- Black-footed Cat Working Group -
Report on monitoring Black-footed cats (*Felis nigripes*) on Benfontein Nature Reserve, South Africa and Grünau Farms, Namibia in 2023

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Introduction:

The Black-footed Cat Working Group (BFCWG) aims to conserve this rare cat species by furthering awareness and conducting multidisciplinary research on the species biology. The BFCWG owns a research vehicle (Ford Ranger 2.6 l) which is insured, and its running and maintenance costs are covered through a dedicated Non-Profit Company since 2019. The specialised equipment required for our research is stored at the McGregor Museum, Kimberley, Northern Cape Province.

In 2023 no captures were performed in the two study areas to exchange the radio collars of individual black-footed cats (BFC) in the current long-term study area, Benfontein Nature Reserve (BFN), near Kimberley and in southern Namibia, on farmland in Grünau (GR), since all these collars were still within the battery capacity. We also report here, in abbreviated form, on the Black-Footed Cat Research Project Namibia, which is managed locally by Martina Küsters (wildlife specialist) and supported by Dr Morgan Hauptfleisch (Namibia University of Science and Technology). This project uses a dedicated field vehicle, a Mitsubishi Triton, from funds received from the Cat Life Foundation. At the same time accessories and insurance came from Pupkewitz Foundation and April Campbell in April 2022.

Background and Study Areas

Background: This project is part of a multidisciplinary effort to study the distribution, ecology, health, and reproduction of *Felis nigripes* to collect long-term data. The aims are repeated captures of BFCs for biological sampling and radio-collaring for subsequent observation. Several methods like camera trapping, den monitoring, and focal animal surveys, were used to survey areas previously known to hold BFCs. From November 2005 until the present, almost annual capture operations have been conducted on BFN. From 2009 to 2018, yearly captures were also performed on two additional properties in the Upper Karoo, Northern Cape, close to the town of De Aar, before research ended on these properties in November 2018. In February 2020, we started with a new study area in southern Namibia, Grünau Farms (GR). Twenty reports detailing previous fieldwork are available for download as PDFs on the website www.black-footed-cat.wild-cat.org.

1 - Benfontein Nature Reserve (BFN):

A private nature reserve owned by De Beers Consolidated Mines, located 10 km southeast of Kimberley on the border of the Northern Cape and Free State Provinces in central South Africa. Majority of the 11 400 ha consists of arid plant communities receiving an average annual precipitation of 450 mm. BFN has been the subject of the first field study on the species by A. Sliwa in the 1990s (1992-1998) (Sliwa 2004, Sliwa *et al.* 2010) and continues to be an important site for long-term monitoring.

1 – Grünau (GR) study areas in Namibia:

A private farmland comprising an extensive area of 70 000 ha with Dwarf Shrub Savannah vegetation in typical Nama Karoo habitat. The area receives low rainfall average of 80-120 mm on average and is lightly stocked with sheep (*Ovis aries*). We captured and radio-collared four female BFCs in February 2020 in the area (Sliwa et al. 2021). One of these females dispersed 25 km to the north two months later, followed by 2 additional adult females leaving the immediate area later. In June 2021 we captured

and collared another two adult females in addition to exchanging the collars of the four. In November 2022 we exchanged the collars of five of those females and captured an additional five new cats (Sliwa et al. 2023). A well-maintained grid of sand and gravel roads traverses the property allowing good survey coverage.

Methods:

No captures were performed in the year 2023.

The following persons worked on BFN (South Africa) in 2023:
Ms. Michelle Swanepoel, field technician from March 2023, swanepoelmichelle896@gmail.com
Ms. Michelle Schroeder, field technician until February 2023, MustelaMichellea@gmail.com
Dr. Alexander Sliwa, zoologist, Cologne (Kölner) Zoo, Germany, sliwa@koelnerzoo.de
Mr. Byron Mannie, wildlife rehabilitator; Kimberley, South Africa mannienexus1@gmail.com

The following persons worked on GR (Namibia) in 2023:
Ms. Martina Küsters, Black-footed Cat Research Project Namibia, Swakopmund, bfootedcat@gmail.com
Mr. Shipala Ndele, field technician and NUST student, Windhoek, Namibia, phillemonferguson@yahoo.com
Dr. Alexander Sliwa, zoologist, Cologne (Kölner) Zoo, Germany, sliwa@koelnerzoo.de

Results:

Monitoring radio-collared cats on BFN and GR*:*

BFN: Field technician Michelle Schroeder (until early February 2023) and Michelle Swanepoel from April 2023 tracked the five radio-collared BFCs in their dens during daylight and at night, and wildlife rehabilitator Byron Mannie helped interim. Sufficient waypoints were acquired for three out of the five cats, apart from female *Gale* who died in early May, and the male *Rodeo* who left BFN in August, to determine their overall home ranges (HR) accurately to their full extent. A total of 3.015 waypoints were collected up until 30 December 2023. HR size estimates incorporating all collected waypoints for all the individual cats tracked in 2023 are provided in Table 1 and Minimum Convex Polygon (MCP100%) outlines are shown in Map 1.

GR: Field technician, Shipala Ndele, completed two longer tracking periods totalling four months in 2023. From 5 February to 4 May (3 months) tracking the five females and four males (n=9). He then returned to the study site from 2 August until 6 September (>1 month)(Figs. 17,18,20). Because only one female (*Nama*) survived by August, all but one HRs are thus based on just 3 months of tracking during the first tracking period. The HR sizes were thus incomplete and can't be taken as a good measure for annual HRs. Altogether in 2023, 450 waypoints were collected for the nine individuals. HR size estimates incorporating all collected waypoints for all the individual cats tracked in 2023 are provided in Table 2 and Minimum Convex Polygon (MCP100%) outlines are shown on Map 3.

Ranging and survival of Black-footed cats in 2023:

BFN: Altogether five BFCs were monitored in 2023. Two cats died and another one moved off the property, presumed dead, thus we had a survival rate for adult cats of 40%.

Male *Rodeo*: An adult with an initially stable HR in east-central BFN, where we first captured him in November 2022. He was difficult to habituate, thus few photos of him exist (Fig.4). He started leaving BFN on 25 June onto neighbouring properties to the northeast, towards Susana and then onto Rooifontein Nature Reserve. He returned on 7 July, to leave again and for good after August 9th. Despite a later search (February 18th and 25th 2024) via small airplane (Fig. 5 & Map 2) he could not be located again, he is presumed dead or his collar failed (or possibly out of range of the search area. With 21.04 km² his 2023 HR (412 waypoints) was initially well-defined, including the first six months of the year. His HR size was average for the annual HR size of a resident male (Sliwa 2004).

Male *Shongo*: A smaller adult captured on central BFN in November 2022. Afterwards he immediately left in a westerly direction deep into the neighbouring Mauritzfontein Stud Farm. H returned three weeks later and has been in central BFN since, overlapping strongly with male *Rodeo* and female *Ember*. His HR, with 12.17 km² was small for a resident male, however extremely well-defined (n=889 waypoints; Map 1). He has habituated well (Fig. 11.), particularly to the use of camera traps at his den, resulting in some excellent images and observations of interactions with other species (Fig. 6, Fig. 12).
Female *Ember*: An older adult captured close to the pan. She had an existing upper right canine fracture. She was resident in the central part of BFN in 2023, well-habituated to the vehicle (Fig.10). The HR she covered in 2023 was 11.83 km² (748 waypoints), slightly over average for females (Sliwa 2004). During den location search on 3 December, Ember's collar was found, with signs of predation by a black-backed jackal.
Female *Gale*: An adult captured in the West of BFN, slightly south of *Kazi's* HR. She was an excellent hunter and partly overlapped with her HR with that of *Kazi*. She had a relatively small HR of 6.94 km² (170 waypoints) in 2023, which may not have been completely defined due to her being found dead already on 12th May. Her body was dug up in a den, with only the hind left leg fed on. It is unclear whether predation was the cause of death or whether her leg was scavenged. We could not take samples to check for diseases, as her body was only discovered a few days after her death.
Female *Kazi*: A large adult, tracked since November 2018. She has habituated to such a degree that she is oblivious to a vehicle, as witnessed when tracked on another visit of Alex Sliwa in August 2023. She stalked and took down a double-banded courser (*Rhinoptilus africanus*) (Fig. 9) in close full view of the vehicle. When incorporating all waypoints collected in 2023 her HR was an impressive 17.61 km² (796 waypoints, Map.1), and thus much larger than the previous ones, of between 5.8 km² - 7.2 km² in 2020-2022. However, when the four outlier waypoints, of two westward excursions of 2.8 km and 6.4 km are excluded from her HR centre, a MCP95% of only 8.1 km² results. This is more in line with her three previous annual HR estimates.

Looking at Map 1 all five cats overlap to some extent, particularly in respect of *Rodeo*, *Shongo* and *Ember*. When including the two excursions of *Kazi* she also overlapped with all the previous three cats. Female *Gale* overlapped only with *Kazi*.

Flying to find male *Rodeo*: Alex Sliwa and Michelle Swanepoel contacted the Bateleurs https://www.bateleurs.co.za/, and were kindly assigned Andrew Conroy (Fig. 3), from Jacobsdahl, to perform the search. After meetings with Michelle, they set out flying on two days, on 18.2.24 and 25.2.24, covering an extensive search route (Map 2), actually searching an area of 1 050 km² (flying 300 km in 3 hours) and 501 km² (flying 184 km in 2.5 hours) respectively. Unfortunately, the flights were unsuccessful in locating *Rodeo*, while the other radio-collared cats on BFN were heard.

Fire on BFN: 9.9.23 – With this second fire, after the one in 2021, approximately 25% of the BFN burned (Fig. 5). 85% of *Shongo's* HR was burned (Fig. 6). The fire went over his daytime den, leaving him unscathed. Despite this alteration of his HR, and becoming increasingly vulnerable due to the lack of cover vegetation, he adapted and hunted successfully. The HRs of females *Kazi* didn't burn, but that of *Ember* burnt by 42%. The morning following the fire, Ember was located ~700 meters beyond the burnt area's boundary. She continued to move farther away, and on the 15th of September, she approached the burned area, briefly crossing over into it for approximately four minutes before re-entering the vegetation outside the burnt boundary. Subsequently, she once again moved away from the burned area. Only a few weeks later she began venturing into the scorched area, exploring previously uncharted territories within it. So, in contrast to *Shongo* she didn't use the burnt part of her HR immediately but only several weeks later.

GR: Female *Kara:* Adult older cat. Between Feb-May 2023 she had a 7.40 km² HR (52 points). Both her HR in previous years were larger, however, more data was collected over longer periods in these years.

Her collar was found in August, close to human habitation in the Gamkab riverbed, where she must have moved. She was likely killed by dogs in July, determined from the bite marks on her collar.

Female *Lace*: As with *Kara,* she had a much smaller HR in 2023 (6.30 km², 52 waypoints). Her mummified remains were dug up from a den (Fig. 23). She may have died from starvation or disease. Her location at death was 4.7 km distant from her last location, so she had left her usual HR.

Female *Nama*: Adult in good condition. Her 2023 HR was 9.71 km² (67 waypoints), comparable to the previous year in size. However, she was also tracked for a longer period, as the last surviving female in August. Despite still being shy of the tracking vehicle, Alex Sliwa managed to get some good images (Fig. 25) of her in mid August. Like *Kara*, she moved into the Gamkab riverbed in October and likely died of dog predation too. Her collar and remains were found via aerial VHF tracking, and later ground tracking in early December by Martina Küsters (Fig. 24).

Female *Prima*: She had the largest HR of all cats in 2023 due to two disjunct centres of her HR, with 17.22 km ² (65 waypoints). She really was an interesting animal with her multiple HR shifts as an adult over the three years since her capture in March 2020. She had a litter of two kittens in early March (Fig. 28.). She unfortunately went missing, and could not be found in August, and again when flying in December 2023 whilst looking for her and the other three cats.

Female *Tima*: She frequented a small HR of 3.02 km² (45 waypoints) in the 3 months of monitoring in 2023. She had another large litter of three kittens in February (Figs.29, 30, 31), which must have restricted her movements to around them, typical of female cats with litters (Molteno et al 1998). Like *Prima,* she unfortunately went missing, could not be found in August, nor when flying in December.

Male *Hom*: He was tracked for three months, and his HR was 8.26 km² (46 waypoints) in 2023 (Fig. 26). He could not be found again in August, and neither when flying in December 2023.

Male *Xam*: A young adult, still growing (Fig. 27). In 2023, he used a HR of 4.07 km² (33 waypoints) in the six weeks of tracking. He was found dead on 15 March 2023 and had been observed limping a few days before, resting a lot and seeming weak. His body was found close to the deserted farmhouse by the Gamkab River, already decomposing, but one kidney was preserved for later amyloidosis analysis. He was likely weakened by disease and emaciation, however there were bite marks on him (Fig. 22).

Male *Obub*: A fully grown adult. His HR in 2023 was 5.6 km² (53 waypoints). Only a third of the size of what he covered in the six weeks of tracking in late 2022. He could not be found again in August, and neither when flying in December 2023.

Male *Sasa*: His HR was 8.42 km² (37 waypoints) in 2023. Shipala Ndele and Alex Sliwa only found his collar, no bite marks on it, in an open area on 14 August (Figs. 18 &19), with no sign of his body. This was south across the B1 tarmac road, 4.4 km from his last location on 4 May.

Flying to find four missing cats in Grünau: After the ground-to-ground searches by Shipala Ndele and partly Dr Alex Sliwa, in August and September didn't lead to finding the four missing cats, Martina Küsters took to the skies on 4 and 5 December to search for their VHF signals (Küsters 2024) (Map.4; Fig. 21). Bushskies provided a low-cost aircraft and pilot. Funds came through Kölner Zoo, Germany via Alex Sliwa. Over six hour period, 840 km of transect lines were flown. Only the signal of *Nama* was heard. A day later Martina found her remains on the ground, suspected to have been killed by dogs or by an unconfirmed disease.

Observations of Black-footed Cats: A total of 14 cats were monitored via telemetry during 2023. Most of the ones from previous years were habituated to various degrees by the field technicians and provided valuable insights into the killing of various prey species. Additional information on spray-marking, courting during the mating seasons, also by unmarked individual BFCs, and the birth of kittens was recorded. These data sets allowed limited comparison of annual HR sizes between years and between study areas in future analyses.

BFN: -Social tolerance of two adult females: On May 1st Michelle Swanepoel observed *Kazi* and *Gale* together. After following Gale for approximately four hours, she noticed that there were two cats, and

upon switching between the frequencies, she realized that the other individual was *Kazi*. There was no animosity between the two, both seemed to be resting next to each other, approximately four to five meters apart, for about ten minutes until *Gale* stood up and continued hunting. We did suspect that the two females might have been related to one another.

- Interspecies co-denning: We have now recorded a black-footed cat denning in the same den as an aardwolf (*Proteles cristatus)* on BFN for the first time. *Ember* emerged from the den on 21. June at 13:44, and the aardwolf can be seen stirring at around 15:00 and finally emerging from the den at 16:51 (Figs.13 & 14). Again *Ember* used the same burrow as two Cape porcupines (*Hystrix africaeaustralis*). The camera trap documented her emerging from the burrow at 13:36 on 10.7.23. Later that evening, the first porcupine appeared at 18:12, followed by another porcupine exiting at 19:22 (Figs. 15. & 16).

- **New prey species**: Although suspected in the past to be a prey species, camera trap images of male *Shongo* showed him hunting and consuming two Cape skink (*Trachylepis capensis*) on 27.12.23, at 14:00 and 17:42 (Fig. 12). He thus displayed untypical diurnal hunting behaviour, using the entrance of his den as a vantage and ambush point. More unusual prey species were a double-banded courser (*Rhinoptilus africanus*) that was killed by *Kazi* (Fig. 9).

GR: No unusual behaviours were observed in the GR cats, as Shipala concentrated on tracking the nine individuals to maximise data collection on their HR extent and use. However, a camera trap image showed a subadult cat (uncollared) visiting *Obub*'s den (Fig. 32).

Reproduction on BFN:

Kazi: A single kitten was born at the end of November 2022, and seen in a shallow burrow on 5 December 2022. It was last seen on 22 January 2023, however, we could not ascertain when it disappeared, due to the changeover between field assistants in 2023 (no regular monitoring in February and March). She was observed spraying urine in June and rolling, signs of oestrus, but no further kittens were observed in 2023 with her.

Ember: No kittens were detected in all 2023, despite deploying camera traps at her dens frequently.

Gale: Likewise, as for the two other females we have no information on her potential reproduction due to the changeover of field monitoring persons in early 2023. She died in early May, when it was too early to record kittens in spring after the usual winter mating season.

In summary for BFN, although we had three females radio-collared we have no information on the survival of *Kazi's* single kitten and whether or not the other two females had kittens in early 2023, as none were detected despite camera trapping. Thus, the year 2023 was certainly not a successful breeding period, despite average rains of 441 mm (long-term average for BFN is 450 mm).

Reproduction on GR: Of the five females tracked in 2023, we have confirmed reproduction only in two females (Küsters 2024).

***Tima*:** Had a litter of three kittens likely born in late January or early February, as kittens estimated at three to four weeks were recorded on CT on 27.2.23 (Fig. 29). They were still recorded 10 days later on another CT image on 9.3.23, however not after that and were presumed killed or missing.

Prima: Had a litter of two born in early March, recorded via CT on 13 March 2023 when she moved a kitten. Ten days later two kittens were still captured by CT on 23.3.23 at their den. However, they were not recorded after this, so were likely lost.

In summary for GR, although we had five females radio-collared for the first four months of 2023 we only recorded reproduction in two, with both litters lost within the tracking period of the field monitoring person. Thus, the year 2023 was catastrophic for the GR region. During 2023, there was a severe drought, with only 20 mm of rain recorded, far below the 2020-2023 average of ~90 mm. This very low rainfall may have been too little to maintain successful reproduction in BFCs in the region, and may have also resulted in the death and disappearance of all the adult study animals.

Camera Trapping: The field technicians deployed digital camera traps (Browning Strike Force Pro XD, Secacam Pro, SpyPoint Force-11D) to obtain regular pictorial material of all the monitored cats, and to check for the presence or absence of kittens in the monitored female cats (Sliwa *et al*. 2018, Küsters 2024, Schroeder 2023) at their subterranean dens (Fig.8, Figs. 12-16 & Figs 26-32). Some of the images revealed riveting details on interactions with other species and the predatory behaviour of the cats.

Den use and selection by BFCs in Namibia: Hal Brindley, from the University of Cape Town collected data in GR for his Master's thesis in Conservation Biology in October/November 2022 and submitted his thesis in February 2023 titled "The underground cat: how black-footed cats choose and use burrows of other species". It showed that black-footed cats rely on other mammal species for suitable dens, that provide a safe place for resting and against predators. Springhares (*Pedetes capensis*) create burrow systems that are very favourable for BFCs in terms of size and structure. The study also showed that despite there being ample available burrows, the burrow diameter was an important parameter for females choosing a suitable den, especially when they had kittens (Brindley, 2023).

Scat Detection Dog Project: Michelle Schroeder and BFC scat detection dogs, *Lyka* and *Sebala*, have been operating in a new study site on private farms in South Africa's Free State province (Fig.7). The goal is to assess BFC habitat use in agroecosystems in the grassland biome where cattle grazing and maize cultivation are the primary land uses. In this area, 80 systematic surveys were conducted covering significant distances across eight properties. During which, 50 suspected (to be confirmed through genetic testing) BFC scats were found. Additionally, 480 habitat plots were measured to assess the impact of various factors such as vegetation, burrow density, and signs of other medium-sized carnivores on BFC occupancy. Further exploration will utilize GIS spatial data to better predict the species' distribution across the region. Plans for 2024 include expanding the study to eight additional properties to widen the area coverage and increase the sample size. This research will contribute to understanding the species' tolerance to human-altered habitats and forms part of Michelle's PhD dissertation at the University of Cape Town. The project's ongoing collaboration with Stanford's Program for Conservation Genomics has expanded in scope. PhD candidate Victoria Grant will be investigating gastrointestinal parasites and diets of BFCs, based on scat samples collected since 2020. This project is made possible through continued support by Panthera's Small Cat Program.

Outreach and social media coverage of BFCs and the BFCWG: Throughout 2023, several members of the BFCWG have spread information on the species, through interviews, popular press items and presentations about our joint research. Scientific tourists and interested laypersons were provided the opportunity occasionally to join in tracking sessions of the radio-collared BFCs.

Beryl Wilson Hartmann and Alex Sliwa have regularly updated the Facebook Page "Black-footed Cat Working Group" https://www.facebook.com/groups/black.footed.cat/ with publicly visible posts. These are shared from the public Instagram page "blackfootedcat.life" https://www.instagram.com/blackfootedcat.life/ by Alex Sliwa with posts every 4-7 days using pictures of black-footed cats and other topics of the species biology and the research endeavours taken over the past decades with a few sentences of informative text.

Several BFCWG members helped to provide information for a Mongabay news bit by journalist Petro Kotzé on black-footed cats: https://news.mongabay.com/2023/05/anthill-tiger-putting-one-of-africas-rarest-wildcats-on-the-radar/amp/?print

Michelle Swanepoel provided regular updates on the monitored cats on BFN and wrote four field reports for sponsors, leading to excellent support in 2023.

Publications, reports, conference papers, and presentations by BFCWG group members on *Felis nigripes* in 2023:

- Brindley, H. 2023. The underground cat: how black-footed cats (*Felis nigripes*) choose and use burrows of other species. Dissertation for MSc in Conservation Biology. Supervised by Prof. Justin O'Riain and Dr. Alexander Sliwa. Institute for Communities and Wildlife in Africa, Department of Biological Sciences, University of Cape Town, Rondebosch 7701, South Africa. 75 p.
- Küsters, M. 2024. Black-footed cat research Project Namibia. Project update March 2024. Unpublished report, 16 pp.
- Swanepoel, M. 2023a. Update from the field: Black-footed Cat Working Group, South Africa. April 2023, 2p.
- Swanepoel, M. 2023b. Update from the field: Black-footed Cat Working Group, South Africa. June 2023, 7 p.
- Swanepoel, M. 2023c. Update from the field: Black-footed Cat Working Group, South Africa. September 2023, 7p.
- Swanepoel, M. 2023d. Update from the field: Black-footed Cat Working Group, South Africa. December 2023. 5 p.
- Sliwa, A., Wilson-Hartmann, B., Küsters, M., Schroeder, M., Shipala, N., Hartmann, A. & Drouilly, M. 2023. Black-footed Cat Working Group - Report on surveying, catching and monitoring Black-footed cats (*Felis nigripes*) on Benfontein Nature Reserve, South Africa and Grünau Farms, Namibia in 2022. July 2023. DOI: 10.13140/RG.2.2.16495.61608.

Non-Profit Company (NPC): The Working Group continues to be solvent and funding for fieldwork is still possible for the financial year 2024. There are no outstanding debts or stipends owed.

Discussion and Conclusions:

Highly valuable data on the monitoring and behaviour of black-footed cats was collected again by the BFCWG and the Black-footed cat Research Project Namibia in 2023. As we didn't capture cats during 2023, we have no comparative data on population estimates in the study sites through sighting frequencies by spotlight censusing. However, this past year has been a sad and even a catastrophic one for cats in both study areas.

On BFN female *Kazi* had a single reproductive event in December 2022 only with the single kitten last seen in late January 2023. Maybe due to the changeover between two field monitoring persons on BFN, and thus a gap of two months (February and March) of only low-intensity monitoring on BFN, we have no good data on reproduction for these summer months and thus possible kittens born in that period. We have no records for the three females then, whilst the death of the female *Gale* in early May would also not have affected this, as May is already approaching the period when kittens are rarely born at this study site (Sliwa et al. 2010). Whilst we have data on two litters from February/March by two females in GR, both litters seemed to not to have survived past the end of March, thus not past an estimated age of 5 and 8 weeks respectively, which is too early for independence and dispersal at 4-5 months (Olbricht & Sliwa 1995; Küsters 2024). Remarkably, the three other females in GR showed no signs of having litters in this period. Thus we have no records of successful reproduction on GR. In summary, eight monitored females at both study sites likely produced no surviving kittens to dispersal in 2023. This may have been due to the drought conditions in southern Namibia, leading to such a failure, after the comparatively higher prey densities through good rainfall in the years 2022 and 2021 (Küsters et al. 2022). BFN had an average rainfall in 2023, at 441 mm close to the average of 450 mm for BFN (while 800mm in 2020, 700mm in 2021, 650mm in 2022). We speculated that this would improve reproduction for BFN cats, as the three years of La Nina's wet influence transitions back to drier conditions (Sliwa et al. 2023), but this was not what happened.

Adult mortality and emigration on BFN with three out of five (60%) adult monitored cats was even higher in 2023 after 44 % mortality in 2022. Mortality and disappearance, together with suspected mortalities, was catastrophic in GR. Out of nine cats monitored all but one were dead or disappeared by August and the last surviving female *Nama* died in October, resulting in a 100% mortality. This is an extreme difference from zero mortality for two years (2020, 2021), and only 9% in 2022. We are perplexed by this loss, which may be due to extreme drought, leading to three of the cats (*Xam*, *Kara*, *Nama*) leaving their HRs towards the slightly wetter dry riverbed of the Gamkab with marginally better vegetation and prey base left, and dying there. Due humans and their domestic dogs settling there, in the hyper-dry landscape, this approach likely resulted in the death of weakened cats falling victim to the unrestrained and free-roaming domestic dogs. Other cats also made longer movements out of the usual HRs. The long period of three months between monitoring periods by the field monitoring person, didn't allow for a more accurate picture of the causes of death. The fact that we didn't manage to find the four missing cats, despite flying extensively over a large area, could even allow to speculate that some of the

collars had been destroyed. Intensive small carnivore eradication (seen by A.Sliwa in August 2023), via long-distance night shooting, including small carnivores with very similar eye shine characteristics, like Cape foxes (*Vulpes chama*) and African wildcat (*Felis lybica*), could lead to mistaking a BFC for another predator, thus collateral and the accidental shooting of our study animals and uncollared BFCs within the study area and on surrounding properties.

HR sizes of female cats on BFN were similar to those previously recorded (Table 1, Maps 1), and published for BFN from the 1990s (Sliwa 2004). The exception of HR size for *Kazi* (BFN) with 17.61 km² in 2023 was due to two excursions westward, while her 95% MCP was only 8.1 km². Female *Ember* had an average HR size, although she died in early December. The three months of monitoring of *Gale*, before she died in May, gave an incomplete estimation of her HR size. The HR of *Shongo* was typical of a younger male, while that of *Rodeo* was similar in size to the average annual HR for BFN (Sliwa 2004). However, he left the site in August for good, it was likely also incomplete. No complete HRs were described for any cat in GR in 2023 (Map 3., Table 2). With only three months of monitoring between February and May for nine cats and an additional month only for *Nama* in August, this is only 25% and 33% of the period of an annual HR. Thus we can't compare this to previous years' medians, for females only, of 6.45 km² (± 1.96 km² SD) in 2022 and 15.55 km² (± 28.04 km² SD) in 2021. Only *Prima*'s HR with 17.22 km² was exceptional due to her shifting between two centres within her HR.

Remarkably the HRs of the four monitored males were similar (median: 6.93 km²± 2.12 km² SD) to those of the five females (median: 7.18 km²± 5.34 km² SD). It is to be considered that with only 3 months of monitoring, thus 25% of the annual range, this can only be a preliminary estimate of male HR sizes in this part of Namibia. While the veldt gradually dried up in southern Namibia, due to the drought conditions of late 2022 and early 2023, that the cats could have extended their HRs to acquire enough food, two of five females were then still caring for kittens, resulting in the typically more restricted movements of females close to small kittens (Molteno et al. 1998).

The observations of the second veld fire on BFN and the two affected cats' ranging behaviours in the weeks afterwards has been decidedly interesting. Removal of grass cover, used to conceal themselves from prey for ambush and also from predators only seems to affect them partially. It is interesting that the young male immediately used the burnt area whilst the female only returned weeks later. Much more systematic information must be collected on this shaping agent of the environment for BFCs. Connected to this may have been the incidental camera trap record of *Shongo,* hunting small reptiles close to his den surroundings during daylight, certainly aided by the skinks' activity then and the better visibility for capture for him.

We are particularly astounded by the temporary co-denning of female *Ember* in wintertime with much larger denning mammals, like an aardwolf and two porcupines. Apart from the added security from black-backed jackal (*Lupulella mesomelas*) predation through the impressive canine teeth of and defence prowess of the aardwolf and the sharp spines of the porcupines for the cat, the co-denning with larger bodied co-habitants probably has thermal advantages for the cat in this confined space. Systematic camera trapping at dens has opened up further topics for study on the BFCs on BFN.

After losing our last radio-collared cat in GR by October 2023, southern Namibia, the Black-footed Cat Research Project Namibia has come to a halt. We aim to start a new study, after scouting for a new study area within this country. Fr this, permission needs to be sought and funds sourced starting in 2024. With only one active field site, BFN close to Kimberley, and only two BFCs left at the end of 2023, the BFCWG is happy to enlist the work of field technician Michelle Swanepoel in 2024.

The BFCWG will return to the study sites for capturing and sampling of wild black-footed cats in May-June 2024, because the batteries of the currently fitted radio collars should be operational for a minimum of 18 months, thus at least until mid-2024.

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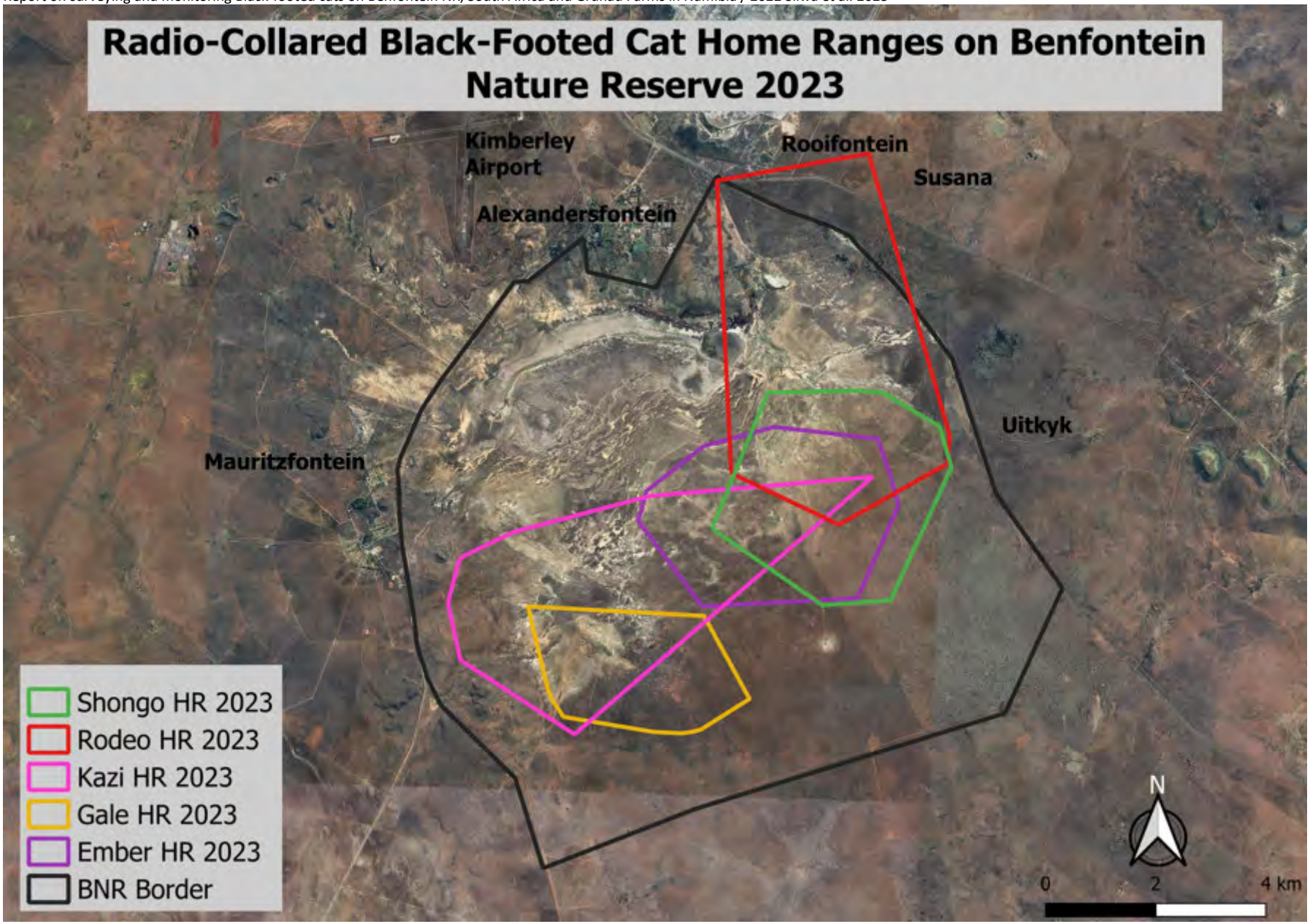
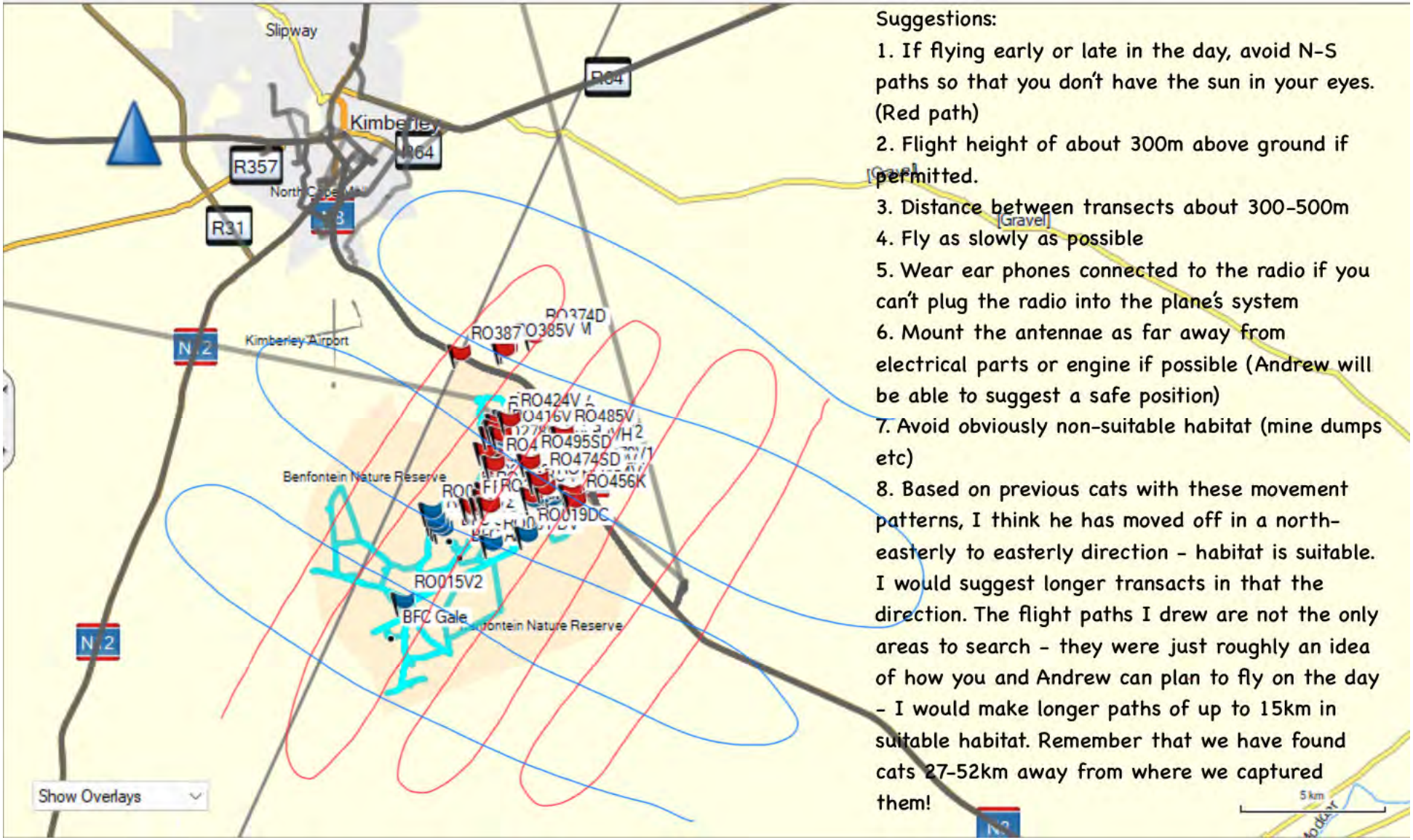
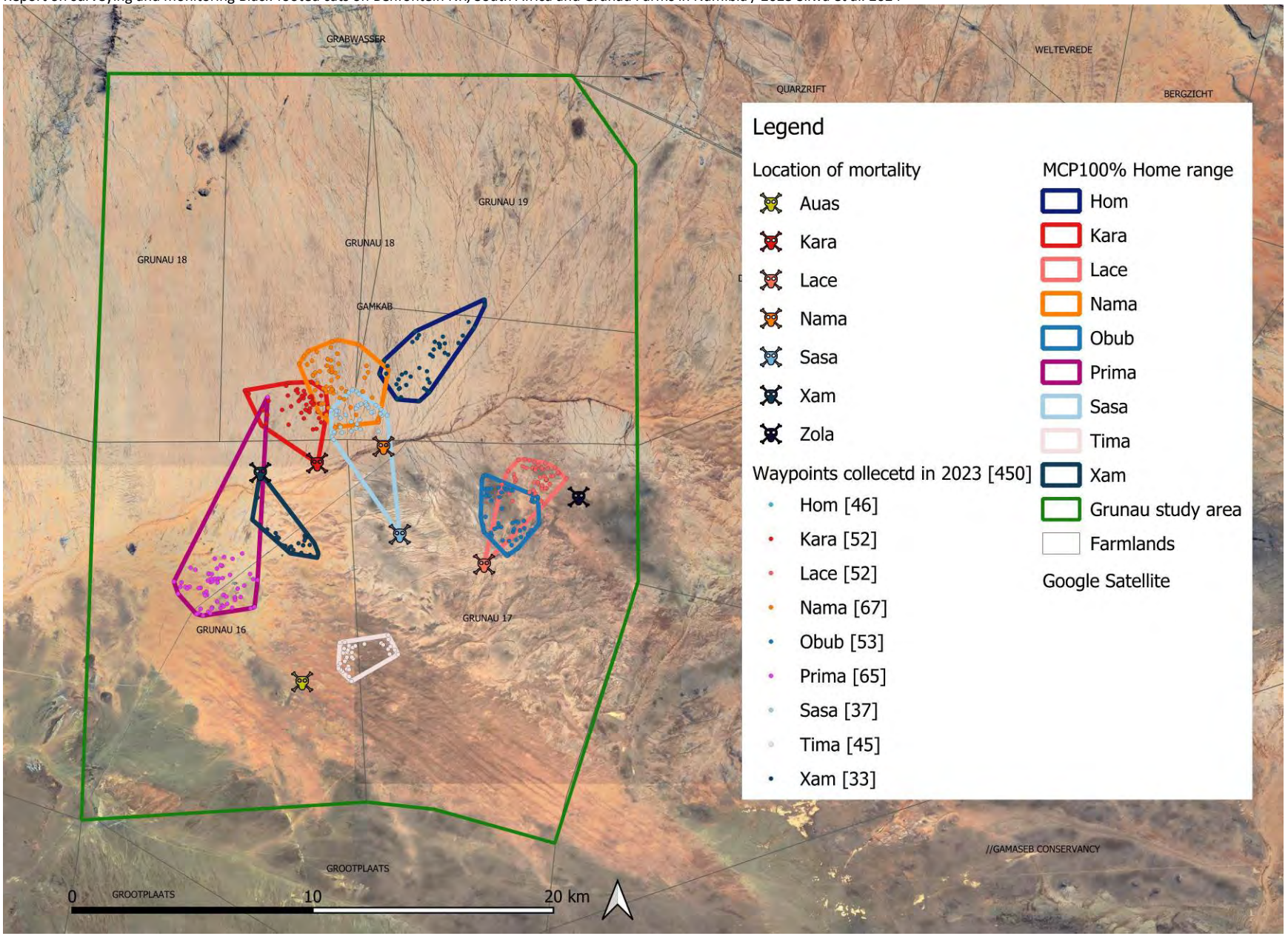


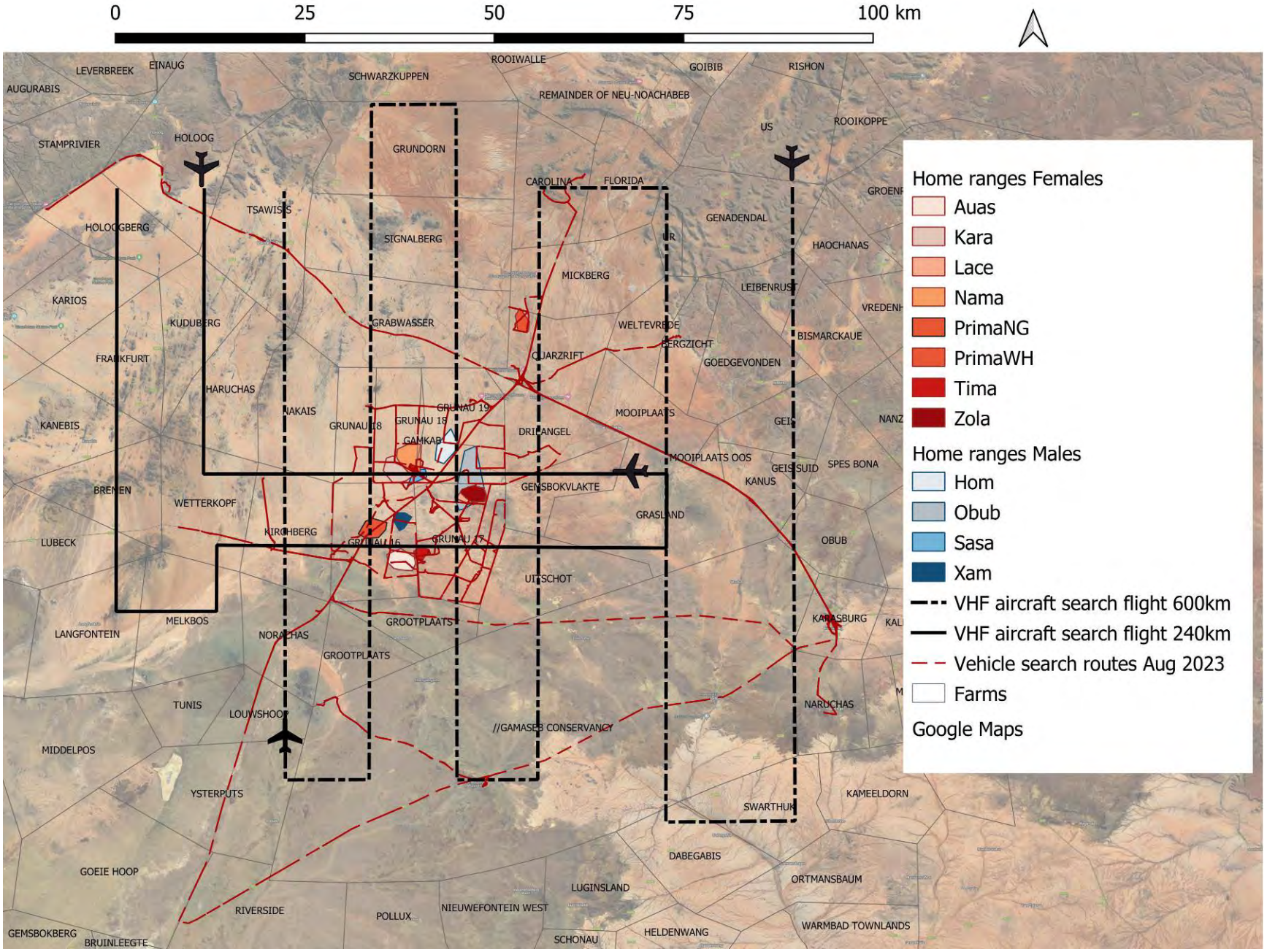
Map 1: Map of Benfontein (BFN; black polygon) with ranges of BFCs in 2023, minimum convex polygons (100% MCP) encompassing the locations (*n* = 3.015) of five radio-collared black-footed cats monitored between January – December 2023. Female Gale died in May and male Rodeo left in August after several excursions to Rooifontein.



Map 2: Map of planned flight path of airplane searches for male Rodeo on 18.2.24 and 25.2.24, including suggestions for the flight by map creator Beryl Wilson Hartmann.



Map 3: Map of Grünau (GR) study area (green polygon) with 100% MCP HR polygons of 9 tracked cats, their waypoints, as well as death locations of 7 cats (2 females, *Auas*, *Zola*, died already in late 2022). The satellite topography image allows for discerning the Gamkab riverbed as well the as the B1 tarmac road and farm boundaries. (Map by M. Küsters).



Map 4: The search effort by aircraft (total 840 km) and vehicle (3520 km) to search for the four missing cats; searching the larger study area in a radius of 50 km from the centre of ranges (Küsters, 2024; Black-footed Cat Research Project Namibia).

Fieldwork, cats, wildfire on Benfontein (BFN), South Africa, in 2023

Fig. 1: Monitoring team, meeting on BFN in August (self-release)

Fig. 2: Michelle Swanepoel setting camera trap at *Shongo*'s den during daylight (A. Sliwa)

Fig. 3: Andrew Conroy and Michelle flying for *Rodeo* (self release)

Fig. 4: *Rodeo* hunting (M. Swanepoel)

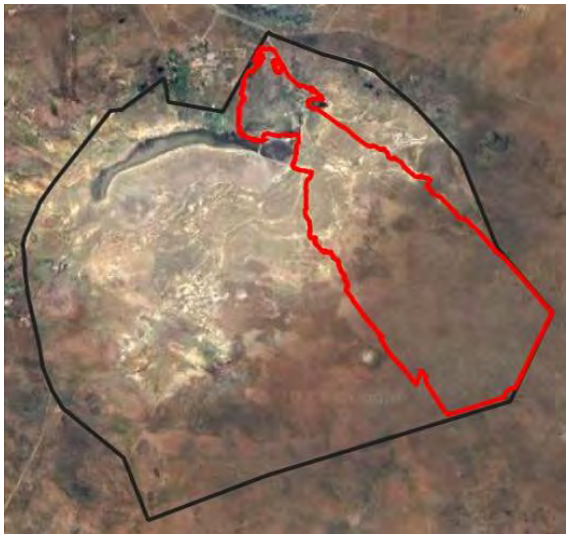


Fig. 5: Wildfire (red) burnt area on 9.9.23; BFN boundary in black (map by M. Swanepoel)

Fig. 6: Male *Shongo* after wildfire on 20.9.23 (CT set by M. Swanepoel)

Fig. 7: Michelle Schroeder with BFC scat detection dog *Lyka* searching (drone- A. Brassine)

Fig. 8: *Kazi* shaking after leaving a tight sandy den (CT set by M. Swanepoel)

Black-footed Cats on Benfontein (BFN) in 2023.

Fig. 9: *Kazi* having just caught a double-banded courser (*Rhinoptilus africanus*) (A. Sliwa).

Fig. 10: *Ember*, golden-eyed (A. Sliwa).

Fig. 11: *Shongo* (A.Sliwa).

Fig. 12: *Shongo* with Cape skink (*Trachylepis capensis*), hunted at his den during daylight (CT set by M. Swanepoel).

Fig. 13: *Ember* denning with aardwolf on 21.6.23 (CT by M. Swanepoel).

Fig. 14: Aardwolf (*Proteles cristatus*) denning with *Ember* (M. Swanepoel)

Fig.15: *Ember* emerging from den with two porcupines, at 13:36 (M. Swanepoel)

Fig.16: Two porcupines leaving same den as *Ember* at -1 °C (M. Swanepoel).

Grünau (GR), Namibia - Fieldwork in 2023

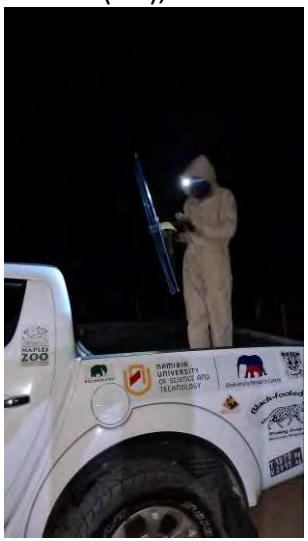


Fig. 17: Night tracking to find missing cats (A. Sliwa).

Fig. 18: Ndele Shipala standing at location where collar of *Sasa* had been found the previous night (A. Sliwa).

Fig. 19: *Sasa's* collar (A.Sliwa)

Fig. 20: checking signals from hills and mountains (A.Sliwa).

Fig. 21: Flying to find signals of missing cats 4.12.23 (M.Küsters).

Fig. 22: Remains of young male *Xam*. Dried blood in mouth and head wounds, skull is intact (M. Küsters).

Fig. 23: *Lace*'s mummified body found in a den. Hair was removed to expose tissue and skeleton remains (M. Küsters).

Fig. 24: *Nama*'s remains in field on 5.12.23 (M. Küsters).

2023 – Namibian cats

Fig. 25: *Nama* in mid-August 2023 – by then the last surviving cat (A. Sliwa)

Fig. 26: Male *Hom* leaving his den 8.3.23 (CT set by S. Ndele – BFC-RPN)

Fig. 27: Male *Xam* on 6.3.23 (CT set by S. Ndele – BFC-RPN)

Fig. 28: *Prima* at her den on 27.3.23 (CT set by S. Ndele – BFC-RPN)

Fig. 29: *Tima* with 3 kittens 7.2.23 (CT by S. Ndele – BFC-RPN).

Fig. 30: *Tima* returning to her den with 3 kittens 6.3.23 (CT by S. Ndele – BFC-RPN)

Fig. 31: *Tima* with kittens on 9.3.23, when last recorded (CT set by S. Ndele – BFC-RPN)

Fig. 32: Subadult cat at male *Obub*'s den (CT S. Ndele – BFC-RPN).

Table 1: Range sizes (km²) and remarks on 5 black-footed cats captured in November 2022 and tracked for all or part of 2023 on Benfontein Nature Reserve (BFN), South Africa. Shaded animal columns indicate individuals that died of left the study area (missing) in 2023.

Last Capture Date	4.11.22	5.11.22	8.11.22	9.11.22	9.11.22
Name (also on Map)	***Rodeo***	***Shongo***	***Kazi***	***Ember***	***Gale***
No. captured (last)	Cat 1 22	Cat 2 2	Cat 3 22	Cat 5 22	Cat 6 22
Sex	M	M	F	F	F
Age (judged by teeth)	Adult	Adult	Adult	Adult	Adult
No. fixes collected in 2023	412	889	796	748	170
Range (100MCP) 2023 (km²)	21.04	12.17	17.61	11.83	6.94

Total fixes collected in 2023 for 5 BFCs, n = 3.015

Remarks:

1) *Rodeo* (Cat 1 22): adult male, left BFN first in 5-23, but returned, then once after, left for good after 9 August 2023, never found again. **MISSING** presumed **DEAD, despite a search flight in**.
2) *Shongo* (Cat 2 22): adult male, has habituated well to vechilc and camer trap setting at his dens, he is still I the central part of BFN, his behaviour to veld fire was documented.
3) *Kazi* (Cat 3 22): adult female; large & good condition. Going strong, in stable home range since November 2018.
4) *Ember* (Cat 5 22): adult female in central BFN, habituated well. Her collar was found 3.12.23 with signs of predation by jackals. **DEAD.**
5) *Gale* (Cat 6 22): adult female, captured in W of BFN, died on 12.5.23; found dead in den entrance, **DEAD**. Home range calculation incomplete.

Table 2: Range size (km²) and remarks on 9 black-footed cats captured and/or tracked in 2023 on Grünau Farms (GR), Namibia. Shaded animal columns indicate individuals that died or went missing in 2023.

Last Capture Date	11.11.22	12.11.22	13.11.22	14.11.22	14.11.22	15.11.22	15.11.22	15.11.22	16.11.22
Name (also on Map)	***Hom***	***Xam***	***Lace***	***Nama***	***Obub***	***Sasa***	***Prima***	***Tima***	***Kara***
No. captured	Cat 7 22	Cat 9 22	Cat 10 22	Cat 12 22	Cat 14 22	Cat 15 22	Cat 16 22	Cat 17 22	Cat 19 22
Sex	M	M	F	F	M	M	F	F	F
Age (judged by teeth)	Adult	SubAdult	Adult	Adult	Adult	Adult	Adult	Adult	Adult
No. fixes collected in 2023	46	33	52	67	53	37	65	45	52
Range (100MCP) 2023 (km²)	8.26	4.07	6.30	9.71	5.60	8.42	17.22	3.02	7.18

Total fixes collected in 2023 for 9 Namibian BFCs, n = 450

Remarks:

6) *Hom* (Cat 7 22): adult male, tracked for 3 months, February – May; **MISSING, presumed DEAD**
7) *Xam* (Cat 9 22): subadult male, only 1 month of tracking in 2023, last seen alive last 13.3.23, found dead on 15.3.23, was weak and limping the night before. **DEAD**.
8) *Lace* (Cat 10 22): adult female, last seen alive on 29.4.23, then carcass found 4.7 km away on 7.8.23. **DEAD**
9) *Nama* (Cat 12 22): adult female, only cat found alive and present in study area in early August, last seen 6.9.23, probably died in October, then found remains on search flight on 6.12.23. **DEAD**
10) *Obub* (Cat 14 22): adult male with big head, older cat, upper left canine slightly blunted, last seen alive on 29.4.23, not found in August and December. **MISSING, presumed DEAD**
11) *Sasa* (Cat 15 22): young adult male, last seen on 4.5.23; collar found on 15.8.23, 4.4 km from last location, no bite marks on collar, no body found; collar displaced? **DEAD**
12) *Prima* (Cat 16 22): adult female; had two kittens in March. Last seen 3.5.23, not found anymore in August and December. **MISSING, presumed DEAD**.
13) *Tima* (Cat 17 22): adult female, had another large litter of three in early 2023. Last seen 28.4.23, not found anymore in August and December. **MISSING, presumed DEAD**
14) *Kara* (Cat 19 22): older adult female; well-habituated. Last seen 3.5.23, found bite marks on her collar. **DEAD**