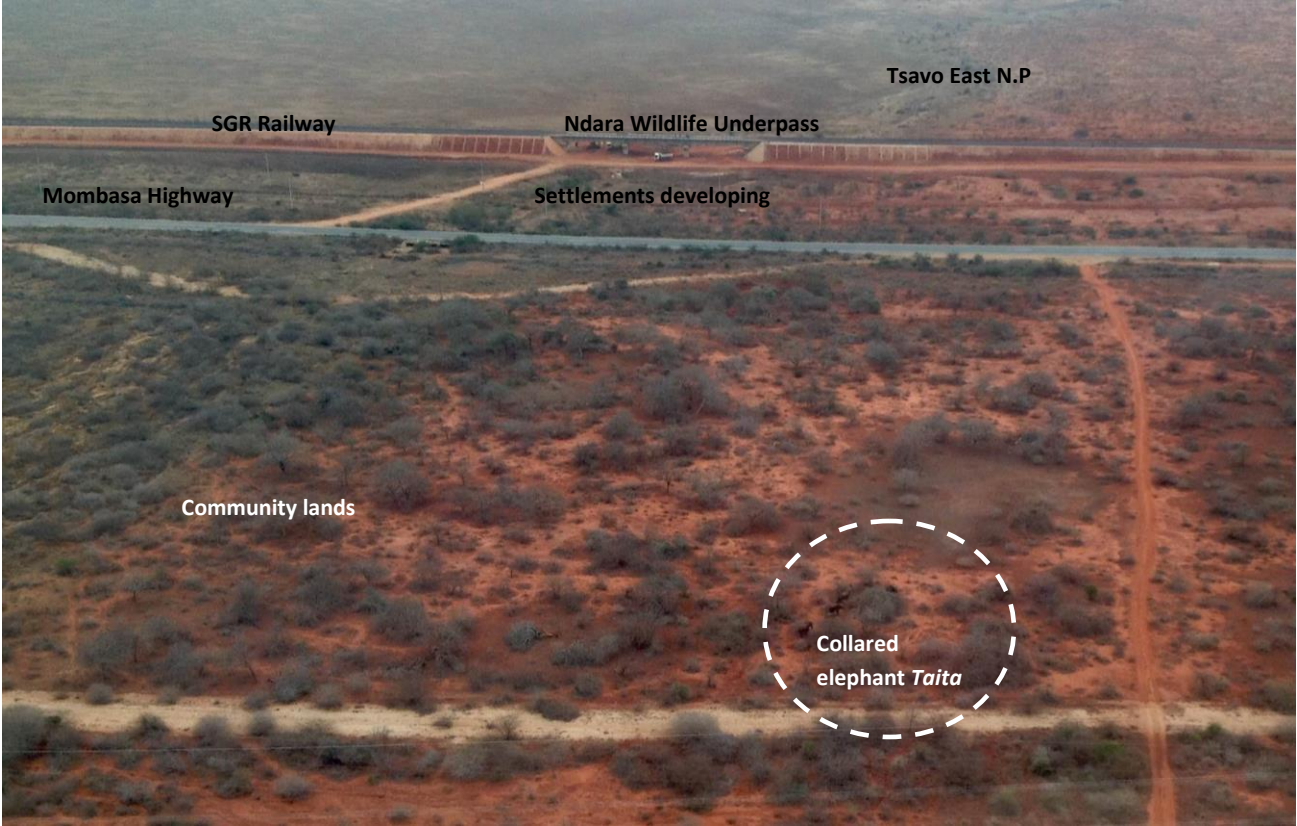


Tracking and monitoring of elephant movements along the Standard Gauge Railway and highways in the Tsavo Ecosystem, Kenya (March 2016 – June 2017)



About this report: This report is an update of the 6-month report produced in October 2016. It covers observations made between March 2016 and March 2017 of the collared elephants and between July 2016 and June 2017 of the elephants monitored from vehicles and on foot along the SGR. The observations are illustrated using maps, graphs, tables and photos.

Cover photo: Taita a collared female elephant and her family approaches the SGR Ndara underpass in September 2016 (Photo by Keith Hellyer, Wildlife Works Gyrocopter Pilot)

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Summary

The new Standard Gauge Railway (SGR) linking Mombasa to Nairobi became officially operational in June 2017. It is a flagship project for Kenya under Kenya's blue print Vision 2030, whose goal is to transform Kenya into a middle-income industrialized economy by 2030. More than a quarter i.e., 135 km of the 487 km railway is through the Tsavo Conservation Area, bisecting the range of Kenya's largest surviving single elephant population of 12,800 animals, as well as many other wildlife species. This presents a challenge.

While the old railway line lay level with the ground, the new SGR is elevated up to 10 metres in some sections and fenced on either side, creating a substantial barrier to wildlife movement with likely negative consequences. The contractor of the SGR, the China Roads and Bridges Cooperation, built six official wildlife passages to connect Tsavo East to Tsavo West National Parks and Tsavo East to the Taita Ranches to allow animals to travel in search of food, water and mates. The 2 km Tsavo River super bridge, the Kenani and the Maungu railway crossing bridges makes a total of nine wildlife passages.

Save the Elephants in partnership with the Kenya Wildlife Service has been tracking elephants to understand the effectiveness of these passages. We fitted ten elephants (eight along the SGR and two along the Voi – Taveta road) with GPS satellite radio transmitters in March 2016. In June 2016, we initiated systematic vehicle and foot monitoring along the SGR of elephants and other species, not fitted with radio transmitters, by using their signs such as footprints and dung. Some elephants have used them effortlessly, with families in tow, while others have preferred to use the culverts and bridges that perforate the line but which have not officially been classed as wildlife passages. Even though the details of other wildlife species crossings are not reported here, it is important to highlight here that giraffes generally avoided any form of underpasses with only one footprint recorded on 13th March 2017 at culvert DK234+062. Generally, however the culverts offer an opportunity for wildlife crossing points between the two sides of Tsavo National Park and adjoining ranches keeping genetic diversity open and a flow of inter-seasonal movements.

The barrier fences either side of the SGR railway must be brought up to a suitable wildlife-proof standard, but organized to allow free movement through selected culverts as well as through the official wildlife passages. Opening up such culverts can ensure increased porosity of the SGR thus minimizing the observed fence breakages and the associated maintenance costs. This should enhance safety, and reduce the likelihood of a terrible train-animal accident. The threat is not theoretical. The Qinghai-Tibet railway in China was built with wildlife passages beneath it, but it took the Tibetan antelope more than 10 years to learn the new paths, significantly affecting their migration pattern and breeding. And the process of learning the use of passages can be costly. In Tsavo, 20 elephants were killed by trains on the old railway or by trucks on the Mombasa-Nairobi and Voi-Taveta highways between January 2016 and June 2017. This was a dramatic increase compared to years before the SGR was constructed.

In summary, we know that any fence construction should funnel animals to wildlife passages and keep culverts open. This will reduce the incentive to break the protective fences and cross the railway elsewhere which, if successful, would endanger the lives of Kenyans on the train and the wildlife attempting the crossing. We also strongly recommend the construction of wildlife passages and speed bumps in specific areas of the Mombasa-Nairobi highway to ensure that as this road expands adjacent to the SGR, wildlife and people can continue to utilize the area safely. We will continue to monitor the elephants for another two years until 2019.

Elephant crossing points along the SGR

Five out of the eight elephants collared along the SGR crossed the SGR. They included three bulls *Kenani*, *Rukinga Tsavo Bull*, and two females *Manyani* and *Taita*. A female named *Kamboyo* that was tagged inside Tsavo West National park approximately 15 km from Mtito Andei town has never crossed the SGR and stayed away from the busy transport corridor. Another female named *Maungu* collared around Maungu town, south of Voi town has also never crossed the SGR. *Maungu* mostly only moves along the SGR to as close as 10 meters but never crossed. *Ndara* is the only male collared elephant near the SGR that has not crossed the SGR, only coming close and utilizing the area between Voi River and the Galana Ranch. A summary of the status of the collared elephants is given in Table 1.

Table 1: summary of the details of the collared elephants in Tsavo East and Tsavo West National Parks

Date collared	Elephant name	Sex	Capture location	Family size	Remarks about the animal
15/03/2016	<i>Makitau</i>	Male	Makitau; in TWNP, 1km north of Voi - Taveta highway, northwest of Makitau town	1	Has crossed the Taveta highway 118 times. Possible crop-raider at north of Taveta
15/03/2016	<i>Murka</i>	Female	Murka; in TWNP, 300 meters north of the Voi – Taveta highway	18	Has crossed the Taveta highway 311 times
15/03/2016	<i>Maungu</i>	Female	Maungu; in TENP, 600 meters east of the SGR, approx. 1km north west of Maungu town	16	Has never crossed the SGR
15/03/2016	<i>Ndara</i>	Male	Ndara; in TENP, 600meters east of the SGR	5	Has never crossed the SGR and his range extends to Galana Ranch
16/03/2016	<i>Kenani</i>	Male	Kenani; in TENP, 3km east of the SGR, approx. 17Km north west of Tsavo River Bridge	1	Killed on July 2016, but had crossed the SGR 104 times
16/03/2016	<i>Kamboyo</i>	Female	Kamboyo; in TWNP, 20Km west of the SGR, approx. 16Km south west of Mtito Andei town	10	Has never crossed the SGR
16/03/2016	<i>Manyani</i>	Female	Manyani; in TENP 1km east of the SGR	4	Crosses the SGR at Manyani. Has crossed it 7 times
16/03/2016	<i>Tsavo Bull</i>	Male	Manyani; in TWNP, 800meters west of the SGR	1	Crosses the SGR mostly at Manyani corridor. He has crossed 14 times
17/03/2016	<i>Rukinga</i>	Male	Rukinga Ranch; south east of Maungu town, approx. 7km from the SGR	3	Has crossed the SGR 35 times and also crop-raids at Sagalla
17/03/2016	<i>Taita</i>	Female	Taita Ranch; south east of Maungu town, approx. 7km from the SGR and 9Km south west of Bachuma town	15	Has crossed the SGR 11 times and her range extends into Tanzania

Main elephant crossing areas

Unfortunately, one of the five elephants (*Kenani*) that regularly crossed the SGR was poached for his ivory on 8th July, 2016, north of Maktau inside Tsavo West National Park. The other four elephants occasionally crossed the SGR between the Parks and the Ranches. On average, they used the

underpasses 31% of the times they crossed the SGR (Table 2). This proportion is however derived from the sum of all crossings pre and post erection of an electric fence along the SGR to keep the animals away from the railway. *Rukinga* crossed the highest number of times and most of the incidences were from Ngutuni Wildlife Conservancy to the area between the highway and SGR or from the park to the Sagalla farms as shown in Figure 1a.

Table 2: SGR crossings and use of the underpasses by the radio tracked elephants

Elephant Name	Total SGR crossings March 2016 – March 2017	Underpass use* of the total crossings	Percentage of crossings in the underpasses
<i>Tsavo Bull</i>	14	7	50%
<i>Manyani</i>	7	1	14%
<i>Rukinga</i>	35	15	43%
<i>Taita</i>	11	2	18%
Total	67	25	31% average

*Any crossing within 100m of an underpass was assumed to represent use of an underpass. The assumption is in consideration of the GPS precisions and the settings for the hourly frequency of data transmission by the radio transmitters.

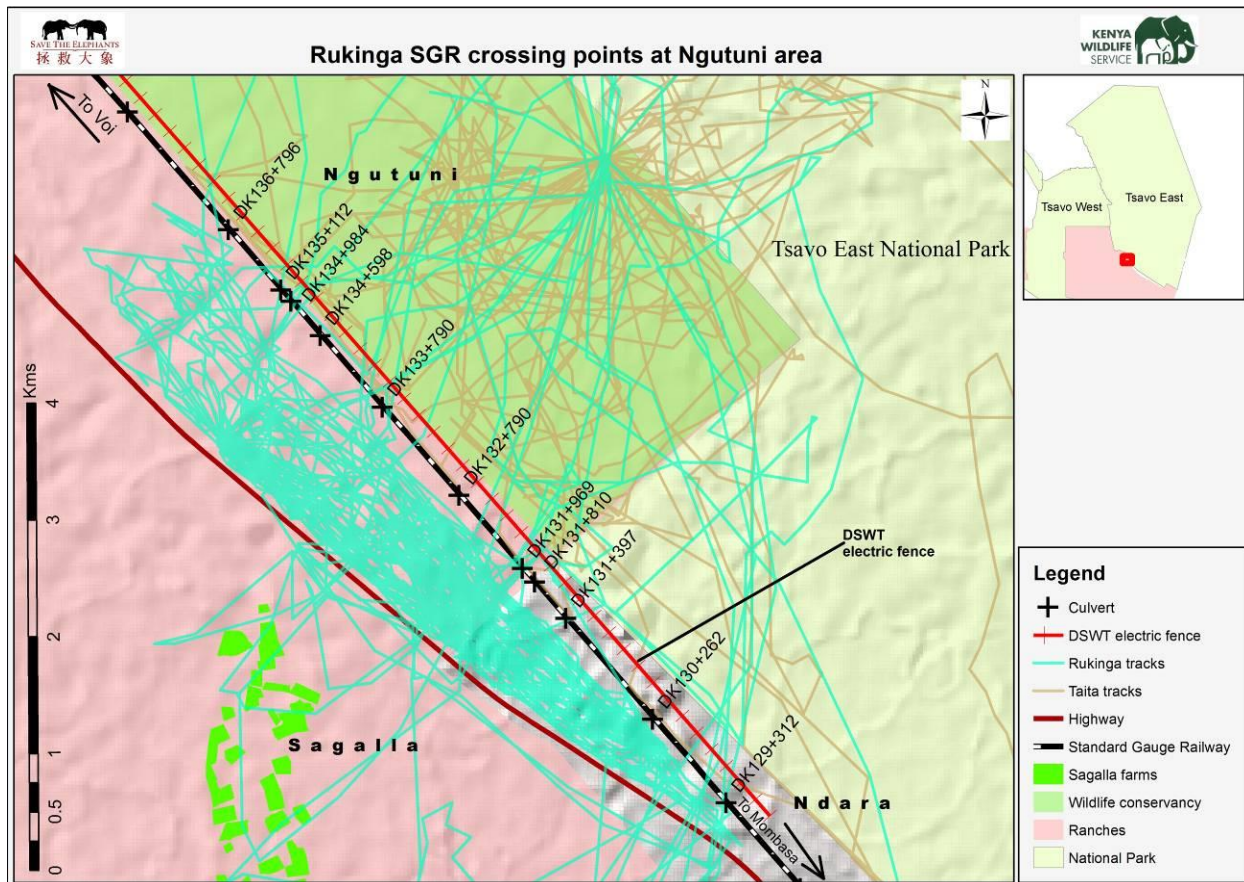


Figure 1a: *Rukinga* crossing area at Ngutuni south of Voi between Ngutuni Sanctuary and Sagalla Farms.

Rukinga most likely utilized the culverts between DK129 and DK136 in the Ngutuni area and in other incidences was observed crossing over the SGR embankment. This was before the David Sheldrick Wildlife Trust (DSWT) erected and completed a continuous electric fence in October 2016 along the SGR and adjacent to the SGR fence as shown in Figure 1a. The graphs in Figure 3a and 3b also corroborates this using the data collected from vehicle and foot monitoring of animal signs along the SGR.

Apart from crossing the SGR at the Ngutuni area, *Rukinga* also crossed at an area south of Maungu town between DK106 and DK112. *Rukinga* frequently used one specific water point in Rukinga Ranch. Interestingly, *Taita* also frequently crossed the SGR at this area (Figure 1b) and at the Ndara area. She is likely to have utilized the SGR water bridge at DK120, designated as Maungu water bridge 3 (Figure 1c).

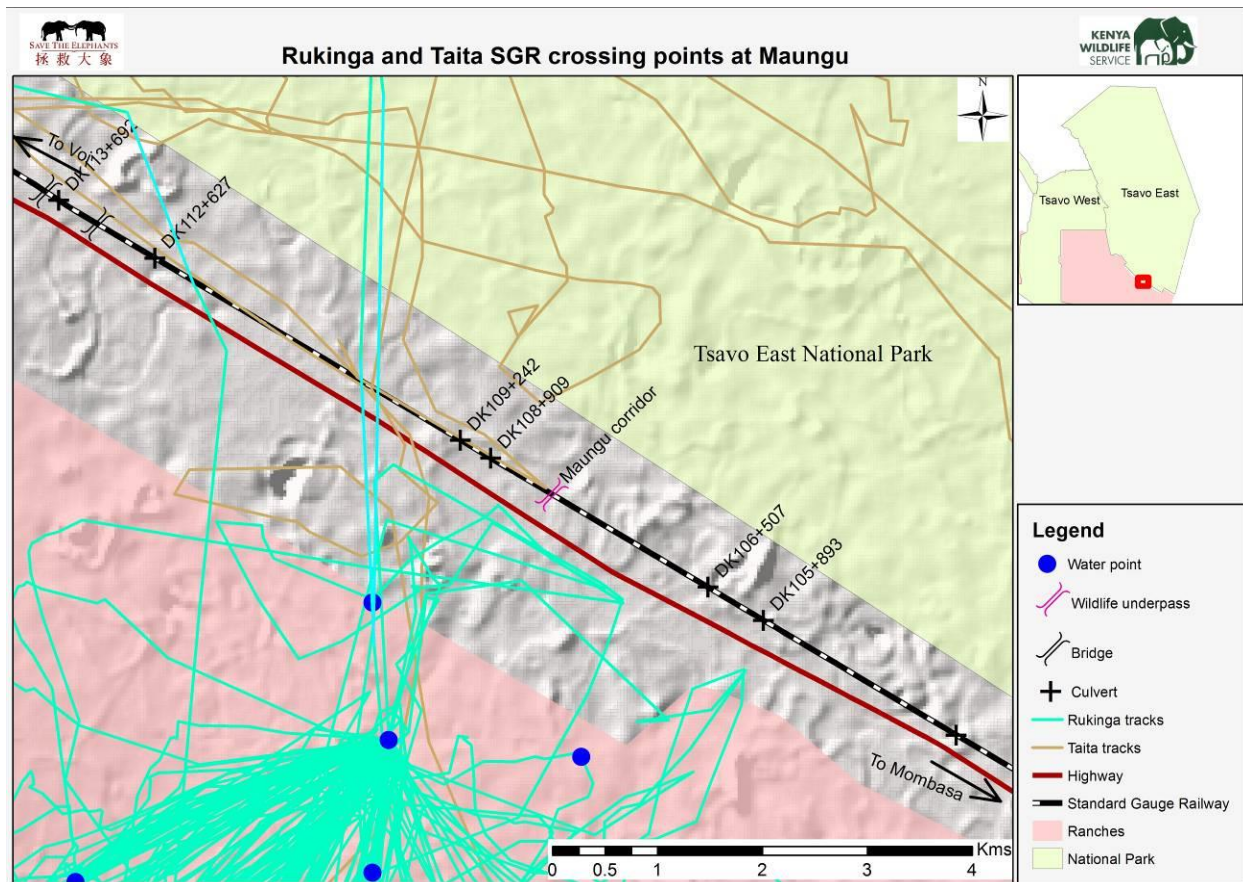


Figure 1b: *Rukinga* and *Taita* crossing area at Maungu between Tsavo East and Rukinga Wildlife Sanctuary

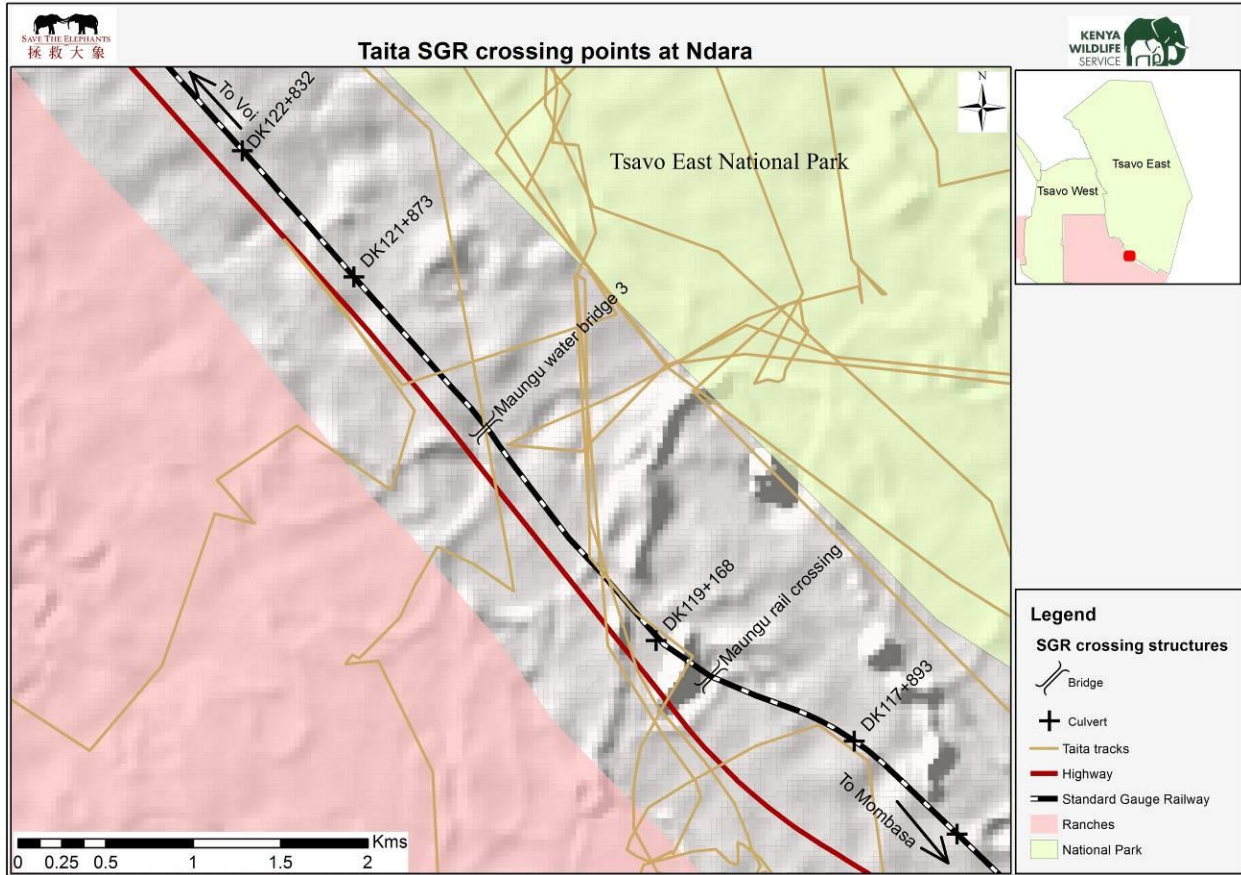


Figure 1c: Crossing areas at Maungu utilized by the Female elephant *Taita* and her family

The bulls *Manyani* and *Tsavo Bull* frequently crossed at the Manyani area (Figure 1d). These two elephants could most probably have utilized the Manyani corridor to cross over the SGR in some incidences. They have a relatively small range and spend most of their time around the secure Manyani area where we have a KWS Training Academy and the Manyani prisons. The three water points appear to be attractants to sustain these bull elephants in this area.

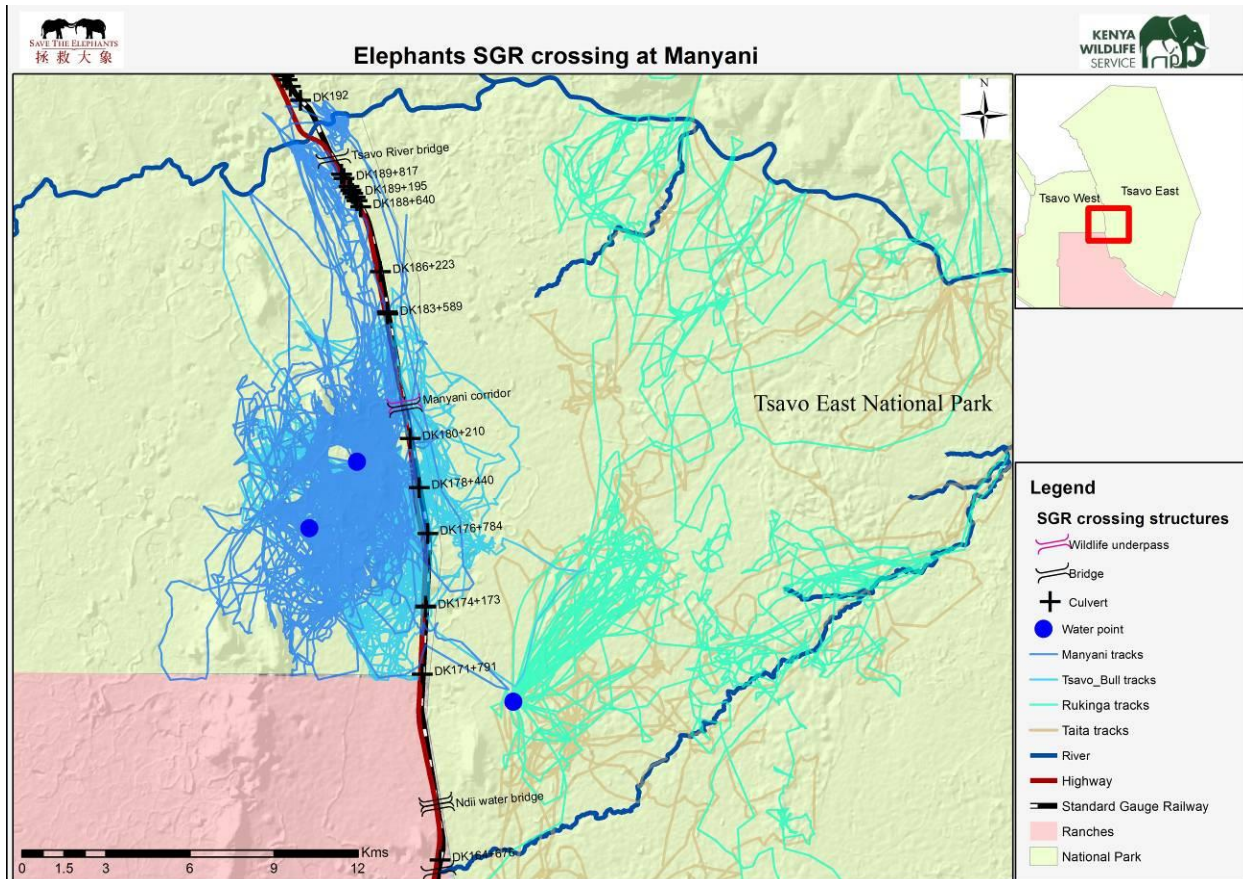


Figure 1d: *Tsavo Bull* and *Manyani* crossing points at Manyani area

Elephant tracking density

The following three density maps of elephant movements by kernel method show where the tracked animals spent most of their time in the 1 year of tracking (See Figures 2a, 2b & 2c). The red spots show the highest concentration of elephant movement while the green areas show the lowest concentration. High concentration on one side of the SGR/highway can be interpreted to mean the infrastructure obstructed free elephant movement. On the other hand, where the high concentration extends to both sides of the SGR/highway means the elephants are likely to have crossed the infrastructure with relative ease.

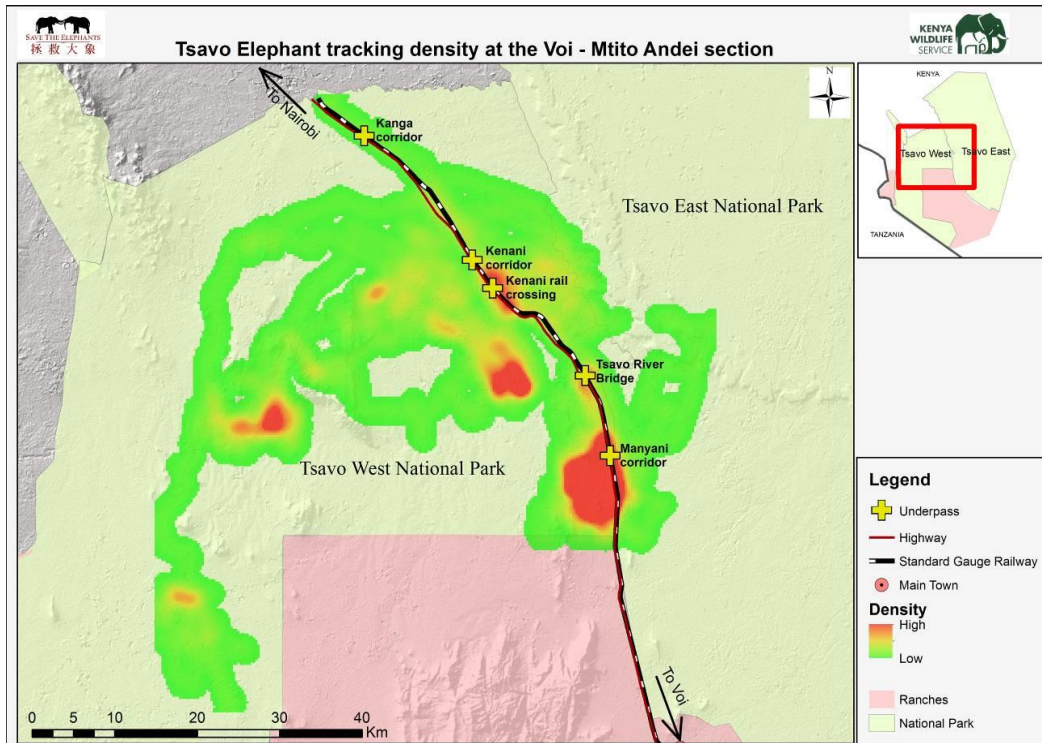


Figure 2a: Elephant movements density at the Voi – Mtito Andei northern section of the study area. The locations of the main underpasses are also shown.

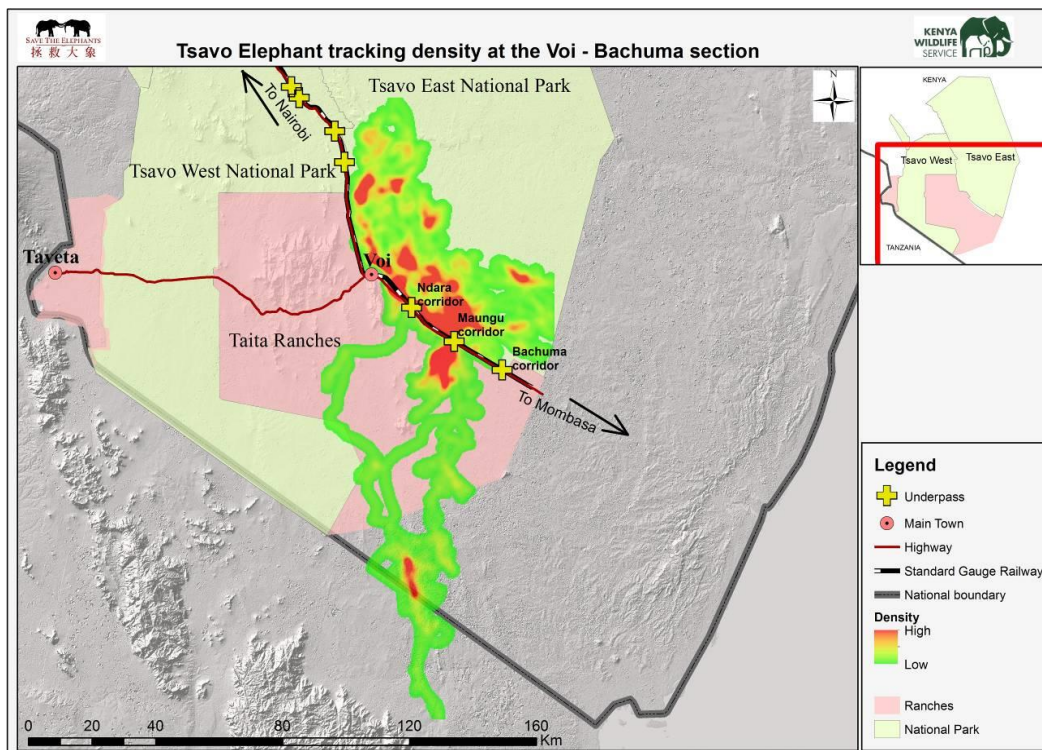


Figure 2b: Elephant movements density and the main underpasses at the Voi – Bachuma on the southern section of the study area. The locations of the main underpasses along the SGR are also shown.

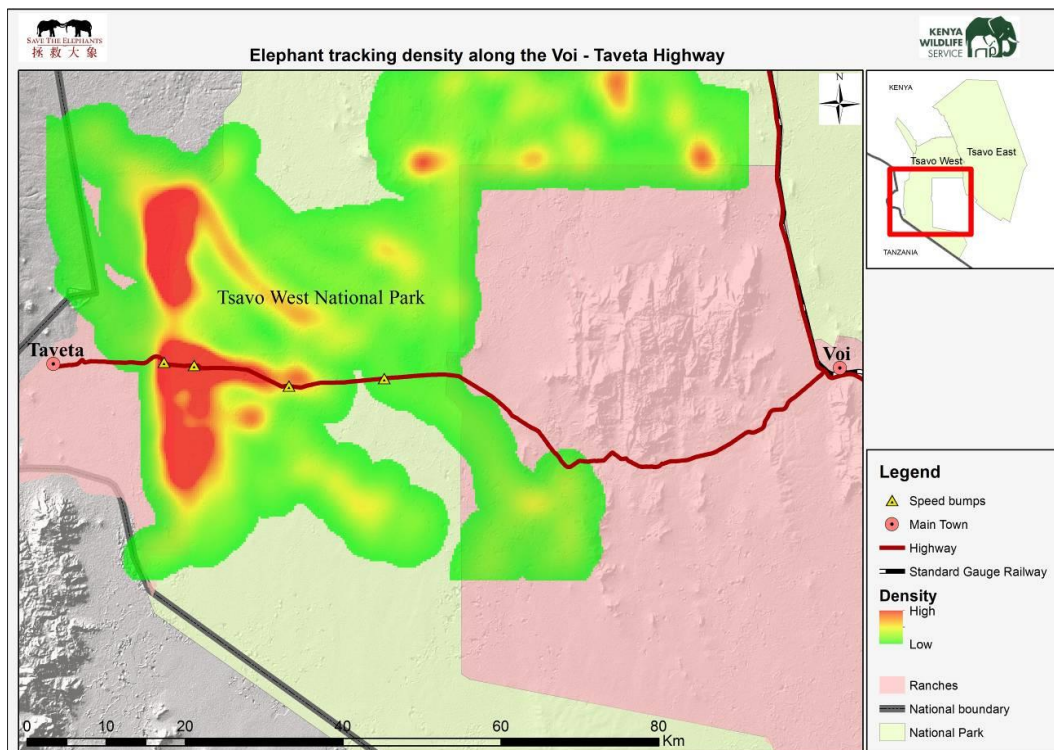


Figure 2c: Elephant movements density at the Voi - Taveta, the western section of the study area. The locations of speed bumps along the Voi - Taveta highway are also shown.

Elephant use of the underpasses

Vehicle and foot monitoring of the use of the SGR underpasses and culverts by elephants and other wildlife species using their indirect signs such as foot prints along the SGR from Bachuma to Voi and from Ndii to Mtito Andei was conducted in July, August, September and partly October 2016 before the completion of the SGR fence line and again in March, April and May 2017 after the completion of the SGR fence. Monitoring was carried out for 3 alternating days per week culminating to a total of 12 days a month. Fence breakages or crossing the SGR over the embankments were recorded in addition to the different species signs. Here we report observations of elephant movements only. It is however important to note that only one giraffe incident was recorded as using an underpass or culverts during this period. This is an indication that it will take a longer period for shy wildlife species to get used to the SGR infrastructure.

Voi – Bachuma section

This section is facing an upsurge of illegal human settlement. The western side of the SGR in some ranches also has human settlements that are gradually blocking the designated SGR underpasses. The high frequency of elephants crossing over the SGR embankment between July and October 2016 (Figure 3a) may indicate a greater need for the elephants to access the habitat on the other side of the SGR. This access between TENP and the Sagalla Ranches was completely blocked by the David Sheldrick’s Wildlife Trust electric fences and the SGR fence between Voi and Ndara area since October 2016 as shown in Figure 1a. These two parallel fence lines were completed around October 2016 and February 2017 respectively, and may explain the observed decrease in the number of elephants who crossed the SGR via the embankment between the park and Sagalla. The double fencing at Ngutuni also completely

blocks elephants from utilizing the culverts in this area. The animals seem to have shifted to use the previously underutilized designated underpass at Ndara (see Ndara corridor in Figures 3a & 3b). However, human-elephant conflict is imminent at this particular underpass given the increasing illegal settlements directly under and around the main Ndara elephant underpass (Plates 1a & 1b). A presence of charcoal for sale has also been observed from these illegal road side settlements. It is recommended that these new and illegal settlements are moved as soon as possible to pre-empt any human-wildlife conflict incidents from occurring in this main Ndara wildlife corridor.

Some open culverts between DK112+727 and DK115+420 (specifically DK112+627, DK113+692 and DK115+126) funnel elephants from the National Park into Maungu town and therefore are recommended for closure to reduce cases of human-elephant conflict from occurring in this busy town.

Voi – Mito Andei section

Kenani rail crossing bridge was the most utilized by elephants on this section. Kanga Bridge, Tsavo River Bridge and Ndii Water Bridge were also frequently utilized. Other main wildlife underpasses utilized were Kanga, Kenani and Manyani corridors. Of all the main wildlife underpasses on this section, Kenani corridor was the least utilized. This is can be attributed to its proximity to the Kenani rail crossing which has the highest elephant usage.

There was an exponential increase in the frequency of underpass usage between March – May 2017 compared to between July – October 2016 (See frequency of use of corridors in Figures 3c & 3d). We could infer that elephants adapted reasonably quickly to the underpasses and particularly after the SGR fence was erected. This inference may be supported by the recorded decrease in the frequency of crossing the embankments in the same period.

Strikingly, the culverts between Kenani rail crossing and Manyani were not been utilized in both periods of monitoring (Figures 3c & 3d). This may be due to the high use of Kenani rail crossing and Tsavo River bridges. Animals may have preferred these two wide underpasses to the narrow culverts.

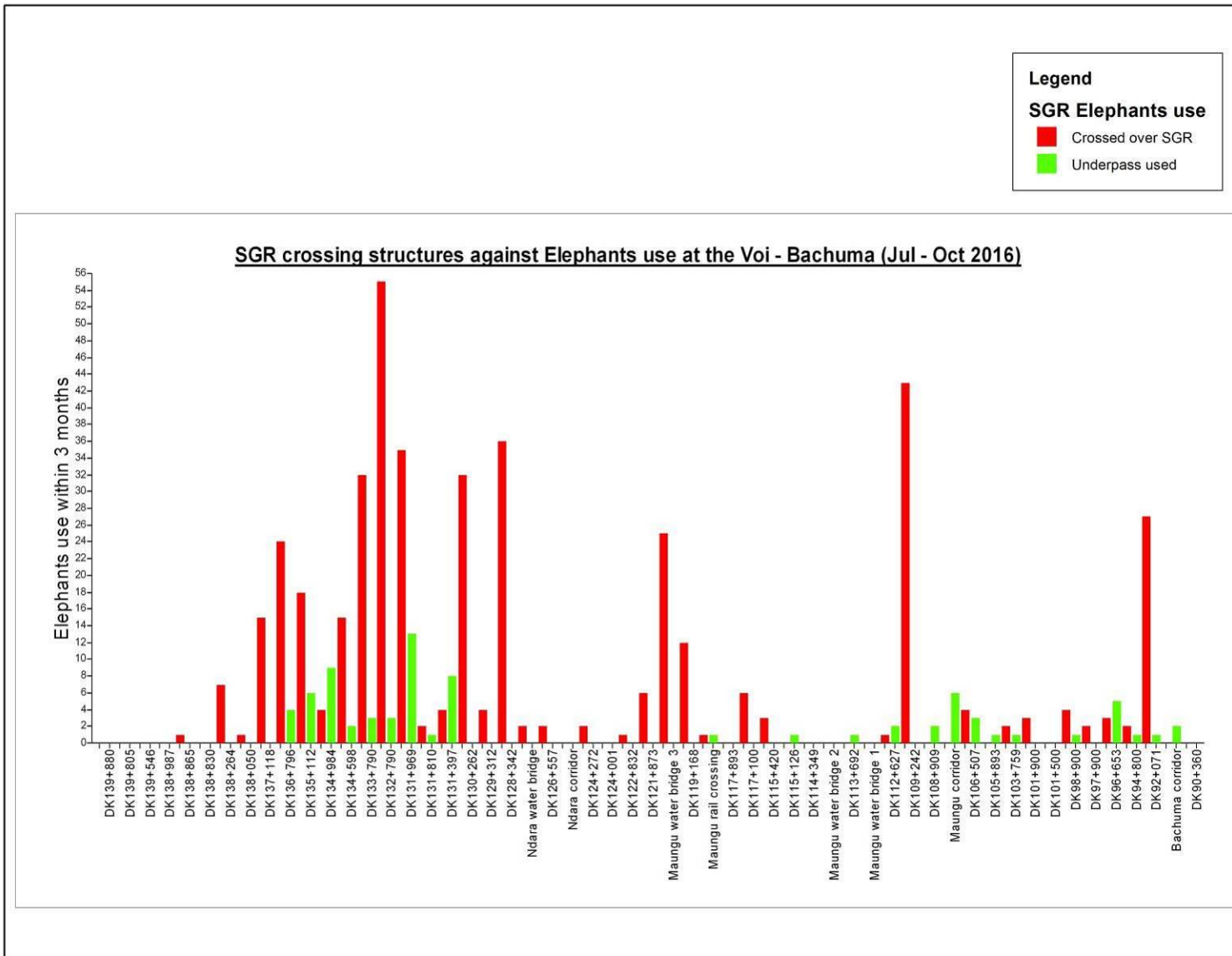


Figure 3a: Elephant – underpass utilization at the Voi – Bachuma, July – October 2016

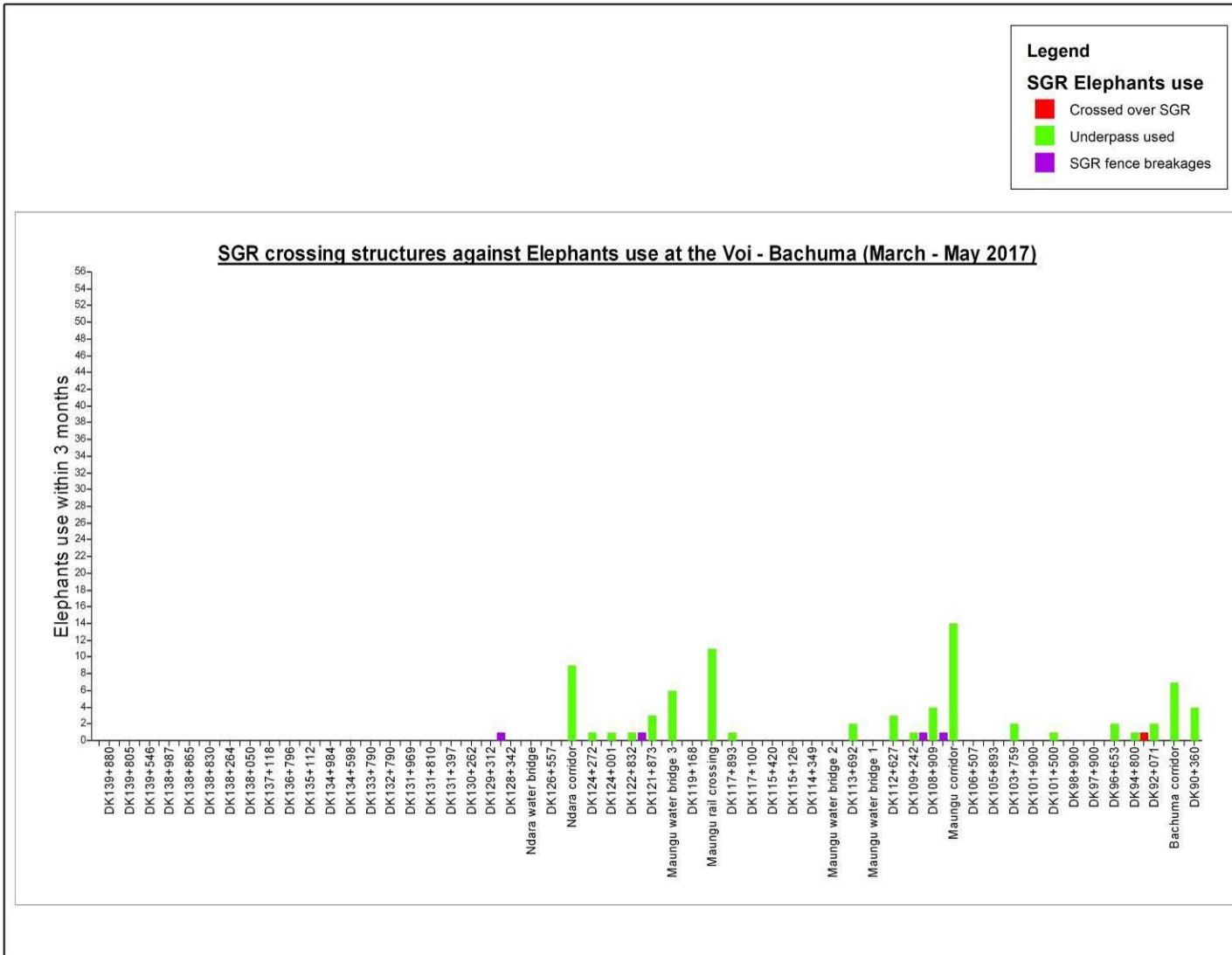


Figure 3b: Elephant – underpass utilization at the Voi – Bachuma, March – May 2017

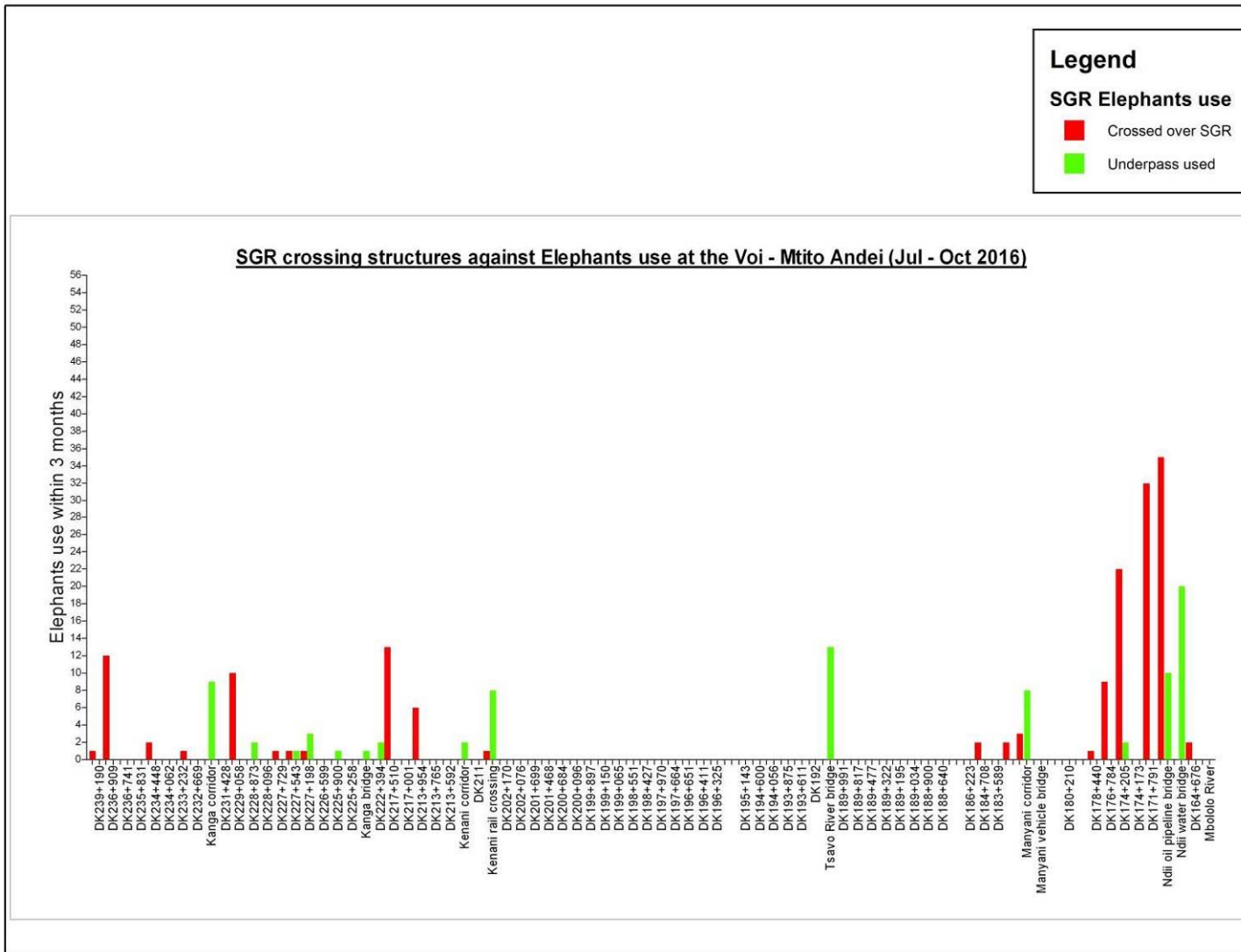


Figure 3c: Elephant – underpass utilization at the Voi – Mtito Andei, July – October 2016

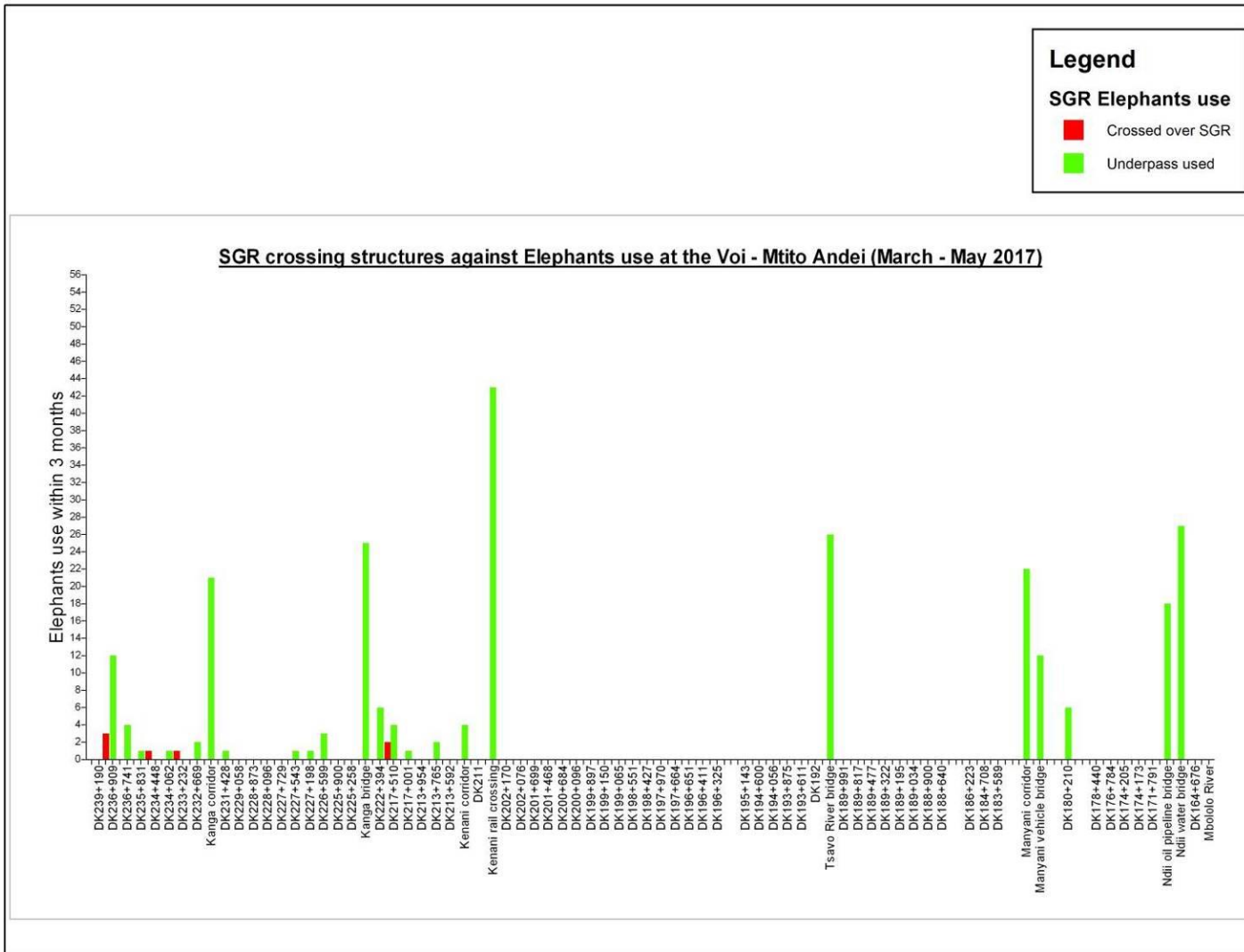


Figure 3d: Elephant – underpass utilization at the Voi – Mtito Andei, March – May 2017.

Exceptional movements of elephants

In this report, we also single out exceptional movements by two collared elephants, *Rukinga* and *Taita*. These movements are exceptional due to the range covered in one year and their nature of crossing the SGR.

Rukinga, a male elephant, was collared on 17 March 2016 within Rukinga Ranch, south of Maungu town. From the collaring location (refer the figure 4a), the bull crossed the highway and the SGR, moved north of Voi town. Later it moved southwards to Ngutuni and crossed the SGR, spending time at the area between the highway and the SGR, and also crop-raiding intensively at the adjacent Sagalla farms throughout April, May and June 2016. Apart from spending time between Ngutuni and Sagalla farms, *Rukinga* spent a lot of time in Rukinga Ranch on the foot of Maungu Hill. In November 2016 *Rukinga* was recorded to cross back over the SGR from Rukinga Ranch into Tsavo East NP, moved north of Voi and onto the Mudanda rock area where there is a permanent water point. He spent considerable amount of time around Mudanda rock and then went as far as to the Athi River and onto the Yatta plateau. He covered a great distance of approximately 3,941km during this whole year tracking period.

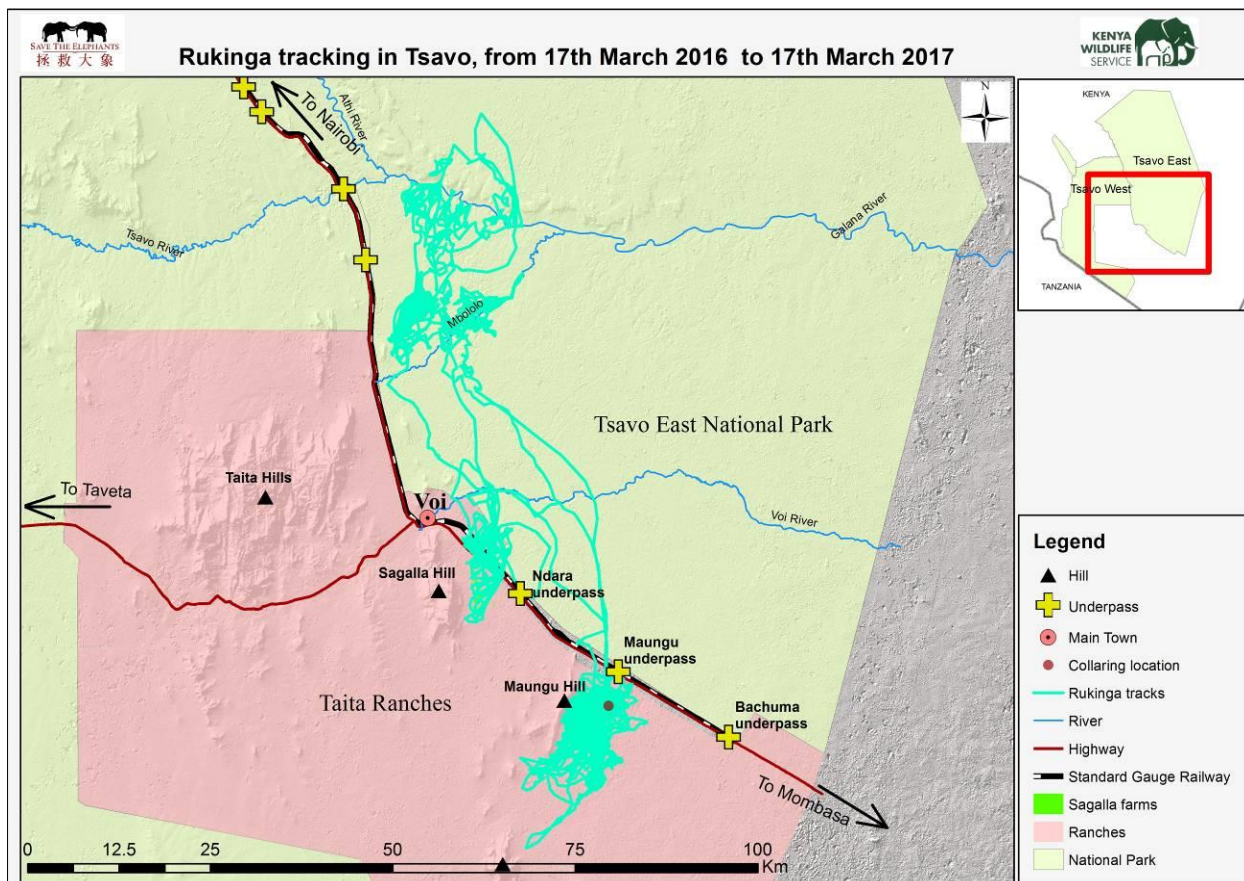


Figure 4a: *Rukinga's* movements from 16th March 2016 to March 2017 showing a 3,941km range over a 12-month period.

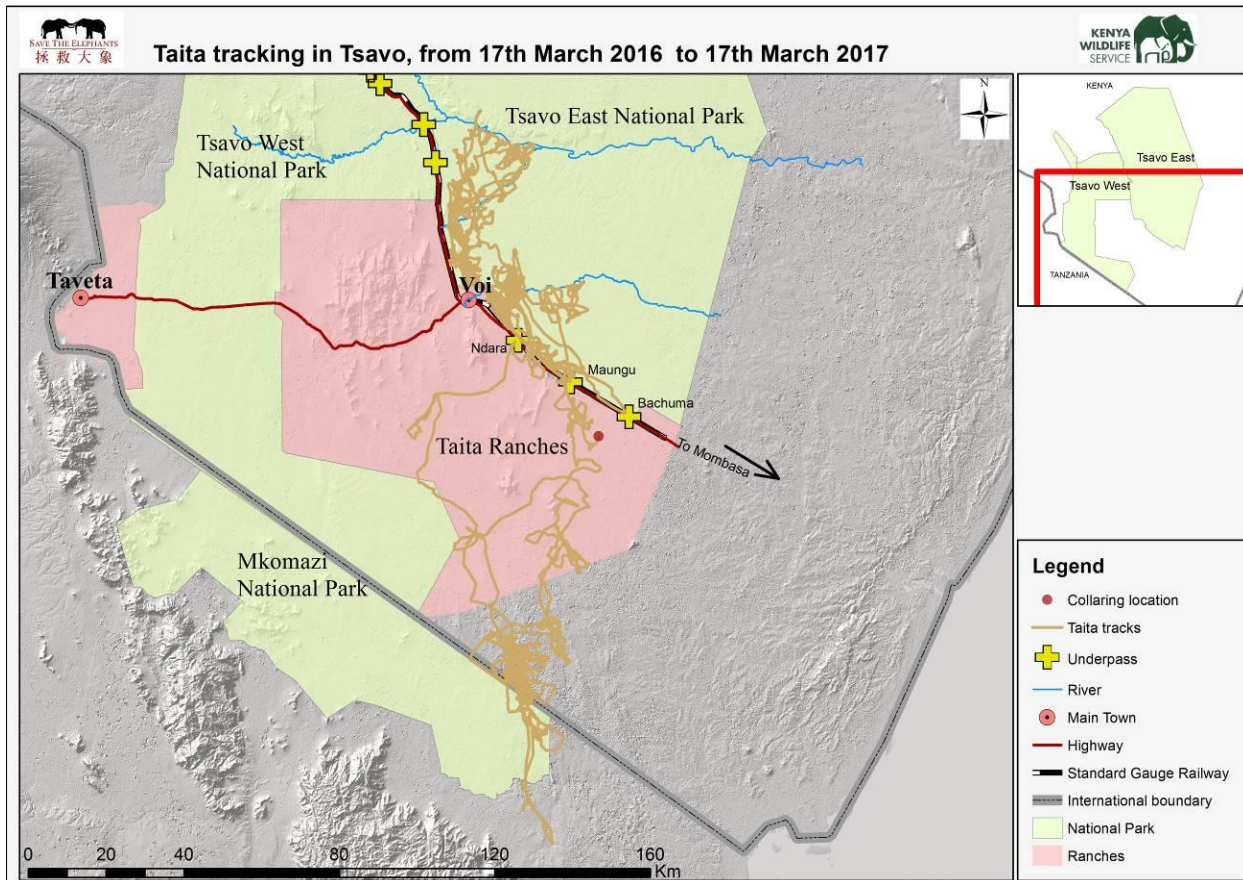


Figure 4b: The female elephant, *Taita's* movement from March 2016 to March 2017. She went further south than *Rukinga* into the Kwale Ranches and into Mkomazi National Park in Tanzania. *Taita* also spent considerable time in the Park and around Voi town. She covered approximately 4,080Km during this tracking period.

Emerging issues

DSWT electric fence and Ngutuni high usage area

The double fencing at Ngutuni has completely cut-off the high usage elephant area south of Voi town, between the highway and the SGR. Elephants had been observed to like this thick bush land, as they frequently crossed the SGR from Ngutuni Wildlife Sanctuary to the Sagalla farms (refer to Figure 1a) before the completion of the DSWT electric fence in October 2017. We recommend perforation of the of the DSWT fence to align with the Ngutuni culvert along the SGR fence. This will improve on ecosystem connectivity, minimise the possibilities of elephants being trapped between these two fences and reduce over utilization of the Ndara underpass.

Ndara human settlement near the wildlife corridor

The blossoming human settlement at Ndara, especially near the underpasses utilized by elephants such as Ndara corridor and Maungu rail crossing (Plates 1a & 1b) obviously have a negative impact on the potential utilization of those underpasses by elephants and other wildlife species. These illegal settlements, and others that can be specified, should be moved from these wildlife passages.



Plate 1a: Illegal Human settlement near an official Ndara corridor underpass at DK125



Plates 1b: Recent illegal human settlement at the Maungu SGR and old railway crossing, at DK118, that is highly utilised by wildlife. These settlements will inevitably suffer from human-wildlife conflict and should be moved before they become more permanent.

Livestock use of the wildlife underpasses

In the course of monitoring the wildlife use of SGR underpasses, it was observed that significant numbers of livestock also use these wildlife underpasses to cross into the Park. In April and May 2017, illegal livestock was recorded to use culverts, bridges and corridors between Ndara corridor and Bachuma corridor as shown in Plate 2 and Figure 5. Stationing of KWS rangers and community scouts at these underpasses would help to stop these frequent illegal livestock movements into the Park. The greater the livestock numbers, the greater the habitat degradation inside the Park which will only encourage elephants to move out into community areas causing conflict. It is opportune that these bottleneck underpasses can be used as a point of blocking livestock incursions into the Park.



Plate 2: Livestock crossing the SGR into the park using Maungu corridor at DK107

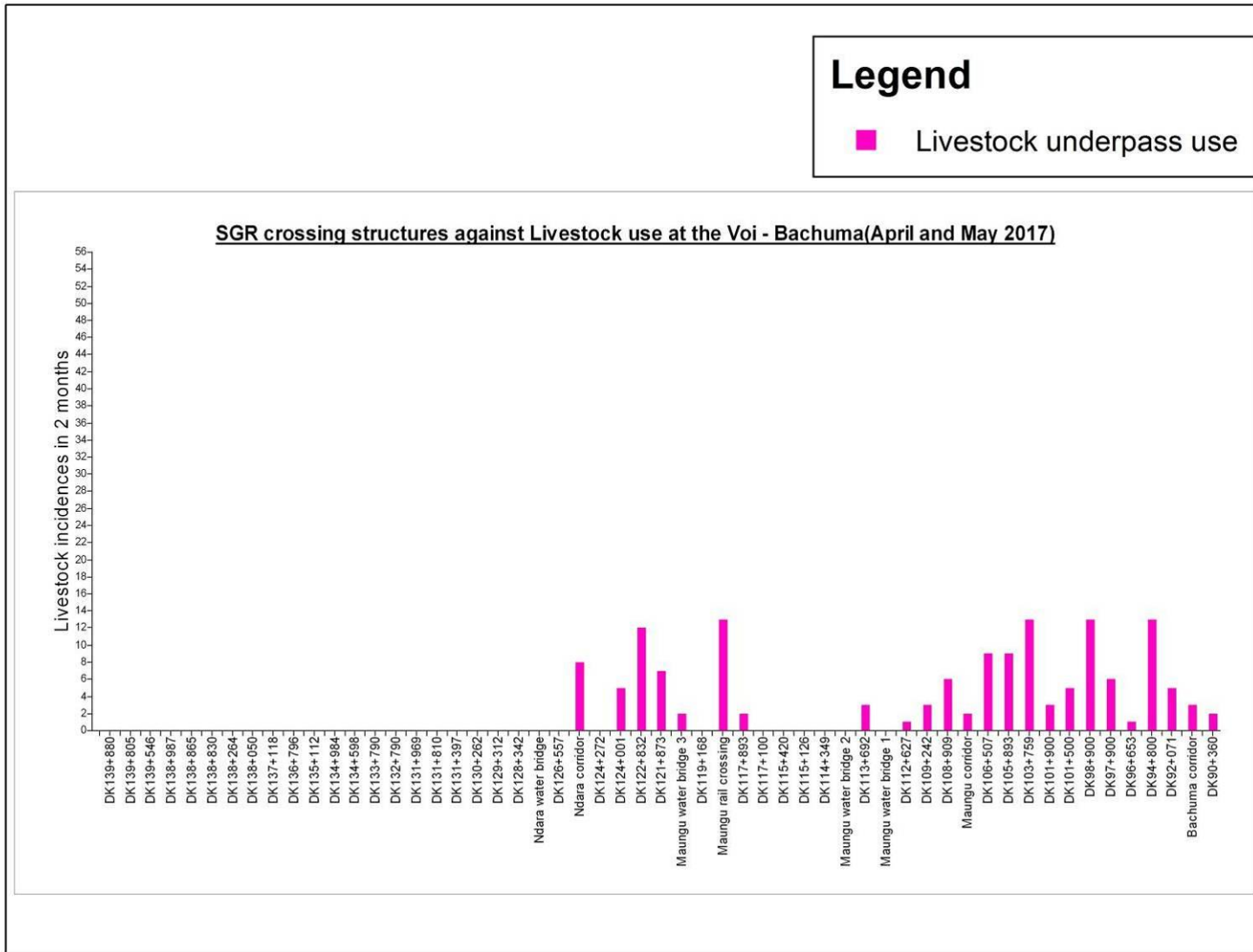


Figure 5: Graph showing the frequency of livestock using underpasses between Voi and Bachuma in April and May 2017

SGR fence breakages by elephants

Elephants were observed breaking through the SGR fences in April and May 2017. This may be due to the fact that the fence was not yet powered by electricity. But it gives a glimpse of the likely disastrous scenario in case of power outages when elephants could easily break the fence and climb up onto the railway tracks (Plates 3a & b). The fences are presently not regarded as elephant-proof and must be brought up to wildlife proof standards and maintained with consistent electrical current to ensure no accidents occur between wildlife and the SGR trains.



Plate 3a & 3b: Trapped elephants inside the SGR fence and breakages by elephants creating a high risk for collision between elephants and the SGR train. *Photo Credit: Tsavo Trust and KWS*

Habitat degradation at the underpasses

Given the restricted movements of wildlife to particular underpasses and the illegal herds of thousands of cattle using the same underpasses to access grazing in the park. Habitat degradation around the underpasses is looming. Mitigation measures will have to be put into place to restrict livestock movements and ensure the land is restored with natural vegetation to avoid extensive soil erosion.



Plate 4: Habitat degradation at the Ndara underpass caused mainly by excessive use by cattle entering and exiting the park through this corridor. *Photo Credit: STE*

Elephants killed along railway and highway

A total of 20 elephants (11 by train, 8 by vehicle and 1 by electric shock) were killed along the transport corridor in Tsavo East and Tsavo West National Parks between January 2016 and June 2017 (Figure 6, Plate 5 & Table 3). Those killed by trains were mainly due to the elephants getting trapped between the old railway and the new SGR fence with no alternative exit route. We recommend that the SGR fence incorporate the old railway line and that all train drivers are given training on how to slow down for wildlife sightings at certain hotspots along the railway.

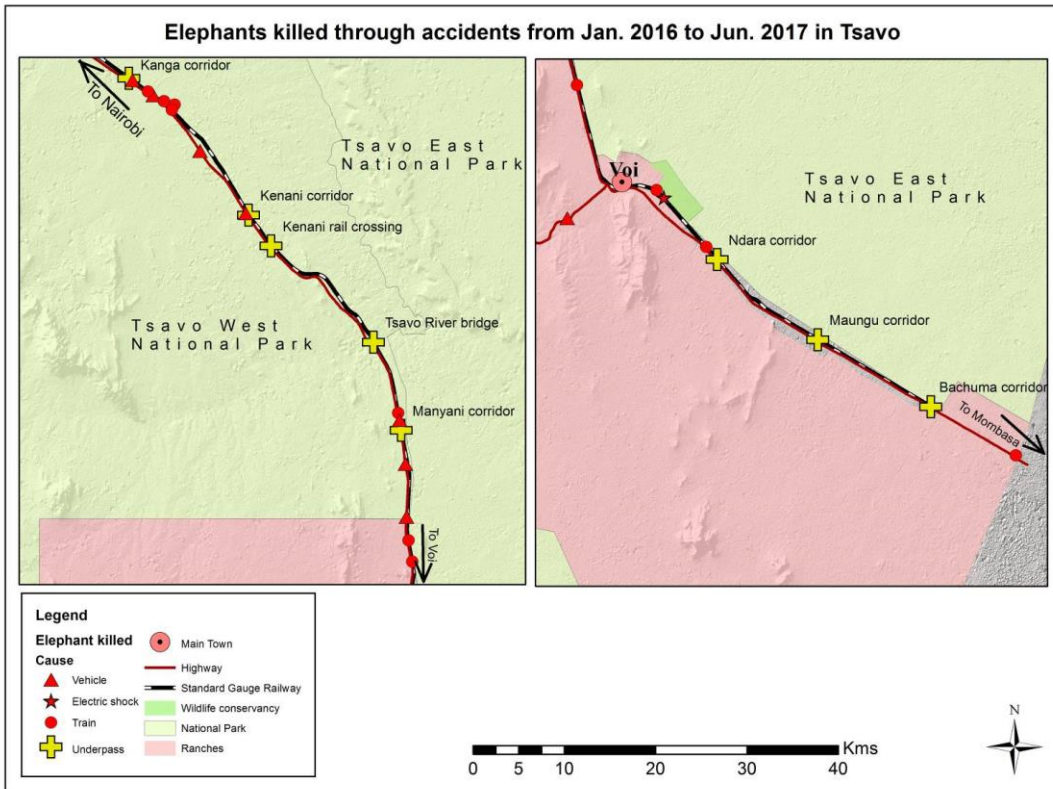


Fig 6: Location of the 20 elephants killed along the transport corridor between Mtito Andei and Voi (Left) and Voi and Bachuma (Right) inside Tsavo East and Tsavo West National Parks.



Plate 5: Three adult elephants (third one partially visible in the center of the picture) killed by train on the old railway line on 9th May 2017 around the Kanga area. Elephants crossing the old rail line panic when they get trapped between the old line and the SGR fence. *Photo Credit: Tsavo Trust*

Table 3: Elephants that died along the transport corridors in Tsavo East and Tsavo West National Park

Date	Age – Sex	Area/Location	Easting	Northing	Cause of Death
10/01/2016	Adult – Male	Manga	37M 0444309	UTM 9647519	Train
13/01/2016	Adult – Female	Manyani	37M 0443171	UTM 9661424	Train
15/02/2016	Adult – Female	Manyani	37M 0443947	UTM 9655846	Vehicle
28/02/2016	Adult – Male	Kasarani	37M 0457590	UTM 9622387	Electric shock
29/03/2016	Adult – Male	Kenani	37M 0426464	UTM 9683197	Vehicle
08/06/2016	Adult – Male	Ndara	37M 0463233	UTM 9615855	Train
25/06/2016	Adult – Male	Morondo	37M 0504462	UTM 9588190	Train
19/07/2016	Adult – Male	Ndara	37M 0444723	UTM 9619640	Vehicle
10/10/2016	Adult – Male	Ndii	37M 0446036	UTM 9637318	Train
26/12/2016	Adult – Female	Ngutuni	37M 0456638	UTM 9623398	Train
16/12/2016	Adult – Female	Kanga	37M 0414049	UTM 9697714	Vehicle
20/01/2017	Juvenile – UnSexed	Triangle	37M 0416330	UTM 9696055	Vehicle
26/01/2017	Adult – Female	Manyani	37M 0443311	UTM 9660648	Vehicle
30/01/2017	Adult – Male	Ndii	37M 0444067	UTM 9650066	Vehicle
11/03/2017	Juvenile – Male	Kanga	37M 0421455	UTM 9689992	Vehicle
14/03/2017	Adult – Male	Kanga	37M 0415758	UTM 9696487	Train
09/05/2017	Adult – Female	Kanga	37M 0417539	UTM 9695420	Train
09/05/2017	SubAdult – Female	Kanga	37M 0417539	UTM 9695420	Train
09/05/2017	SubAdult – Male	Kanga	37M 0417539	UTM 9695420	Train
20/06/2017	Adult – Male	Manga	37M 0444721	UTM 9645190	Train

Conclusion

In just one year, there have been many rapid developments along the new roads and the SGR railway intersecting Tsavo East and Tsavo West National Park. While tracking these ten collared elephants, we have also observed the impact of the new fences and culverts constructed along the SGR as well as illegal settlements mushrooming, several of which are blocking the designated vital wildlife passages. In the short term we run the risk of increased human wildlife conflict along the SGR and in the long term the complete blockage of the connectivity between Tsavo East and Tsavo West. We strongly recommend that these illegal settlements partially blocking the wildlife corridors are moved now before they become more established and harder to relocate. More so, some of these passages are being used illegally to make charcoal and to herd thousands of cattle into the national parks, a practice that exacerbates habitat degradation and risks livestock-carnivore conflict within the parks.

The Kenya Railways should consider the findings in this report to improve safety along the SGR for both elephants and train passengers as a collision between the two could be catastrophic. We recommend that connectivity is maintained between Tsavo East and Tsavo West, which can be done easily according to the recommendations to keep the wildlife crossing points free of human interference.

The findings will also be useful for the Kenya National Highway Authority in anticipating in good time the essential design and implementation of functional wildlife passages as plans are made to expand the Mombasa-Nairobi highway. Crossing points between the SGR and the new highway expansion must be aligned so that animals can pass freely over both infrastructure obstacles to move between these nationally important wildlife refuges.

The SGR presents Kenya with a great opportunity of being the first country in Africa to design such infrastructure with wildlife in mind, developing the nations' economy while keeping her national heritage intact. Without proactive action we could lose a critical opportunity to put Kenya at the forefront of the conservation and development nexus in Africa.