



MINISTRY OF NATURAL RESOURCES AND TOURISM

INTEGRATED MANAGEMENT PLAN FOR THE KILOMBERO VALLEY RAMSAR SITE



Appendix-II Site Management Plan for the conservation of Puku (*Kobus vardonii*)

2018



STRUCTURE OF THE INTEGRATED MANAGEMENT PLAN FOR THE KQRS


The Integrated Management Plan for the Kilombero Valley Ramsar Site is a framework for coordination of actions to conserve and promote the wise use of the wetland landscape.

The IMP is composed of an overall coordination framework and of several specific Component Plans. Some of these Component Plans have been appraised as part of the IMP Foundation phase: these appraisals generated specific reports listed below.

Document	Scope and purpose
Main Report	
Foundation Document	It summarises the rationale, goals and proposed mechanism for the IMP. It presents the summary Action Plan comprising several components.
Appendices: Components' Reports	
I. Ngapemba Conservation Area	Appraisal of conservation rationale and options for the Ngapemba section of the KQRS. Preliminary Conservation Site Action Plan.
II. Site Management Plan for the conservation of Puku	Appraisal of the status of the antelope <i>Kobus Vardonii</i> (puku) in Kilombero Valley; proposed Conservation Plan within the landscape.
III. Ruipa-East Wildlife Corridor Plan	Appraisal of conservation rationale and options for the conservation and rehabilitation of wildlife connectivity between the core valley area and Selous Game Reserve I the central section of the KQRS.
IV. Priority Investment Plan for the Livestock Sector	Appraisal of requirements and opportunities to support the gradual transformation of the livestock sector within the landscape. Priority Investment Plan.
V. Vulnerable Wetlands Appraisal	Appraisal of the status and conservation options of 2 wetland sites at the edge of the valley floor.
Appendices: IMP Foundation Feasibility Appraisals	
VI. Strategic Wetland Review	A summary review of wetland ecosystem status and drivers of change.
VII. Institutional Option Study	Appraisal of options for the establishment of landscape-scale inter-sector coordination within the relevant frameworks of Tanzania.
VIII. Financial Sustainability Appraisal Study	Appraisal of fiscal sustainability of devolution of wetland's natural resource management and fiscal requirements for the establishment and sustainability of landscape-level coordination.
IX. Report on IMP Foundation Consultative events	Record and recommendations from stakeholder workshops organized during the IMP Foundation process at district, landscape, regional and national levels.

The preparation of the Integrated Management Plan for the Kilombero Valley Ramsar Site and associated assessments, consultations, capacity building and other ancillary actions were supported by the Belgian Aid and the European Union, through the Kilombero and Lower Rufiji Ecosystem Management project.

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Abbreviations and Acronyms

ASG	Antelope Specialist Group
BTC	Belgium Development Agency
ECC	Ecological Carrying Capacity (usually expressed in animal/km ² to facilitate comparison between areas of different size)
GR	Game Reserve
IUCN	International Union for the Conservation of Nature and Natural Resources (World Conservation Union)
MNRT	Ministry of Natural Resources and Tourism
SGR	Selous Game Reserve
SSC	Species Survival Commission of the IUCN
TANAPA	Tanzania National Parks
TAWA	Tanzania Wildlife Management Authority
TAWIRI	Tanzania Wildlife Research Institute
WCA	Wildlife Conservation Act
WD	Wildlife Division
WPT	Wildlife Policy of Tanzania (2007)

Glossary

Grazers	Species that feed primarily on grasses and forbs.
Census	Procedure of systematically acquiring and recording information about the members of a given population.
Near Threatened	IUCN Red List category - A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
Demographic	Pertaining to the study of population characteristics including structure (age, sex), growth rates, density, fertility and mortality, distribution and migration.
Ecological carrying capacity	The maximum number of animals that can be supported by the resources of a specific area in the medium term. ECC is a practical tool to help managers estimate MPCC (Maximum Productivity Carrying Capacity), i.e. the desirable stocking rate at which the highest possible growth rates can be attained.
Home range	The area in which an animal usually resides and moves in search of water, food and shelter.
Invasive plant species	A subset of introduced or alien plant species that are rapidly expanding outside their native range. Invasive species can alter ecological relationships among native species and can affect ecosystem function and human health. A species is regarded as invasive if it: (1) has been introduced by human action to a location where it did not previously occur naturally; (2) becomes capable of establishing a breeding population in the new location without further intervention by humans; and, (3) spreads widely throughout the new location. Certain invasive species can smother and replace indigenous species and can significantly lower carrying capacities for puku and other species impacting negatively on the conservation of biodiversity.
Range State	A Country or State in which puku currently occur or historically occurred.
Puku conservation areas	For the purpose of this document the term refers to areas with Puku in their natural habitat.
Species	A taxonomic group whose members can interbreed and produce viable fertile offspring; also based on genetic and morphological differences between species.
Taxon (plural taxa)	A taxonomic (classification) group of species, especially genus or a smaller group.
Translocation	Movement of individual animal from one area to another, either to improve chances of survival, to establish new populations, to keep established populations productive (i.e. at or below estimated), or to introduce new blood into a population or to better protect them from poachers.

Executive Summary

- The puku is a medium sized antelope related to reedbuck, waterbuck, kob and lechwe. All of these species are found on open grassland close to water. Puku are a social species usually found in small groups but coalescing into large herds during the dry season.
- The Kilombero Valley hosted 75% of the population of puku in the 1990s, estimated at around 70,000 animals.
- Changing patterns of land use, increasing floodplain agriculture, widespread poaching, an influx of livestock and uncontrolled poaching has decimated this population leaving only a few pockets of puku within the main floodplain.
- A small remnant population (estimated to be between 1,000 and 2,000 animals) remains at the southern end of the Ramsar Site in the Ngapemba and Ndolo floodplains and surrounding woodland areas. This population is the largest remaining in Tanzania and urgent measures are required for its protection.
- The Ngapemba puku utilise woodlands throughout the year, perhaps as a survival strategy in response to the relatively small areas of grassland habitat remaining.
- The plan proposes increased protection for puku at three sites in the Kilombero Valley (Ngapemba, Chita and Selous).
- This Action Plan is dependent on a number of ongoing conservation related initiatives in the valley. These include the re-establishment of the Kilombero Game Controlled Area and the establishment of a conservation area at Ngapemba in the south of the Ramsar Site.



1 INTRODUCTION

1.1 The Puku Antelope



Described by Livingstone in 1957, the puku is part of the kob grouping of antelopes which include the kob, lechwe and waterbuck. In fact, the puku could be described as the southern kob and their ranges do not overlap.

The puku is a medium sized antelope¹ social species which is mostly found in groups. Female herds are often made up of 3-15 and these groups contain young of both sexes. Adult males typically live in bachelor groups. During the dry season large herds numbering 50 or more males and females can form. Mature male pukus are territorial, defending small territories through which the females move. Like most antelopes, the puku is likely to be most active in the morning and evening. The puku diet is grass based, mainly monocots but with flexibility with regard to species. This allows puku to adapt to changing environmental conditions (Rduch, 2016).

Puku usually move to slightly higher elevations during the wet season, when water levels are high, and down to lower elevations closer to the water's edge during the dry season. This means that they can use the miombo woodlands which are adjacent to the floodplains for food and shelter. As will be discussed further this has been an important strategy for the persistence of puku in the Kilombero Valley.

Although it may breed throughout the year in some areas the puku gives birth mainly during the wet season, when most food is available and there is enough cover for the calves, which lie hidden to avoid predators. The young are born after an eight to nine month gestation period but have a high mortality rate. Female pukus become sexually mature at about two years old, and males at about three years.



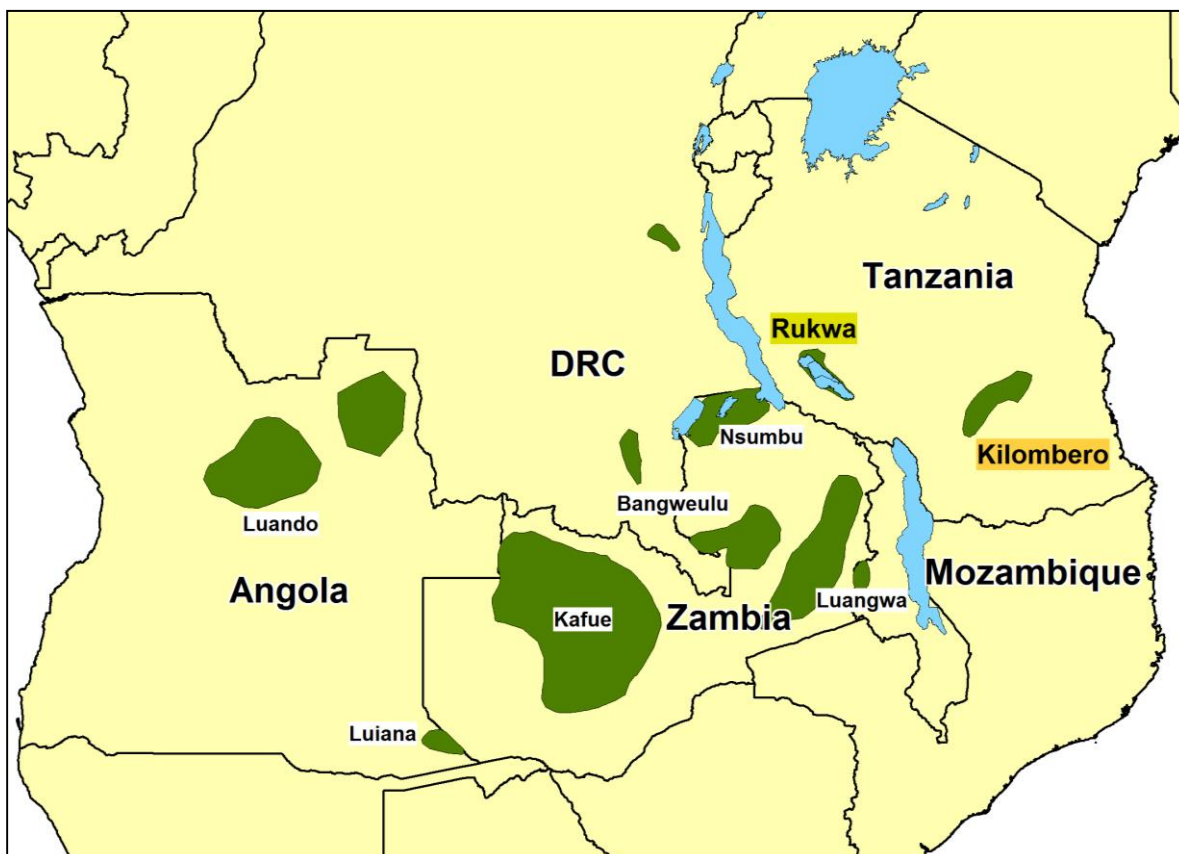
¹ Approx 70 kg and around 80 cm shoulder height

1.2 Puku Distribution

Puku is a rare animal species that has unique and discontinuous distribution mainly occupying grassland near permanent water mainly swamps, rivers, floodplain and higher ground in wet season (Rodgers 1984; Kingdon 2012). Although puku are associated with wet areas and swamp vegetation, they avoid deep standing water. Puku will feed in woodland and shrub-lands in wet season when the swamps or floodplain grassland areas are flooded. Puku are thought to have a high population growth rate as they have a short inter-calving rate and they breed all year round (Goldspink et al. 1998; Kingdon 2012). Therefore populations can be expected to have a fast recovery rate.

Puku formerly occurred widely in grasslands near permanent water within the savanna woodlands and floodplains of South-central Africa. They have been eliminated from large parts of the former range and reduced to fragmented, isolated populations. Currently main stronghold for puku is Zambia with significant concentrations found in the Kafue, Bangweulu, Nsumbu and Luangwa areas.. In Tanzania they are found at two sites - Kilombero and Rukwa (GBIF.org; IUCN 2016; Figure 1).

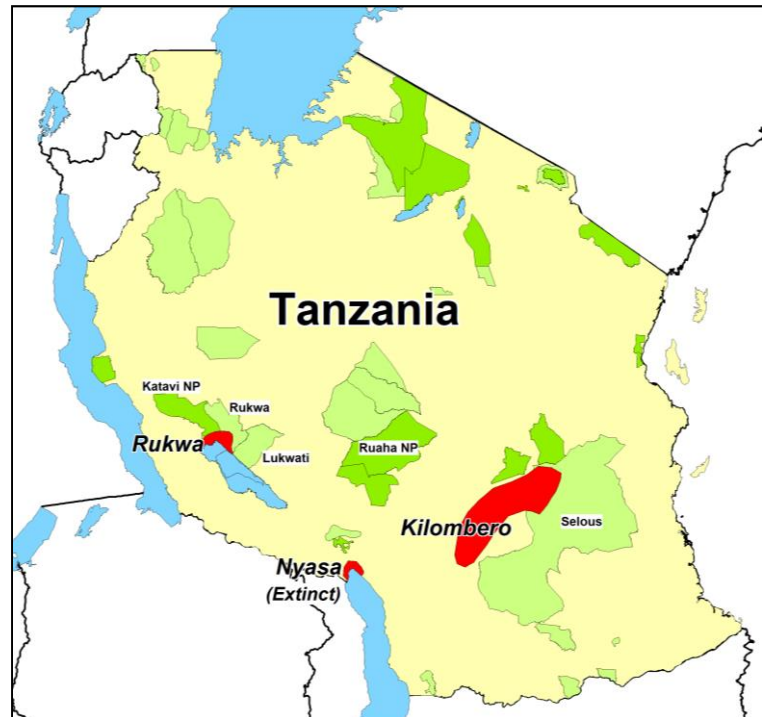
Estimates for numbers of puku at most of the sites shown below is anecdotal, rather than being based on systematic surveys. Estimates for Angola, and DRC are guesses at best and no information their current status was located. Historical density estimates (which are tempered by distributed area definition) of 1.5 animals per km² in North Luangwa and Kasanka, 3.5 per km² in Tondwa (Nsumbu population) and 7.6 per km² in Kilombero (East, 1998). The Kasanka NP has an estimated 5,000 individuals (Rduch, 2016), up from 300 in 1989 (East, 1998). This would give a density estimate of over 12 per km² and probably higher as puku are not distributed evenly throughout the park.



1.3 Puku Distribution in Tanzania

Puku are known from three sites in Tanzania - Kilombero, Rukwa and the northern end of Lake Nyasa. The Lake Nyasa population went extinct before 1960 (Rodgers 1984) and the two remaining populations are threatened (IUCN 2016). The Rukwa population is found on the northern end of Lake Rukwa and its status is uncertain at this time although a small population is known to persist. The Kilombero valley population was distributed throughout the Kilombero Valley and extended into the Selous Game Reserve (Rodgers, 1984; East 1998)

This report deals with the Kilombero Valley population. At its peak in the late 1990s the Kilombero population was thought to hold 75%² of the worlds puku population (around 70,000 animals), The population was reported as being "stable" in 2003 (Jenkins *et.al.*)



1.4 The Kilombero Valley

The Kilombero Valley is located in southern Tanzania. It is the largest lowland freshwater wetland in East Africa, extending over 7000km². The Kilombero river flows north-east through a 35-km-wide flood-plain between the Udzungwa mountains and the Mahenge massif. With significant inflows from its major feeder rivers in the south, almost the entire valley is flooded during April.

The Ramsar Site has three main landforms - the core valley floor and associated wetland areas, the slightly elevated alluvial fans and the miombo uplands. The valley contains a diverse and unusual flora with at least 350 recorded species and plant communities represent a hydrological gradient from the river to valley margins but local variations in elevation give rise to a complex mosaic of communities. The core of the valley contains large areas of low lying valley grassland, ideal for species such as the puku (Ambero 2016, 2018).

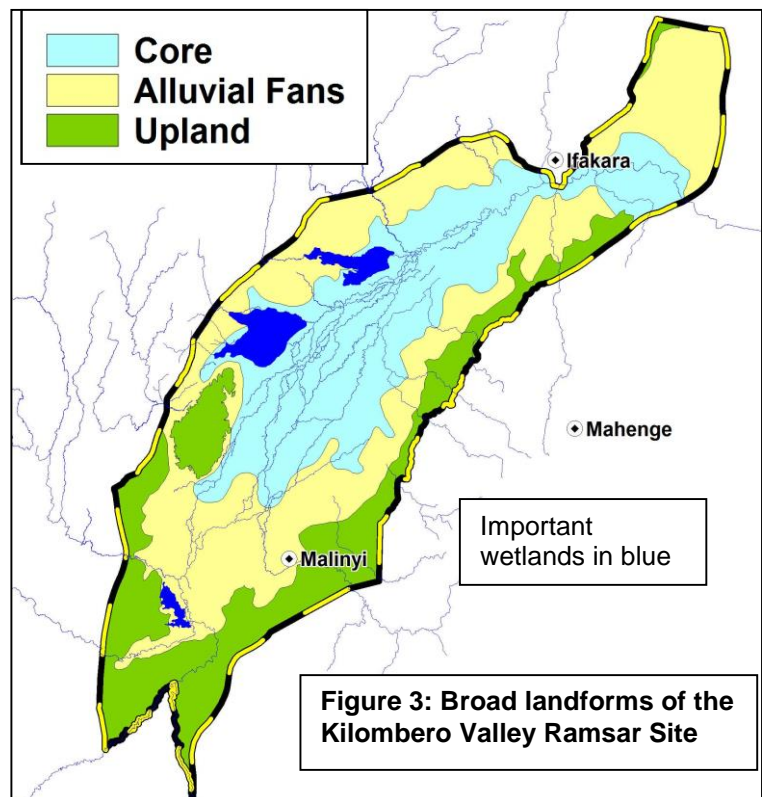


Figure 3: Broad landforms of the Kilombero Valley Ramsar Site

² This source of this widely used figure is unknown. East (1998) using extrapolation, estimated the African population at 130,000 animals (at that time)

1.5 Population Trends and Distribution of Puku in the Kilombero Valley

1.5.1 Population Trends

The Kilombero floodplain has seen an explosion of settlement and agriculture in the last 30 years with settlers been drawn to the fertile and well watered plains. The legislation until 2009 allowed people to settle and farm in Game Controlled Areas, as we review further below.

The upshot of this was that large parts of the floodplain were converted to agriculture³ (Figure 3) (Kangalawe and Liwenga 2005; Dancer and Sulle 2015). Investigations from 2000s onwards show that puku is among the most common targets for bushmeat poachers⁴ (Jenkins et al. 2003; Nielsen et al. 2014; Nielsen and Meilby 2015). Cattle invaded the grasslands in large numbers (17,000 to 50,000 between 1990 and 1998⁵) and the wildlife disappeared⁶. The puku declined from a high point of 70,000 animals to close to zero today, especially in the central areas which were formerly their stronghold.

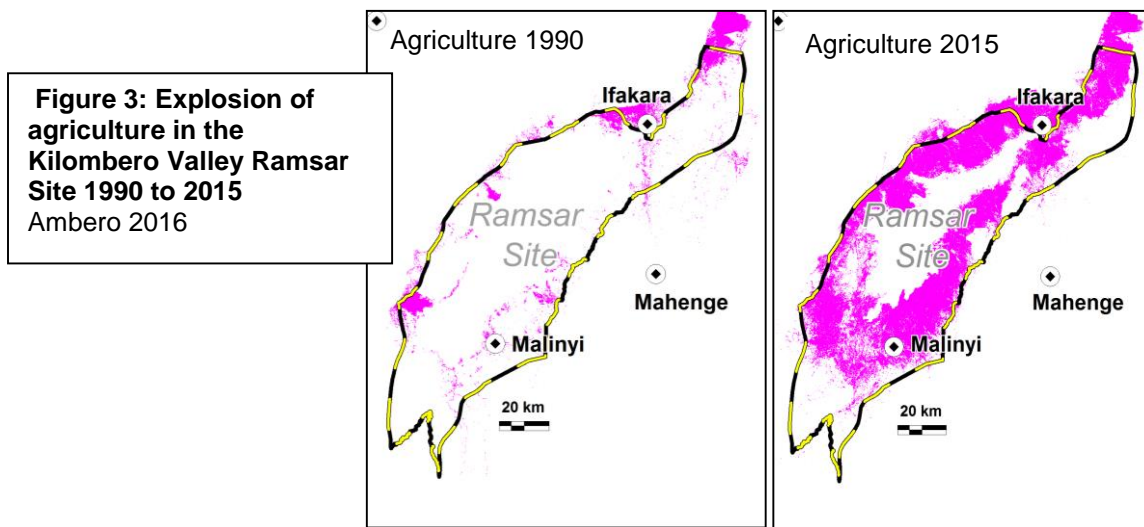


Figure 3: Explosion of agriculture in the Kilombero Valley Ramsar Site 1990 to 2015
 Ambero 2016

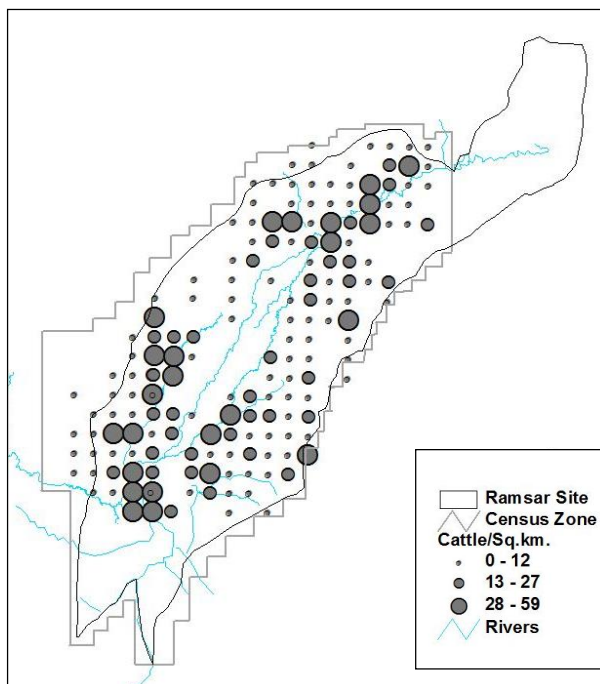


Figure 4: Cattle in Ramsar Site 2008
 TAWIRI Survey

Although there is no direct evidence that cattle are detrimental to puku *per se* (Jenkins et al. 2003), it is believed that the associated disturbance does displace puku. The cattle influx into the valley was flagged as a threat to the puku in the 1980s (Rodgers, 1984). It was also noted that puku and cattle avoided using the same habitats (Corti, *et al.* 2002; Bonnington *et al.* 2007) with puku concentrations focussed in the central floodplain. This may be because cattle had displaced puku from the more peripheral areas at that time.

³ KILORWEMP Project Data

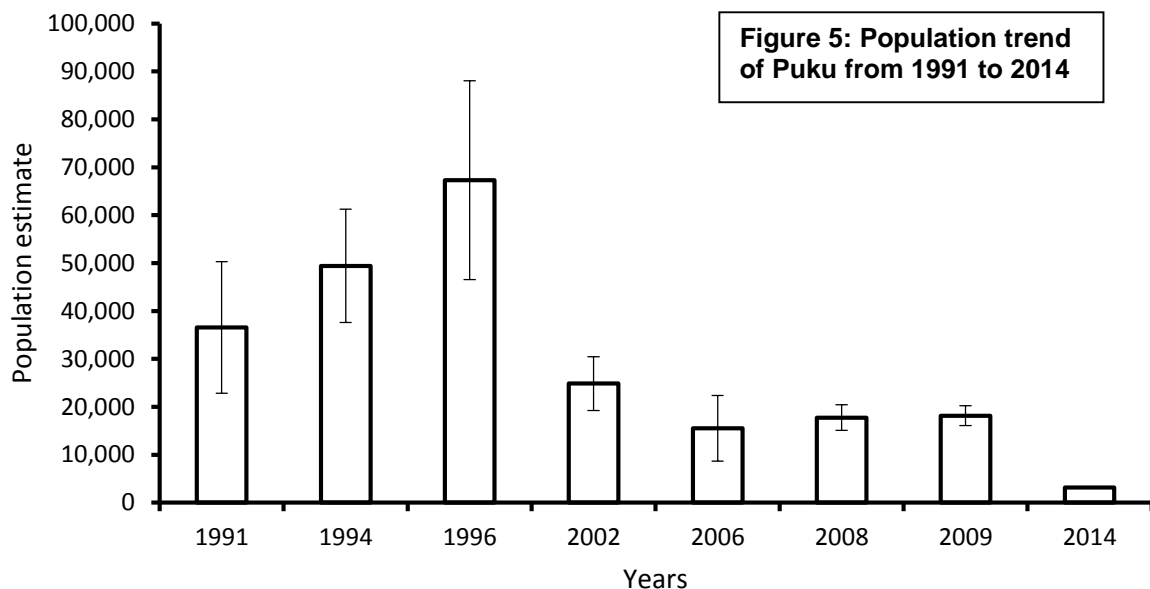
⁴ Nielsen et al., 2014

⁵ Jenkins et al, 2013

⁶ TAWIRI Surveys

TAWIRI is responsible for wildlife surveys in Tanzania and have been surveying the Selous Census Zone (effectively the Selous Game Reserve/World Heritage Site and surrounding areas, including the Kilombero Valley) since the 1980s. Although primarily for larger mammals the surveys also recorded data on many other species, including puku.

The Kilombero Valley has been part of the Selous census zone since 1986 and the survey data shows the shocking decline of what was once the stronghold for the species. The last survey in 2014 recorded around 3,000 individuals, most in the central part of the floodplain. This was from an estimated 70,000 animals in 1996.

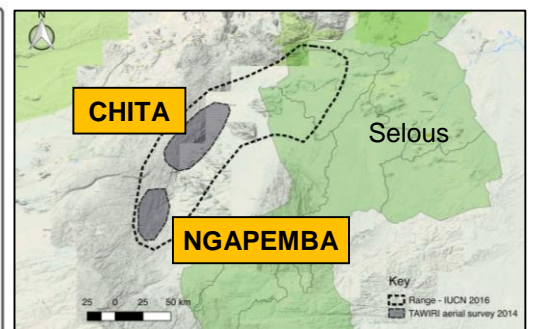
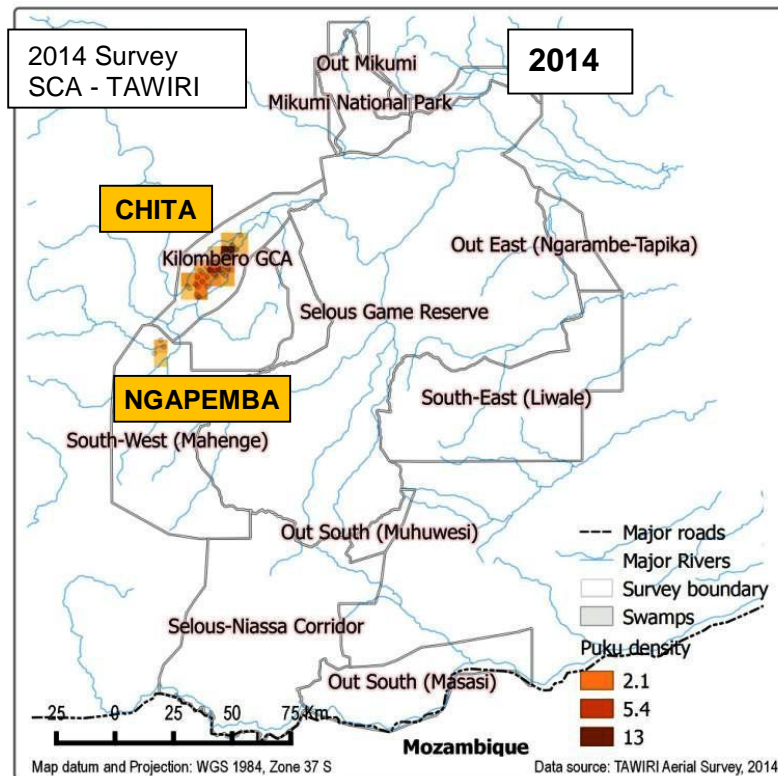
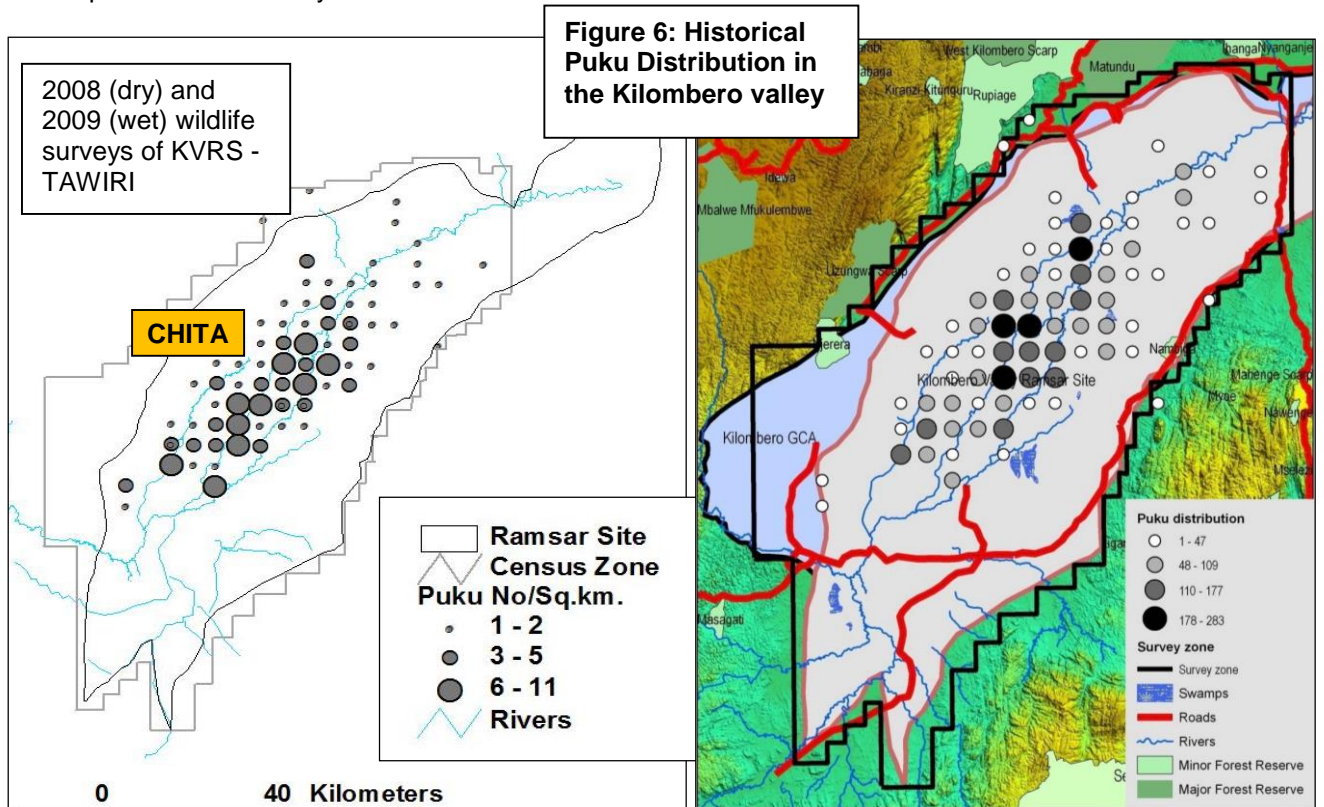


Generally census transects are 5km apart but in 2008 and 2009 two higher intensity surveys (2.5 km spaced transects) were commissioned by the KILORWEMP project only for the Kilombero Valley. The results are shown below but they are also reflected in Figure 5.

The medium size of the puku and the fact that it concentrates in the open floodplain areas during the dry season means that it easily spotted from the air during these surveys. Clumped distribution does have an effect on survey precision and at least one research project has suggest that aerial survey data for puku should be treated with caution (Starkey *et. al.* 2002). Puku could be confused with other fawn coloured antelope such as impala and observers probably have pre-conceived "search images" assigning those in wetland areas to puku and those in wooded areas to impala.

1.5.2 Historical Distribution

Puku were widespread throughout the floodplain grasslands of the Kilombero Valley with significant numbers found east of Chita. The Ngapemba population does not show up in these surveys, possibly because of transect spacing and the fact that the puku are found in the woodlands. However, they do show up in the 2014 survey.

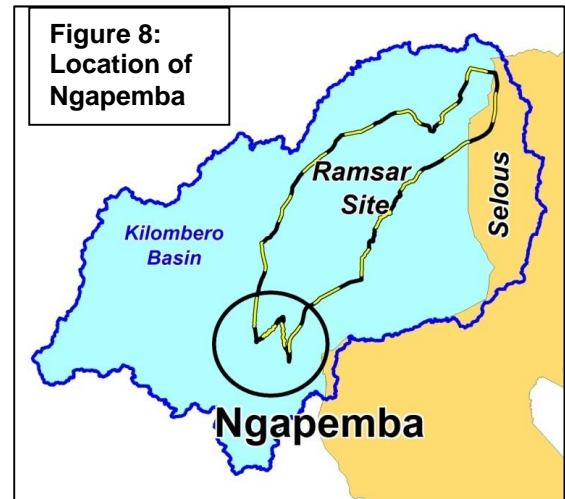
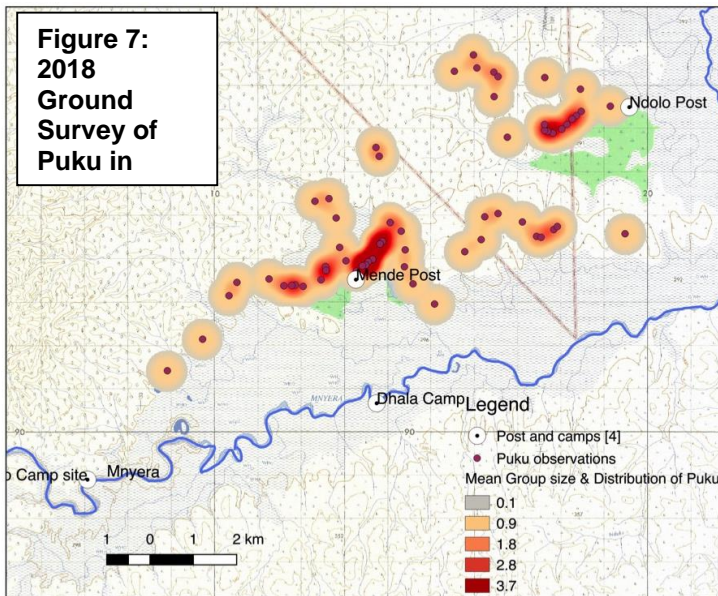


The puku range as identified by IUCN.

This includes the Kilombero Valley and suitable grasslands in the the western part of the Selous Game Reserve.

1.5.3 Current Distribution

Currently, most puku are found in the Ngapemba area at the southern end of the Ramsar Site. Ground based surveys (Ambero 2018) here indicate that there are between 1,000 and 3,000 animals remaining, most in a small area on the north bank of the Mnyera River (see figure below). These puku utilise the woodland areas throughout the year which may be in response to density in the relatively small floodplain areas.



Although no formal surveys were carried out in the rest of the valley during this project, no puku were seen in the central part of the floodplain during non-systematic habitat survey flights (see 2008/2014 surveys for historical concentrations). A few individuals were seen between Ifakara and the Selous Game Reserve, noted as being present in the past (Jenkins, *et. al.* 2003).

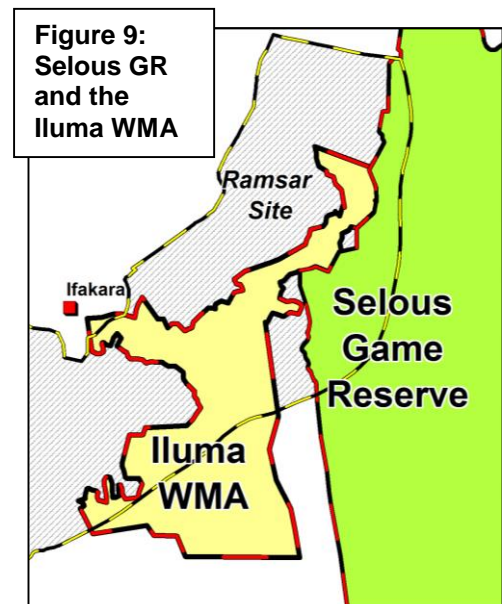
1.6 Conservation In the Kilombero Valley

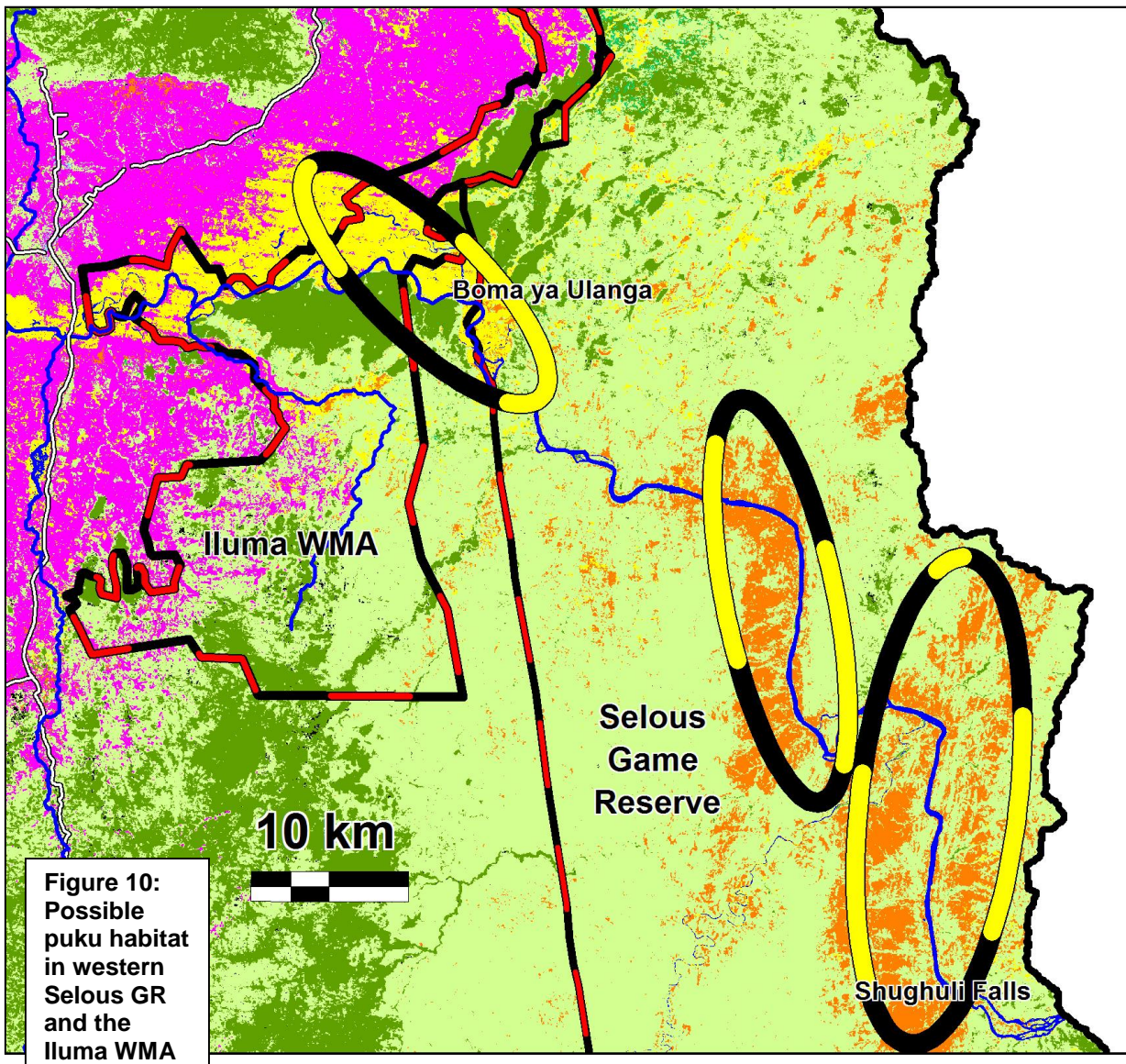
1.6.1 Selous Game Reserve

The Selous Game Reserve is Tanzania's largest protected area and a World's Heritage Site. At almost 50,000 km² it represents an important biodiversity hotspot in southern Tanzania. The reserve could play a role in any re-establishment programmes for puku as it has areas of suitable habitat, especially along the Kilombero river (Boma ya Ulanga to Shughuli Falls). During previous aerial surveys, impala were common in the Boma ya Ulanga to Shughuli Falls area and there is a possibility that if there were already puku in this area, they could easily have been confused with impala. Puku are still on quota for five hunting blocks within the Selous (K1, K2, K4, K5 and IH1; all adjacent to the Kilombero floodplains),

1.6.2 Iluma Wildlife Management Area

The Iluma Wildlife Management Area is a newly established WMA adjacent to the Selous Game Reserve. Its relevance to this discussion is that it covers some prime puku habitat at the eastern end of the Kilombero floodplain and small numbers of puku are said to still remain in this area.





1.6.3 Kilombero Valley Game Controlled Area

The Kilombero Game Controlled Area was gazetted in 1974, under the Wildlife Conservation Act of 1974. The Game Controlled Areas were established in dispersal areas, and corridors with hunting tourism being the main activity. Settlements were not prohibited as thus mushrooming villages were established within GCAs across the country. Human use, including grazing and farming was permitted. Protection of wildlife was de-facto left mostly to the policing by hunting concessionaires and occasionally with zonal anti-poaching units. In 2009 the new Wildlife Conservation Act upgraded the conservation status of Game Controlled Areas to a standards similar to those of Game Reserves.

Aware that circumstances in the valley had changed significantly initiatives to re-establish the GCA began in 2010 and are still continuing to this day. As of mid 2018 boundary beacons have been established by MNRT in Malinyi and Ulanga Districts after discussion with residents and authorities. The work is expected to continue in Kilombero District in 2018 and 2019.

Once established the MNRT is expected to secure the central core of the floodplain as a protected area. This will include policing and management. An established protected area could allow a re-introduced puku population to establish itself and expand. It should be noted that an oil/gas extraction project may be approved in the central floodplain area. MNRT has requested that the company produce a Puku Management Plan as a mitigation measure. The status of this is unknown.

1.6.4 Ngapemba Conservation Area

Investigations during the KILORWEMP project (Ambero 2017 and 2018) stressed the importance of the Ngapemba area in the southern part of the Ramsar Site. This area holds most of the remaining puku in the Kilombero Valley and will therefore be very important in any management plan for the puku. Discussion are expected to continue on the status of this area and what protection model it should fall under - community based protection of state protection. Importantly, there is an emerging consensus amongst all stakeholders that this area is vital for the biodiversity of the valley and needs protection (reference to minutes of meetings).

1.6.5 Legal Utilisation of Puku

Puku, even after their catastrophic decline, are still on the tourist hunting quota in Tanzania. Quota numbers are low (one per hunting block) but 12 blocks are listed, with five being inside the Selous, four as being the Kilombero hunting blocks (which are now defunct), two for Mahenge and one for Lake Rukwa. Clearly quota allocation for puku needs to be reconsidered.

1.7 Key Points for Development of a Puku Management Plan

- From having 75% of the world's puku population in the 1990s (around 70,000 animals) the Kilombero Valley is thought to only have a remnant population of a few thousand individuals. This catastrophic decline should be a major cause for concern for Tanzanian conservation authorities,
- Puku, as a near threatened species, could play a role as a flagship species for conservation initiatives in the Kilombero Valley
- Puku can reproduce quickly aiding population recovery
- They are able to flourish at high densities and this may be related to having an unselective diet and the ability to utilise different habitat types
- The present population across the landscape is likely fragmented in isolated sub-populations.
- There are several conservation areas in the Kilombero catchment that can be the focus for a population recovery initiative.
- Connectivity among these conservation areas should also be pursued as a medium to long term perspective. This is complicated by steadily growing human settlements and intensification of farming.
- The Integrated Management Plan for the Kilombero Valley Ramsar Sites identifies priorities for the strengthening/establishment of conservation areas and rehabilitating wildlife connectivity.

2 THE MANAGEMENT PLAN

This section outlines the management plan for puku in the Kilombero Valley. It is expected that this will feed into a country-wide action plan at a later stage that also considers the Lake Rukwa population.

2.1 Objective

The objective for management of puku in the Kilombero Valley is to:

To restore the Kilombero Valley as Africa's puku stronghold

2.2 Strategies

The strategies to achieve this objective are as follows

1. **Protection Improved**
2. **Puku numbers in three core areas in the Kilombero Catchment Increased**
 - Substantially increase the puku population in the Ngapemba Conservation Area
 - Re-establish puku in their former high density area - the Kilombero Game Controlled Area
 - To establish a puku population in the western part of the Selous Game Reserve
3. **Monitoring Programme Implemented**
4. **Research Programme Developed**
5. **Education and Awareness**

Table:1: Puku Management Plan Strategies	
Strategy	Overview
Increase puku numbers in three core areas in the Kilombero Catchment	As outlined in the introduction achievement of the objective is reliant on several conservation related initiatives ongoing in the valley. These include the re-establishment of the Kilombero Game Controlled Area and the establishment of the Ngapemba Conservation Area. These initiatives are critical elements for the Integrated Management Plan for the KVRS.. The puku management plan cannot be considered in isolation from these initiatives
Education and Awareness	The plight of the puku is not well recognised at the grassroots village level or in the administration. Referred to as <i>sheshe</i> few people are aware that the Kilombero Valley represented the main stronghold for this species in the 1990s. Puku was among the top target species for bushmeat. To many it is just another antelope and wonder what the fuss is all about. Education and awareness of the puku and the need to protect it will be an important component of this management plan. Using the puku as a focal umbrella species for the protection of the KGCA may help to galvanise efforts

However, this management plan could be considered as one of the factors ensuring that formal protection for the Ngapemba Conservation Area and the Kilombero Valley Game Controlled Area move forward. This report should be read in conjunction with the Ngapemba and KGCA documentation add ref.

The status of these three areas, as well as a summary of the way forward is outlined below.

Table 2: Puku focal areas		
Ngapemba	KGCA - Chita	Selous
<ul style="list-style-type: none"> • Currently without formal protection • Last remaining viable puku population in the valley • Growing consensus on protection evident, protected area status and size to be negotiated 	<ul style="list-style-type: none"> • Chita will likely become part of the KGCA or should alternatively receive adequate protection if remaining part of village land and Chita JKT land. • Previous puku stronghold but population decimated 	<ul style="list-style-type: none"> • Formally protected • Suitable habitat between Boma ya Ulanga and Shughuli Falls • Will require translocations
<ul style="list-style-type: none"> • Interim status as hunting block to continue until WMA or other formal protection status established. • Existing population will be starter population 	<ul style="list-style-type: none"> • KGCA boundary designation and marking completed • MNRT protection installed and operating • Starter puku population translocated 	<ul style="list-style-type: none"> • Habitat suitability investigation • Starter puku population translocated • Improved protection for flagship species.

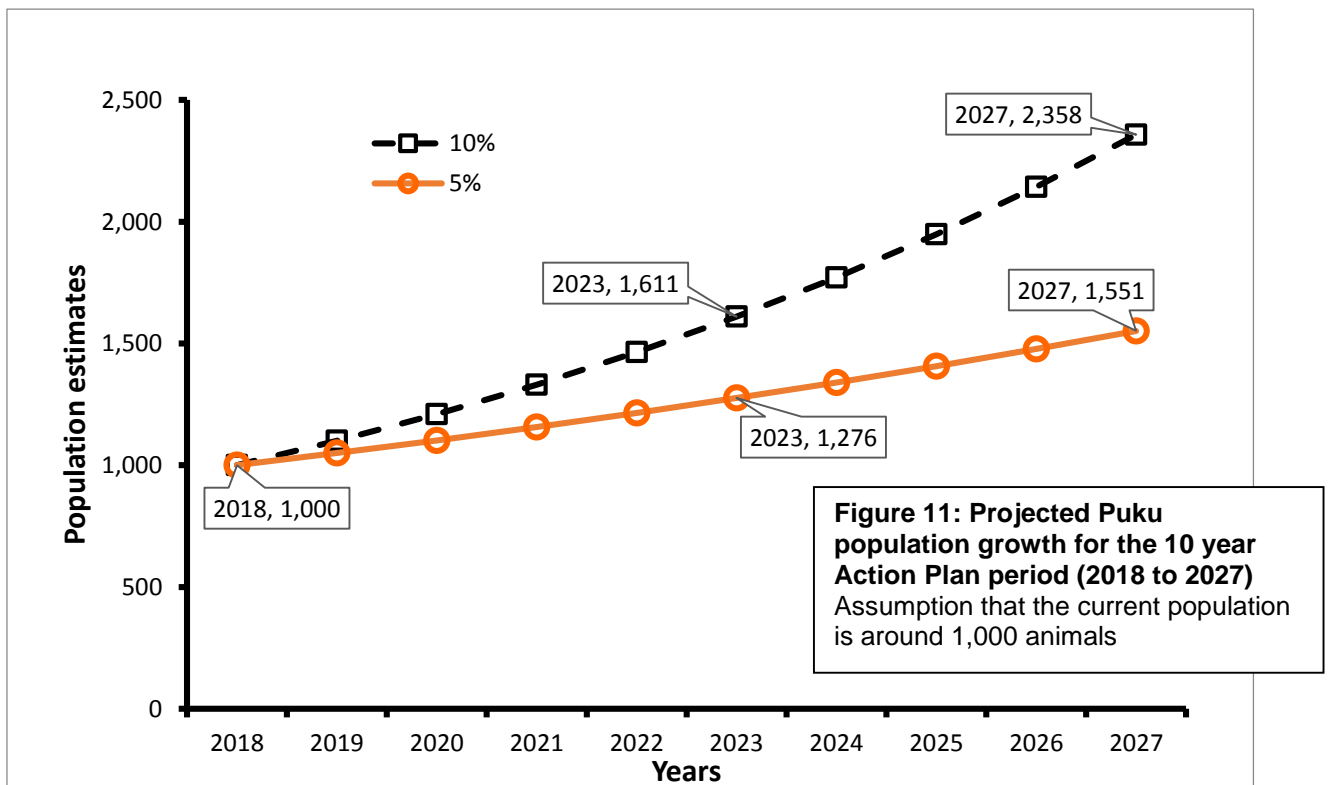
Built into the improvement of protection and active conservation measures on the ground for the puku are several sub-components common to all areas. These include

- Protection and Anti-poaching
- Monitoring and Research (incl. Grassland Restoration)

Table 3: Strategy sub-components	
Component	Description
Protection and Anti-poaching	Virtually the entire puku population of the Kilombero Valley disappeared in 15 years. Although agriculture and competition with livestock for grazing had a role to play there is little doubt that poaching for bushmeat was the major reason. The previous status of the GCA meant that access was unlimited and the area was not properly policed. It is expected that the KGCA will be clearly marked and policed in the near future.
Monitoring and Research	<p>Monitoring will be a key component of any management plan to restore the puku in the Kilombero Valley. To date a number of research projects have been carried out. These, and the TAWIRI survey data, documented the decline of puku in the valley. The future of monitoring for puku will be to document the recovery ! In addition to numbers based monitoring, other important aspects to be monitored include puku movements, home ranges, age and sex composition, calving rates, causes and rates of mortality, and habitat use. Monitoring of law enforcement activities and their (positive) effects is also important. In addition, research into use of miombo woodlands by puku could have practical management implications</p> <p>The first step will be the development of a monitoring protocol for puku that will be used in all three areas. It must be reliable and consistent with a strong information management system. A collaboration of TAWIRI and other relevant institutions will be important in monitoring the recovery of Puku population. Research, as opposed to routine monitoring will be encouraged as part of the protocol. Satellite collars will provide useful information.</p>

Table 3: Strategy sub-components	
Component	Description
Grassland Restoration	<p>Puku primarily depend monocots for forage (Kingdon 2012; Rduch 2016). Dicots have also been recorded in the diet but only at very small proportion during the dry season (Kingdon 2012). Conservation of the grassland will be key for the recovery of puku population in the Kilombero valley.</p> <p>Most of the puku range has been converted to agriculture. There is very little data and analysis on the impact of human activities over the natural grassland. The preliminary evidence available (Andrew et al, 2012) points that overgrazing and seed dispersal through cow dung appears to favour certain invasive species (e.g., <i>Polygala paniculata</i>). Any programme aimed at increasing the puku population needs to assess the risk of an ecological transition affecting species that are palatable (and favoured) for puku. Any forward movement on this line of research presupposes that cultivation is prohibited in the re-established GCA and that grasslands would need to be pushed back to their former ecological state to allow the puku to flourish.</p>

As described in the introduction, puku are thought to be a good species for population restoration as they have the capacity for a relatively high rate of increase. The potential for a 10% rate of increase under good conditions is there. The figure below outlines the likely increase of puku from a starter population of 1,000 animals (thought to be existing in Ngapemba presently). A doubling of the population can be expected in ten years with numbers reaching 20,000 over a 30 year period.



Translocations of breeding groups will have to be sourced from the Ngapemba population to stock (re-stock) the Chita and Boma ya Ulanga areas. It is believed that these populations will do well and that it may be possible to account for far more than 20,000 animals by 2050.

Table 4 : Puku Management Plan - Kilombero Valley				
Strategy	Target	Action	Activities	
Protection Improved for key puku habitats	Ngapemba	Ngapemba Conservation Area established	Conservation type (state or community) agreed	
			Boundary agreed and marked	
	KGCA Chita	KGCA Re-established	Protection Improved	Protection established based on NCA conservation protocol
			Protection Improved	Boundary marked and formally gazetted
	Selous	Protection Improved	Active management and anti-poaching based on KGCA conservation protocol	
			Active management and anti-poaching using existing staffing	
Puku Numbers Increased	Ngapemba	Existing population	Ongoing protection	
	Chita	Puku founder population established	Translocation of suitable individuals from Ngapemba	
	Selous	Puku founder population established	Habitat suitability surveys Translocation of suitable individuals from Ngapemba	
	All Areas	Review of puku hunting quotas	Reconciliation and formal adjustment of quotas	
Monitoring Programme Implemented	Aerial Surveys	Selous Conservation Area census	Sub-sectors with increased coverage	
	Ground Counts	Protocol for all areas developed	Chita access more difficult so methodology required	
	Demography studies	Standard methods developed	Implementation across all three areas	
Research Programme Developed	Improved Forage	Situation assessment	Research studies leading to action plan	
	General Biological studies	Priority research topics identified	Encouragement of academic institutions and NGOs	
Education and Awareness	Decision Makers	Communication strategy	Target audiences for presentations Documentation (flyers, booklet, video) Also to stress value of conservation in the bigger picture	
	Local residents		Raise knowledge of puku and wetland environment in schools Materials developed and distributed	

3 BIBLIOGRAPHY

Ambero 2016. Ngapemba Conservation Area. KILORWEMP Survey Report

Ambero 2017. Land Diagnostic Report. KILORWEMP Report

Ambero 2018. Wetland Landscape Issues KILORWEMP Report

Ambero 2018. Ngapemba Conservation Area. KILORWEMP Report

Corti, G. Fanning, E., Gordon, S. and Hinde, R. 2002. Observations on the puku antelope (*Kobus vardoni*, Livingstone, 1857) in the Kilombero Valley, Tanzania. *African Journal of Ecology* 40: 197–201.

Dancer H, Sulle E. 2015. Gender implications of agricultural commercialisation: the case of sugarcane production in Kilombero District, Tanzania. *Work Pap Agric.*
GBIF.org. GBIF Occurrence Download <https://doi.org/10.15468/dl.0hd0kd>.

East R. 1998. African Antelope Database 1998. IUCN, Gland, Switzerland.

Goldspink CR, HOLLAND R., Sweet G, Stjernstedt R. 1998. A note on the distribution and abundance of puku, *Kobus vardoni* Livingstone, in Kasanka National Park, Zambia. *Afr J Ecol.* 36:23–33.
doi:10.1046/j.1365-2028.1998.112-89112.x.

Haule, K., Johnsen, F. and Maganga, S. 2002. Striving for sustainable wildlife management: the case of Kilombero Game Controlled Area, Tanzania *Journal of Environmental Management* (2002) 66, 31±42

IUCN. 2016. *Kobus vardonii*. The IUCN Red List of Threatened Species 2016: e.T11037A50189881. IUCN Species Surviv Comm.

Jenkins RKB, Maliti HT, Corti GR. 2003. Conservation of the puku antelope (*Kobus vardoni*, Livingstone) in the Kilombero Valley, Tanzania. *Biodivers Conserv.* doi:10.1023/A:1022426026881.

Jenkins R.K.B., Corti G.R., Fanning E. and Roettcher K. 2002. Management implications of antelope. habitat use in the Kilombero Valley, Tanzania. *Oryx* 36: 161–169.

Kangalawe RYM, Liwenga ET. 2005. Livelihoods in the wetlands of Kilombero Valley in Tanzania: Opportunities and challenges to integrated water resource management. *Phys Chem Earth.* 30:968–975.

Kingdon J. 2012. *The Kingdon Field Guide to African Mammals*. London: Bloomsbury.

Nielsen MR, Jacobsen JB, Thorsen BJ. 2014. Factors determining the choice of hunting and trading bushmeat in the Kilombero Valley, Tanzania. *Conserv Biol.* doi:10.1111/cobi.12197.

Nielsen MR, Meilby H. 2015. Hunting and trading bushmeat in the Kilombero Valley, Tanzania: Motivations, cost-benefit ratios and meat prices. *Environ Conserv.* doi:10.1017/S0376892914000198.

Rduch V. 2013. Ecology and Population Status of the Puku Antelope (*Kobus vardonii* Livingstone, 1857) in Zambia. Dissertation for the degree of Doctor of Science (Dr. rer. nat.) in Zoology at the Rheinische Friedrich-Wilhelms-Universität Bonn.

Rduch V. 2016. Diet of the puku antelope (*Kobus vardonii*) and dietary overlap with selected other bovids in Kasanka National Park, Zambia. *Mammal Res.* 61:289–297. doi:10.1007/s13364-016-0268-y.

Rosser A.M. 1989. Environmental and reproductive seasonality of puku *Kobus vardoni*, in Luangwa Valley, Zambia. *African Journal of Ecology* 27: 77–88.

Rodgers WA. 1984. Status of puku (*Kobus vardoni* Livingstone) in Tanzania. *Afr J Ecol.* 22:117–125.

Skinner JD, Smithers RHN. 1990. The mammals of the Southern African subregion. Pretoria: Univ. of Pretoria.

Starkey, M., Birnie, N., Cameron, A., Daffa, R.A., Haddelsey, L., Hood, L., Johnson, N., Kapapa, L., Makoti, J., Mwangomo, E., Rainey, H. & Robinson, W. 2002. The Kilombero Valley Wildlife Project: an ecological and social survey in the Kilombero Valley, Tanzania. Kilombero Valley Wildlife Project, Edinburgh.

Appendix - Landcover in the Kilombero Basin 2014

Landcover 2014 from GlobE project. Perhaps not accurate for cultivation along road to Mahenge

