range of SP1 was 92.5 km^2 and that of SP2 was 47.4 km^2. The home-range estimates with 50% kernel, the core areas within home range, were 12.2 km^2 for SP1 and 4.1 km^2 for SP2. The estimated home ranges with 90% and 50% harmonic mean of both the individuals are given in Table 1.

Resource selection of trans-located leopards

To understand the resource selection of trans-located leopards, 12 models were analysed in combination with different habitat types, encounter rate of wild prey species and livestock, elevation and encounter rate of tigers (Table 2). A correlation test was done amongst all the resource variables. The *Butea*-dominated forest and barren land were found to be significantly correlated

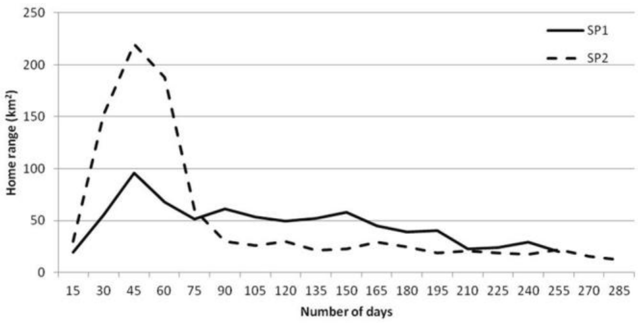

Figure 2. Estimation of home ranges of the two leopards every 15 days after being released into the forested habitats.

Table 1. Estimation of overall home range of leopard using different methods in Sariska Tiger Reserve between 2009 and 2010

Methods	SP1*	SP2*
100% MCP	84.3	63.2
95% MCP	66.3	42.1
90% MCP	58.9	35.0
95% Kernel	92.5	47.4
90% Kernel	72.4	25.9
50% Kernel	12.2	4.1
90% Harmonic mean	58.7	27.6
50% Harmonic mean	9.4	3.5

*Home range in km^2.

(P = 0.796 and 0.891 respectively) with *Zizyphus* mixed forest and scrubland respectively and hence they were excluded from the aforementioned models. The model with habitat variables (excluding *Boswellia*-dominated forest) and wild prey species (excluding peafowl and sambar) was top-ranked based on lowest Akaike Information Criterion (AIC), but no single model best explained patterns of resource use by leopards in the study area (Table 2). The differences between AIC values were less than four for the top-three models, which were averaged to obtain the best explained estimate. The model-averaged importance value for each parameter is given in Table 3.

The *Acacia* mixed forest influenced most positively ($P = 4.61e^{-07}$) amongst the habitat variables explaining resource use of the trans-located leopards followed by *Zizyphus* mixed forest ($P = 2.00e^{-16}$). For instance, the leopard's use of an area increased by a factor of 1.06 and 1.04 (log-transformed estimates) with unit increase of *Acacia* mixed forest and *Zizyphus* mixed forest respectively (Table 3). *Anogeissus*-dominated forest (P = 0.014) and scrubland ($P = 2.88e^{-05}$) had negative influence in explaining resource use by the trans-located leopard in the study area. Leopard's use of an area decreased by a factor of 0.99 and 0.98 with unit increase of *Anogeissus*-dominated forest and scrubland respectively. These two leopards significantly used more habitat with higher encounter rate of nilgai ($P = 5.67e^{-09}$) and wild pig (P = 0.009) and used less habitats with higher encounter rate of chital (P = 0.019) and common langur (P = 0.006). Leopard's use of an area increased by a factor of 1.08 and 1.01 with unit increase in encounter rate of nilgai and wild pig respectively. Subsequently, leopard's use of an area decreased by a factor of 0.87 and 0.95 with unit increase in encounter rate of chital and common langur respectively. Encounter rate of tiger had a negative correlation with resource use of trans-located leopards, but it was not found significant.

Discussion

Leopards are endangered in Southeast Asia and yet little is known about their resource necessities which are to be secured for long-term conservation. The present study used radio-telemetry to investigate home-range size of trans-located 'problem' leopards in STR. Like all large carnivores, leopards maintain home ranges that must be large enough to provide them with sufficient prey year round. The land tenure system of leopards is broadly similar to that of many other cats and adult males typically occupy large areas that overlap with home areas of one or more adult females. Female ranges are usually smaller than those of males[35,36]. In semi-arid areas like STR or other sites of low primary productivity, the home-range sizes of leopard are much larger and range overlap

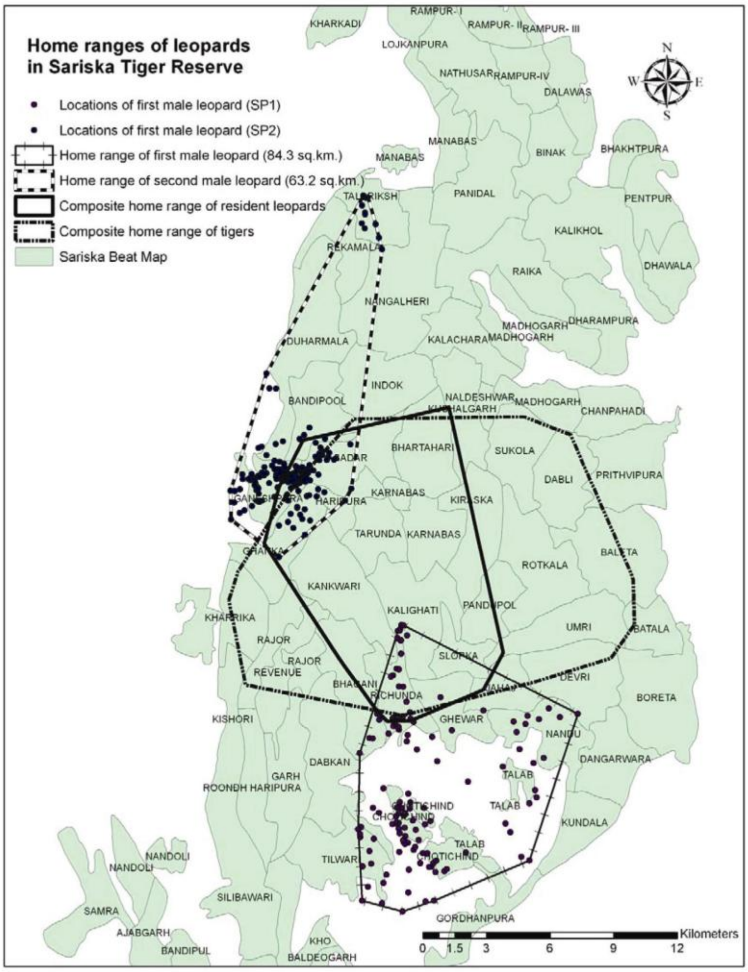

Figure 3. Home ranges (MCP) of radio-collared leopards in Sariska Tiger Reserve between 2009 and 2010.

for the same-sex animals is more common[37]. In the Israeli desert[38], female home ranges averaged 84 km^2 whereas those of males measured 137 km^2. Two adult females in the Russian Far East[39] had ranges between 33 and 63 km^2 and an adult male home range was 280 km^2. In northeastern Namibia[40] male ranges were even larger (mean = 451 km^2; range 210–1164 km^2), and female ranges measured 183–194 km^2. Jenny[37] placed radio-collars on one male and two female leopards in the Taï NP, Ivory Coast, and found that the home range was 86 km^2 for a male, and 29 and 22 km^2, respectively, for the two females.

In the present study, the home range of leopard was estimated following different estimators, such as MCP (100%, 95% and 90%), adaptive kernel (95%, 90% and 50%) and harmonic mean (95%, 90% and 50%). But the estimate using 100% MCP method was considered for comparing home range of trans-located leopards in the present study with other available studies in Africa and Southeast Asia (Table 4). It was found that the leopard home ranges estimated in the study area were larger than in many other areas (Table 4). Estimates from various regions were made using a variety of techniques, which probably accounts for a large degree of variation, but even when analyses were restricted to those made using the 100% MCP technique, estimates of home range size of leopard varied from 9.8 to 451 km^2. These studies were conducted in a variety of habitats, with large variation in prey abundance, different rainfall regimes, as well as disparities in other factors such as whether the study was conducted in a protected area and whether larger sympatric carnivores coexisted in the area. The reported home ranges of leopard in tropical forest are smaller than those in the dry deciduous forest or savanna forest[41–44]. Most of the African studies reported larger home ranges for leopards in woodland savanna or dry thorn forest[35,40,45–48]. The home range estimate in the present study was similar to those in African studies as the habitat of STR falls under dry deciduous forest (with some savanna patches) and dry thorn forest.

In the present study, habitat use of trans-located leopard was determined by its trajectory, sub-sampled by radio locations. Since the study was based on direct accidental conflict between humans and leopards, which involves capturing of the ‘problem’ leopards from conflict locations, release into forested areas and subsequent monitoring, determination of required sample size was

Table 2. Model selection statistics of generalized linear mixed model (GLMM) analysis for resource selection of trans-located leopards in STR (2009–2010)

Models in GLMM	*K*	AIC	ΔAIC
(la + ni + wp + ch + ziz + scrb + aca + ano)	8	307.0807	0
(la + ni + wp + ch + ziz + scrb + aca + ano + tiger)	9	307.6718	0.5911
(pe + la + ni + wp + ch + ziz + scrb + aca + ano + tiger)	10	309.6696	2.5888
(pe + la + ni + wp + sa + ch + ziz + scrb + aca + ano + bos)	11	311.1797	4.0990
(pe + la + ni + wp + sa + ch + ziz + scrb + aca + ano + tiger)	11	311.3301	4.2494
(pe + la + ni + wp + sa + ch + ziz + scrb + aca + ano + bos + tiger)	12	311.8580	4.7773
(pe + la + ni + wp + sa + ch + livs + ziz + scrb + aca + ano + bos + tiger)	13	312.0693	4.9886
(pe + la + ni + wp + sa + ch + livs + ziz + scrb + aca + ano + bos)	12	312.2868	5.2061
(pe + la + ni + wp + sa + ch + livs + ziz + scrb + aca + ano + bos + demcv)	13	314.2867	7.2061
(ziz + scrb + aca + ano + bos)	5	355.1378	48.0571
(tiger)	1	464.5915	157.5108
(demcv)	1	465.7565	158.6758

K, Number of parameters; pe, peafowl; ni, nilgai; la, common langur; wp, wild pig; sa, sambar; ch, chital; livs, livestock; ziz, *Zizyphus* mixed forest; scrb, scrubland; aca, *Acacia* mixed forest; ano, *Anogeissus* dominated forest; bos, *Boswellia* dominated forest; demcv, elevation; Tiger, encounter rate of tiger.

Table 3. Most influential model-averaged parameter estimates from the top models (< 4 AIC) explaining resource selection of trans-located leopards in Sariska Tiger Reserve (2009–2010)

Parameters (fixed effects)	Estimate $\beta \pm$ SE	Log-transformed estimate	*Z* value	Significance (*P* value)
Acacia mixed forest	0.062 ± 0.012	1.063962	5.042	$4.61e^{-07}$
Anogeissus-dominated forest	–0.007 ± 0.003	0.993024	–2.448	0.014
Zizyphus mixed forest	0.034 ± 0.003	1.035413	8.769	$2.00e^{-16}$
Scrubland	–0.018 ± 0.004	0.982161	–4.182	$2.88e^{-05}$
Chital	–0.137 ± 0.063	0.87197	–2.332	0.019
Common langur	–0.041 ± 0.015	0.959829	–2.734	0.006
Nilgai	0.084 ± 0.014	1.087629	5.826	$5.67e^{-09}$
Peafowl	–0.001 ± 0.028	0.999	–0.048	0.961
Wild pig	0.011 ± 0.004	1.011061	2.577	0.009
Tiger	–0.087 ± 0.075	0.916677	–1.162	0.245

SE, Standard error.

not governed by the authors. Though in many areas, problem leopards have been trans-located from conflict areas to forested areas, no literature is available on home ranges and resource selection of trans-located leopards. The present study documented ranging pattern and resource selection of leopards which are trans-located from conflict areas and have successfully established their home ranges in and around forested areas.

Before the release of these two male leopards, five tigers (two males and three females) were re-introduced in the SNP area. Though both the leopards were initially released in the tiger-occupied area in SNP, later they established their home ranges outside the tiger-occupied areas of STR. Since both the leopards were rescued from conflict areas, they were more familiar with human-dominated landscapes. Even after establishment of their home ranges, a proportion of their home ranges was found outside the protected area. The annual home range of SP1 was calculated to be 84.3 km^2 (100% MCP), out of which 47.8 km^2 was found outside forested areas. Similarly, the estimated annual home range of SP2 was 63.2 km^2 (100% MCP), out of which 6.8 km^2 was found outside forested areas. Although parts of the home ranges of both trans-located leopards were found outside forested areas, less than 20% locations were found outside the forest. The part of the home ranges of both the leopards found outside the forested areas comprised of largely barren lands, scrubland and sparse human settlements. The prime habitat in SNP was occupied by tigers and resident leopards. The trans-located leopards, probably being pushed off by tigers and resident leopards, established their home ranges in the peripheral areas of STR, which are comparatively inferior habitats in terms of prey base and anthropogenic disturbances (Figure 3). In general, both the leopards significantly ($P < 0.001$) selected *Zizyphus* mixed forest and *Acacia* mixed forest in the periphery of STR, which showed a disparate observation to other conflict studies[10]. In the periphery of STR, distribution of *Zizyphus* mixed forest and *Acacia* mixed forest is scattered along with scrubland and barren land. The total area of *Acacia* mixed forest and *Zizyphus* mixed forest together is less (15%) in the total available habitat in home ranges of both the animals, but it was used more than its availability, thereby influenced most in the resource selection of trans-located leopards in the study area. Amongst the prey species of leopard, presence of

Table 4. Home range of leopards in different study sites

Study area	Habitat type	Method	Mean home range size (male; km^2)
Present study, Sariska TR, India	Dry deciduous/thorn forest	100% MCP	73.8
KaengKrachen NP, Thailand[44]	Forested hills	100% MCP	17.7
Kaudom Game Reserve, Namibia[40]	Woodland savanna	100% MCP	451.2
Kruger NP, South Africa[35]	Woodland savanna	100% MCP	76.2
Cape Province, South Africa[47]	Fynbos/plantation	100% MCP	388
Tai NP, Ivory Coast[32]	Tropical forest	100% MCP	85.6
Waterberg Plateau Park, Namibia[46]	Thornbush savanna	100% MCP	118.7
Hula KhaKueng WLS, Thailand[41]	Dry tropical forest	–	32
Kalahari Gemsbok NP, SA[45]	Desert/grassland	95% Kernel	2182
Nagarhole NP, India[42]	Tropical forest	95% MCP	21.7
Serengeti NP, Tanzania[48]	Plains/woodland	Sightings	57.5
Sabie River, Kruger NP, SA[35]	Woodland savanna	100% MCP	27.7
Wilpattu NP, Sri Lanka[43]	Tropical forest/scrubland	–	9.5

nilgai and wild pig influenced positively the resource selection of trans-located leopards, as both the ungulates species occur in high densities in *Zizyphus* mixed forest and *Acacia* mixed forest in the periphery of STR and near the village areas. Chital influenced negatively the resource selection of trans-located leopards, as chital mostly occur in *Zizyphus* mixed forest in the valley habitat of SNP, which was less used by these trans-located leopards. The abundance of chital and sambar is low in the peripheral areas of STR[28], where the trans-located leopards established their home ranges. In contrast, the resident leopards inside STR preferred *Boswellia*-dominated forest and *Anogeissus*-dominated forest inhabited by large number of sambar and chital[49]. Forty-one scats were collected from the two trans-located leopards, which revealed that nilgai was the most dominant prey item (20%) followed by peafowl (18%), goat (18%), cattle (14%), wild pig (11%), sambar (11%) and chital (7%). Common langur influenced negatively the resource selection of trans-located leopards, which can be attributed to the low abundance of the former in those areas. Though there were few villages inside the home ranges of both the leopards, encounter rate of livestock could not define the resource selection of trans-located leopards; hence they were not selected in the top models in GLMM. In contrast, the resident leopards inside STR significantly selected habitat with less encounter rate of livestock[49]. The trans-located leopards showed negative correlation with tiger encounter rate for the selection of resources, but it was not statistically significant. Leopard–human conflict study in Pauri-Garhwal showed that the scrubland area was highest in proportion among the entire land-use/land-cover patterns across the conflict areas[10,50]. It was estimated that the habitat utilization pattern by leopard and wild prey was mostly similar and therefore, the encounters of leopards with humans and domestic prey were not deliberate from the leopard's point of view as natural forested habitat was altogether least available in that region[50].

The present study shows that the 'problem' leopards trans-located from conflict areas to forested areas established their home ranges in and around STR. The resource use of these trans-located leopards increased with increasing area of *Zizyphus* mixed forest and *Acacia* mixed forest and decreased with increasing area of *Anogeissus*-dominated forest. Similarly, they selected habitats with higher encounter rate of wild pig and nilgai and used less the habitats with high encounter rate of chital and common langur. Finally, it was observed that the 'problem' leopards in this study showed significant positive selectivity to the available natural vegetation types and wild-prey abundance, rather than degraded habitats and domestic prey species.

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