

Kenya's first White Rhino Conservation and Management Action Plan

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Introduction

Kenya conserves both subspecies of the white rhino (*Ceratotherium simum*). There are currently circa 750 southern white rhinos (*C. simum simum*) (SWR), on private, community and State lands (Table 1). The species was introduced into Kenya from South Africa to support conservation efforts, in total 51 animals (six animals in 1965, 20 in the 1970s, 5 in 1992, and 20 in 1994; six of the latter individuals died due to disease) (Rookmaaker 1998). The population has grown rapidly over the

last 20 years at an average rate of 6.76% (95% CI: 6.19%–7.33%) per annum (Fig. 1). It has so far been managed with guidelines largely under the umbrella of the Black Rhino Conservation and Management Action Plan (Okita-Ouma et al. 2007). However, due to their rapid growth, there was an urgent need to develop a separate action plan to inform best practice management of the subspecies.

Despite continuing grave threats, including poaching and habitat loss, the SWR is currently the most abundant rhinoceros in the world, with about 18,000 individuals living primarily in South Africa

Table 1. Status of the southern white rhino in Kenya, information based on aerial census conducted in December 2020). (Note: rhino population numbers on request from authors)

Conservation area	Land ownership	Available habitat
Il Ngwesi Community Conservancy	Community	81 km ²
Lake Nakuru National Park	State	124 km ²
Lewa–Borana Landscape	Private	376 km ²
Meru National Park	State	83 km ²
Nairobi National Park	State	117 km ²
Nairobi Safari Walk	State	
Ol Choro Oiroua Community Conservancy	Community	10 km ²
Ol Jogi Conservancy/Pyramid	Private	50 km ²
Ol Pejeta Conservancy	Private	300 km ²
Ruma National Park	State	120 km ²
Solio Game Reserve	Private	70 km ²
National Total	~750	1,331 km ²

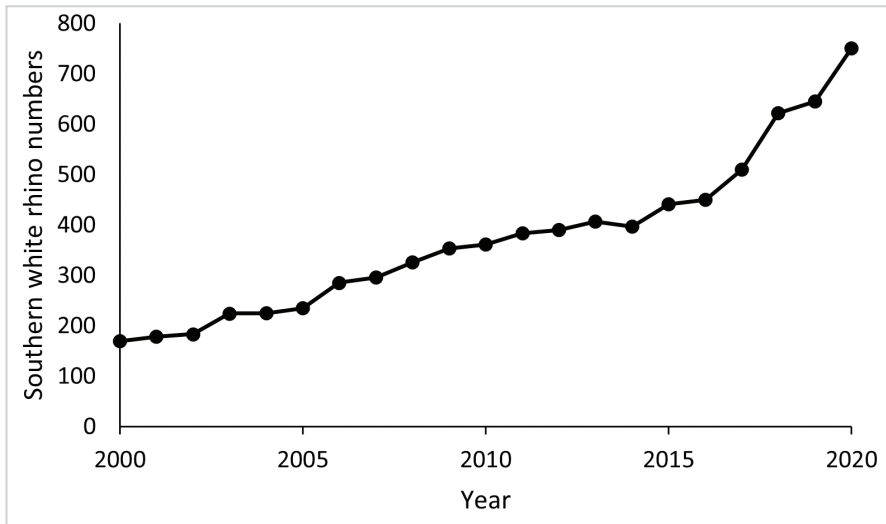


Figure 1. Population trend of southern white rhino in Kenya, 2000–2020.

(Emslie 2020). Nearly extinct at the beginning of the 20th century after being reduced to a single population of *circa* 200 individuals in South Africa (Rookmaaker 2002), subsequent conservation efforts have led to a dramatic recovery of this subspecies. However, poaching remains a serious threat (Emslie 2020), and the subspecies is listed as Near Threatened on the IUCN Red List of Threatened Species and is on Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

The northern subspecies or NWR (*C. simum cottoni*), listed as Critically Endangered is believed to be extinct in the wild. Only two remaining individuals, both females are held in captivity in Kenya (Emslie 2020). The NWR once ranged in large numbers throughout north-central Africa south of the Sahara (Central African Republic, Chad, the Democratic Republic of Congo, South Sudan, Sudan and Uganda). In 1960 there were approximately 2,250 animals remaining (Rookmaaker and Antoine 2012) but in the 1970s and early 1980s, poachers reduced the number of NWR to 15 surviving in Garamba National Park, DRC. However, by 1995, under protection, the population had recovered to 31 and for many years overall numbers remained stable. In mid-2003 there was a major upsurge in poaching in Garamba National Park and by May 2006 numbers had been reduced to *circa*

three individuals. In May 2004 ten NWR were maintained in two zoological institutions; ZOO Dvůr Králové, Czech Republic (seven animals), and San Diego Wild Animal Park, USA (three animals) but breeding had been poor (Hermes et al. 2006). As a last effort to save the sub-species the four remaining NWR (from ZOO Dvůr Králové) were moved to Ol Pejeta Conservancy, Kenya in December 2009. The recovery of the NWR faces significant challenges, and steps have been identified for a long-term programme to “rewind” the extinction process and secure a viable population with sustainable levels of genetic diversity (Saragusty et al. 2016).

The development of the first Kenya White Rhino Conservation and Management Action Plan (WRAP) (2021–2025) involved a six-stage process: 1) review of existing Kenya white rhino management guidelines and laws, and a national-level population SWOT analysis (Strengths, Weaknesses, Opportunities, Threats); 2) site-level population assessments with SWOT analysis; 3) preparation of a zero-draft action plan for feedback from the IUCN AfrSG, stakeholders and technical experts; 4) virtual stakeholder meeting to review feedback; 5) presentation of the updated action plan to the National Rhino Steering Committee for further comments; and 6) endorsement of the Action Plan by the Rhino Executive Committee and the KWS Board of Trustees (KWS BoT).

Southern White Rhino Conservation and Management Plan

The long-term vision of the WRAP for the SWR is to have viable populations living in healthy ecosystems, valued as both a national resource and a global heritage. It aligns with national and regional conservation efforts through introduction/reintroduction programmes, and promotes local conservation education, tourism and community conservation initiatives. The overall goal is to maintain demographically and genetically healthy populations. With an average annual growth rate of 6.76%, realized over the period 2000–2020, there is every indication that the national population could reach 2,500 SWRs in the next 20 years (Fig. 2). The white rhino plays an important role in grassland ecological dynamics in a number of sanctuaries. However, their numbers need to be managed to maintain the health of the ecosystems they inhabit.

The WRAP is guided by five key components with strategic objectives: (1) *Rhino Protection and Law Enforcement*: to keep rhino poaching below 1% of the total population per annum by maintaining protection and law enforcement at required levels in all SWR areas; (2) *Biological Monitoring and Management*: to biologically manage SWR, and their habitats, for demographically and genetically healthy

populations over the longer term; (3) *Communication and Engagement*: to use targeted communication and engagement of relevant stakeholders to increase the understanding and support for white as well as black rhino conservation; (4) *Sustained financing*: to sustain financing of key components of white rhino conservation, alongside Kenya’s black rhino conservation requirements, for successful delivery of the plan; (5) *Overall Programme Management, Coordination and Collaboration*: to ensure effective programme management, coordination and collaboration nationally and regionally so as to achieve the strategic objectives of the Plan (Fig. 3).

Key activities of the WRAP include the following: (1) incorporating SWR meta-population management as a component in the East Africa Community–Rhino Management Group (EAC-RMG), (2) conducting grassland management through the control of invasive alien plant species, implementing a fire management plan, and maintaining sustainable grazing levels in SWR areas, (3) securing more space for SWR through the assessment of new areas and the expansion of existing areas, (4) developing and implementing a white rhino metapopulation translocation plan, (5) developing and implementing a white rhino database monitoring system based on the *Kifaru* model, (6) promoting white rhino via various platforms to bolster national and international tourism, and to support their conservation, and lastly, (7) coordinating white rhino management across all rhino areas and landscapes.

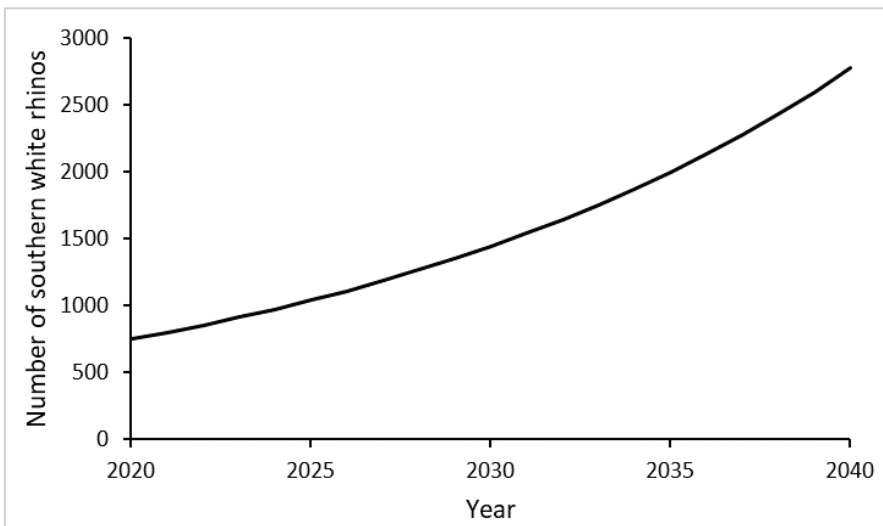


Figure 2. Projected increase in the population of southern white rhino in Kenya, 2020–2040.

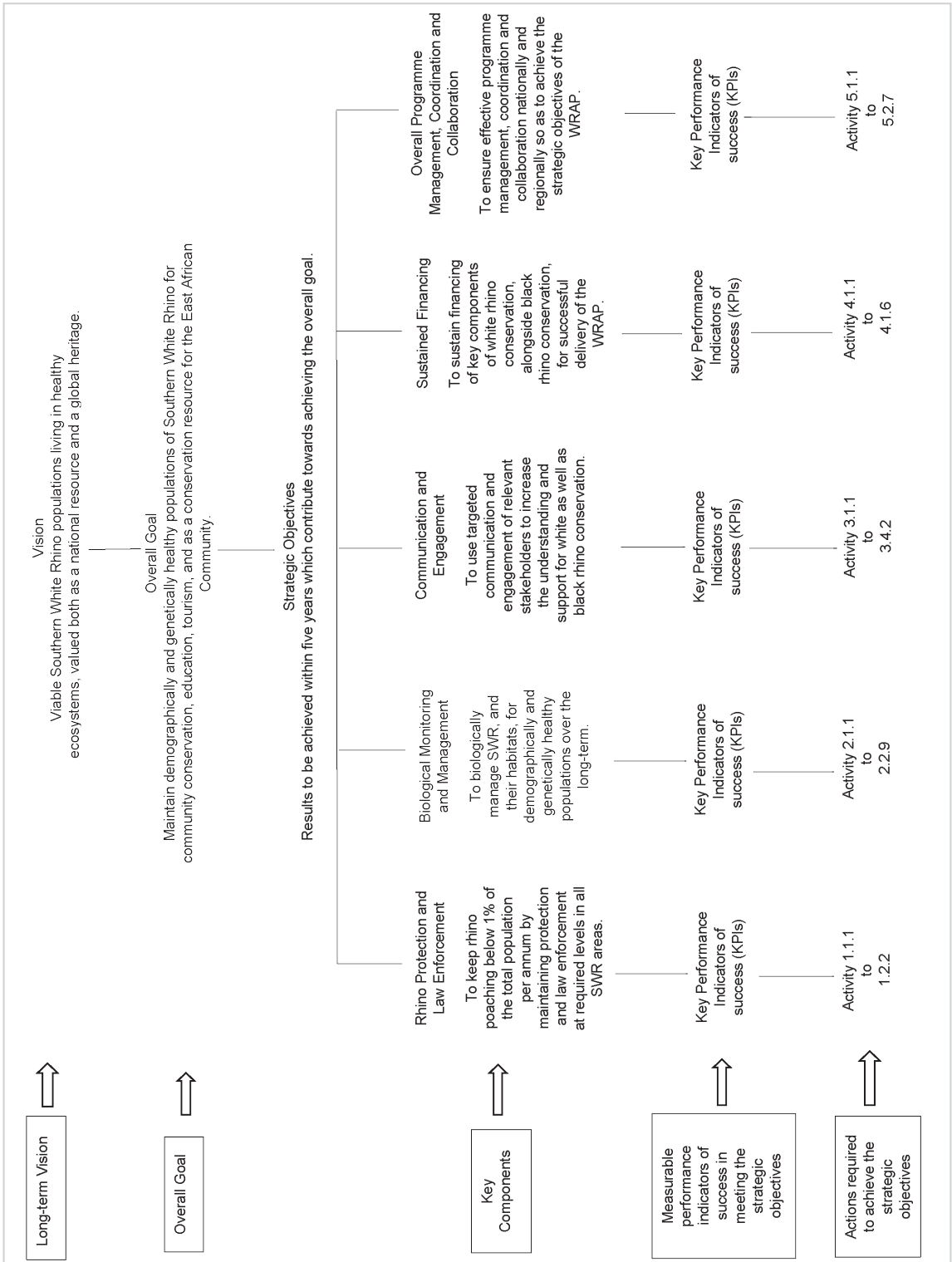


Figure 3. Framework of the southern white rhino component of the WRAP 2021-2025 (Anon 2021), showing the connection of actions or activities to the overall goal to maintain demographically and genetically healthy populations.

Northern White Rhino Recovery Plan

Background

On the 11 May 2009, senior representatives of the African rhino range states, wildlife agencies and stakeholders working under the umbrella of the East African Community held the first meeting of the EAC–RMG and produced the Nairobi Declaration (Okita-Ouma et al. 2009). Among its main goals, the participants agreed to "support all efforts to re-establish and recover the NWR within its former eastern African range states". Kenya is not a range state but is supporting the recovery efforts of the NWR.

In December 2009, four NWR were transported to Kenya (Ol Pejeta Conservancy) from the Czech Republic where they had been housed in the Dvůr Králové Zoological Gardens since 1975. A custodian agreement was made in the hope that bringing the rhinos into a natural environment close to their original habitat and conditions might encourage their natural, social and territorial behaviour and thus prompt successful breeding. These included two females (Najin and Fatu, the latter being Najin's daughter) and two males (Suni and Sudan, Sudan being the only animal that was born in the wild). The two males died of natural causes: Suni died on 16/17 October 2014 and Sudan 19 March 2018.

After no successful natural breeding was observed during the first five years after their translocation, health checks in late 2014 showed that none of the remaining animals were capable of natural reproduction. Consequently, a decision was made in January 2015 to ask a team of experts from ZOO Dvůr Králové, IZW Berlin and Avantea Cremona to develop an Assisted Reproduction Technique protocol and contingency plan. It was identified as necessary to produce an embryo *in vitro*, either through fertilization of oocytes (immature egg cells) harvested from live NWR donors (with NWR semen that is currently cryopreserved) or through fertilization of artificial gametes that would be produced from induced pluripotent stem cells. Such an embryo would be inserted into a SWR female and carried to term by this surrogate mother. Crucial for the large-scale generation of transferrable embryos produced *in vitro* was

the optimization of the oocyte harvesting technique, so called ovum pick-up (OPU). In the following years, the OPU technique was developed on captive SWR in European zoos, which involved the ovarian stimulation of females as well as the collection of their eggs. *In vitro* procedures needed to generate a viable embryo from these eggs were also developed.

In August 2019, five oocytes were collected from Najin and five from Fatu. Two of Fatu's eggs developed into embryos that were cryo-preserved for future transfer. The procedure was repeated in December 2019 when three oocytes were collected from Najin and six from Fatu, and one of Fatu's eggs developed into an embryo. The procedure thus proved to be safe and reproducible and could be performed on a regular basis before the animals become too old.

In December 2019, semen of Sudan, and tissue and blood samples of Sudan, Najin and Fatu were transported to IZW Berlin. The aim is to use the samples in future for production of more embryos. Due to the restrictions related to Covid-19, only minor operations could be conducted in 2020. None of the 10 oocytes collected in August 2020 developed into a viable embryo. Another procedure was undertaken in December 2020 and 10 oocytes were harvested from Fatu out of which two eggs developed into embryos bringing the total number of NWR viable embryos to five at the end of 2020. In March 2021, 19 oocytes were collected from Fatu and four of them made it to viable embryos. Another 17 oocytes were collected from Fatu during an exercise conducted in July 2021 and three developed into viable embryos, so at the time of writing this paper (July 2021) the total number of NWR embryos stood at twelve. Eleven of the embryos were created with semen from the NWR rhino male Suni while one of the last three embryos was developed with semen from Angalifu, a NWR from San Diego that died in 2014. Using semen from completely unrelated rhino, raises hopes in genetic pool diversification of the cryo-preserved embryo population.

The Recovery Plan

The long-term vision of the Recovery Plan (under WRAP) hoped for is to have a stable population of the NWR in Kenya that provides individuals for reintroduction of the NWR to former range states. The overall goal of the Plan is to have a number of NWR calves born in Kenya through IVF techniques. Given the situation as of July 2021 with 12 embryos produced

so far, but not a fully successful embryo transfer conducted yet, and given the long terms of rhino gestation, it is clear that having a few calves in the coming decade would be a significant achievement and very good foundation for accomplishing the long-term objective of the Recovery Plan that is aligned with the objectives of EAC-RMG (Okita-Ouma et al. 2009). The Recovery Plan is again guided by the five key components of Protection, Biological Management, Communication and Engagement, Sustained Financing, and Programme Management, Coordination and Collaboration.

The main activity in the Recovery Plan is to conduct OPU three to four times a year, depending on the health condition of the animals. The aim is to produce as many viable NWR embryos as possible before the health of the two females eventually deteriorates to a level at which it would be too risky to anesthetize them for the procedure. At the same time, work on perfecting the embryo transfer method would continue, with eventual transfer of the embryos into surrogate SWR in Kenya. Embryo transfer has to coincide with approximately a nine-day period after ovulation. Four SWR females have been identified as surrogates based in the OI Pejeta Conservancy. To determine the time of ovulation in these females, the use of a SWR teaser bull, to live with the would-be surrogate mothers has been identified as the best option. The teaser bull was translocated to OI Pejeta Conservancy from Lewa Conservancy in November 2020 and in December 2020 he was successfully sterilized.

To give the NWR the best chances to circumvent extinction, it is also necessary to work—apart from harvesting oocytes from live donors—with cellular technologies. At present, cell cultures from 12 specimens are available in Europe and the US. The current proposal being considered is to produce in vitro primordial germ cells from iPS cells (induced pluripotent stem cells) obtained from the NWR somatic cells cryo-preserved on previous occasions in the past, and through a second step these germ cells will then be transformed into eggs and sperm. This would substantially enlarge the founding genetic diversity of the future NWR population.

In summary, the Kenya WRAP provides a framework for the conservation and

management of the SWR rhino by adopting best practice for population and habitat management through a consultative process involving all relevant stakeholders. This WRAP identifies key activities to conserve the species and to enhance its management by building synergy among the various stakeholders. The novel intervention for NWR, while not without challenges, is the only hope for saving valuable genetic material to perpetuate the NWR. Other opportunities remain to hybridize the northern and southern subspecies also, in order to preserve valuable genetic lineage if the attempts to produce pure NWR progeny are not successful.

A progress report of the White Rhino Conservation and Management Action Plan will be considered in 2023.

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References

- Anon. 2021. Kenya white rhino (*Ceratotherium simum*) conservation and management action plan (2021–2025). Kenya Wildlife Service. Kenya.
- Emslie R. 2020. *Ceratotherium simum*. The IUCN Red List of Threatened Species 2020: e.T4185A45813880. <https://dx.doi.org/10.2305/IUCN.UK.2020-1.RLTS.T4185A45813880.en> [Accessed on 28 April 2021].
- Okita-Ouma B, Amin R and Kock R. 2007. Conservation and management strategy for the black rhino (*Diceros bicornis michaeli*) and management guidelines for the white rhino (*Ceratotherium simum simum*) in Kenya (2007–2011), third edition. Nairobi, KWS, pp. 1–70.
- Okita-Ouma B, Kock R, Amin R and Kasiki S. 2009. Proceedings of the East African Community Rhino Management Group inaugural meeting. Kenya

Wildlife Service, Nairobi.

Rookmaaker LC. 1998. The rhinoceros in captivity: a list of 2,439 rhinoceroses kept from Roman times to 1994. SPB Academic Publishing, The Hague.

Rookmaaker LC. 2002. Miscounted population of the southern white rhinoceros (*Ceratotherium simum simum*) in the early 20th century? *Pachyderm* 32: 22–28.

Rookmaaker LC and Antoine PO. 2012. New maps representing the historical and recent distribution of the African species of rhinoceros: *Diceros bicornis*, *Ceratotherium simum* and *Ceratotherium simum cottoni*. *Pachyderm* 52: 91–96.

Saragusty J, Diecke S, Drukker M, Durrant B, Friedrich Ben-Nun I, Galli C et al. 2016. Rewinding the Process of Mammalian Extinction. *Zoo Biology* 35: 280–292. doi: 10.1002/zoo.21284–DOI – PubMed.