



Mara Meru Cheetah Project

ANNUAL REPORT 2023

CHEETAH CONSERVATION FUND
CARNIVORES, LIVELIHOODS AND LANDSCAPES
MAASAI MARA 2024

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INTRODUCTION

The cheetah *Acinonyx jubatus* once widely distributed across Africa, is now found only in 9% of its historical range. Since the beginning of 20th century cheetah population in the wild reduced dramatically from over 100,000 to around 7,000 individuals, and it is rapidly declining due to habitat loss and fragmentation, human encroachment, and reduction in prey base, illegal trade, conflicts with other predators and people (retaliatory killing), poaching, diseases, disturbance, and accidental death on roads and in snares, and tourism-related issues. (Woodroffe, 2000, Durant et al. 2017). Cheetah considered “Vulnerable” by the IUCN and is listed in CITES Appendix I (Nowell & Jackson 1996). Rapid contraction in range supports the reassessment of this species and listing it as “Endangered” by the International Union for the Conservation of Nature (IUCN) Red List (Durant 2022).

Current genetic study revealed that East African cheetahs (*Acinonyx jubatus raineyi*) are genetically distinct from Southern African individuals (*A. j. jubatus*), warranting their recognition as a distinct subspecies (Prost et al. 2022). In East Africa, remaining wild population strongholds occur in Tanzania and Kenya, wherein Maasai Mara Ecosystem holds one of the most viable cheetah populations in the country, with connectivity with Tanzania's population. In Kenya, the cheetah is listed as an Endangered species under the Wildlife and Conservation Management Act, 2013. Since 2018, more conservancies have been formed in the Mara Ecosystem around the MMNR, offering more secure habitats for predators including cheetahs.

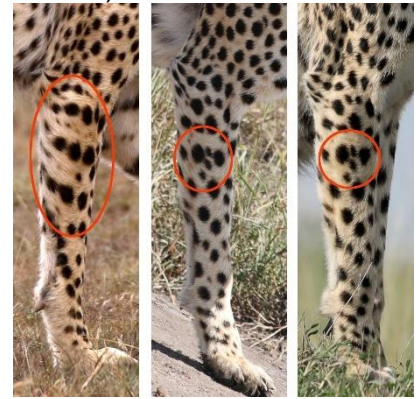
Since 2011, the Mara-Meru Cheetah Project (MMCP) operates in the Mara Ecosystem, mainly focusing on the territory of the Maasai Mara National Reserve (MMNR), where tourism activity is high throughout a year. The Project team works closely with the Narok County Government authorities, Kenya Wildlife Service (KWS) Mara Veterinary Unit, wardens and rangers of the Maasai Mara National Reserve and conservancies, and with other local stakeholders. Since 2012, we involved over 150 guides from different Mara facilities and tour companies into cheetah monitoring. Guides provide us with vital information on cheetah health and sightings. With years, they became strong supporters of cheetah research and wildlife conservation. We regularly update them with important data on particular Mara cheetahs through workshops, meetings in the various tour facilities and in the field, share our findings and information, which help them to better understand behavior and ecology of animals and educate guests. We communicate with rangers of the Reserve and conservancies on the daily basis and assist each other with cheetah monitoring and anti-harassment activities.

In 2023, our two research teams spent 196 days (1,692 hours) and 190 days (1,413 hours) in the field and covered 6,098 km and 5,853 km respectively. Field work included quantitative (scouting for cheetahs) and qualitative data collection (cheetah behavior observations). We collected behavioral data on 34 adult cheetahs (21 males and 13 females with and without cubs) in the Reserve and surrounding Conservancies. Below we provide data for 2023 on the Mara cheetah population trends, challenges and behavioral adaptations.

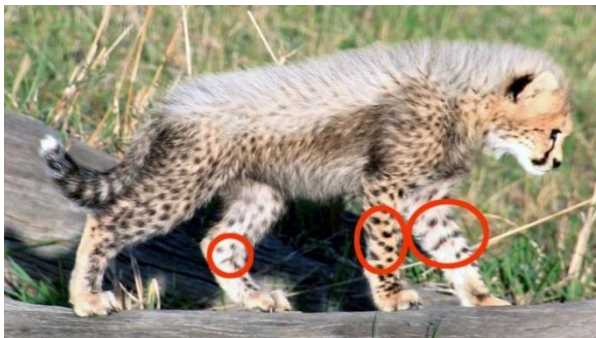
I. CHEETAH POPULATION

1.1. Individual identification as key to population monitoring. Identification of individuals allows tracking long-term population trends, generating life-history data, such as habitat use, survival, reproductive success, recruitment, immigration and emigration. This information can then be used to improve of management strategies.

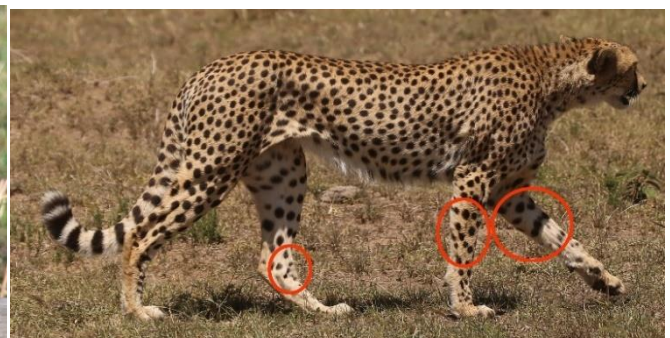
Mara cheetah database has been built on the basis of the original method of cheetah identification, developed by Dr. Elena Chelysheva in 2001 (Chelysheva, 2004). The method is based on the visual analysis of the unique spot patterns on front limbs (from toes to shoulder) and hind limbs (from toes to the hip), and spots and rings on the tail. It helps to identify individuals from the age of one month (Pic.1,2). In the example below, spot patterns (circled in red) of 1 month old cheetah cub match with those of an adult cheetah, revealing their phenotypical identity. Correct identification of cheetahs from collected photos enables building the Mara cheetah Pedigree (Pic. 3), where the year of birth and kinship among cheetahs (parents/grandparents/ littermates) has been revealed. To date, MMCP team processed over 90,000 photographs with dates and time taken, provided by researchers, who had been working in the area in the early 2000-s, professional photographers, guides who have been taking photos since 2000-s to date, and photos taken by Dr. Elena Chelysheva, who was working in the Maasai Mara Cheetah Conservation Project with the Kenya Wildlife Service in the period between 2001-2002.



Pic. 1. Same cheetah (center and right)

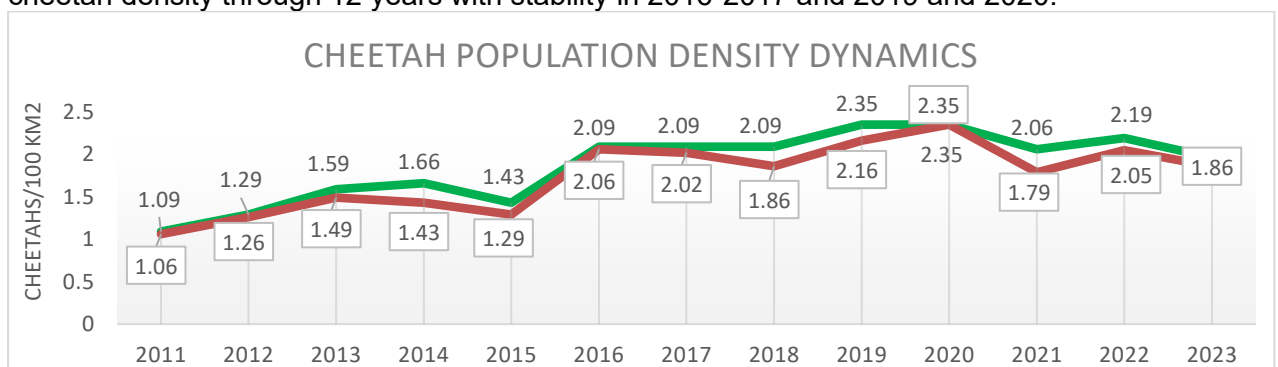


Pic. 2. Female Karembo at the age of 1,5 months



3. Female Karembo at the age of two years

1.2. Mara cheetah population trends. Population monitoring is key to wildlife conservation and management. Our long-term Mara cheetah population monitoring revealed that Maasai Mara National Reserve (MMNR) provides important cheetah habitat in Africa. Using a search-encounter design with multi-session SCR models to collect spatially indexed photographs, we found out that cheetah density between 2005 and 2013–2016 in the Masai Mara National Reserve (MMNR), was ~1.2 cheetahs/100 km². The density fluctuated annually (Linden *et al.* 2020) due to variable movement between the reserve, surrounding areas (e.g., Serengeti National Park, conservancies) and areas outside of protected territories. However, recording throughout a year adult individual who have been utilizing the Mara Ecosystem, which comprises of the Maasai Mara National Reserve (1,510 km²) and surrounding conservancies (1,500 km²), reveals fluctuation of the cheetah density through 12 years with stability in 2016-2017 and 2019 and 2020.



Pic. 4 Cheetah population dynamics: Green - based on the total number of adult individuals recorded in the Mara ecosystem through the year and Red - based on the number of adult individuals by the end of each year (31 December) excluding confirmed dead individuals

However, after a slight increase in numbers in 2022, there was a decrease in density and numbers in 2023, which could be associated with the following factors:

1) Cheetahs of the reproductive age, including those reached independence in the previous year temporary/permanently disappeared from the Mara (established their home ranges outside the Mara or died).

- A male coalition (M130 and M131), that have been observed in the Mara Triangle along the Oololo escarpment in 2022, have not been seen in 2023.
- 8-years old Rahisi (F59) crossed to Tanzania with her three 10-months old cubs and has not been seen in 2023.
- 22-month-old female Nariku (F98), daughter of Neema (F68) disappeared soon after the family had split up in the end September, when she split up with her brother Noma (M120), and has not been seen in 2023.
- Three cubs of Siligi (F63) – males M142, M143 and M144 established their home range in Tanzania after mother left them by October 2022.
- Two cubs of Rahisi (F59) – M129 and F103 also established their home ranges within Tanzania and visited MMNR only briefly in September 2022
- Four-year-old female Nia (F81), daughter of Entito (F78), with her 4 cubs crossed to Tanzania in July 2022 and has not been spotted in 2023.
- Two out of three cubs of Sila (F80) – M121 and F101 have not been spotted in 2023, unlike Siankiki (F100), who was showing up randomly in the Mara in 2023.

2) Adult cheetahs died to different causes (i.e. disease, interspecific competition, human-wildlife conflict etc.).

- Three male coalitions of two males each lost one member (M84, M134 and 146 respectively). While death of M146 has been documented, other two males have been considered dead due to the observed behavior of their partners. In both cases males were roaming in the Mara alone and were not calling their coalition-mates, which was clear indicator that they accepted the loss. The 8-year-old Mbili (M84), brother of Milele (M84) and son of Kiraposhe (F56) disappeared in the end of May 2023 between Mara North and Lemek conservancies. Milele (M83) returned to the Lemek conservancy in the end of May 2023 alone and not calling. Another male, M133 lost his coalition-mate by June 2023 most probably in Tanzania.

Table 1. Sex ratio changes with years

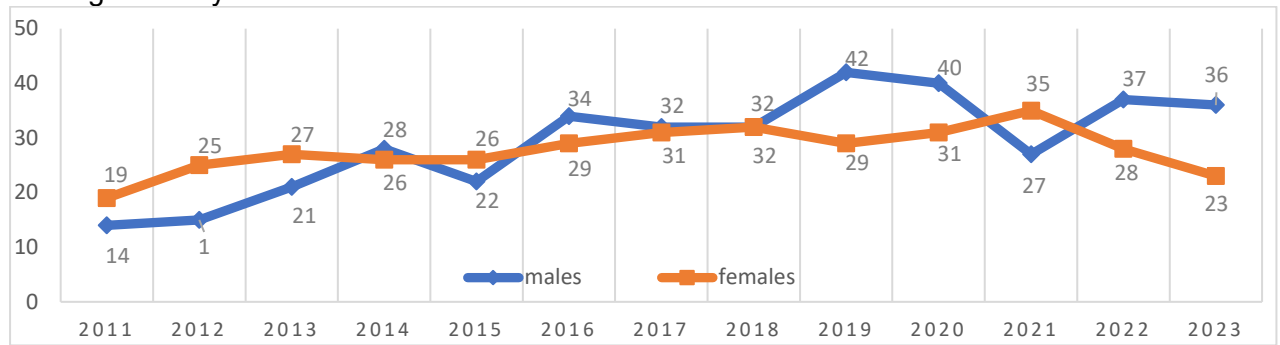
1.3. Number of males and females using the Mara ecosystem differed from year to year, with sex ratio deviation more towards males (46.1%, n=6). In 15,4% years, sex ratio was equal (n=2), and in 38.5% deviation was towards males (n=5) (See Table 1).

Lower total number of observed cheetahs in the first two years of our research could be attributed to the limited time of field work (3-5 months per year) but with essential data collected by our field scouts. From 2013 to the present, our research teams have been working in the field throughout the year.

Year	Adult cheetahs (males/females)	Sex ratio (M/F)	
2011	33 (14.19)	1:1.35	
2012	40 (15.25)	1:1.6	
2013	48 (21.27)	1:1.3	
2014	54 (28.26)	1:1	
2015	48 (22.26)	1:1.2	
2016	63 (34.29)	1.2:1	
2017	63 (32.31)	1:1	
2018	64 (32.32)	1:1	
2019	71 (42.29)	1.45:1	
2020	71 (40.31)	1.3:1	
2021	62 (27.35)	1:1.3	
2022	66 (38.28)	1.35:1	
2023	60 (36.23.1)	1.56:1	

The proportion of females in the population appears to be more stable over the years with exception of 2023, when several adult females of reproductive age have not been spotted. Number of males has been fluctuating over 12 years (Pic.5). This can be attributed to the shorter average lifespan of males compared to females (2,8 and 6,2 respectively) (Kelly et al. 1998), and the intense movement

of young individuals and coalitions, which, after reaching the age of independence, may go to the Serengeti or beyond conservation areas.



Pic. 5 Number of Males and Females observed in the Mara per year

1.4. New cheetahs. The absence of fences along the Tanzania border, allows animals to move freely within the Mara Serengeti ecosystem. Therefore, every few months we observe new cheetahs in the Mara: sometimes adults, but more often adolescents, who have reached the age of independence and have begun to explore new areas.

In 2023, 13 new cheetahs (11 males 1 female and 1 unk sex) appeared in the Mara. Three males were seen in the Reserve: a coalition of 2 adolescent males (M156, M157) at Keekorok area, and a single male (M150) at the Tanzanian border. Other 10 cheetahs (8.1.1) were found in 5 different conservancies. A single male (M136) appeared in Naboisho and M148 in Ol Kinyei conservancies. One new female (F107) was seen in Ripoi conservancy. A coalition of 3 males (M137, M138 and M139) was observed in Ripoi conservancy (Pic.6), and M142, M143 and M144 – cubs of F63 Siligi, appeared in the Mara Triangle at the Tanzanian border. These three males have been raised by Siligi in Tanzania. One adult individual was found dead with the hind quarter eaten by the predators, which made it unable to identify the sex, although the physical built resembled a female.

Cheetahs, born and raised outside of the Mara, are extremely shy and vigilant. Our long-term observations have shown that in order to be successful in the Mara, cheetahs must become tolerant of the presence of vehicles. Skittish cheetahs are less likely to relax, successfully hunt, breed and raise offspring than cheetahs accustomed to the presence of cars. Certainly, subject to the recommended distance and silence by tourists. Conservancies play a vital role in maintaining the natural balance and biodiversity in the Mara ecosystem. In addition, they provide cheetahs with the opportunity to adapt to tourism. An important event for the Mara was the appearance in March 2023 of a coalition of 3 young males in the newly formed Mara Ripoi conservancy. Unfortunately, by August 2023, M138 disappeared. Since



Pic.6. A new male coalition (M137, M138, M139) at Ripoi Conservancy

it is not possible to determine the relationship of the males, it is difficult to say what could have caused the separation of one male – his death or the separation of the males that had previously formed a temporary union.

1.5. Lifespan of cheetahs. To date, the maximum documented age was 11,5 years for males and 13 years for females. By the end of 2023, the **oldest females** were F42 (11 years 8 months) and F50 (11,5-years old). One female was 9 years old (F63) and three females (F67, F68, F69) – 8 years old. The **oldest males** were 11,5-years-old solitary male Hodari M30 (son of Amani, brother of Imani (F50) and two 9-years-old remaining males of the Tano Bora coalition. The life expectancy of males is much shorter than that of females, and this makes it possible for females to mate with different males during their lifetime even during the same estrus, and thus enriching the genetic diversity by giving birth from different males.

1.6. Causes of death. From 2011 to 2023, 45 (26.18.1) adult cheetahs died of different, mostly unknown causes – 41%, followed by predation – 32%. No deaths have been recorded in 2020. In 2023, two cases of death were documented by the rangers: on 27th September, 16-month-old male M146 (brother of M147, cub of F84), died of unknown cause in the Mara Triangle (Pic.7). Another adult cheetah was found dead with eaten hindquarters at Olarro conservancy. (Pic.8).



Pic.7. M146 found dead in the Mara Triangle



Pic.8. Adult cheetah of unknown sex found by conservancy rangers at Olarro



Pic.9,10. Dead cub of Risasi (F84) in the Mara Triangle



The 8-months-old female cub of Risasi (F84) was found dead on 18 January 2023 in the Mara Triangle. (Pic. 9,10). The cause of death was unclear, but a crocodile bite was suspected.

The major threat to the Mara cheetah population is interspecific competition with other large predators (lions and hyenas) for the resources and with other species for the space (e.g. baboons, warthogs). Such competition has both a direct and indirect impact on the survival of the cheetah. Direct impact includes but not limited to: losing food for kleptoparasites (lion, hyena, leopard, warthog etc.), predation of cubs (by lion, hyena, leopard, jackal, baboon etc.) and adults (by lion and leopard). Indirect impact includes, but not limited to the events, when lactating mothers, young, weakened or old cheetahs lose their kills to other animals.

In some cases, young cheetahs, being inexperienced hunters, get killed by the animals they try to hunt (adult Warthog, Impala, Grant gazelle, Topi, Zebra, Eland, Giraffe etc). M146 have been possibly killed by an ungulate with the sharp horn or by a Warthog.

Table 2. Death cases documented from 2011 to 2023

Year	Total number (M/F)	ID	Details	Age (years)	Cause of death
2011	1 (1.0)	M2 Honey Boy	One male from a coalition of 3	5	Predation (lion)
2012	1 (0.1)	F9 Resy	Single female	13	Unknown
2013	3 (2.1)	M1 Honey Boy	One male from a coalition of 2	7	Predation (lion)
		M3 Honey Boy	Single male	7	Unknown
		F2 Hanna	Female with cubs	5	Predation (lion)
2014	7 (5.2)	M26, M27 Kisiri's Sons	Two males in a coalition of 2	3	Infectious disease
		M4 Oloololo Brother	One male from a coalition of 2	5	Infectious disease
		M14	One male from a coalition of 3	4	Unknown
		M34	One male from a coalition of 2	3	Predation
		F4 Sidai	Single female	10	Predation (leopard)
		F5 Saba	Single female	10	Unknown
2015	1 (0.1)	F16 Narasha	Single female	12	Predation (lion)
2016	1 (0.1)	F39 Nabiki	Single female	6	Unknown
2017	2 (1.1)	M38 Chiko	Single male	4	Predation (lion)
		F57 Malkia	Last trimester of pregnancy	3	HWC Road accident
2018	7 (4.3)	M5 Martin (Oloololo Brother)	Single male (previously a member of a coalition of 2)	10	Predation
		M12,M13	Two males in a coalition of 2	8	Unknown
		M47	Single male	Appr.4	Predation (lion)
		F64 Naretoi	Single female	4	Disease
		F13 Malaika	Single female	10,3	Possibly drowned
		F40 Kisiri	Single female	Appr.9	Unknown
2019	6 (4.2)	M16 Siriwua	Single male	11	Predation (lion)
		M91 Mwenzi	One male from a coalition of 2	Appr.5	Unknown
		M68, F79	Littermates	2	HWC in Tanzania
		F26 Rosa	Single female	9	Unknown
		Cub Male of F85	Sub-adult cub male with the mother and littermates	1	HWC Road accident
2020	0	-	-	-	-
2021	8 (3.5)	M63 Lemara	One male from a coalition of 2	6	Unknown
		M66 Mkali	One male from a coalition of 2	Appr.4	Unknown
		M88 Olaretoni	One male from a coalition of 2	Appr.5	Accident at hunt
		F3 Amani	Single female	12	Unknown
		F7 Miale	Single female	13	Unknown
		F8 Rani	Single female	13	Unknown
		F56 Kiraposhe	Female with 3 cubs	Appr.9	Predation (lion)
		F89 Namelok	Single female	2	Predation (lion)
2022	4 (3.1)	M58 Olpadan	Single male	7,5	Predation (lion)
		M72 Olarishani	One male from a coalition of 4	7,5	Predation (lion)
		M70 Leboo	One male from a coalition of 4	7,5	HWC
		F78 Entito	Female with 2 cubs	6	Unknown
2023	4 (3.0.1)	M84	Mbili, a male of a coalition of 2	8	Unknown
		M134	One male from a coalition of 2	Appr.2,5	Unknown
		M146	One male from a coalition of 2	1y4m	Unknown
		Unk sex adult	Cheetah with eaten hindquarters	Over 3	Unknown
TOTAL	45(26.18.1)				

1.7. Birth and death of cubs. It is important to note, that in the wild it is hard to learn how many cubs have been born in each litter. If the den was accidentally found by the guides, we advise them NOT to post photos of the cubs/dens on social media and NOT to share location. We report to the park authorities, and subsequently, rangers/ wardens close the area with the road signs which we

provide to them for this purpose. We rely on the photos taken by the guides/guests and/or rangers of the mother and cubs and record the ID of the female and number of spotted cubs. In some cases, the number of the born cubs remains unknown because they disappear/die before anyone spots the cubs and the female appears without signs of pregnancy (large belly for several continuous days) and nursing cubs (brown fur around the nipples). Therefore, the real number of the cubs born each year in the Mara remains unknown. Here we use information documented by photo materials, provided by the rangers, guides and guests and by our own observations of females with the cubs following the mothers when they start exploring the Mara. Before delivery, females are looking for secure place and if leave cubs for hunting, use different route on the way back. Cubs are mostly seen when mother takes them out of the den and they m others at the age of 1,5-2 months.



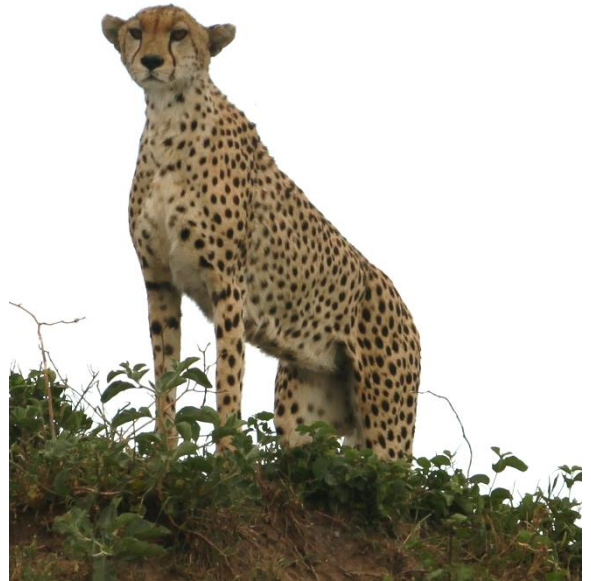
Pic. 11. Nashipae (F69) with 4 cubs in October 2023

In 2023, 13 females (F42, F63, F68, F69, F74, F82, F83, F84, F96, F99, F100, F102, F105), gave birth to cubs in 15 litters, herewith Nora (F42) and Neema (F68) gave birth to two documented litters each. The number of cubs was known for 10 litters (33 cubs) and for 5 litters, numbers were unknown. Three females gave birth in the MMNR (F42, F63, F69) to 4 litters and 10 females in different conservancies to 11 litters. Out of these litters, 14 cubs in 5 litters survived by the end of the year, when five females have been spotted with the cubs of different age, namely F69 (4 cubs), F74 (1 cub), F96 (4 cubs), F100 (3 cubs), F102 (2 cubs).

Cheetah is one of the iconic species in the Mara ecosystem and one of the major tourist attractions. Cheetahs perform successfully in presence of tourists: hunt, eat, raise cubs, mate etc. when tourists obey Rules and Regulations: keep appropriate distance and quiet. Disrespectful tourists' behavior directly impacts cheetah welfare (e.g. losing opportunity to hunt when cars surround the prey, move in between cheetah and its prey or behind it, limit the hunting space etc.), indirectly affects cheetah survival (tourists visiting cheetah dens in closed areas force mothers to move cubs more often and therefore expose them to different threats (e.g. predators) and directly affect cheetah cubs survival (e.g. cars off-road blocking the mother with cubs from the other predators, who slip between cars and attack/kill cheetah cubs). On 7th January 2023, 11-year-old Imani (F50) with her single 4-month-old cub was surrounded in the Reserve by several cars off-road, which limited the female's field of vision and she did not see the approaching predator. The lioness approached the family been covered by the vehicles and ambushed from a short distance, caught and killed the cub in front of visitors.

At the old age, females may experience some health issues, that can affect the delivery process and health of the offspring. For example, cheetahs usually give birth at night or in early morning hours. However, in old cheetahs (10 years and over), the parturition process may occur at any time of the day and can take many hours. On 7th February 2023, 11-year-old Nora (F42) gave birth to one cub at 16:00 in presence of a tour vehicle. It is difficult to reveal if she had given birth earlier that day or it was the only cub born in the litter. If cubs are sick or still-born, cheetahs eat them. If delivery took several hours, female could have moved to another spot before the next cub was born, therefore, there were no signs of parturition (blood) at the place she was observed giving birth.

Signs of lactation – a hanging ridge with long fur with brown areas around the nipples – disappear gradually within a week after the female has lost her litter (Pic.12).



Pic.12. F42 in 3 days after losing her three 10-day-old cubs (October 2023) – the ridge is still visible

1.8. Infanticide. In 2023, there were two cases on infanticide recorded. On 27th October 2023 8-year-old Neema (F68) gave birth at MNC, and was spotted next day with two newborn cubs, one of which was smaller and noticeably weaker. The female ate him and next day moved the alive cub to another location. Unfortunately, Neema lost the cub within the first month.

The second case took place in the Reserve. At the age of 2 years and 10 month, Nagol (F99) gave birth on 27th September, and the next day was spotted by the tourists carrying her 4 cubs to another den. The Reserve rangers closed the denning area and started monitoring and the protecting the female from that day. Unfortunately, at 06:35 on the 1st October, Nagol was spotted leaving the den and calling. Within the next hour, she came back to the den twice, sniffed the grass and left the area. Examination of the den by the ranger team revealed that all cubs were dead and eaten. (Pic.13). Young and unexperienced females commit infanticide to the first-born litter, and shy females kill and eat their cubs when disturbed in the den by the animals or humans and are not able to protect or move them away. It is not possible to determine what prompted Nagol to kill her litter. Although, there were several elephants roaming in 200m from the den within the same ravine where the den was.



Pic.13. Remaining of the cubs eaten by F99

Survival rate varies through years depending on different factors, including but not limited to the mother's age and personal experience. The older females gain more experience, and by the age of 6, some females manage to raise their first litter. Our long-term observations confirmed that cheetahs in the Mara who encounter tourists, have very low chances of raising their litters due to high level of predation, without rangers' support. Nashipae (F69) managed to keep all four cubs (1.3) till the end of the year only with significant help from the Mara Cheetah Unit and our field teams (Pic.14).

1.9. Cheetah monitoring and protection in the MMNR - MCU. In 2023, a landmark event took place in the Mara: The County Government of Narok established a **Mara Cheetah Unit** – a special team of dedicated rangers for monitoring and protecting cheetahs, operating in the Maasai Mara National Reserve within a frame of the Mara Cheetah Monitoring and Protection Program (as the joint efforts of the MMCP and the County Government of Narok). From the very first week, we have been sharing our knowledge with the team through regular workshops and daily communication in the field. MMCP provided valuable equipment, including powerful binoculars, rugged photo cameras with build-in GPS, Cheetah identification catalogues, etc. to 7 ranger field teams. We are proud to be a part of the Mara Cheetah Unit, working with the rangers closely every day in the field.

When our team had noticed pregnancy of Nashipae (F69) in May 2023, we reported to the park authorities and started following the female ensuring that she had free space for hunting and peace for resting. In July 2023 we noticed the signs of nursing. Fortunately, the female gave birth on a slope of a hill in the bushes, in a completely inaccessible area, where nobody could drive. While cubs are still dependent on milk only, the mother has to hunt and for that, leaves the den for 1-6 hours. In search of suitable prey, the female sometimes walks 5-6 kilometers and returns after feeding to maintain milk production. The more cubs in the litter, the sooner the female would introduce them to solid food. For that, the mother must ensure that she hunts at a distance that either she can carry the carcass (usually of a small prey), or that her cubs can follow her to a hidden carcass. We have not observed Nashipae carrying any prey to her cubs, but once she started moving with them, she introduced them to big carcasses. Nashipae took out her 4 cubs from the den on 11th September and walked down a hill to the roads, and from day, the Cheetah Unit started following her family daily from early morning hours till dark.



Pic.14. Nashipae with 3 out of 4 cubs

To prevent disturbance by the tour vehicles in the areas, where the family was resting, all roads and pathways have been temporary closed by the rangers with the road signs “AREA CLOSED”, that we provided to the MCU. By the end of 2023, we delivered to different ranger stations over 270 road signs: “AREA CLOSED”, “TRACK CLOSED”, “RANGERS ONLY” and “RESTRICTED AREA. DO NOT DRIVE BEYOND THIS POINT” (Pic. 15). These road signs served in the MMNR also for recovering of the grass (Pic.16).



Pic. 15, 16. Closed area before (left) and after (right) recovering from off-road driving

1.10. Cubs raised to independence. Within the last four years, 2023 was the least successful by the total number of cubs reached independence.

In 2020, six females raised 13 (6 males and 7 females) cubs to independence.

In 2021, five females raised 13 (7 males and 6 females) cubs to independence.

In 2022, six females raised 15 (9 males and 6 females) cubs to independence.

In 2023, four females raised 8 (6 males and 2 females) cubs to independence.

5-year-old Sila (F80) raised one son (M145) and left him at the age of 14 months. Interestingly, the mother and her son joined 3 cubs of F83 (M140, M141, F106) and spent with them 2 days, after which Sila left the son. Joining the group could increase Sila's cub survival. Young male spent with Kweli's cubs 39 more days, after which M145 disappeared.

5-year-old Kweli (F83) raised 3 cubs (2.1) – two males (M140, M141) and a female (F106) and left them at the age of 16 months. 14-month-old son of Sila (M145) joined them when the cubs were 21 months old.

5-year-old Risasi (F84) raised two males out of 4 cubs (M146, M147) and left them at the age of 16 months. Unfortunately, M146 died within the first month after mother left them.

7,5-year-old Kisaru (F74) raised two cubs – a male (M135) and a female (F104), and left them at the age of 19 months.

1.11. Lifespan of the cheetah families. In the Masai Mara, mothers spend from 12 to 23 months with their litters. The average age of independence in the Mara is 16.7 months, $n=47$ litters (See Table 3), which is similar to Serengeti, where it is 17.1 months (Kelly et al., 1998). Although we have been observing many litters, it is not always possible to witness the exact time of dispersal of the family. Therefore, we use below the data, obtained from photographic materials and/or our observations.

Our long-term observations reveal, that if the female gets pregnant, she leaves her sub-adult cubs from the previous litter one month before delivery. Littermates stay together for up to six months perfecting their hunting skills. When females reach sexual maturity at approximately two years of age, they leave their brothers and start solitary life. The most successful hunter female in the family, can leave her litter-mates, while the other female remains with the brother.

Males-littermates remain together for the rest of their lives in groups called "coalitions", which may consist of up to 5 individuals. Usually, male cubs move from the mother's territory while female cubs usually establish territories (home ranges) within their mother's home range. If females (sisters) raise cubs in the same area, one of them can adopt sister's cub/cubs (see Annual Report 2020 for details).



Pic.17. Sub-adult cubs of F74 (1 male, 1 female)



Pic.18. Sub-adult cubs of F69 (1 male, 3 females)



Pic.19. Neboo (F102) with 2 male cubs

Table 3. Lifespan of cheetah families

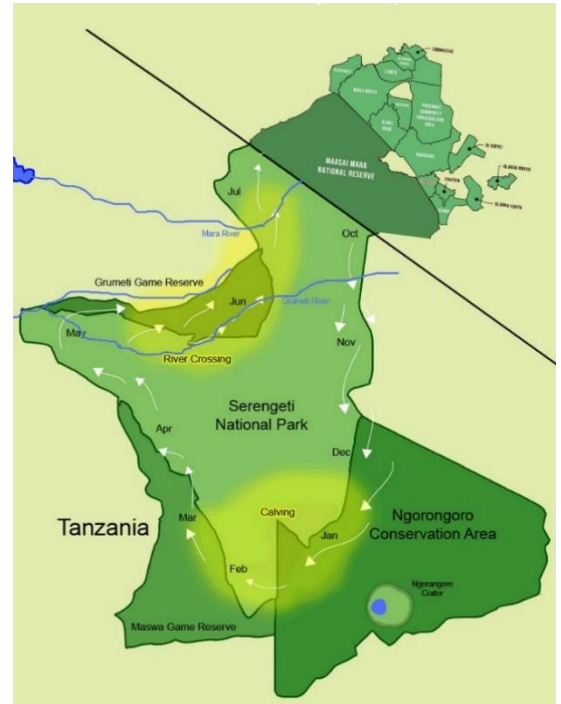
No	Lifespan of a Family (months)	No of Cubs	Sex of Cubs	Cheetah Female ID
1	23	2	1.1	F13
2	23	3	0.3	F74
3	21	2	0.2	F9
4	21	2	2.0	F13
5	21	3	2.1	F83
6	20	2	1.1	F16
7	19	1	0.1	F4
8	19	5	1.4	F19
9	19	3	1.2	F3
10	19	2	1.1.	F74
11	18	3	1.2	F26
12	18	3	1.2	F8
13	18	3	3.0	F63
14	18	1	1.0	F7
15	18	3	1.2	F51
16	18	3	1.2	F3
17	17	3	1.2	F80
18	17	2	0.2	F70
19	17	2	0.2	F3
20	17	3	3.0	F59
21	17	3	2.1	F78
22	17	3	2.1	F53
23	17	2	2.0	F7
24	16	3	2.1	F50
25	16	3	1.2	F68
26	16	2	2.0	F82
27	16	1	1.0	F13
28	16	1	0.1	F3
29	16	4	3.1	F67
30	16	3	1.2	F74
31	16	2	2.0	F84
32	15	3	2.1	F78
33	15	2	1.1	F69
34	15	1	1.0	F42
35	15	1	1.0	F67
36	15	1	1.0	F5
37	15	2	2.0	F40
38	15	1	0.1	F3
39	15	2	1.1.	F59
40	14	1	1.0	F24
41	14	3	2.1	F56
42	14	1	1.0	F1
43	14	3	2.1	F3
44	14	1	1.0	F76
45	14	1	1.0	F80
46	13	1	0.1	F26
47	12	6	4.2	F6
	TOTAL	CUBS	60.48	

II. CHEETAH POPULATION CHALLENGES, SURVIVAL STRATEGIES AND ADAPTATIONS

2.1. Territory utilization. In order to find secure places, cheetahs move intensively within the Mara-Serengeti Ecosystem.

In 2023, out of 59 (36.23) identified adult individuals observed in the Mara Ecosystem, 52.7% of males (n=19) and 39% of females (n=9) have never been seen in the Reserve. In total, 52.5% of cheetahs utilized the territory of the Reserve and Triangle (1,510 km²), surrounding Conservancies (1,500 km²), and areas at the Tanzanian border, while 47.5% (n=28) of cheetahs (19.9) have not been seen in the Reserve, which is almost a half of the Mara cheetah population. In 2020, out of 71 cheetahs, proportion was 80.3% to 19.7% (n=14 (6.8), in 2021, out of 62 cheetahs, 67.8% to 32.2% (n=20 (4.15). In 2022, out of 66 cheetahs, proportion was 75.8% to 24.2% (n=16, (9.7) cheetahs.

A higher percentage of cheetahs avoiding the Reserve in 2023, could be attributed to the higher level of disturbance by tourists in the Reserve.

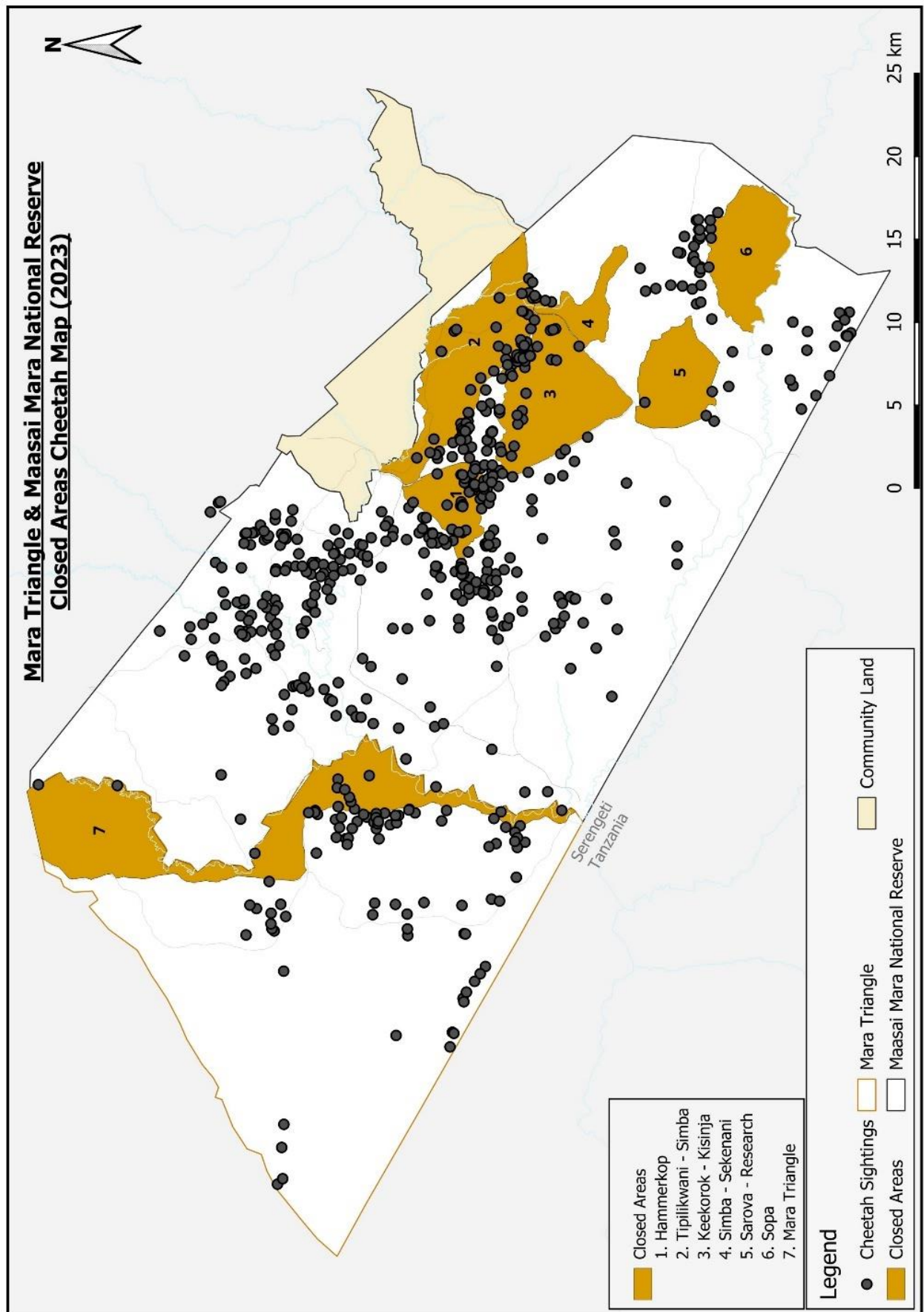


Pic. 20. Mara-Serengeti Ecosystem

2.2. Cheetah distribution in the MMNR. 2023 revealed a trend in spatial distribution of cheetahs in the MMNR Talek being the most visited of the reserve areas and this trend is supported by data from previous years. (Pic.22). The most accustomed to tourism cheetahs are found in the central and northern parts of the Reserve, especially in the Talek area, where tourism is active all year round. Concentration of cheetahs on the Northern areas of the MMNR is attributed to shrublands coverage along the border with Olare-Motorogi conservancy on the east, plays a role of a refugee zone to cheetahs, especially females with cubs, coming from the eastern and northern conservancies, or young individuals raised and dispersed the neighbouring conservancies. The Southern areas of the MMNR (Sand River, Osero-Sopia and Sopa) give opportunity to cheetahs to get used to the tourist activity, which is very low at the side of Tanzania border and increases gradually towards the centre part of the Reserve. Lack of disturbance, open fields and mosaic dense vegetation patterns of these areas, provide cheetahs opportunity to successfully hunt, rest, mate and raise cubs. The dense vegetation as well rocky areas also make it difficult to see cheetahs and hence fewer sightings.



Pic. 21. M71 and M73 marking their territory



Pic.22. Cheetah distribution in MMNR in 2023

2.3. Closed areas of the MMNR. Following the Mara Management Plan implemented in 2023, new roads and 6 closed areas have been designated (Pic.27,28). In all seasons of the year, cheetahs utilize Closed Areas or Restricted Areas. These areas serve as safe refuges to avoid disturbances from human activities, such as tourism and illegal grazing. These areas are particularly important for different groups of cheetahs, including old individuals, newly dispersed ones, females with cubs, and shy or more elusive cheetahs. By using these undisturbed zones, cheetahs can maintain lower stress levels and enhance their chances of survival, particularly for vulnerable groups like cubs or inexperienced individuals.



Pic. 23. Nashipae (F69) hunting in the closed area

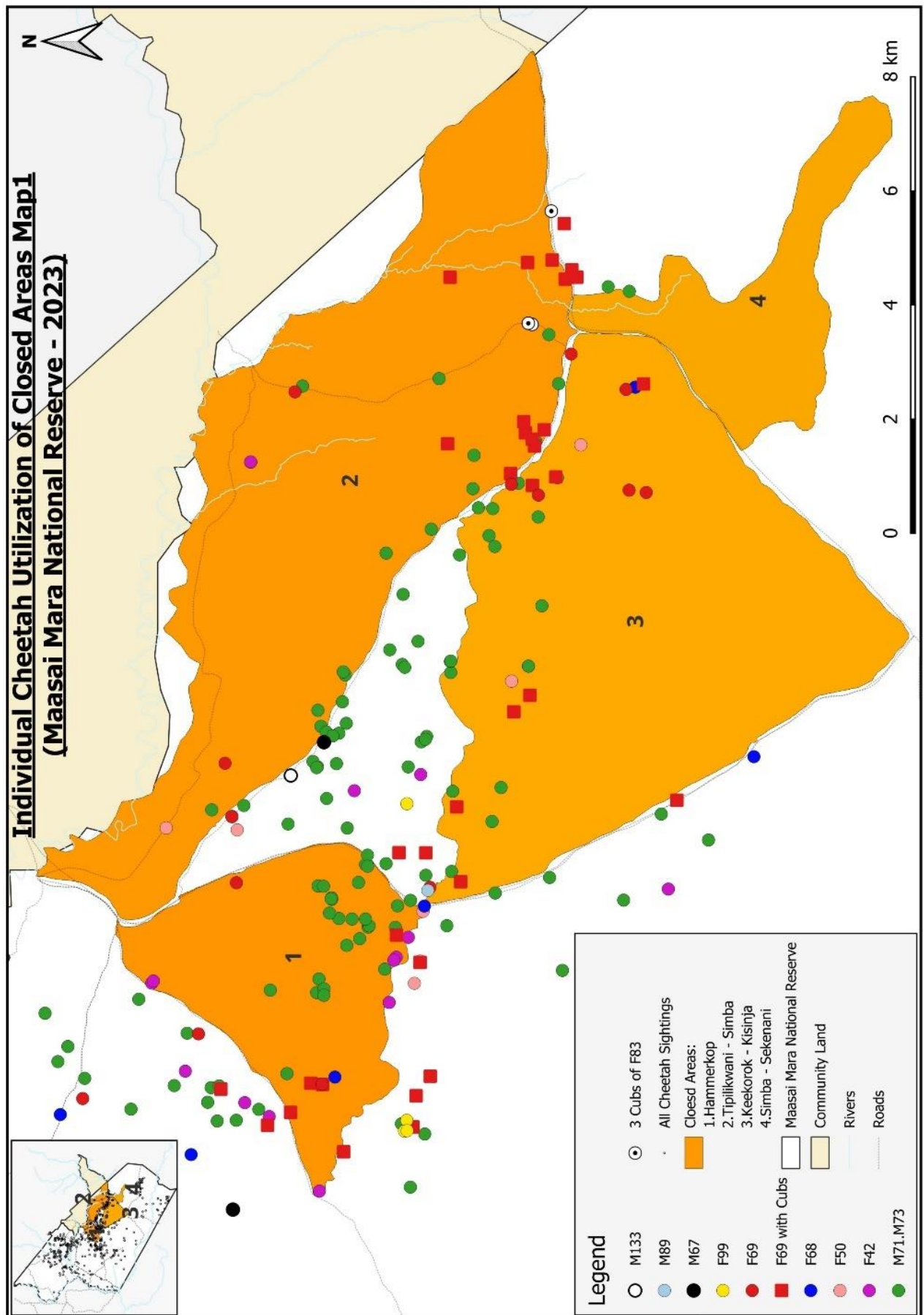
This behavior highlights the importance of maintaining closed areas within wildlife reserves to support cheetah and other species' conservation efforts. In 2023, 12(7.5) cheetahs used the Closed areas. Most often three areas (N1-3) have been used the most vulnerable categories of cheetahs – 9-year-old males in a coalition Tano Bora (M71,M73) and 8-year-old Nashipae with 4 cubs. Areas 4 and 5 have less sightings, area N4 due to harder accessibility (bushy slopes with no roads). However, we observed two shy males M67 and M133 using these areas.



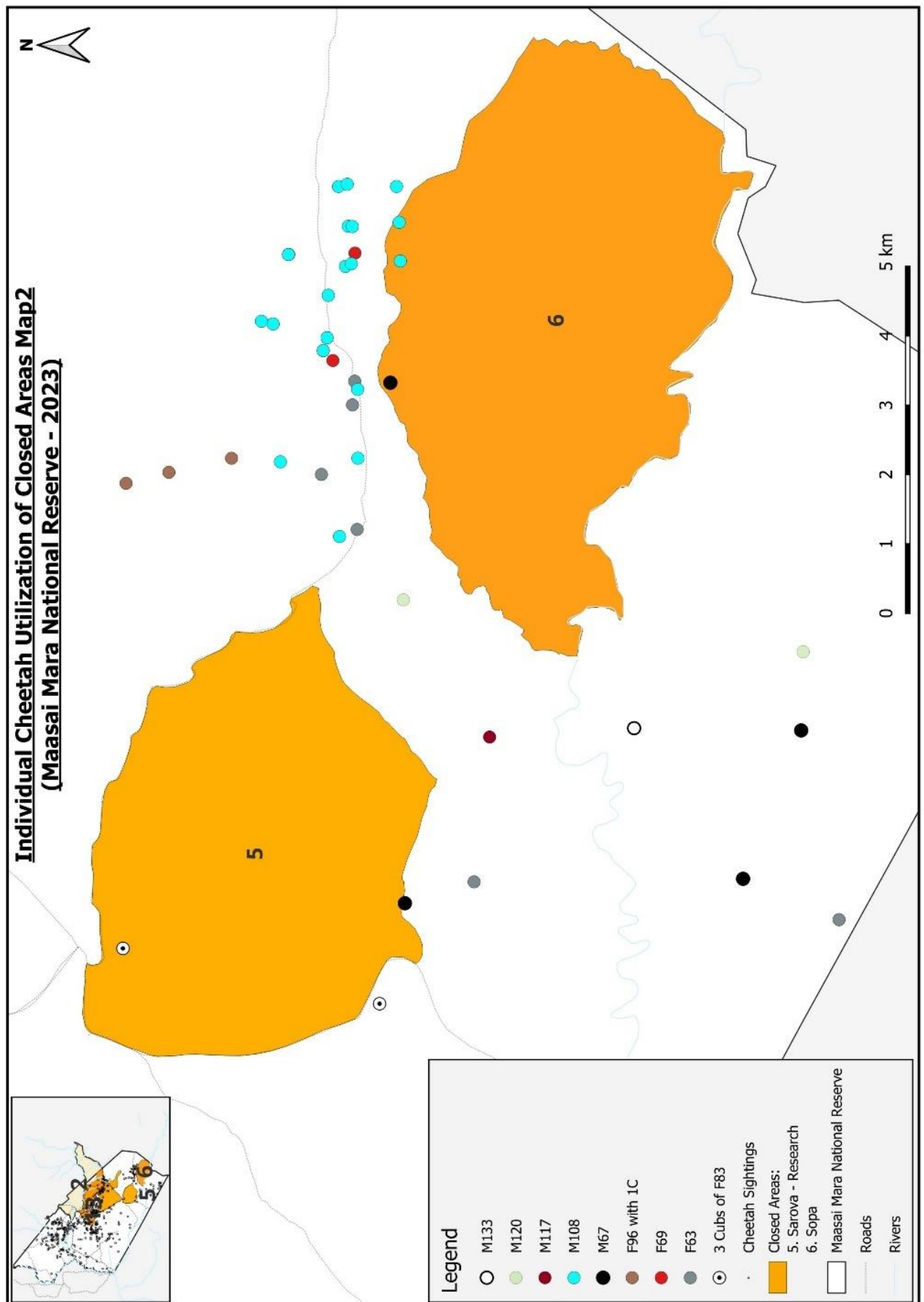
Pic. 24. Mwanga (M67) resting in closed area



Pic. 25,26. Nashipae (F69) hunting successfully in the closed area and carrying a kill to her cubs hidden in a bush



Pic. 27. Individual cheetahs who utilized closed areas #1,2,3 and 4 of the MMNR in 2023



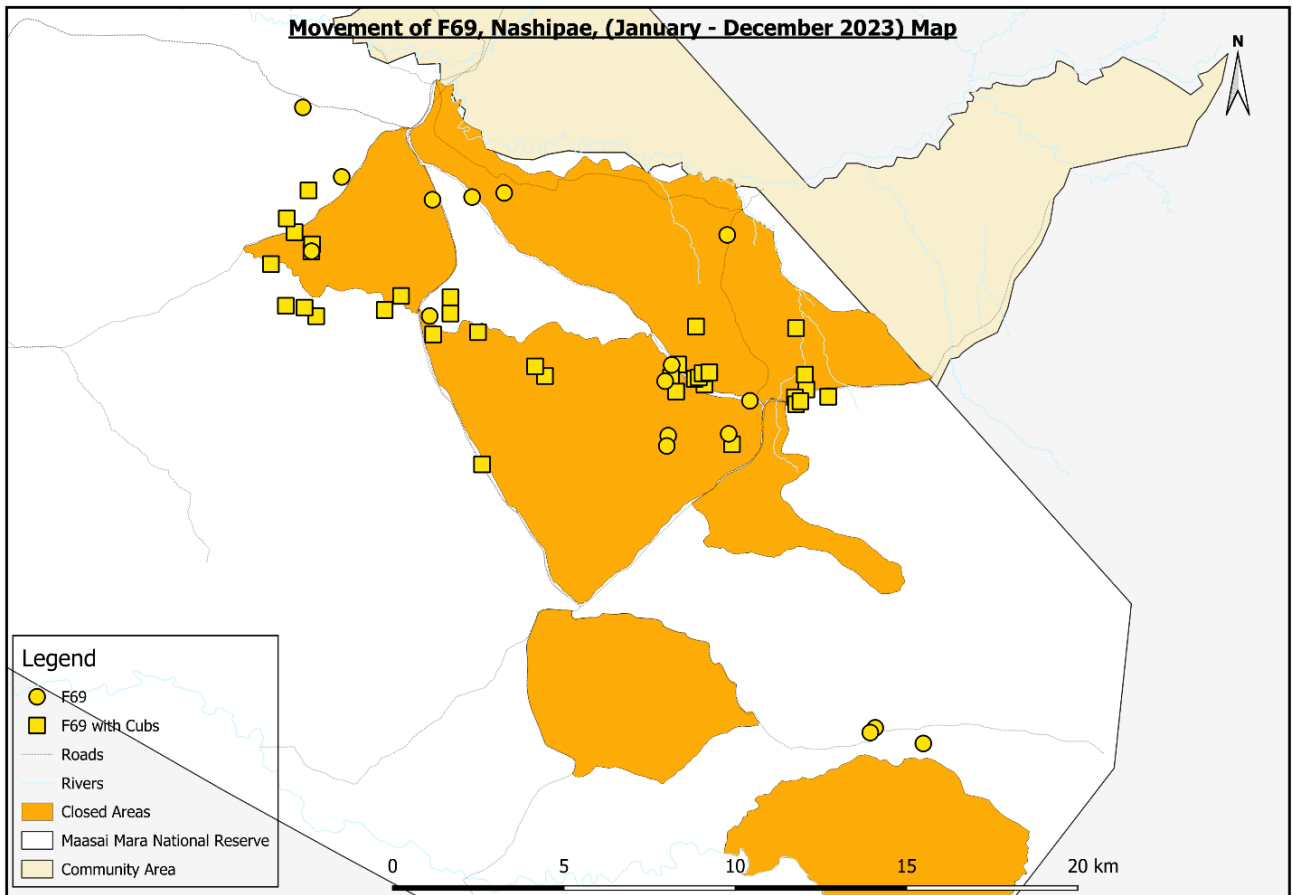
Pic. 28. Individual cheetahs who utilized open areas and closed areas #5 and 6 of the MMNR in 2023

2.4. Movements of the Nashipae's family.

Before appearing with 4 cubs in the second week of September 2023, Nashipae (F69) utilized the SE side of the National Reserve before and during her pregnancy. Due to the tender age of the cubs, availability of prey, open plains with patches of grass and bushes, and high risk posed by other predators, she reduced movements during the last quarter of the year to Talek area. With the coming of cubs, Nashipae kept a reasonable distance from the community area and the Talek River. This is contributed by the threat of many hyenas as well as human activity (illegal grazing) in the said area. During this period, she spent most of her time in the closed areas to avoid disturbance and hide cubs. (Pic.29,30).



Pic.29. Nashipae (F69) with cubs



Pic.30. Movements of Nashipae (F69) alone and with cubs in the Maasai-Mara National Reserve in 2023

2.5. Cheetahs in the Mara Triangle. Our long-term observations in the Mara Triangle showed that its territory is capable of having up to 10 individual cheetahs during the year, including at least one male coalition. The gradual disappearance of the Lemai Boys coalition (M90, M91) from the Triangle by 2021, provided a good opportunity for the two Risasi's brothers, Ruka (M110) and Rafiki (M109), to settle in the Mara Conservancy. But since they also began to often leave for Tanzania, new males began to appear one after another on the territory of the Triangle: Oloti (M114), Mpaka

(M126), and a couple of new very shy males (M131,M132). Cheetahs born and raised in the Serengeti and on the border with the Maasai Mara, after reaching the age of independence, begin to travel in search of convenient habitats. Young males, unlike young females, go quite far from the territories and home ranges of the mothers, which is a natural limiter of inbreeding. While some juveniles are settling into the vast areas of Tanzania, some adolescents, mostly males, are showing up in the Mara.

In 2023, initially, eleven adult cheetahs (9 males and 2 females) have been observed in the Mara Triangle. Out of 9 males, 2 were singletons: Oloti (M114) and Mpaka (M126) and 7 were in coalitions - Rafiki and Ruka (M109, M110), Sons of Siligi M142.M143.M144, and M146.M147 – two sons of Risasi (F84), dispersed with the mother on 15th of September 2023. Unfortunately, in 12 days, M146 died of a fatal injury, thereby, the total number of adult cheetahs did not exceed 10, as in previous years.

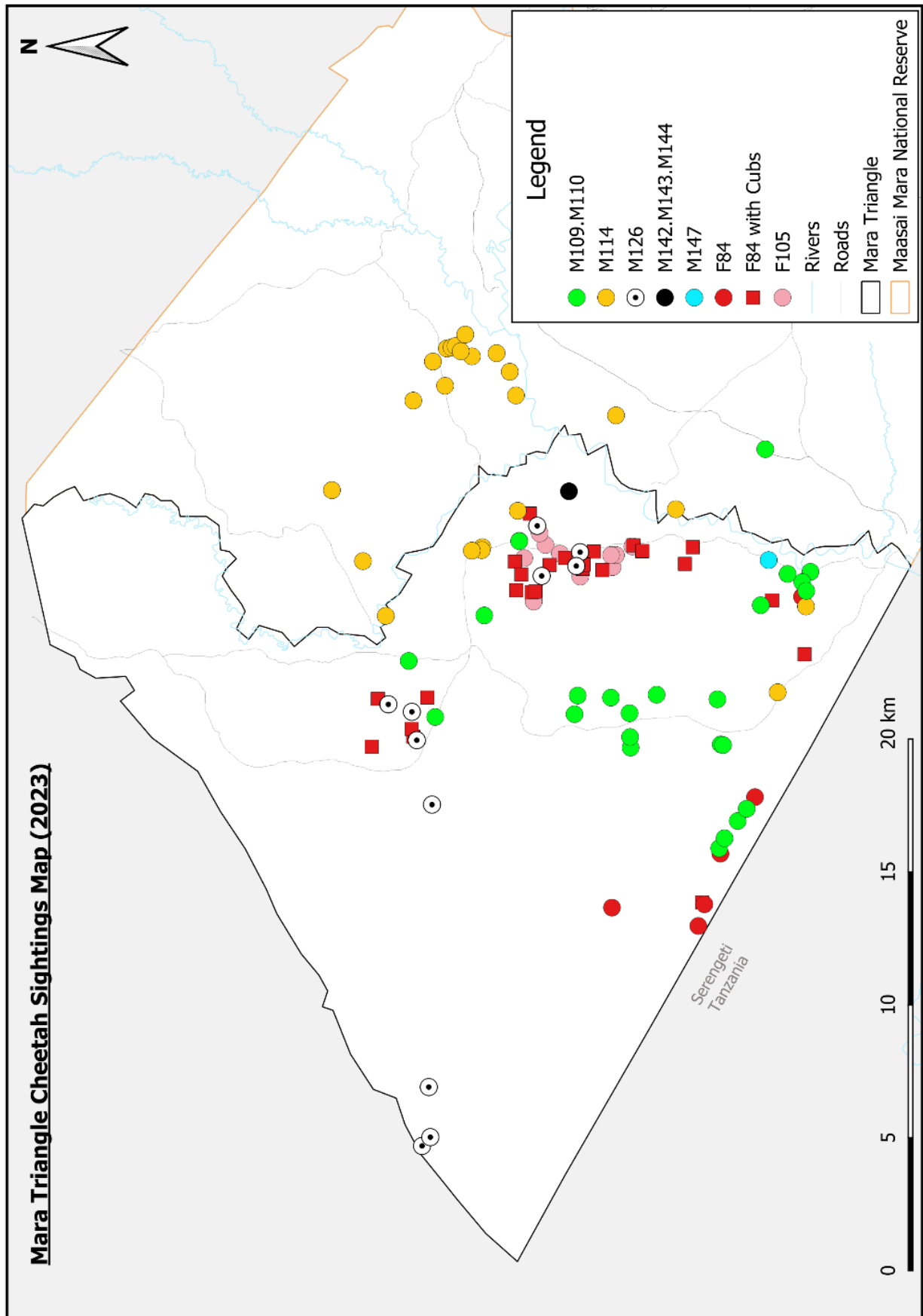
In 2022, 9 cheetahs have been observed in the Mara Triangle: 7 males (Oloti M114, Mpaka, M116, Kijana M126, Rafiki M109 and Ruka M110, and two shy males M130,M131) and 2 Females (Risasi F84 and Imani F50). Cheetah sightings in the Mara Triangle increased in 2023 compared to 2022, largely due to enhanced ranger presence monitoring cheetah with cubs Risasi (F84). This increased protection likely contributed to higher visibility. Additionally, the Triangle's location bordering the Maasai Mara Reserve and Tanzania saw new cheetahs moving into the area, while some cheetahs seen in 2022 were not sighted in 2023, possibly due to migration across the borders. For example, 3 sons of F63 Siligi, born in April 2021 and raised at the Tanzanian border of the Reserve and in the Northern Serengeti, reappeared in the Mara from the Tanzanian side in the beginning of July 2023 in Triangle. The combination of better monitoring and natural movement patterns accounts for the fluctuation in sightings between the two years. However, just like in previous years, the South Eastern side of the Triangle was the most visited by different cheetahs.

Cheetah distribution in the Mara Triangle during the year 2022 was mostly dense along the Tanzanian border. However, sightings of 2023, show a wider distribution towards the Mara River. Such movement can be contributed to the land use and grass management in the Triangle, which provide for cheetahs the most suitable habitats, which is represented by mosaic distribution of patches of tall grasses, short grasses and shrubs. Each element provides shade to different animals, including cheetah prey (hares, antelopes), and cheetahs, especially those with cubs. Sick/injured cheetahs get opportunity to hunt in the tall grass or in the bushes, as it has been observed in case of F84 with cubs and limping male Oloti (Pic.20).

Oloti (M114) - a single male appeared in the Mara Triangle in the beginning of July 2020. In early September, he crossed the Mara River and started exploring the Maasai Mara National Reserve, but after 2 months he returned to the Triangle. His appearance in Mara coincided with the emergence of a new coalition – Rosetta's two sons – Ruka and Rafiki, who gained independence in March 2020 and began to travel in the Mara. To date, Oloti's movements from the Triangle to the Reserve and back were partly dictated by movements of other cheetahs and coalitions (Pic. 31).



Pic.31. Male Oloti (M114) in the Mara Triangle



Pic.32 Individual cheetah sightings in the Mara Triangle in January-December 2023

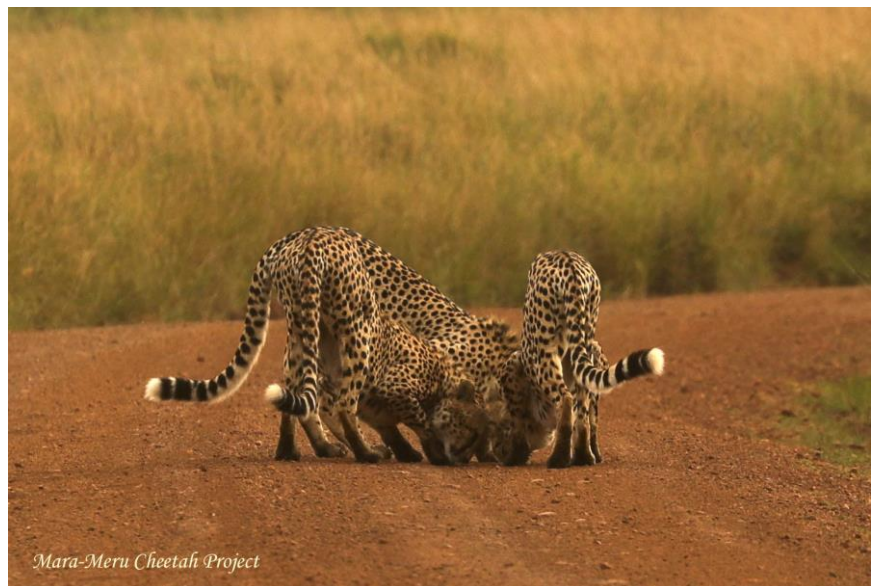
Mpaka (M126), appeared in the Mara Triangle in the mid-July 2022, and since then has been regularly seen in the conservancy between the Tanzanian border and the Mara River area.



Pic.33. Mpaka (M126)

Rafiki (M109) and **Ruka (M110)**, born in the first week of September 2018 in the Reserve, littermates of Risasi (F84), crossed to the Mara Triangle in May 2022 and since then, have been roaming in the Mara Triangle and across Tanzania border.

Siligi's Sons (M142, M143, M144) – born in April 2021 and raised in Tanzania, appeared in Triangle as fully grown strong male coalition in the beginning of July 2023. Their movement from Tanzanian border deeper into the Triangle, affected movements of another male coalition - M109 and M110, who left Triangle by crossing the Mara river to the side of the Reserve.



Pic.34. Siligi's Sons exploring Triangle.

Risasi (F84). Like her ancestors, Risasi spent a significant amount of time in Tanzania. However, Risasi, like her brothers (M109 and M110), were the first members of the family to move to the Mara Triangle (Mara Conservancy). Of the 4 cubs born in May 2022 in the Triangle, Risasi has

unfortunately lost two females, but successfully raised two sons to independence in September 2023.

Naado (F105), daughter of Siligi (F63), was the only surviving cub out of 7 born in the Reserve in October 2019 and raised in Tanzania from the age of 5 months. She reappeared in the Mara from Tanzania in the Mara Triangle in the beginning of March 2023. In the middle May, she was observed at the last trimester of pregnancy, but by July, lost her litter and soon after, left the Triangle.



Pic.35. Female Naado (F105)

III. CHEETAH BEHAVIOR

Cheetahs the Mara have home ranges, that they cover within a year: Single male 372 - 646 km², Male coalition 506-812 km², Single female 335 - 766 km². Within a home range, individuals may stay at the certain area for one-two weeks, and that smaller area can be defined as a temporary territory (See our Annual Report 2019 for the details). Home ranges and territories of male and female cheetahs overlap. Sometimes, females in oestrus cover large distances in search for the partners. By that, they get a chance of meeting with different males for courtship during one cycle. By travelling within their large home ranges, males also get opportunity to encounter different females and enrich genetic diversity by mating with them. Moreover, some individuals of both sexes get to know each other well.

3.1. Courtship events with mating. Cheetahs are very secretive animals and whereas most of courtship activities happen during the daytime, mating occurs usually at night or at any other time with no witness. However, from 2017 to the end of 2023, there were 11 cases of cheetahs' mating observed in the Mara during day time:

- M12, M13 with F8 in October 2017
- M72, M70, M71, M73 with F42 in December 2017
- M58 with F8 in March 2018
- M30 with F73 in March 2018
- M73 with F69 in August 2018
- M70 with F7 in October 2019
- M81 with F68 in January 2022
- M81 with F80 in February 2022
- M83, M84 with F74 in December 2022
- M71 with F69 in February 2023
- M71 with F42 in April 2023

In the wild, actual mating may not always lead to a pregnancy, whereas following without mating observed, can end up with successful pregnancy. For example, three courtship events observed in 2023 without actual mating seen, ended up with pregnancy of all three females:

1. On 26 June 2023, Winda (M71) was observed following Nagol (F99), and Nagol gave birth on 28 September 2023 in the MMNR.

2. On 24 and 25 April 2023, Jasiri (M108) spent two full days with Nashipae (F69), and she gave birth in the end of July 2023 in the MMNR.
3. On 26 July 2023, Neema (F68) was followed by Tano Bora males Winda (M71) and Olonyok (M73), and gave birth on 28 October 2023 in the MNC.

Out of three, only one full litter survived – of Nashipae (4 cubs), who gave birth and kept cubs in inaccessible area on the slope of a hill. Nagol and Neema both committed infanticide to their four and 2 cubs respectively, most probably due to disturbance, because their dens were accidentally discovered and visited by cars.

It is also important to note, that not always mating can lead to the pregnancy, especially when two males compete for a female. For example, daytime mating of Winda (M71) with Nora (F42) in presence of several vehicles following cheetahs in courtship through the bushes on 6 April 2023, was not successful. Nora supposed to give birth in the beginning of July 2023, but the delivery occurred on 22 September, which indicated that the female came into estrus again in late June, and gave birth in 3 months. Nora also lost her cubs in 9 days to unknown cause. On 02 October, buffaloes were scattered all over the place where Nora's den was noticed by the MMNR ranges.

When female lose receptivity in three days, males usually leave the female and go for hunting. However, in rare cases, males chase female from their territory perceiving a female as an intruder to their territory.

One measure of success for male cheetahs is the ability to establish and maintain a territory. If there are coalitions in the area, it is more difficult for a loner to hold the territory, and he becomes a floater. The key to the success of a singleton is the physical power, confidence and ability to protect his territory from other loners, driving them away. Males attack intruders, and if the latter does not run away, he can be seriously injured in the fight. This partly explains the short life expectancy of young males – about 3 years. Jaziri (M108), a male born and brought up by Amani (F3) in the northern part of the Mara, firmly settled in Sopa in 2022, after driving out Olanyuani (M89), a male who had lost his coalition-mate in July 2021.



Pic.36. Jasiri (M108) with Nashipae (F69) in courtship



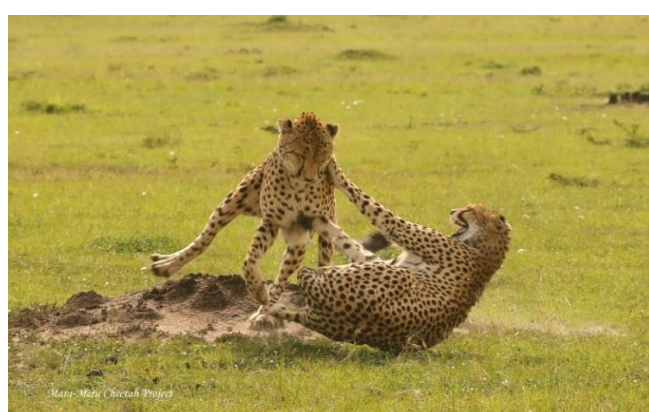
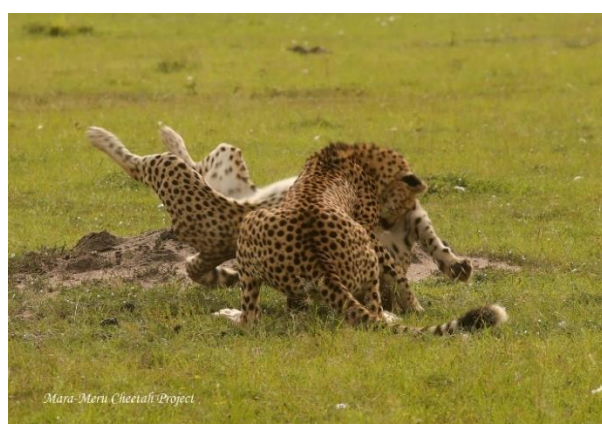
Pic.37. Jasiri attacking Nashipae

3.2. A case of territorial behaviour after courtship behaviour. In April 2023, at Sopa area of the MMNR, we observed two females and a male within 1,5 km: Siligi (F63), which spent most of her time in the Serengeti, Nashipae (F69) and Jaziri (M108). It is interesting that on the same day, but at a distance from each other, Siligi and Jaziri actively marked objects and often climbed termite mounds, examining the area, and Jaziri also called loudly. The next day, on 24 April, we found Jaziri with Nashipae, and he delicately and uncertainly followed her, and the female made no attempt to leave the male. On that day, Siligi watched the couple from afar. She was well acquainted with Jaziri, as they have met before.

On the third day, on 25 April 2023, the situation changed: Jaziri lost interest in Nashipae, but did not let her leave. When she managed to move away at 100m and lie down on a mound, the male approached her with very specific intentions – now she was not a mating partner, but a territorial competitor. Jaziri attacked Nashipae in the same manner as the males: he walked around with a howl and periodically pounced. The female fought back and displayed a pose of submission, and after a series of attacks, the male left her alone and moved away. Since Jaziri sniffed her resting places without flehmen (an olfactory mechanism for identifying the reproductive state of females based on pheromones in the female's urine or genitals), Nashipae was not in oestrus, but the males are not always ready to give up, and keep the female hostage for at least a full day.



Pic.38. Jasiri (left) is displaying territorial behavior towards the female (Nashipae)



Pic.39-43. Jasiri (M108) attacking a female after the end of courtship, displaying aggression similar to aggression towards the male intruder

Also, encounters between males and non-receptive (or pregnant) females are not peaceful. Males may fight with each other in the presence of a female, and in these conflicts, the female may be injured. For example, Winda (M71), one of the Tabo Bora males was in courtship with Nagol (F99) on 26 June 2013, and that encounter resulted in pregnancy. On 24 September, when the female was on the last trimester of pregnancy, she encountered both Tano Bora males Winda (M71) and Olonyok (M73), and that meeting resulted in serious fight between the males, where accidentally, males were attacking the female. They chased the female into a ravine, where they periodically were fighting with each other and eventually wounded the face of a female. As only one of the Tano Bora males – Winda was in courtship with Nagol, the other male could perceive her as intruder and could attack her. In two hours, Olonyok left the female, followed by Winda, and went to the open field, where from both were keeping an eye on the ravine from a distance. Only in the darkness did the female manage to leave the area safely and gave birth in 3 days.

IV. HEALTH MONITORING

Following one of the Project objectives (i.e. *Identification of major threats to the cheetah population including health problems*) the research team performs cheetah health monitoring by direct observations and collecting photographic materials from the rangers and guides. In case of any health issues observed, we report to Reserve/conservancies authorities and the KWS Mara Mobile Veterinary Unit and assist them in locating these individuals who required treatment.

4.1. Sarcoptic mange. Sarcoptic mange is a highly contagious mite infection caused by *Sarcoptes scabiei* burrowing under the skin of domestic and wild mammals. It has been reported from 10 orders, 27 families and 104 species of domestic, free-ranging and wild mammals, including cheetahs. Cheetahs acquire it via direct contact with infected prey species or conspecifics. Study in the Mara (*Gakuya et al 2012*) has shown that cheetah infection with *S. scabiei* was associated with the climatic conditions (dry more than wet season) and the prevalence of infected Thomson's gazelles. Once the number of healthy gazelles increased, number of infected cheetahs decreased.

Clinical symptoms of mange depend on the immune status of the respective host. The initial stages of scabies can be identified by the appearance and behavior of the animal. The first signs appear on the muzzle in the form of gray areas under the eyes and on the bridge of the nose (Pic.48,49). At this time, lesions of the skin on the limbs are not yet visible, but the animal often and for a long time licks the same part of the body (usually the front leg or stomach), quenching the itching. Soon, scabies affects the auricles (Pic.44,54), and their edges become uneven and hard, sometimes with blood clots. At the latest stage, the skin becomes extensively thickened, greyish in colour, there is a marked eosinophilia throughout the epidermis and dermis (the skin becomes red in colour) (Pic.39), and often almost complete alopecia. The skin cracks, dries and exfoliates exposing the unprotected tissues.

Treatment of infected individuals in the field has been successful, although cases of self-recovery of cheetahs without intervention were observed in the Mara.

From 2012 to 2022, **48 (23.23.2)** cheetahs were spotted with different stages of mange, of which 9 (4.3.2) were treated by the Veterinary Units, and 5 (1.4) recovered on their own. We documented two sources of mange in cheetahs: prey (feeding on infected Thompson's gazelle) and another cheetah (contact with infected individual during courtship). In general, cheetahs with mange majorly come from Tanzania.

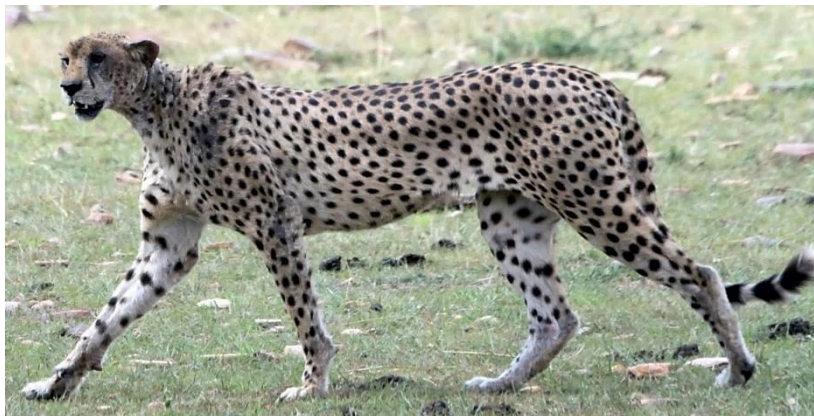
In **2012**, 22 (10.10.2) cheetahs (**29%**) were spotted with different stages of mange, of which 8 (3.3.2) were treated by the Veterinary Units, and 3 (1.2) recovered on their own.

In **2014-2015** there were 10(3.6) adult cheetahs spotted with mange, or **13%** of the Mara cheetah population;

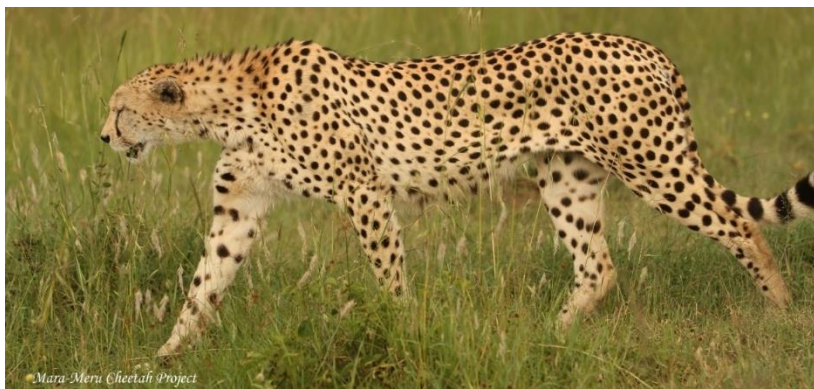
In **2016**, 5(3.2), which was **8.5%**;
 In **2017**, 4 (2.2) with mange, i.e. **5.4%**;
 In **2018**, 2(1.1) – **3.5%**, both spent most time in Serengeti;
 In **2019** – 5(3.2) or **7%** adult cheetahs, out of which 2 males spent most time in Serengeti. In 2019, two young cheetahs (1.1) have been treated by the KWS Vet Unit and one female (F61), recovered on her own;
 In **2020** and **2021**, no cheetahs were spotted with mange;
 In **2022**, 1 (1.0), M85 came from Tanzania with mange of 5 stage (Pic.44,46).
 In **2023**, 2(1.1) or 3,4% - both recovered by themselves

Osidai (M85). After reaching the age of independence, young cheetahs disperse into the Mara-Serengeti ecosystem. Females tend to live within the home range of their mothers, while males migrate over long distances. This is an effective mechanism for avoiding inbreeding. Osidai was the only one out of 5 Miale's cubs, born in 2016, who disappeared in Tanzania soon after reaching independence in 2018. In August 2022, he appeared in the Reserve after 4.5 years, which became the longest absence of a cheetah that we recorded in the Mara. At that time, he was affected by Sarcoptic mange. It took him a year to begin to recover without any assistance.

Pic. 44,45. Face of Osidai (M85) on 19 October 2022 (left) and on 15 December 2023 (right)

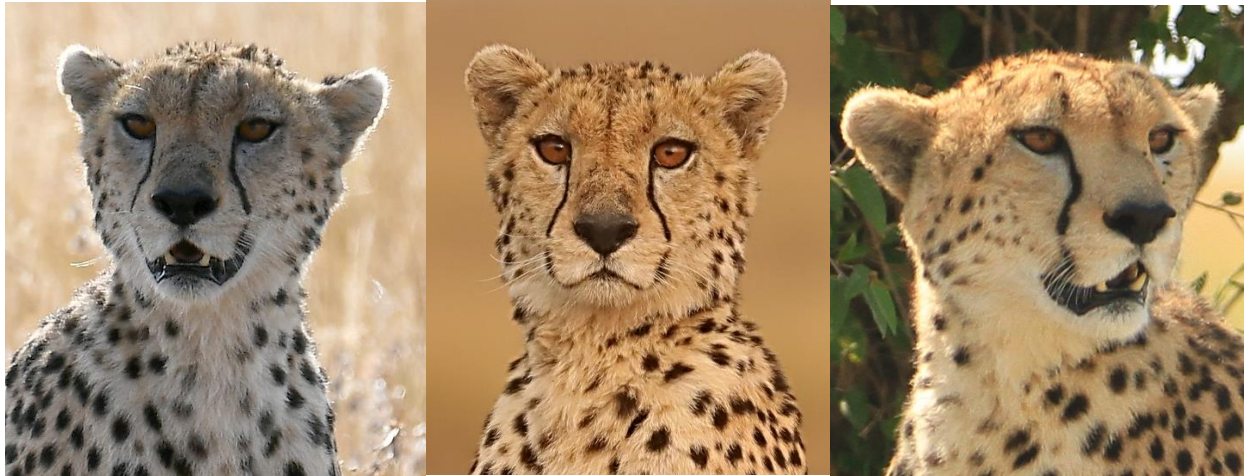


Pic. 46. Male Osidai (M85) appeared from Tanzania with mange after 4,5 years of absence (19 October 2022)



Pic.47. Osidai fully recovered on 15 December 2023

Neema (F68) born in 2015, was first affected by mange in November 2017, and in the beginning of January 2018 was treated by the KWS Vet team and slowly recovered within the next 3 months. Second time she started developing mange in July 2023 (face was affected), but fully recovered by the beginning of October 2023.



Pic. 48,49,50. Neema (F68) with mange - 27 July (left), recovering - 30 July (middle) and recovered - 2 October 2023 (right)

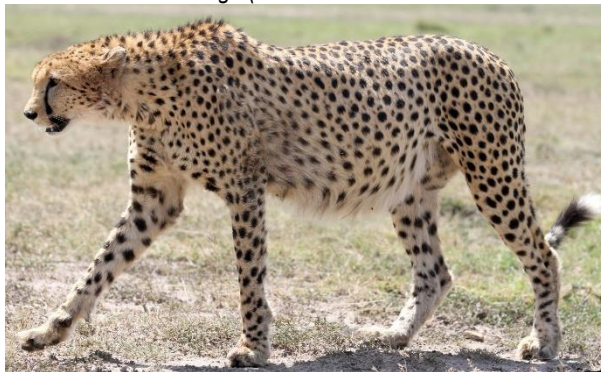
Jasiri (M108) born in 2018, was spotted at the Tanzania border area of the MMNR, on 10 June, 2023, with mange affected his left front limb. By the middle of July, he started recovering, but it was not possible to monitor him because he disappeared in Tanzania. When he reappeared at the Tanzania border in the beginning of September, his condition has worsened significantly: mange affected his head, face, belly and inner and outer sides of his limbs.



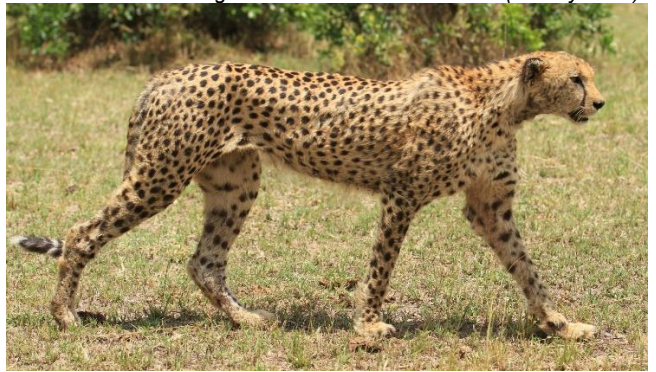
Pic. 51 Jasiri with mange (10 June 2023)



Pic. 52 Jasiri with mange well visible from a distance (07 July 2023)



Pic. 53 Jasiri is recovering from mange (15 July 2023)



Pic. 54 Jasiri with progressive mange (06 September 2023)

4.2. Temporary lameness. Regular monitoring of the physical condition of animals and their behavior helps to identify deviations and problems in a timely manner and, if necessary, provides prompt assistance. Good network built by our team with the local stakeholders (including rangers and guides) from the MMNR and the conservancies, and guides outside the Mara, gives us the opportunity to respond immediately and check the status of the reported sick/injured individual and report to the authorities.

In the wild, it is difficult to detect the exact event, which caused lameness of cheetahs. It can be caused by an injury of a pad by a thorn or a rock during hunting, or by dislocation of the joints due to fight or other events. Some cheetahs recover within days, some – within months. The time of full recovery depends on the stage and the cause of lameness, general physical condition of the individual, its social status, intensity of movements within the home range/territory and personal hunting experience.

For example, **Milele** (M83), who started limping in December 2022, fully recovered only in 5 months. His brother Mbili (M84) was hunting and sharing meals with his brother, which facilitated the process of recovery. Although, males have been moving intensively within 4 conservancies: from the OMC through the MNC, Lemek and Ol Chorro to the Enonkishu.

For a solitary cheetah with the same initial stage of lameness, it may take longer to recover. If cheetah cannot hunt on its own, supplementary feeding and treatment give positive results. For example, it took young female **Nagol** (F99) about one week to start hunting successfully after one treatment and single supplementary feeding.

The case of Nagol (F99). Two-year-old Nagol is daughter of Neema (F68), granddaughter of Rani (F8) and great granddaughter of Shakira (Pic.3).



Pic. 55, 56. Female Nagol (F99) is limping on left hind leg (left) and on right hind leg (right)

On 17th of January 2023, we received information from the tour guides about a female who was walking with great difficulty. We found her sleeping in the bush, and within 2 hours she got up only once (by that we identified her as Nagol), and from the manner of her movement (limping on the left front and both back legs) it was suspected that she might had a problem with the spine of unknown etiology (Pic. 55,56). We immediately reported to the MMNR authorities and KWS veterinarians, and the necessary assistance was provided to the female. On 18th of January, the KWS veterinarian team operating on the DSWT SKY Vet program, administered anti-inflammatory medicine with the help of a dart (without immobilization of the animal), which had a beneficial effect. (Pic.57). After 3-hour rest, the female moved noticeably more freely. On 19th January, the female got supplementary feeding by the MMNR rangers, and that day, walked for over 2 km. Over the course of several days of close monitoring, we watched the stiffness of her limbs disappearing, allowing Nagol travelling over 10 km and in 7 days, and hunting successfully on her own. In some cases, repetitive treatment and feeding is required.



Pic. 57. Limping female Nagol (F99) receiving assistance from the SWT Mara Mobile Veterinary Unit

The case of Oloti (M114). On 19th of February 2023, we received information from one of the tour guides about badly limping cheetah. The guides helped us locate him near the thick bushes. The cheetah was **Oloti** (M114), he was thin, limping on his right hind leg and with several wounds on his body, apparently from a collision with a predator. He was emaciated and from his locomotion, it was clear that he could not hunt any sufficient prey and survived on hairs, which he could find in the thickets (Pic.46, 53). We reported to the park authorities and the KWS vets, and the male was assisted first with a fresh kill and next day, treated distantly by the vets from the KWS DSWT Mara Veterinary Unit (Pic.49,50). Since there were no positive changes in the male's condition, full examination was performed by the vet on 26th of February (Pic.50,51), and dislocation of the joints of his right hind limb was found. Since the male was extremely shy and preferred to spend much of his time in thick bushes and forests, he was difficult to monitor.

In the first ten days of March, Oloti crossed the river and settled in the Mara Triangle, where he was assisted and constantly monitored by the Rangers of the Mara Conservancy. By the time he crossed, he was fed and treated twice in the Reserve. In the Mara Triangle, Oloti gradually



Pic. 58. Oloti limping

recovered, and started independently hunting variety of game (hares, young and adult gazelles) and gradually getting used to the presence of tourist cars. By 31st of March 2023, when Ruka and Rafiki (M109,M110) returned to the Mara Triangle from the Serengeti, Oloti again moved to the Reserve (See Pic.32). Despite the fact that by the 31 December 2023, the male was still limping, he adapted to hunt relatively large prey – adult Impalas, in dense bush at any time of the day, including dusk hours.



Pic. 59. Oloti darted



Pic.60. Vet team at the spot



Pic. 61. Oloti after second treatment



Pic.62. Examination of Oloti

V. WORKING WITH THE MARA STAKEHOLDERS

5.1. Workshops for the rangers and tour guides in the Mara. The project research team works closely with the teams of rangers of the MMNR and conservancies, provides rangers monitoring equipment: binoculars and rugged NIKON digital ranged photo cameras with built-in GPS and conducts conservation workshops for them at the ranger stations and tourist facilities. At the workshop, participants receive updated information about cheetah ecology and behavior, based on new data obtained by our research, as well as training in cheetah identification methodology.

In 2023, MMCP team conducted 6 workshops, including several at the research base for rangers and wardens from all Mara conservancies, including newly formed. Photos taken by the rangers with the photo cameras which we give to different rangers patrolling teams, help following cheetah movements in the Mara ecosystem.

5.2. Greater Maasai Mara Ecosystem Management Plan and Maasai Mara National Reserve Management Plan Meeting. By the invitation of the Narok County and MMNR authorities, the project team participated in the meeting with stakeholders and partners held at the Mara Keekorok lodge on 17th February 2023. The meeting was dedicated to updating the Greater Masai Mara Ecosystem Management (GMME) Plan and Maasai Mara Management Plan 2022-2032. It brought together all stakeholders of the Greater Masai Mara Ecosystem, including representatives of the Government of Narok, KWS, MMCA, WWF and the Mara Conservancies. The plans provide a policy framework that will guide development in all sectors of Narok County for the next ten years. MMCP team suggested several edits, including:

- Reforestation in several areas of the MMNR, including planting Croton bushes in the open areas, such as along the main road Talek-Keekorok and Talek-Naibor camp area. Bushes planted in 10-15 meters from the main roads, provide good shade to various wildlife, including ungulates, carnivores and rodents.
- Creating artificial waterhole on the side of the main road Talek-Keekorok. Such waterhole made in appr. 30 meters from the main road, will attract various wildlife and by that, provide spectacular game viewing from the main road, especially during dry months.
- Closing the side roads, which are passing by the lonely trees and small bushes in the area, and extending the distance to these bushes and trees, taking in account movement of the shade around the trees from the sunrise till the sunset. The pathway for cars shall be created in 20 meters from the shade of the tree crown at any time of the day. Such trees are often used by different animals, including cheetahs with cubs. Viewing from 20-meter distance will provide visitors with opportunity to observe animals without disturbing them.
- Promote animal-friendly guiding in the MMNR by free of charge education/training programs for the local guides.
- Improve Park Rules by adding and reinforcing the following rules:
 - * This Reserve is a no music zone. Switch off your music while in the park
 - * Do not make a circle around the animal, it needs to check environment for a potential danger
 - * Turn off the engine and radio when stopped to observe animals. Keep quiet while watching animals - noise disturbs the wildlife and may irritate your fellow visitors
 - * Do not make any noise, accelerate or start/stop an engine to attract animal's attention, respect privacy of the animals
 - * Do not use flash/external light/headlights while photographing/filming animals, it can affect their vision
 - * Do not separate any baby animal from the mother by driving. If you hear group members (mother/baby/coalition-mates etc.) calling being separated, immediately stop driving and switch off the engine and radio. Noise confuses animals and prevents finding each other if lost
 - * Do not drive whenever animals are hunting. Perpetration will be equated to the animal harassment
 - * Animals have a right of way and right to eat. Blocking any walking wild predator and approaching it before it has started eating after successful hunt is harassment and punishable
 - * Wild cats (cheetah, leopard etc.) on/in the vehicle are strictly prohibited. Keep a distance from the cats (with cubs or without) of 25 meters, and under no circumstances do not approach cats moving towards your car, as it may encourage them climbing a vehicle.
 - * Do not smoke near animals, leave for 100 m
 - * Do not use drones and remote recording devices



Pic.63. Vehicles at the cheetah siting in MMNR

5.3. Workshops for local communities. On 20 July 2023, our Project team actively participated in the five-day **Mara Grazing Workshop**, an event organized by the Maasai Mara Wildlife Conservancies Association (MMWCA). This workshop brought together a diverse group of stakeholders, including wardens, conservation authorities, community liaison officers, and



Pic. 64. S. Mpooya is giving a talk to stakeholders

representatives of pastoralist communities from both the MMNR and the broader network of conservancies across the Mara region. During the workshop, Project Scientific Assistant S. Mpooya delivered a specialized presentation focusing on the intricate dynamics of human-cheetah interactions (Pic.64). This talk covered several critical aspects, including the key behavioral and biological characteristics of the cheetah, strategies for mitigating human-wildlife conflict through livestock protection measures, and best practices for safely encountering cheetahs in natural habitats. These recommendations are designed to minimize risks to both humans and livestock while promoting cheetah conservation. To enhance engagement and comprehension, the presentation was

complemented by a series of photographic illustrations collected during our ongoing field research and ecological monitoring efforts. The visual evidence provided an in-depth look at cheetah behavior, habitat use, and conflict scenarios, reinforcing the scientific and practical aspects of the discussion.

The information was well received with keen interest and appreciation by workshop participants, who recognized its potential to reduce human-cheetah conflicts and enhance coexistence strategies. In the long term, the dissemination and application of these insights will contribute to the conservation of cheetah populations in the Mara ecosystem while simultaneously safeguarding the livelihoods and security of local pastoralist communities.



Pic. 65. Cheetahs did not react to approaching shoats that were not accompanied by a herder

5.4. Training and issuing equipment for the MMNR rangers. Our team continues to train rangers and guides of the reserve and the conservancies. During the workshops, participants receive from us the most important and updated information about the behavior and adaptations of cheetahs, the problems they face, as well as the most effective ways to protect these rare felids. We also provide rangers with high-quality binoculars and rugged photo cameras for monitoring cheetahs.



Pic.66,67. Binoculars issued by MMCP to the Wardens and ranger teams of the Maasai Mara National Reserve



Pic.68,69. A lesson in the field of cheetah identification for the MMNR ranger teams

5.5.WRTI First Wildlife Scientific Conference on 26th-28th September, 2023 Lake Naivasha Resort, Naivasha, Kenya



Pic.70,71. WRTI Wildlife Scientific Conference

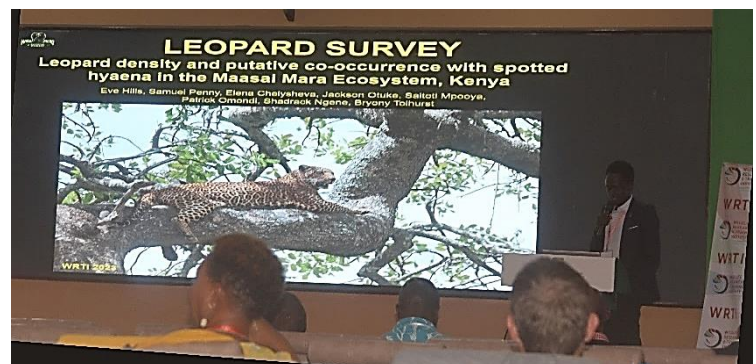
On 26th-28th September, 2023 our team participated in the First Wildlife Scientific Conference organized by Wildlife Research and Training Institute (WRTI) at Lake Naivasha Resort. In order to effectively address the challenges within the wildlife sector and optimize the economic benefits derived from wildlife resources for the Kenyan people, the conference was centered around the theme "Use of Wildlife Science for Enhanced Biodiversity Conservation and Improved Livelihoods"

which highlighted the nexus between science, policy, management and livelihoods. Additionally, it aligned seamlessly with the National Wildlife Research Agenda 2023-2027.

The conference brought together scientists, wildlife managers, policy and decision makers, private sector and wildlife conservation stakeholders from all over the country, who presented and discussed the most recent innovations, trends, and concerns as well as practical challenges encountered, and solutions adopted to sustain biodiversity conservation for socio-economic development. Ouk tam took an active part in various discussions and shared our research findings. In behalf of our team, Saitoti Mpooya, the Project Manager, presented the results of the first study of the leopard population in the Mara ecosystem, conducted by our team: «Leopard (*Panthera pardus*) Density and the Impact of Spotted Hyaena (*Crocuta crocuta*) Occurrence on Leopard Presence in the Maasai Mara Ecosystem, Kenya», which was met with interest and appreciation.



Pic.72. Discussing wildlife conservation with colleagues. Pic.73. S.Mpooya presenting results of the Leopard Study at the Conference



We conducted camera-trapping in the Maasai Mara Ecosystem (MME) to estimate leopard (*Panthera pardus*) population density and investigate whether lion (*Panthera leo*) and hyaena (*Crocuta crocuta*) impact leopard presence, while accounting for potential prey presence and habitat. In 2019, we deployed cameras at 34 stations in the Mara Triangle within the MME for 63 nights. We estimated leopard density using a closed population spatially explicit capture–recapture (SECR) framework and examined potential predictors of leopard presence using generalised linear mixed modelling. We recorded 725 leopard images and estimated population density at 1.90 ± 0.56 individuals 100 km^2^{-1} , relatively low compared to other areas and only slightly higher than previous MME estimates of cheetah, an ecologically subordinate competitor. The best model predicting leopard presence contained hyaena occurrence and showed a positive association, indicating ‘co-occurrence’. Hyaenas commonly kleptoparasitise leopard kills in MME; that is hyaenas may follow leopards for this reason. Although our preliminary results indicate that hyaena populations may limit leopard populations in the MME, further work is required to explicitly test hypotheses relating to hyaena–leopard interactions.

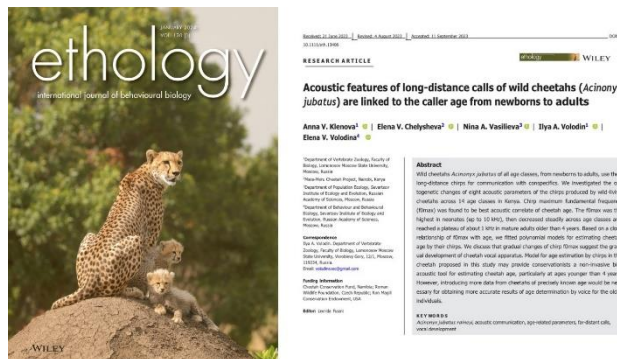
VI. PUBLICATIONS

In 2023, we have published the results of our long-term study of cheetah acoustic communication in two papers titled «Advertising sex and individual identity by long-distance chirps in wild-living mature cheetahs (*Acinonyx jubatus*)» and «Acoustic features of long-distance calls of wild cheetahs (*Acinonyx jubatus*) are linked to the caller age from newborns to adults» in peer-reviewed journal *Ethology* and became the most cited research in 2024. (Pic.74,75).



Pic.74. Our publication on cheetah acoustics – the first study of wild cheetah acoustic communication in the world

Until now, all studies of cheetah calls have been conducted in captivity, in zoos and captive breeding facilities. In captivity, animals can see each other and have no need to use long-range calls for calls. Therefore, in captivity, cheetahs use such calls mainly to communicate with their keepers, demanding food or to be let out for a walk. Thus, the function of these calls and the information encoded in them remained unknown until cheetah calls were recorded in their natural environment, in Kenya. Our study showed that cheetahs' long-range calls are as high-pitched as those in captivity, and fully justify the term chirps used in the literature for this type of call.



Pic.75. Our second publication on our unique study of wild cheetahs

Wild cheetahs of all age classes, from newborns to adults, use their long-distance chirps for communication with conspecifics: calls between male coalitions, between potential mates, and between family members, including mothers and cubs. We investigated the ontogenetic changes of eight acoustic parameters of the chirps produced by wild-living cheetahs across 14 age classes in Kenya. Chirp maximum fundamental frequency (f0max) was found to be best acoustic correlate of cheetah age. The f0max was the highest in neonates (up to 10 kHz), then decreased

steadily across age classes and reached a plateau of about 1 kHz in mature adults older than 4 years. Based on a close relationship of f0max with age, we fitted polynomial models for estimating cheetah age by their chirps. We discuss that gradual changes of chirp f0max suggest the gradual development of cheetah vocal apparatus. Model for age estimation by chirps in the cheetah proposed in this study may provide conservationists a non-invasive bio-acoustic tool for estimating cheetah age, particularly at ages younger than 4 years. In order to obtaining more accurate results of age determination by voice for the older individuals, we are collecting more data from cheetahs of precisely known age.

Chirps of adult male cheetahs are longer and lower in fundamental frequency than chirps of adult females. Discriminant analysis of acoustic parameters showed that chirps of adult cheetahs also contain information about features that allow to distinguish individuals by calls individually. However, analysis of repeated recordings made after one or two years indicates that individual features in calls are unstable, and cannot be used for long-term identification of individuals by calls. Thus, cheetahs probably have to constantly update their knowledge of changes in the voice of conspecifics during regular encounters with them in order to reliably distinguish individuals by sounds that are out of sight.

1. Chelysheva E.V., Klenova A.V., Volodin I.A., Volodina E.V., 2023. Advertising sex and individual identity by long-distance chirps in wild-living mature cheetahs (*Acinonyx jubatus*). *Ethology*, v. 129. <https://doi.org/10.1111/eth.13366>

2. Klenova, A. V., Chelysheva, E. V., Vasilieva, N. A., Volodin, I. A., & Volodina, E. V. 2023. Acoustic features of long-distance calls of wild cheetahs (*Acinonyx jubatus*) are linked to the caller age from newborns to adults. *Ethology*, 00, 1–18. <https://doi.org/10.1111/eth.13406>

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Maps: Saitoti Mpooya



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