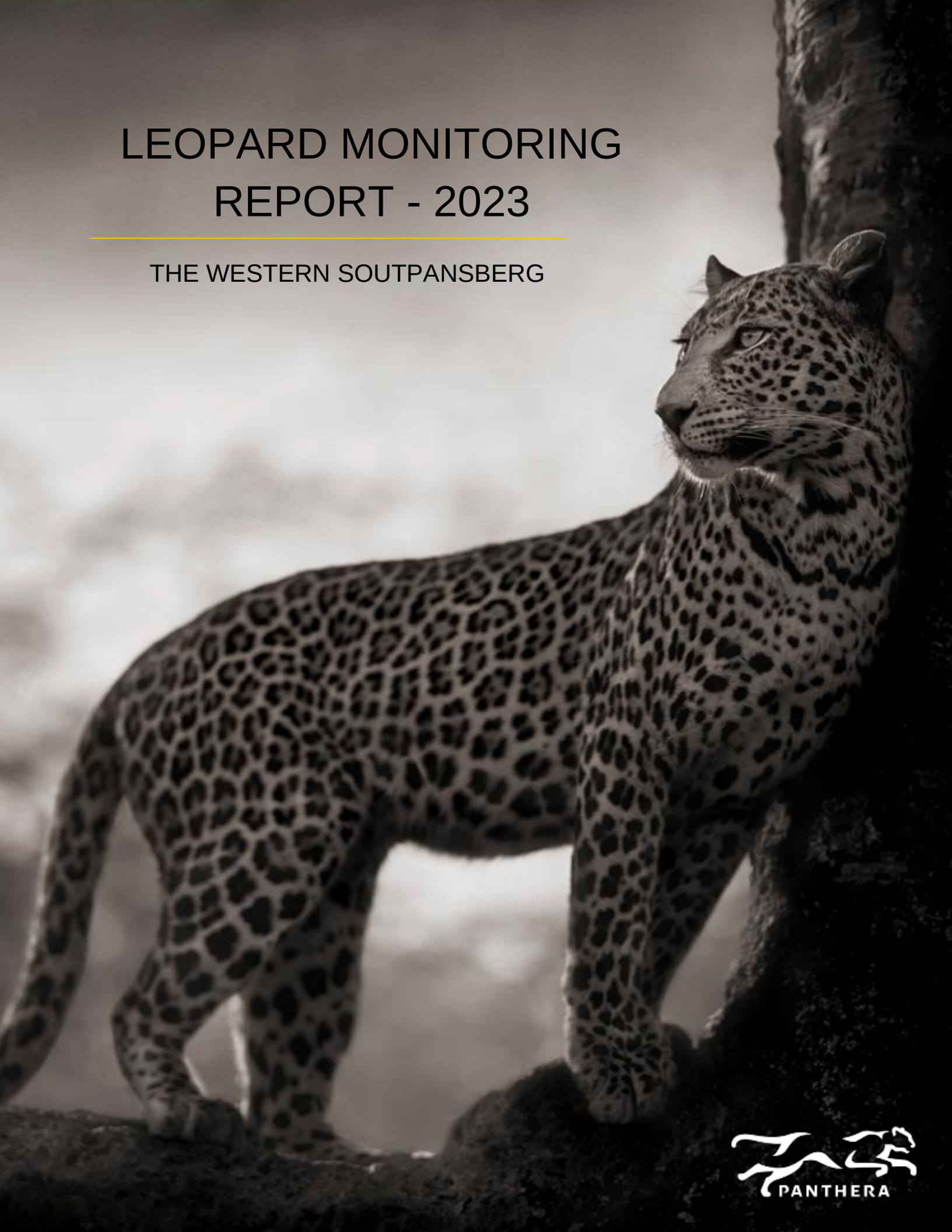
LEOPARD MONITORING REPORT - 2023

THE WESTERN SOUTPANSBERG



PANTHERA

SOUTH AFRICA LEOPARD MONITORING PROJECT

WESTERN SOUTPANSBERG CAMERA-TRAP SURVEY 2023

Sean Morar, Lauren Foden, Annie Basson, Rebecca Garbett*

* *rgarbett@panthera.org* (Corresponding author)

INTRODUCTION

The South African Leopard Monitoring Project aims to provide robust data on leopard population trends in South Africa to inform conservation policy and management. The survey spanned across several properties on the northern and southern sides of the mountain with the operations base being at the Primate and Predator Project field office at Medike Nature Reserve. This is the ninth survey covering the Western Soutpansberg area, since the initial survey in 2014.

METHODS

We deployed paired camera stations at 39 locations for a total of 52 days. To ensure all individuals within the sampled areas had a probability > 0 of being captured, camera-traps were distributed an average of 1.5 km from one another. To maximize the probability of photographing leopards, camera-traps were placed in high-use areas, such as drainage lines, animal paths, and roads. Camera-traps were mounted on trees or steel poles located 2–4 meters from the focal movement pathway. To reduce false photographic captures, we cleared any vegetation that might obstruct the camera-trap's field of view. Battery life in camera-traps require that cameras are visited at least between once a week or once every two weeks to be serviced: for batteries to be changed, date and time to be reprogrammed to GPS time, and for images to be downloaded.

Camera-trap images were catalogued using Panthera's Integrated Data Software, PantheraIDS, a custom-built camera trap data processing package, within the R Statistical Environment (R Core Team, 2020). Unique leopard identities were obtained through the recognition software in PantheraIDS, which compares and analyses the pelage patterns of all photographed leopards. All computer-assisted identifications were manually verified and, where possible, the sexes of the uniquely identified individuals were determined.

Spatially-explicit capture-recapture models

All Spatial Capture-Recapture (SCR) models were fit using the package secr 3.20 (Efford, 2019) using the Nelder-Mead optimisation method and a half-normal detection function. The models included a measure of effort through a matrix of camera station activity, where active stations were represented with a '1' and inactive stations with a '0' for each 24-hour sampling occasion during the survey. A camera station was "active" if at least one of the pair of cameras at a camera station was operational. Sampling effort was thus measured as the total number of trap days during which at least one camera at each station was active. To account for sex-specific capture heterogeneity (Sollmann et al., 2011), we also included leopard sex as a covariate, affecting both baseline detectability (g0) as well as the sigma parameter of the detection function in the models. As the sex of some individuals could not be reliably determined, sex was modelled as a partially-observed latent mixture. We produced a leopard habitat layer at 0.25 km^2 resolution using a 15-km buffer from the outermost trap locations (15 km is recommended as a suitable buffer for wide-ranging species such as leopards; (Gopalaswamy et al., 2013), using the South African National Biodiversity Assessment land cover data (Skowno 2018). Any grid cells in which more than 50% of the surface area was classified as 'built up' or 'open water' were deemed to be unavailable to leopards.

Accounting for over-estimation of leopard density

The ideal identification for an individual leopard is when both flanks are known to be from the same animal. Often there are right flanks and left flanks of individuals which cannot be matched up to each other and it is unknown whether these are many separate individuals or a few individuals for which the flanks have not yet been matched up. To avoid overestimating leopard density, we use the Integrated Data Software, Panthera IDS, to determine which group of individuals with unmatched flanks (the group with *only* left flank photographs or the group with *only* right flank photographs) have the fewest individuals, and the individuals in this group are removed from the analyses.

In addition to estimating population density, we assessed the demographic composition of the sampled population. We estimated the age and sex of captured leopards using their relative body dimensions, the presence of a well-developed dewlap, and facial scarring (Balme et al., 2012). We classified leopards into three age classes: juveniles (≤ 2 years), subadults (>2 years; ≤3 years) and adults (>3 years). For adult males, we distinguished between individuals less than seven years and seven years or older.

RESULTS

The total area covered by camera-trap stations in Western Soutpansberg amounted to around 178 km^2. The survey ran from the 7th of March 2023 to the 27th of April 2023, and sampling effort comprised 1,932 camera-trap days.

Leopards were photographed at 79% of camera-trap stations (31 stations, Fig. 1).

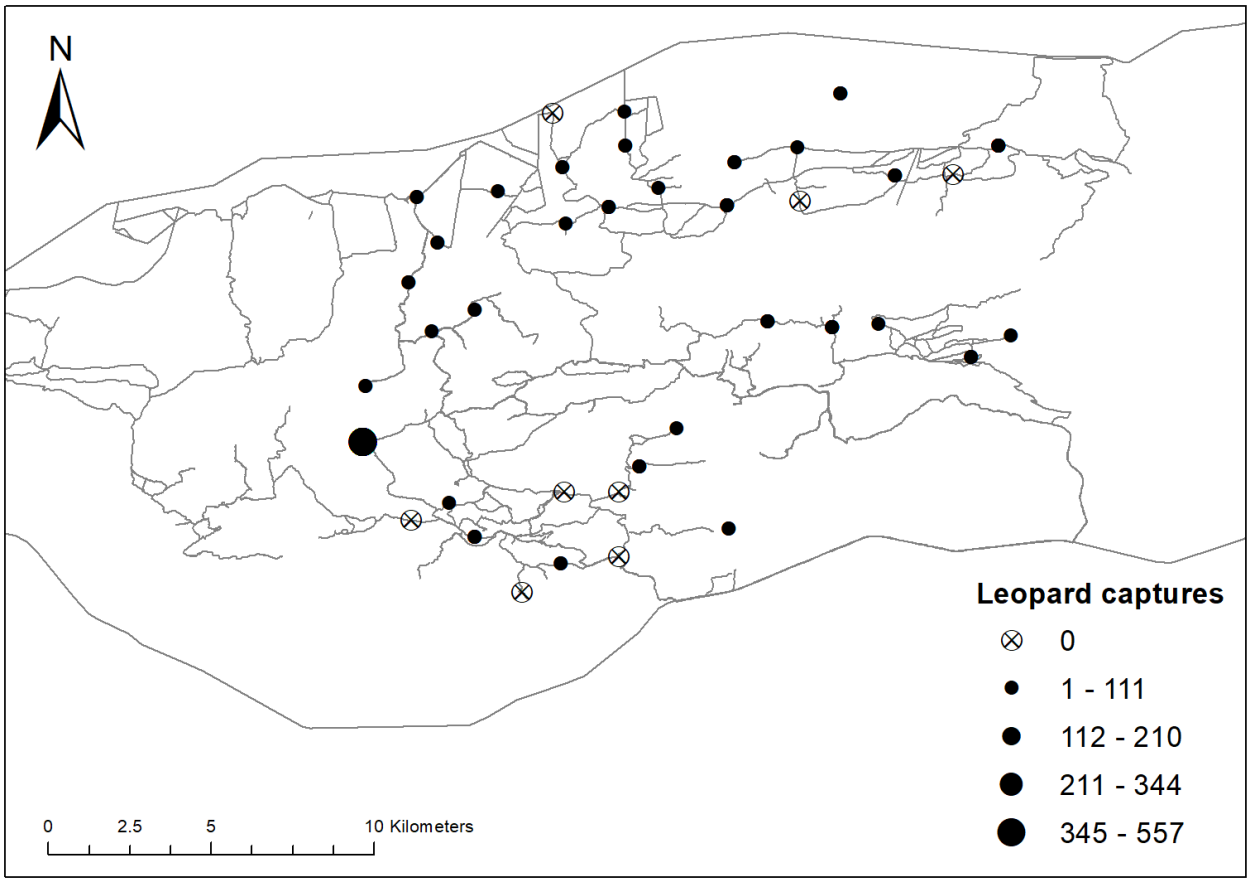


Figure 1. Leopard capture frequencies recorded at camera-trap stations in Western Soutpansberg during the 2023 survey. Larger circles indicate greater leopard activity.

We identified twenty-five individuals based on 713 captures during the survey period ("capture" referring to a leopard being photographed by a camera), with 544 of these being of one individual (female 667). Of the twenty-five individuals identified, fifteen were classed as adult females and four as adult males below

seven years of age. An additional two males were classified as being above seven years of age, two as sub adults of unknown sex, and two for which neither sex nor age could be reliably ascertained; Fig.2).

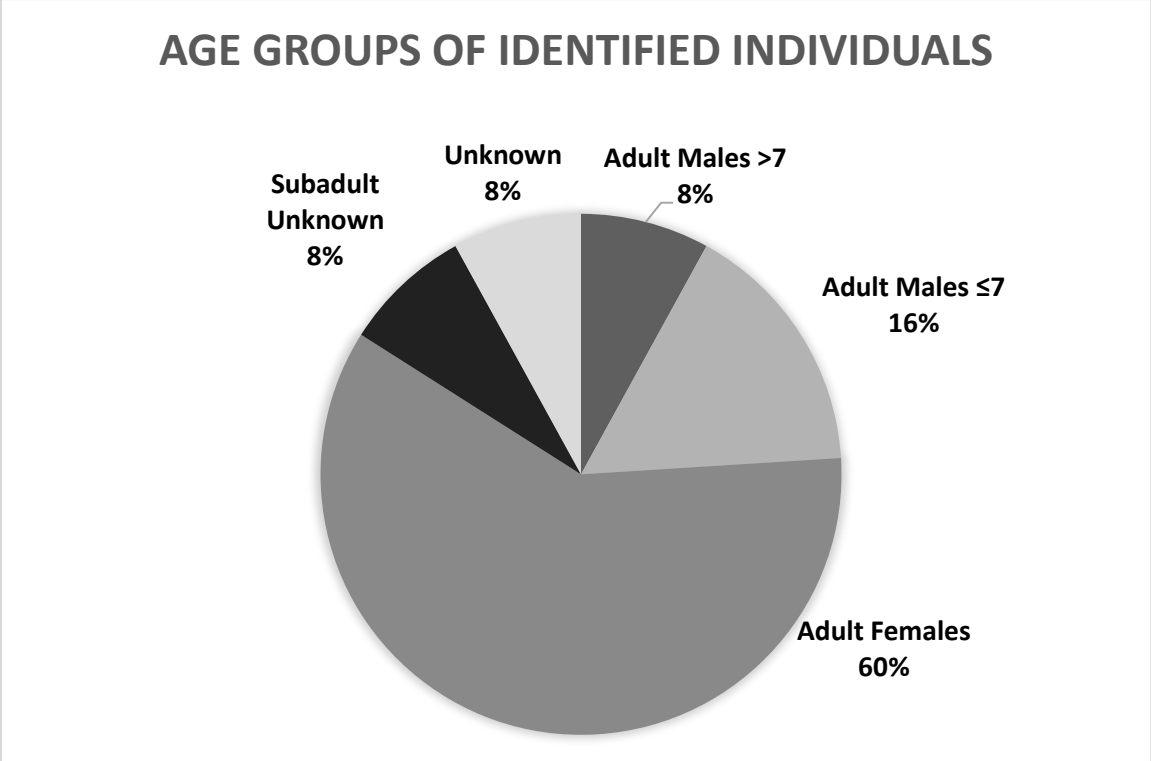


Figure 2. Proportional composition of leopard age-sex classes for Western Soutpansberg from the 2023 camera-trap survey.

Spatially-explicit capture-recapture analysis estimated the population density to be 4.7 ± 1.1 leopards per 100 km^2 for 2023. This is a decrease from the 2022 estimate of 7.2 ± 2.1 leopards per 100 km^2.

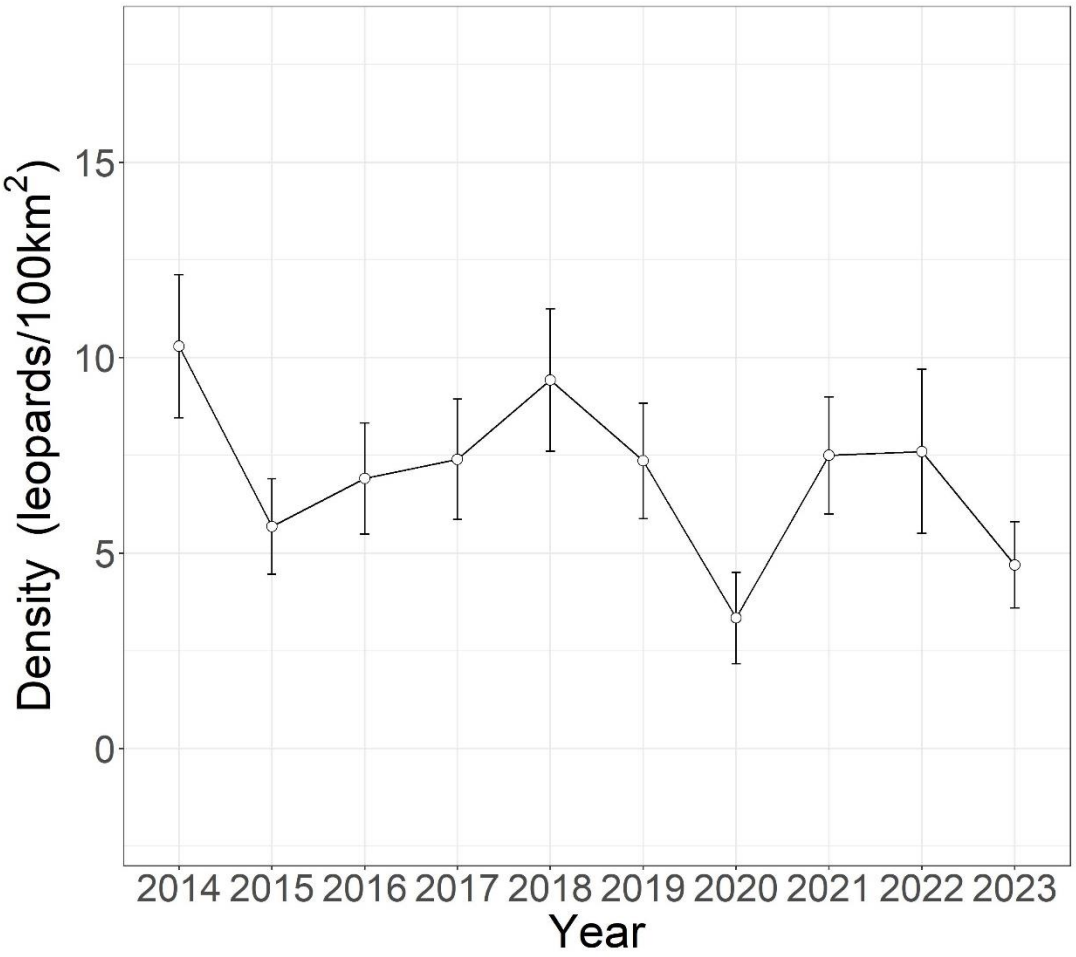


Figure 3. Leopard density estimates for Western Soutpansberg. All estimates were calculated using the package *secr* with a Maximum-Likelihood approach.

DISCUSSION

The 2023 leopard density for Western Soutpansberg is substantially lower than that for 2022 (4.7 ± 1.1 vs 7.2 ± 2.1 respectively), with an increase in precision for the 2023 estimate (smaller standard error). The 2023 estimate is the second lowest estimate of all surveys in the Western Soutpansberg since 2014, with the lowest being the one for 2020, which may have been influenced by a decrease in data due to the impact of COVID-19 on running the survey that year. With this in mind, the 2023 estimate is concerning, particularly given that it shows such a steep decline from the previous two years.

Interestingly, there were captures at more stations in 2023 (28 in 2022 vs 31 in 2023), with noticeably less gaps in captures at stations in the north of the survey area. The capture frequency for 2023 was significantly affected by the amount of individual captures of one particular individual, female 667, which constituted 544 (76%) captures of the 714 total captures. The spread of stations that had leopard captures in 2023 is more comparable with the pattern of captures from the 2021 survey, with captures having decreased across the southern section of the survey in 2022, suggesting a potential shift in space use. However, these subtle potential changes in movement behaviours are not unusual within any leopard population.

The 2022 and 2023 demographic survey data are highly comparable, with both showing a relatively stable sex ratio. The number of adult females in both years has constituted the largest proportion of the population (>70%), which has consistently been the case for the Western Soutpansberg surveys each year (aside from 2020). The number of adult males >7 years old has also been much the same across years apart from for the 2021 survey, where the number was a lot higher than any other year. Interestingly, this year (2021) also produced the highest number of adult females of all surveys. Despite the slight fluctuations in age class of individuals across years, the Western Soutpansberg surveys show relative stability in the population structure, and also indicate that the overall population health is good, with consistently more adult females compared with males. Looking briefly at the individual captures from the 2022 and 2023 surveys, four adult females were captured during both surveys, but there were no recaptured males. It would be interesting to look back across more survey years to identify recaptures over the longer term. This would provide deeper insights into population stability and broader landscape dynamics.

Continual long-term monitoring will provide more insights into the state and stability of the leopard population in Western Soutpansberg, which is particularly important with the observed decline in the density estimate this year.

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APPENDIX 1: SUMMARY OF SPECIES CAPTURES DURING THE 2023 SURVEY IN WESTERN SOUTPANSBERG

Species	Captures	Species	Captures
Aardvark	30	Impala	3589
Antelope_Sable	29	Insect_Unspecified	305
Baboon_Chacma	15478	Jackal_Black_Backed	24
Badger_Honey	73	Klipspringer	156
Bat_Unspecified	38	Kudu_Greater	1888
Bird_Unspecified	1347	Leopard_African	713
Buffalo_African	2154	Mongoose_Banded	128
Bushbaby_Greater	33	Mongoose_Slender	151
Bushbaby_Lesser	6	Mongoose_Unspecified	1
Bushbuck	1156	Mongoose_Water	6
Bushpig	78	Mongoose_White_tailed	9
Caracal	10	Monkey_Samango	30
Cat_Unspecified	1	Monkey_Vervet	275
Civet_African	189	Nyala	418
Domestic_Cat	12	Porcupine_Cape	667
Domestic_Dog	62	Rabbit_Jamesons_Red_Rock	82
Domestic_Horse	132	Reedbuck_Southern	3
Duiker_Grey	256	Rodent_Unspecified	14
Duiker_Red	116	Springhare	118
Eland	116	Squirrel_Tree	28
Fox_Bat_Eared	3	Warthog	705
Gemsbok	29	Waterbuck	387
Genet_Large_Spotted	263	Wildcat_African	3
Giraffe	1986	Wildebeest_Blue	726
Goat	383	Zebra	770
Grysbok_Sharpes	11	Warthog	705
Hare_Scrub	83		
Hippopotamus	14		
Hyaena_Brown	84		
Hyaena_Spotted	3		
Hyrax_Rock	3		

* Blank, unclassified, and vehicle captures have been omitted