UN environment

CMS

CONVENTION ON MIGRATORY SPECIES

Distribution: General

UNEP/CMS/COP12/Inf.19/Rev.1
24 October 2017

Original: English

12th MEETING OF THE CONFERENCE OF THE PARTIES
Manila, Philippines, 23 - 28 October 2017

ROADMAP FOR THE CONSERVATION OF THE AFRICAN WILD ASS, *EQUUS AFRICANUS*

Summary:

The African Wild Ass (*Equus africanus*) was once widespread in north and north-east Africa, but its range and numbers have been drastically reduced. It is currently critically endangered.

The object of this Roadmap is to outline the current status of African Wild Ass and the threats that it is facing. This Roadmap builds on information discussed at the Range State meeting held in March 2017 in Bonn, Germany, and a commenting process that followed.

It is intended for this Roadmap to be the tool used to coordinate African Wild Ass conservation for the period of 2017-2027.

Convention on the Conservation of Migratory Species of Wild Animals (CMS)

Roadmap for the Conservation of the African Wild Ass *Equus africanus*

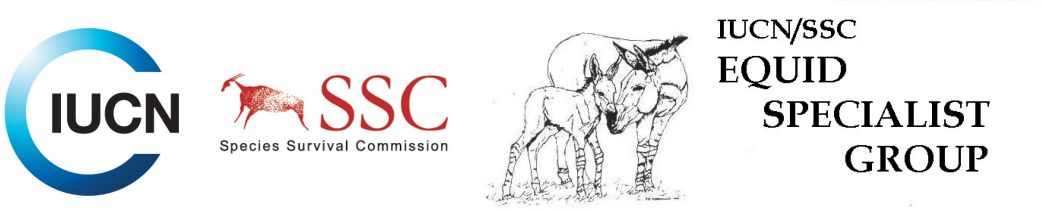
CMS Technical Series No. 34
September 2017

Prepared with funding from

Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety

Support for this action plan:
The development and production of this action plan has been achieved with the financial support of the Government of the Federal Republic of Germany, through the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit; BMUB). http://www.bmub.bund.de

Additional support provided by:
IUCN Equid Specialist Group



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Recommended citation: UNEP/CMS 2017. Conservation Road Map for the African Wild Ass *Equus africanus* 2017-2027. CMS Technical Series No. 34. Bonn, Germany.
ISBN 978-3-937429-22-9

Picture on the cover: © *Patricia D. Moehlman 1998*

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ISBN-978-3-937429-22-9

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Executive Summary

The African Wild Ass (*Equus africanus*) was once widespread in north and north-east Africa, but its range and numbers have been drastically reduced. It is currently confirmed in Eritrea and Ethiopia; there is possible presence in Djibouti, Egypt, Somalia, and Sudan.

African Wild Ass play a vital role in the health of their arid ecosystems and can serve as flagship species for the conservation and maintenance of important landscapes.

The object of this Roadmap is to outline in broad terms the geographic range, population, habitat and ecology of African Wild Ass and the threats that they are facing. This Roadmap builds on information discussed at the Range State meeting held in March 2017 in Bonn, Germany, and a commenting process that followed.

Included are background information on the species, a summary of current threats, and suggested conservation measures, to coordinate international conservation of African Wild Ass across their range. Objectives and actions were developed separately for Eritrea and Ethiopia (the two key Range States), other Range States, captive population, and regional coordination.

It is intended for this Roadmap to be the tool used to coordinate African Wild Ass conservation for the period of 2017-2027.

Acknowledgements

In 2016, the CMS Secretariat invited the Range States for the African Wild Ass to the first-ever international meeting dedicated solely to this species, to bring together experts from the region, and decide on the way forward to conserving this critically endangered species.
As a result of this initiative, we were able to produce the Roadmap for the Conservation of the African Wild Ass. We would like to thank the many individuals who contributed their time and expertise to the creation of this Roadmap:
Firstly, great thanks is due to the Government of Germany, specifically Elsa Nickel, Oliver Schall, Christiane Paulus, Gerhard Adams, and Dana Wiemann, who were endlessly supportive of everything to do with this species for nearly a year and a half leading up to the publication of this document. Without their funding or support, this document would not exist.
Many thanks are also due to the tireless work by the head of the Equid Specialist group, Ms. Patricia Moehlman for her willingness to continuously share knowledge and advise, as well as her compiling of the status review included in this report.
A warm thank you needs to be extended to Ms. Gertrud Denzau and Mr. Helmut Denzau, and their tireless championing of the global conservation of wild asses in general, and the African Wild Ass in particular.
Thank you to all the participants at the workshop, both government representatives, as well as researchers and representatives of NGOs, as well as those who could not attend but provided comments on this document.

Figure 1. Participants at the workshop in Bonn, March 2017. © Fanuel Kebede

An enormous amount of work was done by David Mallon, who took on the task of facilitating the meeting, compiling the resulting output into this document, and adding all the comments after the consultation process.
Finally, much thanks is owed to our two interns who took care of many tasks, from correspondence, to research, to taking notes and helping with PowerPoints during the meeting: Ms. Kalliopi Epitzoglou and Mr. Harry Matthews.

Abbreviations and Acronyms

AZA	Association of Zoos and Aquariums
AZAA	Arabian Zoo and Aquarium Association
BMUB	Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit (Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety of Germany)
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Wild Species of Flora and Fauna
CMS	Convention on Conservation of Migratory Species of Wild Animals
DoW	Department of Water (Eritrea)
EAZA	European Association of Zoos and Aquaria
ESG	IUCN/SSC Equid Specialist Group
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
ESHIA	Environmental, Social and Health Impact Assessment
EWCA	Ethiopian Wildlife Conservation Authority
FWA	Forestry and Wildlife Authority (Eritrea)
GIZ	Gesellschaft fur Internationale Zusammenarbeit (German International Cooperation)
IUCN	International Union for the Conservation of Nature
KfW	Kreditanstalt für Wiederaufbau (German Development Bank)
MoEM:	Ministry of Energy and Mines (Eritrea)
MoA:	Ministry of Agriculture (Eritrea)
MoI	Ministry of Information (Eritrea)
MoMR	Ministry of Marine Resources (Eritrea)
MoLWE	Ministry of Land, Water and Environment (Eritrea)
MoTC	Ministry of Transport and Communications (Eritrea)
NP	National Park
PA	Protected Area
SSC	Species Survival Commission
SSP	AZA Species Survival Plan
EEP	European Endangered Species Programme
WS	Wildlife Sanctuary

Foreword

By Dr. Elsa Nickel

On behalf of the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB)

The African Wild Ass is highly threatened by extinction and one of the most endangered mammal species in the world. If urgent and meaningful action is not taken, there is the great and imminent risk that this fascinating ungulate of the deserts will disappear from the last part of its natural range.

Originally occupying a range of arid areas stretching from Morocco to the Arabian Peninsula, hunting pressure and various other human impacts have caused its drastic and sad decline. The last known remnants of this species are nowadays restricted to some regions in Ethiopia, Eritrea and perhaps a few bordering areas.

So we must act now and fast. I am delighted to see that there is a glimpse of hope on the horizon. Thanks to the initiative of the German Wild Ass experts Gertrud and Helmut Denzau and with the engaged help of the CMS Secretariat, a workshop was initiated in March 2017 with a grant from my Ministry. At this workshop, the Range States agreed on a strategy and an action plan to enable the survival and recovery of the last African Wild Ass populations.

The success of this meeting was in particular made possible due to the engagement from both Ethiopia and Eritrea, the two major Range States of the African Wild Ass, the invaluable expertise from the IUCN Equid Specialist Group chaired by Patricia Moehlman as well as the competent guidance of David Mallon, who facilitated the workshop.

With sincere acknowledgments and thanks to all involved let us jointly make sure that the urgently needed measures outlined in this Roadmap will be implemented, so that we will ensure the survival of this wonderful species.

1. Introduction

The African Wild Ass *Equus africanus* was once widespread in north and north-east Africa, but its range and numbers have been drastically reduced. Small remnant populations are currently found only in Eritrea and Ethiopia, with the remote possibility of small remnants populations elsewhere.
The African Wild Ass has been affected by hunting, habitat loss, competition with livestock for water and grazing, and inadequate conservation infrastructure. African wild ass play an important role in the health of their arid ecosystems and they can serve as flagship species for the conservation and maintenance of important landscapes. Their conservation and management need to be based on good science and the participation of local communities.
This Conservation Road Map was developed at a workshop held in Bonn, Germany on 6-7 March 2017. The workshop was convened by the Convention on Migratory Species (CMS) Secretariat and funded by the Government of the Federal Republic of Germany, through the Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit; BMUB). More than 20 participants from government, NGOs, universities, technical aid agencies and local communities attended the workshop. A workshop report is provided in Annex 1 and a list of participants in Annex 2. The Road Map was developed according to the principles set out in the IUCN Species Conservation Strategy handbook (IUCN 2008). The workshop draft was circulated to participants for comments, amended accordingly and then finalized.

2. Status review

2.1. Taxonomy

Three subspecies have been described:
Nubian Wild Ass, *E. a. africanus,*
Somali Wild Ass, *E. a. somaliensis*,
Atlas Wild Ass, *E. a. atlanticus*.

Research on ancient DNA indicates that the Nubian Wild Ass is one of the ancestors of the domestic donkey and that based on mtDNA the Nubian Wild Ass is distinct from the Somali Wild Ass (Kimura et al. 2011).

2.2 Geographic Range

2.2.1. Historic Distribution

The African Wild Ass was originally widespread from the Atlas Mountains across northern Africa to the Sudanese and Somali arid zones (Sidney 1965, Ansell 1974, Groves 1986).
The northern part of the range was occupied by the Atlas Wild Ass *E. a. atlanticus* which is believed to have become extinct around 300 AD / 1700 bp (Groves 1986). Wild asses have been reported in northern Chad, southern Algeria and the Hoggar Massif of the Central Sahara, but the identity of these animals has been disputed and they may be feral donkeys.
The Nubian Wild Ass *E. a. africanus* lived in the Nubian desert of southeastern Egypt and Sudan, from east of the Nile River to the shores of the Red Sea, extending south to the Atbara River and into northern Eritrea (Fig. 2). During aerial surveys in the 1970s, Wild Asses were seen in the Barka Valley of Eritrea and in the border area between Eritrea and Sudan (Klingel 1980, Watson 1982). The Nubian wild ass is probably extinct, though a few may survive in northern Eritrea or possibly Sudan or Egypt (Moehlman et al. 2015).
The Somali Wild Ass *E. a. somaliensis* was found in the Dankelia region of Eritrea, western Djibouti, the Danakil Desert and the Awash River Valley in the Afar region of northeastern Ethiopia and across

northern Somalia, including Meit and Erigavo to the Nugaal Valley (Simonetta and Simonetta 1983, Yalden et al. 1986, Moehlman et al. 2015; Figures 2, 3).
Denzau & Denzau (1999, 2016) provide a comprehensive summary of published reports of African Wild Ass across North Africa dating from the early nineteenth century onwards.
Yalden et al. (1986) provided the most precise documentation and geographic coordinates for the historical presence of African wild ass in north-eastern Africa from 1844 to 1976. Bauer et al (1994) provided the same information with the addition of records from Funaioli and Simonetta (1966) for Somalia.
However, because African Wild Ass and feral donkeys can be difficult to distinguish in the field, historical records should be treated with some caution.

2.2.2. Current Distribution

Confirmed occurrence of the African Wild Ass is now restricted to Eritrea and Ethiopia (Fig. 2). Some animals may persist in Somalia, Djibouti, Sudan or Egypt, but there are no recent confirmed records from any of those countries (Moehlman *et al*. 2015). The current range of the African Wild Ass in Ethiopia and Eritrea covers approximately 23,000 km^2 (Teclai 2006. Kebede 2013).

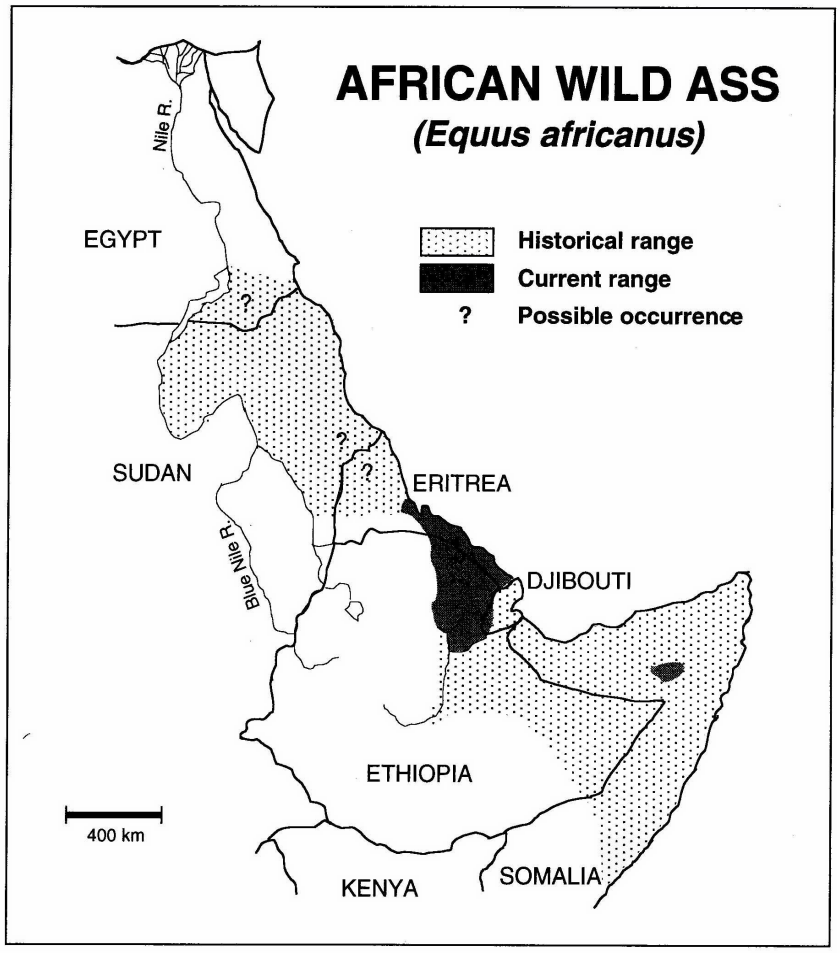

Figure 2. Historic and current distribution of African Wild Ass (Moehlman et al. 2016)

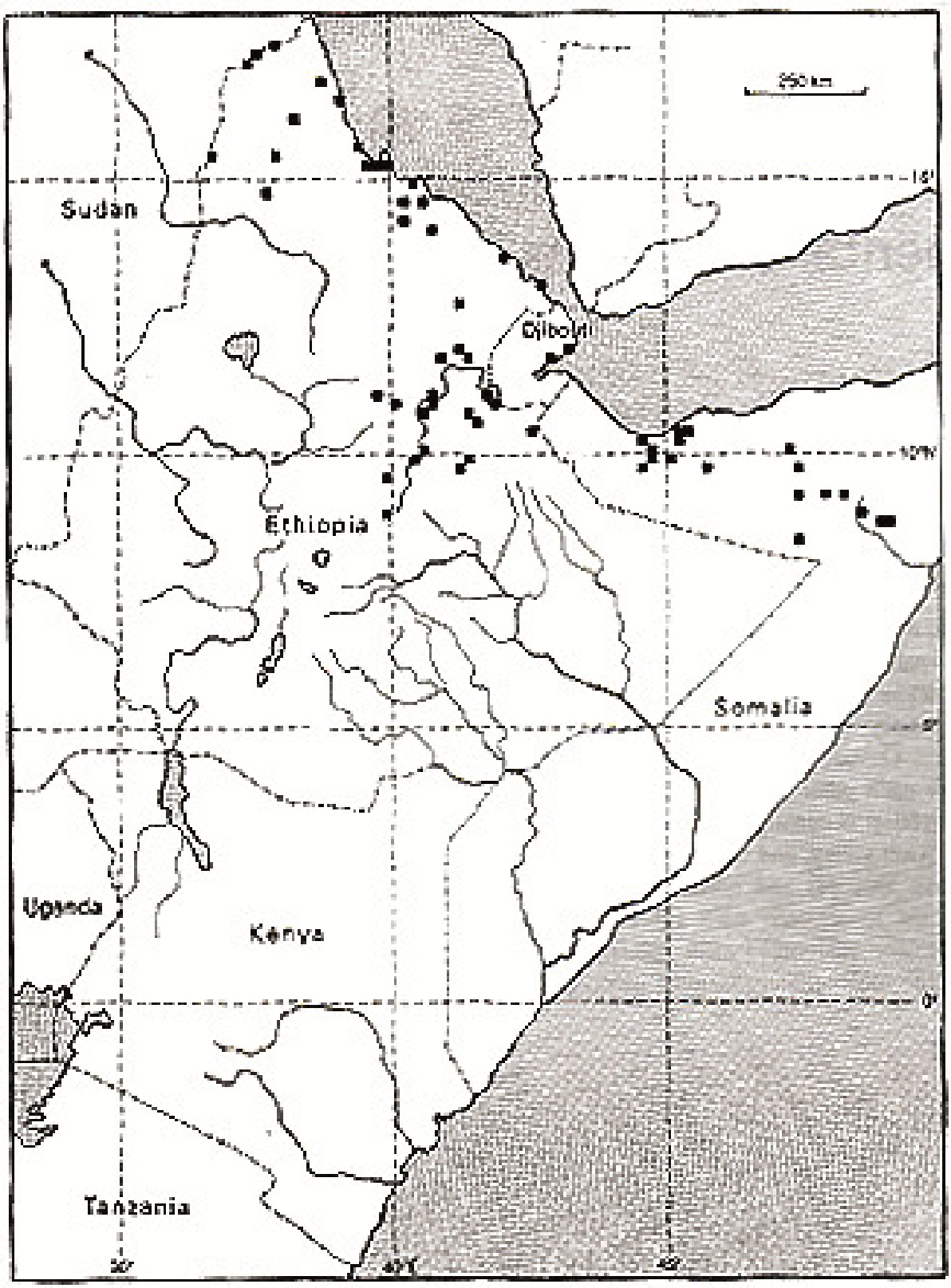

Figure 3. Historical distribution of the African Wild Ass in northeast Africa (Bauer et al. 1994).

Eritrea

Research indicates that African Wild Ass inhabits approximately 11,000 km² in the Denkelia (Danakil) Desert (Teclai 2006, Hagos 2015) but the main study site in the northern Red Sea Zone

covers 100 km² (Moehlman et al. 1998, Moehlman 2002). Surveys and geospatial analyses of suitable habitat are needed to determine the distribution and density of African Wild Ass in this larger area. The Messir Plateau is a critical area for reproduction. A survey in the Yob area in the far north of Eritrea in January 1996 did not document the presence of African Wild Ass, but local people reported that they had been observed in the area (Moehlman and Yohannes pers. comm.). If confirmed, this may represent the only known population of Nubian Wild Ass.

Ethiopia
In 2007, a survey of the historic range of the African Wild Ass in Ethiopia (Kebede et al. 2007) determined that they had been extirpated from the Yangudi-Rassa NP and the Somali Region and that the only remaining population was in the north-eastern Afar Region, concentrated in the Serdo and Afdera areas. The 2009-2010 survey results confirmed that the species' distribution is restricted to these few localities in the Danakil.

Djibouti
Historically the African Wild Ass occurred at several localities in Djibouti (Yalden et al. 1986; Figure 3). Jeannin (1945) said it occurred on the Gammaré Plateau between Tewao and As-Eyla and included a photo of a Wild Ass shot there. There are no confirmed recent records and Laurent and Laurent (2002) reported that they had not encountered the species during 12 years of field work in the country, 1981-1993). The species has been recently documented in the Gamari Mountains in Ethiopia near the Djibouti border (Kebede 2013) so may persist in western Djibouti or occur there as an occasional visitor.

Egypt
The species formerly occurred in the southeast corner of the country, east of the Nile and adjacent to the border with Sudan (Moehlman 1997). Osborn & Helmy (1980) mapped four records of Nubian Wild Ass between 1950 and 1980. Nubian Wild Ass are reportedly still present in Gebel Elba National Park (35,600 km^2). In March 2015, 60-80 animals were reported, in five groups; photos of these animals were posted on the internet by Moss'ad Sultan:
https://www.flickr.com/photos/ganay_elba/21992697666/in/album-72157628867476237
(Figure 4). However, the precise identity of these animals has not been confirmed and they may be feral donkeys. Collection of samples for DNA analysis of all herd members, whether showing 'typical morphology' or varying in coat colour or anatomy is urgently needed.

Somalia
Yalden et al. (1986, 1996) and Bauer et al (1994) mapped records of African Wild Ass across northern Somalia in the Somaliland, and Puntland regions (Fig. 2). In the last 30 years, most reports have come from Meit (Maydh) on the north coast, near Erigavo, and in the Nugaal valley (Simonetta & Simonetta 1986, Moehlman et al. 1998). In 1997, local pastoralists said that there were fewer than ten African Wild Ass left in the Nugaal Valley (Moehlman et al. 2013). Surveys in 2006 and 2010 did not yield any local reports or documentation of African Wild Ass (Killeh and Wirth 2006, Moehlman et al. 2013, Mallon and Jama 2015). More recent surveys in Somaliland conducted in 2016 and 2017 also found no evidence that they persist, although a few reports in the Nugaal Valley were documented (Evangelista et al. In review). The current status of African Wild Ass in Somalia is unknown. During a visit to Garowe in Puntland in January 2015 people from local and international NGOs working in the area reported a few Somali Wild Ass in the Nugaal area and said they had seen two individuals several times; a ground survey using local people is needed to ascertain the presence of the species (Osman Gedow in litt. September 2017).

Sudan
The Nubian Wild Ass formerly occurred in the Nubian Desert of northeastern Sudan, east of the river Nile to the shores of the Red Sea and south across the Atbara River into northern Eritrea (Moehlman 2002). Very little detailed information is available on former occurrence in the country. A few were seen in the Red Sea Hills around Jebel Adaramai, not far from the Eritrean border in 1936 and 1938 and numbers were roughly estimated at 30-50 (Mason 1959). In the late 1990s about 30 in four groups

were seen in the Red Sea Hills of the south-east (Hashim 1998, 1999).

Figure 4. Possible African Wild Ass in Gebel Elba NP. These individuals might be feral domestic donkeys or hybrids. © Moss'ad Sultan 2015.

2.3. Population

2.3.1. Ethiopia

An aerial survey in 1970-1971 of the Teo area (5,280 km²), the Tendaho-Serdo area (4,270 km²), and the Lake Abbe area (6,650 km²) resulted in an estimate of 3,000 African Wild Ass, or 18.6 per 100 km² (Klingel 1972). The Teo area which is now part of the Yangudi-Rassa NP had the highest density, 30 African Wild Ass per 100 km². However, Watson (1982) thought that this was an undercount and that the total population was 6,000 to 12,000. In 1976, an aerial survey in some of the same areas reported estimates of 675 in Yangudi-Rassa NP, i.e. approximately 21 African Wild Ass per 100 km² and recorded 725 individuals in the southern Danakil and 75 in the Danakil depression (Stephenson (1976). These figures are not directly comparable with those of Klingel (1972) because they were based on different survey methods, but they suggest that the population may be declining sharply.

In January 1994, no African Wild Ass were seen on a ground survey of Yangudi-Rassa NP, although local Issa pastoralists reported that they were present but rare and occurred at an approximate density well below one animal per 100 km^2 (Moehlman 1994, Kebede 1995). Issa pastoralists were utilizing the Yangudi-Rassa NP and in some areas their herds of sheep and goats exceeded 50 per km² (Thouless 1995). Surveys conducted in 1994-1998 in an area of 2,000 km² indicated approximately 0.5 Wild Ass per 100 km² (Moehlman 2002). In 2007, a survey of the historic range of the African Wild Ass in Ethiopia determined that they had been extirpated from the Yangudi-Rassa NP and the Somali Region and that the only remaining population was in the northeastern Afar Region (Kebede *et al*. 2007). The total number of African Wild Ass observed during this survey was 25 in an area of

4,000 km² yielding an approximate density of 0.625 animals per 100 km². In 2009 and 2010, Kebede (2013) carried out quarterly ground surveys in African Wild Ass range and sampled 17% of the total African Wild Ass range in Ethiopia (12,300 km^2). The density figures obtained were extrapolated to the area of suitable habitat using a Maxent model to estimate the population (Kebede *et al*. 2014). The current population estimate is 112 +/- 4 individual African Wild Ass in the Danakil Desert of the northeastern Afar region (Kebede 2013), representing approximately one African Wild Ass per 100 km² and indicating a significant decline (~95%) since the 1970s.

2.3.2. Eritrea

There are limited long-term data for Eritrea. From individual identification, it has been estimated that 47 African Wild Ass occurred in the 100 km² main study site in the Northern Red Sea Zone (Moehlman *et al*. 1998, Moehlman 2002). Although this estimate is outdated, it is the highest population density found anywhere in the current range and is similar to densities recorded in Ethiopia in the early 1970s (Klingel 1977). Surveys have identified that the African wild ass range is approximately 11,000 km^2 (Teclai 2006, Hagos 2015). Further surveys and spatial modelling (e.g. Maxent) of suitable habitat are needed to determine the distribution and density of African Wild Ass in the whole range. A rough estimate of African Wild Ass population size in Eritrea would yield a total of possibly 400 individuals.

2.3.3. Somalia

Aerial surveys in northern Somalia in 1978-1980, estimated 4,000-6,000 African Wild Ass in the area from the Nugaal Valley to the Djibouti border (Watson 1982). Given the area covered by the survey, this would indicate approximately six African Wild Ass per 100 km^2. In 1979-1982 Simonetta and Simonetta (1983) estimated that there were about 250 African Wild Ass in the northwestern Nugaal Valley and about 50 near Meit, with scattered groups in the Erigavo region. In 1989 a ground survey supported by limited aerial reconnaissance in the Nugaal Valley yielded population estimates of roughly 135 to 205 Wild Asses or approximately 2.7 to 4.1 African Wild Ass per 100 km² (Moehlman et al. 1998). This indicates a significant reduction in the African Wild Ass population during the decade between those surveys. In 1997, local pastoralists said that there were less than ten African Wild Ass left in the Nugaal Valley (Moehlman et al. 2013). It is not known if African Wild Ass currently persists in Somalia.

2.3.4. Global population

In summary, the total number of observed African Wild Ass in Eritrea and Ethiopia is roughly 70 individuals. There may be as many as 600 individuals in these two countries, but this figure is a very rough extrapolation from more intensely studied areas. The number of mature individuals is approximately 30-50% of the population (Feh *et al*. 2001, Moehlman et al. 2015, Hagos 2015), hence the minimum number of mature individuals is 23 and the maximum might be 300. In Ethiopia, in the last 35 years there has been a population decline of approximately 95% and in the last 12 years the African Wild Ass has been extirpated from roughly 50% of its range (Kebede *et al*. 2007). In Eritrea, the population is stable and slowly increasing. However, it is difficult to predict population trends far into the future.

2.4. Genetics

Research on faecal samples collected from animals in Eritrea and Ethiopia identified five mitochondrial DNA haplotypes (group of polymorphisms): one haplotype specific to the Eritrean population (haplotype D); one specific to the Ethiopian population (E); and three shared (A, B, and C). These results suggest that there has been gene flow between the subpopulations (Afdera, Serdo) in Ethiopia and Eritrea (Oakenfull et al. 2002).

Additional faecal samples were collected from African wild ass in Eritrea and Ethiopia. Polymorphic microsatellite markers (N=10) were used to assess levels of genetic diversity, population structure and demographic parameters. The results revealed the absence of geographic structuring among extant African Wild Ass. The Eritrean population had the

highest values of genetic diversity (H_E=0.63; Na=4.7). F_{ST} among these populations was estimated at 0.10 (P<0.05), confirming a scenario of low population structure. Bidirectional historical migration as well as recent migration were detected between the Ethiopian and Eritrean populations. Effective population sizes for both Ethiopian (*Ne* = 26.2) and Eritrean (*Ne* = 25.6) populations were low, confirming that these populations are extremely vulnerable. There was no evidence of hybridization in the wild population. However, one domestic donkey in Eritrea was identified as a first-generation hybrid (Hagos 2016; Rosenbom et al. 2017).

2.5. Habitat and Ecology

2.5.1. Habitat

The primary habitat is arid and semi-arid bushland and grassland. In Eritrea and Ethiopia, the African Wild Ass lives in the volcanic landscape of the Great Rift Valley where it ranges from below sea level in the Dalool Depression to 1,500 m (Yalden et al. 1996).

2.5.2. Adaptations

Research on domestic donkeys (descendants of the African Wild Ass) documented that they have physiological adaptations to life in arid habitats. They can sustain a water loss of up to 30 per cent of their body weight and can drink enough water in two to five minutes to restore fluid loss (Maloiy 1970). Tomkiewicz (1979), using temperature-sensitive implants, determined that feral donkeys varied their body temperature from 35.0 to 41.5°C, depending on air temperature. Females maintained higher body temperatures and thus may have lost less water due to sweating. Tomkiewicz (1979) also found that the biological half-life of water for females was one day longer than for males, indicating that their water use was more efficient. Such information indicates that the ancestral species, the African Wild Ass, is probably even more physiologically adapted to life in the deserts. However, the African Wild Ass still needs access to surface water. The movements of lactating females are more constrained by availability of water and forage than those of non-lactating females.

2.5.3. Social dynamics

Typical of arid habitat wild equids, a female and her offspring form the only stable groups. Females do associate with other females and/or with males, but even temporary groups are small (<5 individuals). Female foals often stay with their mother and are residents in their natal area. Adult males are frequently solitary, but also associate with other males. Some adult males are territorial and are dominant over other males in these areas (Klingel 1977). In more arid environments, limited food availability (both spatially and temporally) usually does not permit females to forage in close proximity and/or to be associated consistently. Females tend to come into oestrus asynchronously which allows territorial males to mate with multiple females. Territorial males establish their territories in and around areas with critical resources, i.e. forage and/or water. Thus they 'indirectly' obtain access to females that need these resources. Territorial males are dominant on their territories and are the only males observed to mate with oestrous females (Teclai 2006). The African Wild Ass can live up to 31 years in zoos (Steck 2017).

2.5.4. Reproduction

The African Wild Ass has a resource-defence polygynous mating system (Emlen & Oring 1977, Moehlman 1998, 2002, Klingel 2005). The species is polyoestrous and foals are usually born from October to April after a gestation period of 12–13 months (Steck 2017). Although further research is needed, seasonality of births in Eritrea is associated with rainfall conditions on the Messir Plateau (Teclai 2006). A known-age African Wild Ass had her first live foal at six years, although they are sexually matured at approximately two years of age. Some females may have a surviving foal every other year and natality correlates with rainfall during the period of gestation (Moehlman *et al* 2013). In zoos, the youngest age at reproduction is 2 years 3 months (females) and 2 years 11 months (males) and the oldest ages 23 years and 28 years for females and males respectively (Steck 2017).

2.5.5. Diet

In Eritrea and Ethiopia, limited observations indicate that African Wild Asses are primarily grazers, but that they will also utilize browse. Dental wear analyses indicate that African Wild Ass are grazers and browse-graze intermediate feeders (Schulz and Kaiser 2013). In the Mille-Serdo Wild Ass Reserve the preferred forage is *Aristida* sp., *Chrysopogon plumulosus*, *Dactyloctenium schindicum*, *Digitaria* sp., *Lasiurus scindicus*, and *Sporobolus iocladus* (Kebede 1999, Moehlman 2002, Moehlman *et al*. 2013). In Eritrea, *Panicum turgidum* is an important forage species (Teclai 2006).

2.5.6. Predators

Spotted Hyenas (*Crocuta crocuta*) and Lions (*Panthera leo*) are potential predators, particularly of foals and yearlings. Since 2009, Spotted Hyenas are reported to have increased their range in the area from Shukoray oasis to the Messir Plateau.

2.6. Species function and values

- A large-sized, non-ruminant herbivore that lives in an arid ecosystem.
- The species can serve as a flagship species for the conservation of desert ecosystems and their biodiversity
- African Wild Ass persist in one of the harshest climates and terrains in the world.
- These arid habitats are also home to human populations that are also at risk from climatic extremes.
- The African Wild Ass as the ancestor of the domestic donkey which has served the mankind for millennia as a valuable animal of burden and has considerable cultural value

3. Threats

3.1. Habitat loss and degradation

In Ethiopia and Eritrea, the major threat to the African wild ass is limited access to drinking water and good forage (largely due to competition with livestock). Reproductive females and foals less than three months old are most at risk. It is important to determine critical water supplies and basic forage requirements, allowing management authorities to determine (in consultation with local pastoralists) how to conserve the African Wild Ass (Kebede 1999, 2007; Moehlman 2002; Teclai 2006; Moehlman *et al.* 2013, Hagos 2015).

3.2. Direct mortality

In Ethiopia and Somalia, African Wild Ass are used for food and medicinal purposes; for example, body parts and soup made from bones are used for treating tuberculosis, constipation, rheumatism, backache, and bone ache (Moehlman et al. 1998, Kebede 1999, Moehlman 2002, Moehlman *et al.* 2013). Research by Kebede (1999) revealed that 72% of 65 adult male Afar pastoralists had killed African Wild Ass for food and/or medicine. Their explanation was that they could not afford to buy medicine or that they were too far from medical facilities. In 2002, discussions were made with the respected religious leader of the Afar region, Sultan Ali Mirah, who played a key role in supporting conservation in the region. The Sultan urged the local elders to actively engage in conservation of natural habitats and wildlife reminding them that eating equid flesh was *haram,* forbidden (Kebede et al. 2007). In Eritrea, local Afar pastoralists do not harm wildlife and guns are strictly controlled.

3.3. Hybridization

Interbreeding with domestic donkeys is a potential threat to the survival of the African Wild Ass (Moehlman 2002, Moehlman *et al.* 2013). However, there is no scientific evidence indicating introgression of domestic donkey genes into African Wild Ass populations (Hagos 2016; Rosenbom 2017).

3.4. Small population size
The remaining wild populations in Eritrea and Ethiopia are small and their effective population sizes (*Ne*) much smaller still (see section 2.4). Small populations are inherently more vulnerable to stochastic events, outbreaks of disease and adverse genetic factors.

3.5. Predation
Predation by Spotted Hyena on wild ass is reported to have become a problem on the Messir Plateau since 2009.

3.6. Mining
The Danakil Basin contains huge deposits of potash. Several exploration licenses, and recently some production licences, have been reviewed and approved in both Eritrea and Ethiopia. The potential impacts of the mining activities on Wild Ass habitat, including on water levels, and the heavy traffic caused by future potash haulage are as yet unknown. Impact assessments have been carried out (e.g. ERM 2012)) and these have taken into account African Wild Ass habitat in planning, road development and water needs.

3.7. Infrastructure development
Construction of settlements, road and railroad developments all present potential threats to African Wild Ass habitat and risk increasing fragmentation of subpopulations. Specifically,
construction of road and rail transport in Ethiopia will link Dallol to the newly developed bulk port at Tadjoureh in Djibouti, and road transport in Eritrea will link Colluli with the port of Massawa. The proposed route of this road lies some way from the two main African Wild Ass breeding areas but passes between them and close to a freshwater oasis.

3.8. Drought and climate change
The desert habitat in both Eritrea and Ethiopia suffers from recurrent and extreme droughts (Kebede 1999). These conditions are likely to be exacerbated by global climate change.

3.9. Inadequate coverage of Protected Areas
In Ethiopia, most of the extant Wild Ass range lies outside formal protected areas (PAs). In Eritrea, there are no Protected Areas in the Wild Ass range; Buri-Irrori-Hawakil Nature Reserve (8,670 km^2) has been proposed but not yet officially gazetted.

3.10. Lack of capacity
Technical and financial capacity in habitat management, modern survey methodologies and regular monitoring is limited and hinders effective conservation.

4. Conservation action

4.1. International agreements

4.1.1. Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
The African Wild Ass is listed on CITES Appendix I which prohibits international trade in specimens or parts of the species (except when the purpose of the import is not commercial e.g. for scientific research).

4.1.2. Convention on the Conservation of Migratory Species of Wild Animals (CMS)
CMS is a framework environmental treaty under the aegis of the United Nations Environment Programme, and the only global convention specializing in the conservation of migratory species, their habitats and migration routes. During the workshop, a proposal to list the African Wild Ass under CMS was suggested. Proposals to list the African Wild Ass under Appendix I and Appendix II

were developed and submitted by Eritrea and Ethiopia. These proposals will be voted on at the 12th Conference of Parties (CMS COP 12) in October 2017.

4.2. National legislation and policy

The African Wild Ass has full legal protection in Eritrea and Ethiopia.

In Eritrea, African Wild Ass is protected under the Forestry and Wildlife Conservation and Development Proclamation No 156/2006. A revised National Biodiversity Strategy and Action Plan (NBSAP) has been developed (The State of Eritrea 2015). A conservation strategy for African Wild Ass in Eritrea was produced in 2011 (Ministry of Agriculture 2011). and Ethiopia (Ethiopian Biodiversity Institute 2015).

In Ethiopia, the Development, Conservation and Utilization of Wildlife proclamation no. 541/2007 and the Ethiopian Wildlife Development and Conservation Authority Establishment proclamation no. 575/2008, the Wildlife Conservation, Development and Utilization Council of Ministers Regulation 163/2008 are among the legal frameworks used for implementation of wildlife conservation. The biodiversity conservation law, environmental protection law and forestry law supplement and support sustainable natural resource use and conservation. A revised National Biodiversity Strategy and Action Plan (NBSAP) has been developed (Ethiopian Biodiversity Institute 2015). An Ethiopian National Equid Action Plan was recently produced (Ethiopian Wildlife Conservation Authority and IUCN/SSC Equid Specialist Group 2017).

4.3. Protected areas

In Eritrea, the Buri-Irrori-Hawakil Nature Reserve (8,670 km^2), which includes important African Wild Ass breeding habitat on the Messir Plateau, has been proposed. It is supported by a UNDP-GEF project to develop the Protected Areas system in Eritrea (The State of Eritrea 2014) and is included among the targets of the revised National Biodiversity Strategy and Action Plan (The State of Eritrea 2015).

In Ethiopia, the Yangudi-Rassa NP (4,731 km^2) and the Mille-Serdo Wild Ass Reserve (8,766 km^2) were established in 1969 mainly for the conservation of African Wild Ass. However, the former has never been formally gazetted, and both areas are utilized by large numbers of pastoralists and their livestock. These areas are remote and extremely arid.

Gebel Elba NP (35,600 km^2) is located in the Hala'ib Triangle and under administration of Egypt.

4.4. International Union for the Conservation of Nature (IUCN)

4.4.1. IUCN Red List of Threatened Species

The African Wild Ass is assessed as Critically Endangered [CR C2a(i)]. It is listed as Critically Endangered as the numbers (at best approximately 200 mature individuals) may be undergoing a continuing decline due to climate and human/livestock impact, and no subpopulation numbers more than 50 mature individuals. The species may also meet the threshold for Critically Endangered under criterion D, as there may be <50 mature individuals in the wild (Moehlman et al. 2015).

4.4.2. IUCN/SSC Equid Specialist Group (ESG)

The IUCN/SSC ESG is responsible for assessing the status of equid species for the IUCN Red List The broad aim of IUCN/SSC ESG is to promote the long-term conservation of wild equids.

In Ethiopia, IUCN/SSC ESG has worked with Ethiopian Wildlife Conservation Authority since 1994 to provide support for research, training and conservation. This cooperative agreement has included support for post graduate training, scouts, workshops and educational materials.

Since 1995 the IUCN/SSC ESG has had a cooperative research, training and conservation programme with the Eritrean Ministry of Agriculture, Hamelmalo Agricultural College, and the Forestry and Wildlife Authority, supporting postgraduate training, research, and local community participation.

4.5. Ex situ

The 2016 international studbook (ISB) reported a total of 271 African Wild Ass maintained in human care, 107 males and 164 females, kept in 53 institutions (Steck 2017). These animals are the

descendants of five individuals (three males and two females) captured in the Nugaal Valley of Somalia and sent to Basel Zoo in Switzerland in July 1970 and 12 individuals captured in 1972 from the Serdo area in the Afar Region of Ethiopia and sent to Hai-Bar in Israel (Moehlman 2002). Not all 17 founders are currently represented in the zoo population. The exact number of founders is unknown; ideally at least 30 founders are needed.

One herd of about 25 animals in Qatar is included in the ISB; no others are known in the Middle East (Arabian Zoo and Aquarium Association, B. Steck, in litt.).

A further 200-250 African Wild Ass are held at three private facilities in the USA. These animals are descended from a separate import and may represent a new bloodline, possibly including Nubian Wild Ass. The owners are willing to permit genetic research on this population which should be conducted as a matter of urgency (H. & G. Denzau, in litt.).

Most zoo animals are managed under collaborative breeding programmes (SSP in North America and EEP in Europe). The North American zoo population has been growing for the last several years and is currently at an all-time high in terms of the number of animals and facilities holding this species Growth of the zoo population elsewhere has slowed, mainly due to the difficulty in finding new holding institutions.

Pagan et al. (2009) provide important management recommendations and veterinary information gathered over several decades at Basel Zoo. African Wild Ass have been documented with the following diseases in zoos: sarcoid tumours and Equine Herpes Virus EHV1 and EHV9 (Abdelgawad 2015, Ulrich et al. 2016). Sarcoids are mainly a problem in Europe but have also been recorded in the USA; they have not been observed in wild populations. African Wild Ass are mainly carriers of EHV and cases of disease are rare to non-existent in the zoo population, but there is risk of transmission to other species in zoos, and possibly also in the wild.

5. Conservation Road Map

5.1. Goal

The overall Goal of the Conservation Road Map is to coordinate conservation of the African Wild Ass across their range.

5.2. Strategic directions

A set of broad strategic directions was agreed, based on discussions of the current threats and conservation measures:

- Reduction in competition with livestock for water and forage
- Protection of known populations.
- Surveys for remnant populations
- Research on demography, ranging and genetics
- Increased coverage of Protected Areas
- Engagement with local communities
- Building technical capacity for research, monitoring and management
- Mitigating the effects of fragmentation and infrastructure development
- Education and awareness programs at global and local levels
- Closer links between ex situ and in situ conservation

5.3. Objectives and actions

Objectives and actions were developed separately for Eritrea and Ethiopia (the two key Range States), Other Range States, captive populations and regional coordination. Sets of Objectives and Actions are shown below in logframe format.

Eritrea

Vision: We envision viable, genetically diverse and ecologically functioning populations of African Wild Ass. These populations will flourish in a healthy ecosystem where they are appreciated and cherished by the local communities who derive economic development and food security benefits. Support by national environmental policy and the building of capacity for both local and national experts is fundamental to the conservation of the African Wild Ass.

Goals: 1. Development of a strategic, science- based National Action Plan and management programme for the African Wwild Aass and the ecosystem it inhabits. 2. Enhance conservation policies through participatory planning that mitigate the level of competition between African Wwild Aass and livestock and promote sustainable use of key resources (forage and water) in critical ranges.

Threat	Objective	Action	Indicator	Stakeholders	Time
1. Habitat degradation, inadequate forage and water	1.1. Develop a Denkelia Ecosystem Conservation programme	1.1.1 Research on the range and ecological requirements of the African Wild Ass and livestock	African wild ass spatial and dietary overlap with livestock established.	FWA, MoA, MoLWE and Academia	3 years
		1.1.2 Establish a sanctuary on Messir Plateau-Irrori Plain	Messir plateau sanctuary delineated.	FWA, MoA, MoLWE, local communities, local government, partners	6 months
		1.1.3 Contribute to the Irrori-Buri Protected area management plan	PA management plan produced.	FWA, MoLWE, MoA, MoMR, local government	1 year
		1.1.4 Carry out habitat assessments in key sites and compile habitat restoration plans where appropriate	Critical sites identified and restoration plan developed.	FWA, local government, local communities, partners	3-5 years
		1.1.5 Improve access to water and forage at key sites	Key water and forage sites delineated.	FWA, local communities, partners	1 year
		1.1.6 Establish a ground water monitoring system	Data on ground water levels recorded	DoW, MoLWE	1 year
	1.2 Monitor the effects of mining development on the Denkelia ecosystem	1.2.1 Monitor implementation of mitigation plans specified in EIAs	Mining EIAs evaluated reports.	FWA, MoA, MoLWE , MoEM	5-10 years

Threat	Objective	Action	Indicator	Stakeholders	Time
2. Climate change and drought	2.1 Mitigate the effects of climate change and drought on forage and African Wild Ass	2.1.1. Conduct long-term research on impacts of climate change and drought	Impact assessment reports	MoLWE, MoA, FWA, MoTC	3-5 years
		2.1.2 Establish meteorological stations at strategic points in the African Wild Ass range	Number of meteorological stations established and monitored.	FWA, MoTC	1 year
3. Direct mortality	3.1 Reduce impact of Spotted Hyena predation on African Wild Ass	3.1.1 Conduct research focused on hyena populations, distribution and impact of predation	MSc research funded and implemented	FWA and MoA	2 years
		3.1.2 Temporary control programme in emergency conditions, if appropriate	Spotted Hyena predation significantly reduced	FWA and MoA	On-going
	3.2. Reduce impact of disease	3.2.1. Organize a short course for wildlife veterinarians	Number of wildlife veterinarians trained	FWA, MoA and Academia	2 years
		3.2.2 Conduct research (including faecal sampling) on the frequency and impact of disease and parasites	Data analysed and published	FWA, MoA and Academia	2-3 years
4. Small population size	4.1 Increase population viability	4.1.1 Research the population dynamics in Denkelia	Population viability assessment report	FWA, MoA and Academia	On-going since 1995
	4.2 Photographic documentation and identification of all individuals	4.2.1 photographs and id sheets of all individuals and record of birth and death	All individuals in photographic record	FWA, MoA and Academia	On-going
	4.3 Population genetics of all populations	4.3.1 non-invasive genetics research on all populations	Genetic analyses of faecal samples	FWA, MoA and Academia	On-going
	4.4. Research nutritional status	4.4.1 Take nutritional analyses of faecal samples	Samples analyzed	FWA, MoA and Academia	On-going
	4.5. Research morphology	4.5.1 Collect all skulls and skeletal material	Morphological analysesconducted	FWA, MoA and Academia	On-going

Threat	Objective	Action	Indicator	Stakeholders	Time
5. Incomplete knowledge of distribution	5.1. Survey areas for undocumented populations	5.1.1 Survey the Hagar Plateau	Survey conducted and reports produced Local scouts engaged	FWA, MoA, local government, local communities, Academia	2-4 months
		5.1.2 Survey southern Denkelia			
6. Human wildlife conflict	6.1 Produce an integrated Community Development Programme at key sites	6.1.1 Analyse alternative sources of income for local communities	Alternative sources of income formulated	FWA, MoA, local government, local communities	5 years
		6.1.2 Conduct socio-economic analysis of local communities	Socio-economic report produced		1-2 years
7. Lack of awareness	7.1 Increase awareness of the importance of the African Wild Ass and Denkelia ecosystem	7.1.1 Organise an awareness campaign for the general public including press, radio, TV, social media	Number of awareness campaigns	FWA, MoI, partners	On-going
		7.1.2 Hold education workshops for local residents, administrators, policy makers, military, and mining employees	Number of training workshop conducted & measured impacts	FWA, local government, local communities, partners	On-going
		7.1.3 Continue to produce posters, conservation information pamphlets, etc	Number of posters, etc produced	FWA, local government, local communities	On-going
		7.1.4 Establish an African wild ass display at the National Museum	Museum display established	FWA, National Museum	1-2 years
8. Lack of technical capacity	8.1 Develop a capacity development programme	8.1.1 Support Diploma and BSc curriculum development and short courses in wildlife and ecology	Curriculum developed and short courses conducted	FWA and Academia	3-week courses
		8.1.2 Support ongoing MSc research programmes	Number of MSc students supported		ongoing
		8.1.3 Provide support and training and equipment for wildlife scouts	Number of wildlife scouts trained and equipped	FWA, MoA, Local Government, Local communities	5-10 years

Abbreviations: FWA- Forestry and Wildlife Authority; MoA- Ministry of Agriculture; MoTC- Ministry of Transport and Communications; MoLWE- Ministry of Land, Water and Environment; MoEM- Ministry of Energy and Mines; MoMR- Ministry of Marine Resources; MoI- Ministry of Information.

Ethiopia

Vision: (from National Equid Action Plan 2017): Ethiopia's three iconic wild equid species are secured in viable and connected populations, ranging freely in healthy ecosystems, coexisting in harmony with people and development activities, and appreciated for their cultural, aesthetic, economic and ecological values for present and future generations				
Goals: 1. To secure the current populations of African Wild Ass and to enhance their viability both demographically and genetically in healthy ecosystems. 2. To enhance the capability and awareness of all stakeholders				
Objective	**Actions**	**Indicator**	**Timeline**	**Stakeholders**
1. Protect African Wild Ass from hunting	1.1. Build capacity for law enforcement at different levels	Successful prosecutions	1 year	EWCA and partners*
	1.2. Increase number of community scouts and build their capacity	11 additional scouts hired, trained and equipped in all three areas (Bidu, Serdo, Hillu)	2 years	EWCA
	1.3. Encourage the involvement of religious leaders and elders to provide support	Directives issued that it is forbidden (*Haram*) to harm African Wild Ass	1 year	EWCA, Afar Regional State (concerned office)
	1.4. Encourage enforcement of customary laws		on-going	Afar Regional State (concerned office and elders)
2. Engage local communities in conservation	2.1. Provide dispensaries	Two dispensaries built and staffed	2-3 years	ECWA, local government and partners
	2.2. Introduce wildlife guardian model (develop community reward scheme for wildlife guardian)		3-5	EWCA, Afar Regional State (concerned office) community elders
	2.3. Launch awareness programmes scaling up best practices in wildlife conservation		1-2	EWCA and partners
	2.4. Provide alternative livelihood options for communities		2-5	EWCA, Afar Regional State (concerned office) and Partners
3. Reduce competition with livestock for forage and water	3.1. Conduct research and monitoring on dietary overlap and resource competition between African Wild Ass and livestock		1-5 years	Academic institutions, EWCA, Research institutions
	3.2. Develop African Wild Ass (species) conservation action plan	Plan completed	ongoing	EWCA, stakeholders and partners
	3.3. Implement African Wild Ass (species) conservation action plan	Plan implemented		EWC, Afar Regional State (concerned office) and partners

Objective	Actions	Indicator	Timeline	Stakeholders
	3.4. Develop rangeland and water management schemes		2-4 years	EWCA, Afar Regional State (concerned office), partners
4. Reduce the impact of climate change on African Wild Ass and its habitat	4.1. Assess and monitor the effect of climate change		1-2 years	EWCA, MEFCC, partners and stockholders (pastoral development…)
	4.2. Develop a climate change resilient adaptive strategy		2-5 years	EWCA, MEFCC, partners and stockholders (pastoral development
5. Reduce the impact of infrastructure development, settlements, road and railroad development	5.1. Establish database on infrastructure developments	Information obtained concerning transport development in the region	1 year	ECWA and stakeholders, ERA, EPC
	5.2. Encourage participatory approach in the planning process	Permission obtained to participate in the planning process	1 year	EWCA
	5.3. Scale up best practices in implementing mitigation measures.	Open communication with other countries (Kenya and Mongolia) concerning transport challenges in sensitive wildlife landscapes	1 year	EWCA, MEFCC, Regional State (concerned office), and partners
	5.4. Monitor and evaluate the implementation of Environmental Impact Assessments	Legislation in place that ensures an environmental impact statements need to be produced EIAs carried out to international standards	1 year-end of the project	EWCA, MEFCC, Regional State (concerned office)
6. Improve Protected Area coverage	6.1. Establish a protected area in African Wild Ass potential areas	PA demarcated and gazetted Infrastructure (office, ranger post, ticket office at Bidu) developed	3 years	EWCA, Regional State (concerned office), and partners
	6.2. Develop a short- and long-term management plan		3-8 years	EWCA
7. Increase capacity	7.1. Strengthen the protected areas located in and around African Wild Ass ranges	Infrastructure and staff in place	Starting year 1	EWCA, Regional State (concerned office) and partners

Other Range States

Goal: Establish the current status of African Wild Ass and implement conservation measures as appropriate			
Djibouti			
Action	**Stakeholders**	**Responsibilities**	**Timeline**
1. Monitor transboundary movements on Gammare Plateau	- Djibouti Nature and Partners - Ministry of Housing, Urban Affairs and Environment - Association DECAN - IUCN/SSC ESG		
2. Establish a local reporting system			
3. Collect samples for genetic analysis			
Egypt			
Action	**Stakeholders**	**Responsibilities**	**Timeline**
1. Collect samples from Elba NP for genetic analysis	- Egyptian Environmental Affairs Agency (Ministry of Environment) - Nature Conservation Egypt - Moss'ad Sultan - IUCN/SSC ESG		
2. Conduct field surveys to determine occurrence, population and range			
3. Establish a local reporting system			
Somalia (includes Somaliland Puntland)			
Action	**Stakeholders**	**Responsibilities**	**Timeline**
1. Conduct field surveys to determine occurrence, population and range	- Ministry of Environment and Rural Development (Somalia) - Ministry of Environment and Rural Development (Somaliland) - Ministry of Environment Wildlife and Tourism (Puntland) - Colorado State University - Somali Wildlife and Natural History Society - IUCN/SSC ESG		
2. Establish a local reporting system			
3. Collect samples for genetic analysis			
Sudan			
Action	**Stakeholders**	**Responsibilities**	**Timeline**
1. Conduct field surveys to determine occurrence, population and range	- Ministry of Environment, Forestry and Physical Development - Sudanese Wildlife Society (I.M. Hashim) - IUCN/SSC ESG		
2. Establish a local reporting system			
3. Collect samples for genetic analysis			

Ex situ population

Goal: Integrate management of the captive population and conservation in situ (One Plan approach)			
Objective	**Action**	**Stakeholders**	**Time**
1. Expand the captive population	1.1 Identify any African Wild Ass held outside the ISB (private holders in the USA)	AZA, Private owners Genetics labs	
	1.2. Identify any African Wild Ass held outside the ISB (private holders in the Middle East)	Arabian Zoo and Aquarium Association	
	1.3. Collect samples from any new animals for genetic analysis	Private owners Genetics labs	
	1.4. Identify potential new holders (zoos, private)	AZA, EAZA	
	1.5. Carry out research into improving the current pedigree	AZA, EAZA, Academia	
2. Improve veterinary health	2.1. Research on sarcoids (possibility of producing a vaccine; occurrence in the wild)	AZA, EAZA, Academia	
	2.2. Research on EHV (transmission risk to other species; occurrence in populations)	AZA, EAZA, Academia	
3. Support in situ conservation	3.1. Develop more links between the ex situ community and in situ conservation (field projects, research)	AZA, EAZA, Private owners, IUCN/SSC ESG	On-going
	3.2. Distribute in situ information to zoos	IUCN/SSC ESG	On-going
	3.3. Use captive African Wild Ass as 'ambassadors'	AZA, EAZA	
	3.4. Develop communication and awareness programmes based on the zoo population	AZA, EAZA	

Regional

Goal: Coordinate implementation of the Roadmap			
Objective	**Action**	**Stakeholders**	**Time**
1. Provide a sound science basis for African Wild Ass conservation	1.1. Conduct genetic research on the two subspecies of African Wild Ass and domestic donkeys to determine the actual and potential hybridization	Academia, IUCN/SSC ESG	On-going
	1.2. Continue research into genetics of wild populations	Academia, IUCN/SSC ESG	On-going
	1.3. Use GIS habitat modelling to predict African Wild Ass range	CSU, IUCN/SSC ESG	2 years
	1.4. Apply standardized monitoring methodology across the range	EWCA, FWA, CSU IUCN/SSC ESG	2 years
	1.5. Maintain a central database of African Wild Ass records	IUCN/SSC ESG	On-going
	1.6. Set up an electronic library of material on African Wild Ass	IUCN/SSC ESG	On-going
	1.7. Make all unpublished reports available in the e-library	All	6 months
2. Build adequate technical capacity for African Wild Ass conservation	2.1. Organize training courses in survey, monitoring, habitat management	EWCA, FWA, IUCN/SSC ESG	On-going
	2.2. Support postgraduate research in key Range States	IUCN/SSC ESG	On-going
3. Ensure effective implementation of the Roadmap	3.1. Establish a coordination mechanism and reporting process	CMS, Government Agencies, IUCN-ESARO, All	6 months
	3.2. Appoint a CMS African Wild Ass focal point		6 months
	3.3. Appoint African Wild Ass focal points in range countries		6 months
	3.4. Carry out a mid-term review of progress		2022
	3.5. Obtain funding to support effective implementation		On-going
	3.6 Develop Somali Wild Ass short- and long-term transboundary management plans		

References

Abdelgawad, A., Hermes, R., Damiani, A., Lamglait, B., Czirják, G.Á., East, M., et al. 2015. Comprehensive serology based on a peptide ELISA to assess the prevalence of closely related equine herpesviruses in zoo and wild animals. PLoS ONE 10(9): e0138370. doi:10.1371/journal.pone.0138370

Afework, B. and Yalden, D.W. 2013. The mammals of Ethiopia and Eritrea. Addis Ababa University Press.

Ansell, W.F.H. 1971. Order Perissodactyla. Pp. 1-14 in The Mammals of Africa. J. Meester and H.W. Setzer, eds. Smithsonian Institution Press, Washington DC.

Bauer, I.E., McMorrow, J. and Yalden, D.W. 1994. The Historic ranges of three equid species in North-East Africa: A quantitative comparison of environmental tolerances. Journal of Biogeography 21: 169-182.

Denzau, G. & Denzau, H. 1999. Wildesel. Jan Thorbecke Verlag, Stuttgart.

Denzau, G. & Denzau, H. 2016. African Wild Ass. English translation by Robin Stocks of pp. 164-180 in Denzau & Denzau 1999. UNEP/CMS/AWA/Inf.1.

Emlen, S.T. and Oring. S.W. 1977. Ecology, sexual selection, and the evolution of mating systems. Science 197(4300): 215-223.

ERM. 2012. Dallol Potash Project. ERM Project 0143047. Draft Environmental, Socila and Health inpact Assessment. December 2012. Environmental Resources Management. www.erm.com. (Available as CMS_AWA_inf16_ESHIA).

Ethiopian Biodiversity Institute 2015. Ethiopia's revised National Biodiversity Strategy and Action Plan 2015-2020. Ethiopian Biodiversity Institute and Government of the Federal Democratic Republic of Ethiopia. Addis Ababa. 49 pp.

Ethiopian Wildlife Conservation Authority and IUCN/SSC Equid Specialist Group. 2017. Ethiopia National Equid Action Plan. Ethiopian Wildlife Conservation Authority, Addis Ababa, Ethiopia. 40 pp.

Evangelista, P.H., Mohammed, A.M, Hussein, I.H., Saied, A.H, Mohammed, A.H., Young, N.Y. (In Review). Integrating local ecological knowledge and species distribution modeling to detect wildlife in Somaliland, Conservation Biology.

Funaioli, U. and Simonetta, A.M. 1966. The mammalian fauna of the Somali Republic: status and conservation problems. Monitore Zoologico. Italiano Suppl. 74: 285-347.

Feh, C., Munkhtuya, B., Enkhbold, S. and Sukhbaatar, T. 2001. Ecology and social structure of the Gobi Khulan (*Equus hemionus subsp*). in the Gobi B National Park, Mongolia. Biological Conservation 101: 51-61.

Gentry, A., Clutton-Brock, J. and Groves, C.P. 1996. Proposed conservation of usage of 15 mammal specific names based on wild species which are antedated by or contemporary with those based on domestic animals. Bulletin of Zoological Nomenclature 53: 28-37.

Groves, C.P. 1986. The taxonomy, distribution, and adaptations of recent *equids*. *In Equids* in the ancient world. (Eds R. Meadow & H.P. Uerpmann), pp. 11-65. Ludwig Reichert Verlag, Wiesbaden, Germany.

Groves, C.P. 2002. Taxonomy of the living *Equidae*. In P.D. Moehlman, ed. Equids: Zebras, Asses and Horses. Status Survey and Conservation Action Plan. Pp. 94-107. IUCN, Gland, Switzerland.

Groves, C.P. and Smeenk, C. 2007. The nomenclature of the African wild ass. Zoologische Mededelingen Leiden 81(6): 121-135.
Groves, C.P. and Willoughby, D.P. 1981. Studies on the taxonomy and phylogeny of the *genus Equus* 1. Subgeneric classification of the recent species. Mammalia 45(3): 321-354.

Grubb, P. 2005. Order Perissodactyla. In: D. E. Wilson and D. M. Reeder (eds), Mammal Species of the World, pp. 629-636. The Johns Hopkins University Press, Baltimore, Maryland, USA.

Hagos, F. 2016. Population distribution, genetics and conservation of the African wild ass (*Equus africanus somaliensis*) in Denkelia, Eritrea. MSc thesis. University of Nairobi. Nairobi, Kenya. 75pp.

Hashim, I.M, 1998. Status, abundance and distribution of four endangered wildlife species in eastern Sudan. Part 1. Gnusletter 17(2): 12-16.

Hashim, I.M, 1998. Status, abundance and distribution of four endangered wildlife species in eastern Sudan. Part 2. Gnusletter 18(1): 16-20.

Jeannin, A. 1945. Les bêtes de chasse de l'Afrique française. Payot, Paris.

Kebede, F. 1995. A field report on the survey of the African wild ass in Serdo area. Report to EWCO. Addis Ababa.

Kebede, F. 1999. Ecology and conservation of the African wild ass (*Equus africanus*) in the Danakil, Ethiopia. M.Sc. Thesis, University of Kent.

Kebede, F. 2013. Ecology and community-based conservation of Grevy's zebra (*Equus grevyi*) and African wild ass (*Equus africanus*) in the Afar Region. University of Addis Ababa.

Kebede, F., Moehlman, P.D. and Berhanu, L. 2007. Distribution and population status of the African Wild Ass (*Equus africanus*) in Ethiopia. Report to Saint Louis Zoo.

Kebede, F., Moehlman, P.D., Bekele, A. and Evangelista, P.H. 2014. Predicting seasonal habitat suitability for the Critically Endangered African Wild Ass in the Danakil, Ethiopia. African Journal of Ecology 52(4): 533-542.

Killeh, M.E. and Wirth, G. 2006. Assessment of the Status of the Somali Wild Ass at Raguda Somaliland. 6pp.

Kimura, B., Marshall, F.B., Chen, S., Rosenbom, S., Moehlman, P.D., Tuross, N., Sabin, R.C., Peters, J., Barich, B., Yohannes, H., Kebede, F., Teclai, R., Beja-Pereira, A., and Mulligan, C.J. 2011. Ancient DNA from Nubian and Somali wild ass provides insights into donkey ancestry and domestication. Proc. R. Soc. B. 278(1702): 50-57.

Klingel, H., 1972. Somali Wild Ass. Status survey in the Danakel Region Ethiopia. WWF project no. 49ó. Final Report to EWCO, Addis Ababa, Ethiopia, 12 pp.
Klingel, H. 1975. Social Organization and Reproduction in Equids. Journal of Reproductive Fertility. Suppl. 23: 7-11.

Klingel, H. 1977. Observations on social organization and behaviour of African and Asiatic wild asses (*Equus africanus and E. hemionus*). Zeitschrift für Tierpsychologie 44: 323-331.

Klingel, H. 1980. Survey of African Equids. IUCN Survival Service Commission Report. IUCN, Gland, Switzerland. 15pp.

Laurent, A. and Laurent D. 2002. Djibouti : les mammifères d'hier à aujourd'hui pour demain. Editions Beira, Toulouse.

Mallon, D.P. and Jama, A.A. 2015. Current status of antelopes in Somaliland. IUCN/SSC Antelope Specialist Group and Nature Somaliland. 25 pp.

Maloiy, G.M.O., 1970, Temperature regulation in the Somali donkey (*Equus asinus*). Comparative Biochemistry and Physiology. Part A. 39:403-412.

Mason, M. 1959. The wild ass free. John Murray, London.

Ministry of Agriculture. 2011. African wild ass (*Equus africanus*) Species Conservation Strategy Meeting 27 July 2011. Ministry of Agriculture, Asmara, State of Eritrea. 10 pp.

Moehlman, P.D. 1994. The African Wild Ass: A Survey of Its Current Status in the Yangudi-Rassa National Park and the Southern Danakil, Ethiopia. Report to the Ethiopian Wildlife Conservation Organization. Addis Ababa.

Moehlman, P.D. 2002. Status and action plan for the African wild ass (*Equus africanus*). In: P.D. Moehlman (ed.), Equids: Zebras, Asses and Horses. Status Survey and Conservation Action Plan, pp. 2-10. IUCN, Gland, Switzerland.

Moehlman, P.D., Kebede, F. and Yohannes, H. 1998. The African wild ass (*Equus africanus*): Conservation status in the Horn of Africa. Applied Animal Behavior Science 60(2,3): 115-124.

Moehlman, P.D., Kebede, F. and Yohannes, H. 2013. *Equus africanus*. In: J. Kingdon and M. Hoffmann (eds), The Mammals of Africa. Volume V: Carnivores, Pangolins, Equids and Rhinoceroses, Bloomsbury Publishing, London.

Moehlman, P.D., Kebede, F. and Yohannes, H. 2015. *Equus africanus*. The IUCN Red List of Threatened Species 2015: e.T7949A45170994. http://dx.doi.org/10.2305/IUCN.UK.2015-2.RLTS.T7949A45170994.en

Moehlman, P.D., King, S.R.B., and Kebede, F. 2016. Status and Conservation of Threatened Equids. In *Wild equids*: ecology, management, and conservation. J.I. Ransom and P. Kaczensky, eds. Johns Hopkins University Press, Baltimore. Pp 167-186.

Oakenfull, A., Yohannes, H., Kebede, F., Swinburne, J., Binns, M. and Moehlman, P. D. 2002. Conservation Genetics of African Wild Asses. Final report for the Zoological Societies of Chicago and San Diego.

Osborn, D.J., Helmy, I. 1980. Contemporary land mammals of Egypt. Fieldiana, Zoology New series 5: 1-618.

Pagan, O., von Houwald, F., Wenker, C., Steck, B.L. 2009. Husbandry and breeding of Somali wild ass Equus africanus somalicus at Basel Zoo, Switzerland, International Zoo Yearbook 43: 198-211.

Rosenbom, S., Kebede, F., Teclai, R., Yohannes, H., Hagos, F., Moehlman, P.D, and Beja-Pereira, A. 2017. Non-invasive genetic assessment of the most threatened equid species, the African wild ass (*Equus africanus*). submitted

Schomber, H.W. 1963. Wildlife protection and hunting in the Sudan. Part I. African Wild Life 16(2): 147-153.

Schulz, E. and Kaiser, T.M. 2013. Historical distribution, habitat requirements and feeding ecology of the *genus Equus* (*Perrisodactyla*). Mammal Review 43(2): 111-123.

Sidney, J.1965. The Past and Present Distribution of some African Ungulates. Transactions of the Zoological Society of London 30: 1-397.

Simonetta, A. M. and Simonetta, J. 1983. An outline of the status of the Somali fauna and of its conservation and management problems. Rivista di Agricoltura Subtropicale e Tropicale 73(4): 457-483.

Steck, B. 2017. International Studbook for the Somali wild ass 2016. Zoo Basel, Switzerland. 77pp.

Stephenson, J.G. 1976. The Somali Wild Ass (*Equus africanus somalicus*) in Ethiopia: A survey of its current status in the Southern Danakil locality and recommendations on its conservation. Report to the Ethiopian Wildlife Conservation Organization, Addis Ababa, Ethiopia. 22pp.

The State of Eritrea. 2014. Integrated Semenawi and Debubawi Bahri-Buri-Irrori-Hawakil Protected Area System for Conservation of Biodiversity and Mitigation of Land Degradation. Project Document PRODOC-4816. The State of Eritrea, Ministry of Land, Water and Environment, Asmara. 108 pp. www.er.undp.org/content/eritrea/en/home/operations/projects/environment_and_energy/integrated-semenawi.html

The State of Eritrea. 2015. Revised national biodiversity strategy and action plan for Eritrea (2014-2020). The State of Eritrea, Ministry of Land, Water and Environment, Department of Environment. Asmara. 161 pp. www.cbd.int/doc/world/er/er-nbsap-v2-en.pdf

Teclai, R. 2006. Conservation of the African wild Ass (*Equus africanus*) on Messir Plateau (*Asa-ila*), Eritrea: The role of forage availability and diurnal activity pattern during the wet season and beginning of the dry season. M.Sc. Thesis, University of Kent.

Thouless, C.R. 1995. Aerial surveys for wildlife in eastern Ethiopia. Report to EWCO. Ecosystems Consultants, London. 30pp.

Tomkiewicz, S.M., Jr. 1979. Heterothermy and water turnover in feral burros (*Equus asinus*) of the Desert Southwest. MS. Thesis, Arizona State University.

Uhlrich, C., Langenhorst, T. and Trunet, E. 2016. Preliminary results of a sarcoid survey in African equid EEPs**.** Veterinary thesis, Ecole Nationale Vétérinaire de Toulouse, France.

Watson, M. 1982. Draft report on the African wild ass. Arusha, Tanzania. 5pp.
Yalden, D.W., Largen, M.J., and Kock, D. 1986. Catalogue of the Mammals of Ethiopia and Eritrea. 6. Perissodactyla, Proboscidea, Hyracoidea, Lagomorpha, Tubulidentata, Sirenia and Cetacea. Monitore Zoologico Italiano. Supplemento 21(4): 35-41.

Yalden, D.W., Largen, M.J., Kock, D. and Hillman, J.C. 1996. Catalogue of the Mammals of Ethiopia and Eritrea. 7. Revised checklist, zoogeography and conservation. Tropical Zoology 9(1): 73-164.

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