Follow-up visits to Alatash – Dinder Lion Conservation Unit

Ethiopia & Sudan

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Summary

The objective of this mission was to consolidate knowledge on the presence of lion (Panthera leo) in the Alatash-Dinder Transboundary Ecosystem, and to gather more information on the ecology of this important area, composed of Alatash NP in Ethiopia and Dinder NP and Biosphere Reserve in Sudan. Both parks have only recently been added as resident lion range in the IUCN Lion database. Lions are definitely present in Alatash NP and in Dinder NP; we had direct observations of lions in both parks. We tried to fit lions with satellite collars, but unfortunately lions never came to the baiting and calling stations. We set up a grid of camera traps to survey the lion population in Alatash. Due to insecurity and to low lion density, a population estimate for Alatash could not be made using these conventional survey methods. The survey however returned evidence for many wild species, and we present an updated mammal list for Alatash NP and Dinder NP. Camera trapping appears to be much more feasible in Dinder NP where human presence, at least in the core zone, is very low due to effective law enforcement. We recommend a pilot survey there. Lions are regularly observed inside both parks and in their immediate surroundings, but rarely, if ever, further than 10km from the park boundary. The status of elephant (Loxodonta africana) is doubtful; some pockets in Dinder are so remote that they are rarely visited by anyone, but the absence of any proof for them over a decade makes us pessimistic.

Our main conclusions are:

- Transboundary cooperation is important; species functionally extirpated on one side of the border could naturally recolonise the other side, in particular leopard (*Panthera pardus*) from Ethiopia to Sudan and Heuglin's gazelle (*Eudorca tilonura*) from Sudan to Ethiopia.
- 2. Due to remoteness and logistics, research costs in Alatash NP are high; we recommend investing in park management based on the precautionary principle, without waiting to know precise population sizes of the larger mammals there.
- 3. Dinder NP is better protected and is naturally richer due to permanent surface water; as a result the park is extremely valuable and it is very interesting from a research and conservation perspective. Lion research should focus on this sector of the ecosystem.

Teams

The Alatash team (1-20 March 2017) was composed of:

- 1. Hans Bauer (WildCRU)
- 2. Eric Bedin (EWCP)
- 3. Eyob Sitotaw (MU)
- 4. Tamrat Meles (driver)
- 5. Sisay Mekuanint (EWCA, warden)
- 6. Yeshitela Damte (EWCA, park ecologist)
- 7. Scouts (6 x EWCA)

The Dinder team (30 April - 16 May 2017) was composed of:

- 1. Hans Bauer (WildCRU)
- 2. Ameer Awad (SWRC)
- 3. Reem Ahmed (SWRC)
- 4. Yousif Mohammed (Police, International Cooperation)
- 5. Alsadeg Mohamed (Police, Wildlife Conservation General Administration)
- 6. Madad Alashaa (Police, Wildlife Conservation General Administration)
- 7. Karlos Zakeria (driver)

Introduction

During a previous mission (Bauer et al., 2016), we ascertained the occurrence of lions in the Alatash-Dinder Transboundary Ecosystem, composed of Alatash NP (ANP) in Ethiopia and Dinder NP (DNP) in Sudan. A convention for transboundary cooperation of the area was signed by the two countries in 1994. This report covers a follow-up mission to gather more information about this ecosystem and to prepare for further research.

The lion is a charismatic species and there is considerable international interest in its status. Recent publications have highlighted declines of lion range and numbers across Africa, especially in West, Central and East Africa (Bauer, 2015a). The lion is listed as Vulnerable on the IUCN Red List of Endangered Species, which shows the most recent lion distribution map; the most relevant part of that map is displayed in Fig. 4 (Bauer et al, 2015b).

The mission reported here was undertaken with permission from the Ethiopian Wildlife Conservation Authority (EWCA; permit no. 31/125/09) and from the Sudan Wildlife Conservation General Administration (SWCGA; permit no. 52/5/1/5/6). It was implemented in partnership with Wildlife Conservation Research Unit, University of Oxford (WildCRU), Ethiopian Wolf Conservation Programme (EWCP) and Sudan Wildlife Research Center (SWRC) and the operational costs were partially covered by the Born Free Foundation (BFF) and Born Free USA.

Methods

We used the following methods:

- 1. Camera traps (30 x bushnell trophycam and 10 x covert; these are cameras that are fixed to trees for as long as necessary, they automatically take a picture whenever their sensor detects movement in front of the camera).
- 2. Surveying for tracks and signs (walking transects looking for footprints in sand or clay substrate, or looking for scats).
- 3. Call-up (using a Monacor 45 megaphone to play buffalo and pig sounds; these sounds have a high probability to attract large carnivores within audible range).
- 4. Lion immobilisation and collaring equipment were available but not used.
- 5. Interviews with park staff.
- 6. Village visits and local community consultation, and their roles in wildlife conservation.
- 7. Listening for roars during the night.
- 8. Reviewing unpublished reports.

Area description - Alatash

The ANP is situated in western Ethiopia, Amhara regional State, on the boundary with Sudan (Fig. 1; Azanaw, 2015). The altitude is around 550m *asl*, the vegetation is dry savannah. The size of the park is 2,666km². There are many seasonal rivers, the only permanent river is in the south of the park and is called Ayma (Ethiopian name) or Dinder (Sudanese name). There is little surface water during the dry season, but there is abundant groundwater; the underground water table is very shallow.

The main threat to the park is poaching, livestock encroachment, and in the longer term agricultural encroachment. Human presence in the park is evident and is said to be most worrisome in the southern parts, bordering the Gumuz areas, where poaching is severe. This is also the only sector of ANP near to the Ayma (Dinder) river, with potentially higher wildlife densities, but due to inaccessibility this could not be verified. There is currently a lot of agricultural investment in all the surrounding woreda's (districts); a lot of bush land is being converted to small and medium size plantations for mechanised cropping. This is very visible from the fires and from the number of tractors on the road.

A special threat to lions is indiscriminate killing, especially by nomadic herdsman and prime among them are the 'Felata', who are pastoralists originally from West Africa but now with Sudanese nationality. They are armed with modern and traditional weapons and spend several months per year inside the park, with their livestock. Scouts do not encounter them frequently, and fortunately no scout has ever become the victim of shooting by the Felata.

The park is managed by EWCA, there is a chief warden, two wardens and 32 experts and scouts. There are two vehicles, one office, and several outposts each with a few buildings and a waterpump. Currently there are no scouts permanently posted at these outposts, due to the shortage of scouts (the number foreseen is 92, but these have not yet been recruited). There are several 'roads', which in some cases are visible car tracks, but in many areas these roads are little more than blotches of paint on trees that can guide cars through the tall grass. There are no bridges, crossing the seasonal rivers requires considerable effort and in some places it is practically impossible.



Figure 1: Map of Alatash NP in western Ethiopia and Dinder NP in Sudan

Area description - Dinder

DNP is contiguous with ANP and was created in 1935 (Fig. 1, polygon taken from WCMC database, 6,985km²), but the boundaries were extended to include important wet season range so that the area is now 10,291km² (Fig. 2, polygon provided by SWRC). DNP has a flat topography at an altitude of about 500 m *asl*. DNP has two seasonal rivers; the Dinder river and its tributary Gelego stream which have their confluence at Gelego Camp (DNP main station) and continue as Dinder, and the Rahad which is the northern boundary. These rivers are small in Ethiopia, but they gather more water from their basins and further downstream, especially in the West of the park, they have very large and wide permanent water ponds, locally called 'maya', and wildlife concentrates around these ponds. In addition to Dinder and Rahad rivers there are many small streams like khor Gelago, khor El Sunate and khor Masaweek.

Rainfall is highest in the south-easterly portion of the biosphere reserve (800 – 1000mm), decreasing to 600 – 800mm in the North-East. The rainy season extends from May through November, with the peak in August. From November to February there is a cool dry period with daily maximum temperature averaging 30°C. From March to the onset of the rains, the weather is hot and dry with daily maximum temperatures averaging 38 °C and a maximum of 44°C (Dasmann1972).

Dasmann (1972) described two types of soils in Dinder biosphere reserve, the vertisols and entisols. The former, which are the most extensive in the park, are dark, heavy clay soils also known as 'black cotton soil' with deep cracks during the dry season. The entisols dominate the eastern limits of the biosphere reserve towards the foothills of the Ethiopian plateau and along riverbanks. This type of soils occurs in patches of sandy loam and sandy clay. They intersperse with the vertisols.



Figure 2: Map of Dinder-Alatash Trans Frontier Conservation Area, projected on Google earth (GERD = Great Ethiopian Renaissance Dam).

There are ~40 villages around the park, and ~10 inside the park was supported by the Nile Basin Initiative project which enabled various Community Based Natural Resource Management activities, but the project funding has come to an end. The team conducted a field visit to two villages namely Um Salala and Huno El Shitab on the western bank of Rahad river inside the park; the local community indicated their interest in conserving the park.

DNP is more intensively managed than ANP. DNP has one grader, five tractors, seven Land Cruiser trucks (many with cannons), 35 camels (used for patrols) and a few boats. There are 290 scouts in active service. Gelego camp has a GSM tower for the Zain cellphone network, has permanent solar and generator power, and has running water and a few buildings with beds ('hotel'). The park has several miradors and a dense road network in the core area with most maya's (waterholes), but also has remote zones with hardly any roads. At most of the important mayas, there is a camp for scouts with seasonal huts, a water pump, and in some cases additional infrastructure such as facilities for fishing. Mayas and their associated wildlife concentrations are thus guarded 24/7 throughout the dry season, and occasionally on camelback patrols in the wet season. Scouts are constantly rotated and spend at least half their time effectively patrolling the park.

We were informed at SGWA in Khartoum that Tora hartebeest (<u>Alcelaphus buselaphus</u> ssp. tora) were last observed in 1999, giraffe (<u>Giraffa camelopardalis</u>) were last observed in 1983 and that elephants have not been seen recently but a small group (~5) might still be present (see below). No particular reason was given for these extirpations, which may be partly due to climate and partly due to human influence. Presumably the leopard has recently been extirpated which would be due to the very intense poaching pressure on this particular species, linked to the strong culturally determined demand for leopard skin slippers throughout Sudan and the region.

Sudan has a Ministry of Tourism, Heritage and Wildlife and a Ministry of Environment, but both ministries do not appear to have any presence on the ground. DNP is entirely managed by the SWCGA, which is a branch of the police and therefore falls under the Ministry of the Interior. Technically SWCGA falls under the supervision of ministry of Tourism, Heritage and Wildlife. They have their DNP Headquarters in the town of Dinder, with 90 staff, various infrastructures and a small zoo. The zoo has various small and medium mammals, but it also has a sub adult male lion that reportedly came from Kassala and which is held in a small cage, an inappropriate facility. Surprisingly, there was also a Hamadryas baboon or sacred baboon (*Papio hamadryas*), a species not found in DNP but further South.

Results - Alatash

We set 33 camera traps with one station in almost every cell of a 10x10km grid (annex 1), at locations that were logistically convenient and that were considered lower risk (see Fig. 3). Out of 33 camera traps, 10 were stolen and 3 malfunctioned. The remaining 20 cameras performed well and took a total of ~100,000 pictures over 977 camera-days. None of the pictures had a lion, only one had a spotted hyaena (*Crocuta crocuta*) and two had a leopard, therefore we cannot calculate large carnivore occupancy or density. Pictures of other species will be analysed later on, but for now we only use them to make an updated list of mammals (Table 1).

Table 1: Updated and annotated list of mammal species of Alatash NP, information for 2017 unless indicated otherwise.

English name	Scientific name	Source / remarks
Carnivores	Carnivora	
Lion	Panthera leo	Camera trap (2016), direct obs.
Leopard	Panthera pardus	Camera trap
Serval	Felis serval	Camera trap, direct obs.
Civet	Civettictis civetta	Camera trap, direct obs.
Common Genet	Genetta qenetta	Camera trap
African (golden) wolf	Canis anthus	Scout information
and/or golden jackal*	(Canis lupaster)	
Striped hyaena	Hyaena hyaena	Scout information
Spotted hyaena	Crocuta crocuta	Camera trap, direct obs.
Ratel	Mellivora capenensis	Camera trap, direct obs.
Slender mongoose	Herpestes sanguinea	Roadkill found near to park (2016)
Egyptian mongoose	Herpestes ichneumon	Camera trap
White-tailed mongoose	Ichneumia albicauda	Camera trap
Rodents	Rodentia	
Crested Porcupine	Hystrix cristata	Camera trap
Ungulates, even-toed	Artiodactyla	
Warthog	Phacochoerus africanus	Camera trap, direct obs.
Bushbuck	Tragelaphus scriptus	Camera trap, direct obs.
Grey duiker	Sylvicapra grimmia	Camera trap
Greater kudu	Tragelaphus strepsiceros	Camera trap
Lesser kudu	Tragelaphus imberbis	Scout information
Reedbuck	Redunca redunca	Camera trap, direct obs.
Oribi	Ourebia ourebia	Camera trap, direct obs.
Afrotheria	Afrotheria	
Aardvark	Orycteropus afer	Camera trap
Primates	Primates	
Olive baboon	Papio anubis	Camera trap, direct obs.
Patas	Cercopithecus patas	Camera trap, direct obs.
Vervet	Cercopithecus aethiops	Camera trap, direct obs.

*The taxonomy of African jackals has been debated; historically it was seen as a relative of the Eurasian jackal and called *Canis aureus*, more recently there were thought to be two species (golden jackal *Canis aureus* in Asia and African wolf *Canis lupus lupaster*); recent genetic studies propose to name this African wolf (*Canis lupaster*) or African golden wolf (*Canis anthus*) (Koepfli et al., 2015).



Figure 3: Map of Alatash NP with roads, rivers and important places; camera trap locations marked by stars.

The area is within the historical range of cheetah (<u>Acinonyx jubatus</u>) and African wild dog (<u>Lycaon pictus</u>), but neither has been reliable observed in recent times and should be considered locally extirpated. The situation of elephant (<u>Loxodonta africana</u>) is remarkable: some Ethiopians believe that they are in Sudan, and could occasionally come into Ethiopia in the wet season, whereas some Sudanese believe that they are in Ethiopia and could occasionally come into Sudan in the wet season. The fact that they are not seen in the dry season on either side doesn't bode well, speculations about presence in the wet season when access is limited may simply persist because they are harder to invalidate. Departments on both sides have not declared the species locally extirpated and remain hopeful, but we are rather sceptical – we have provisionally not included it in our table. Our table includes two species which were previously unreported: Egyptian and white-tailed mongoose.

Lions did not come to bait stations or call-up stations and we were unable to dart lions in suitable habitat. One lioness was darted inside a riverbed, but she ran off into tall grass of the bank sand was not found; presumably she recovered after a few hours. We stayed around for the duration of a normal recovery period to intervene if, for example, hyenas were heard attacking the immobilised lioness in the bushes, but we heard no sound of any event indicating that she recovered quietly.

Camera trapping appeared to be the most likely successful technique for a lion survey in ANP. The alternatives (call-ups, spoor counts, individual recognition, mark-recapture) are all less feasible. However, human disturbance makes even camera trapping impossible under current conditions. Lions are known to use tracks and roads, and cameras are conventionally placed along tracks and roads and in the vicinity of water to improve detection probability. In ANP, this was not possible; all cameras had to be well hidden and in places where their discovery by people was least likely and certainly not on the side of the roads or close to water. Despite these precautions, a third of the cameras were stolen. Due to these precautions, the probability of filming lions was severely reduced. The fact that we failed to get even a single lion photo teaches us two things. First, lions are present and can be observed in very targeted areas, as demonstrated by our camera trap photos of lions last year, but there are probably very few places with high detection probability and they can

only be used for camera trapping if people are physically nearby permanently to guard the equipment. These sites are known to scouts and there are a few of them, but apart from those places, detection probability is very low and a random grid design will not have enough productive camera stations.

We conclude that it may be impossible to establish lion population size with conventional survey methods and at reasonable research intensity. Theoretically, one could collar or brand every single lion, but this would require an unjustifiable budget. It is not imperative to have an exact lion population estimate: we know that there are groups of lions at several locations indicating a population size of ~20-50 lions; if there had been much more they would have been detected more easily. The abundance of prey is unknown but obviously low, another argument to suspect low population size. The viability of such a small population depends strongly on connectivity with the neighbouring population in DNP (next paragraph). The main threat to this small lion population is prey depletion, indiscriminate killing primarily by nomadic herdsmen and, in the longer term, agricultural encroachment.

Spotted hyaenas were present in ANP, but their density is also too low to be measurable, like lions (only one camera trap photo). The same counts for leopard, of which we had two photos (the only good picture in Fig. 4). Leopard presence was suspected based upon information from scouts and



local communities, but this is the first undisputable proof. Leopards are probably fairly widespread at low densities throughout Ethiopia, and their presence in ANP is not very special for Ethiopia, but our photo is a significant observation for DNP in Sudan where the species is believed locally extinct.

Figure 4: Leopard filmed by a camera trap in Alatash NP

Annex 2 shows some of the other camera trap photos. Notable are the pictures of ostrich (<u>Struthio</u> <u>camelus</u>), various smaller carnivores and a relatively limited number of ungulate species (Table 1). The limited number of ungulate photos indicates that prey density is indeed low, although a general wildlife survey using distance sampling needs to determine exactly how low.

An interesting development is the recent creation of Aljemiz NP, adjacent to ANP on the southern border, just across the regional boundary in Benishangul-Gumuz Regional State. Aljemiz NP is said to be 1864 km² and is said to be created due to the recent heightened interest in this ecosystem. Unfortunately, there is no information on the EWCA website, or any other website, and we don't have a shape file to show the location on a map. This positive development requires further investigation.

Results - Dinder

Patas

Vervet

Bushbaby, presumably

The diversity and abundance of wildlife in DNP was impressive, and for an outsider also surprising since DNP is not much advertised and hardly known in internationally accessible scientific literature. DNP is undoubtedly of outstanding conservation interest; today there are very few Sudan savanna ecosystems where you can readily observe so many species in such a short period. Our observations are listed in Table 2; some of these species were encountered once but most of them are easily observed multiple times per day (see last column). The list in Table 2 is possibly not exhaustive, with further research effort it is likely that some of the other species identified in ANP will also be found in DNP. Some species were abundant, others were rare; these are subjective qualifications as we didn't measure abundance. There is an urgent need for a critical review of surveys in the past and for a properly designed new survey using standard distance transects on foot in properly defined habitat strata.

Scientific name Source / remarks English name Carnivores Carnivora Lion Panthera leo Observed once, heard daily Civet Civettictis civetta Awad (2014) African (golden) wolf Canis anthus Awad (2014) and/or golden jackal* (Canis lupaster) Striped hyaena Hyaena hyaena Awad (2014) Spotted hyaena Crocuta crocuta Awad (2014) Egyptian mongoose Herpestes ichneumon Observed once Rodents Rodentia **Crested Porcupine** Hystrix cristata Observed Ungulates, even-toed Artiodactyla Warthog Phocochoerus africanus Observed Buffalo Syncerus caffer Observed Bushbuck Tragelaphus scriptus Observed Waterbuck Kobus ellipsiprymnus Observed defasa Roan antelope Hippotragus equinus Observed once Greater kudu Tragelaphus strepsiceros Awad (2014) Heuglin's gazelle* Eudorca tilonura Observed once Reedbuck Redunca redunca Observed Oribi Ourebia ourebia Observed Primates Primates Olive baboon Papio anubis Observed

Table2: List of mammal species of Dinder NP, updated from Awad (2014); last column indicates information obtained on this trip.

Senegal galago *Hitherto probably incorrectly listed as red fronted or Thomson's gazelle, but the distribution maps suggest that the gazelle species found here must be Heuglin's gazelle which is of tremendous conservation importance since this may be the last remaining population of the species.

Cercopithecus patas

Cercopithecus aethiops

Galago sp. (senegalensi?)

Observed

Observed

Observed

There is no certainty about the occurrence of Tora hartebeest (*Alcelaphus buselaphus tora*) and tiang (*Damaliscus lunatus tiang*) – both subspecies of considerable conservation importance. Both have not been observed for over a decade. For cheetah, African wild dog and elephant, the same holds as for Alatash: probably extirpated. Leopard is also considered extirpated, but was present in Alatash and it should therefore be able to recolonise DNP if poaching is controlled.

Lion is present in DNP, it can be heard every night around Gelego camp and the photo on the cover of the present report was also taken there. While further research on lions in ANP is difficult (see above), it is imperative to study them in DNP. They probably respond to call-ups, there is a road network, they are more frequently observed and therefore probably easier to immobilise. However, this is only true for the North-West of the DNP which may be a core zone for wildlife and for research, but research would also have to be extended into other areas of the park. All other sectors are less accessible, may have lower wildlife densities and are less intensively patrolled. Speculative lion densities could be up to 5 lions/km² for the core zone and 1 lion/km² for the rest, which would work out to a hypothetical population size of 200 lions.

Anecdotal information, images on 'google earth' and our own observations suggest that agricultural expansion has created a hard edge on the northern boundary of DNP, with mechanised farms visible all over the northern bank of the Rahad river and some villages more subsistence farming on the southern bank, in the DNP buffer zone. On the north-eastern border of the park, the area gets progressively drier with less agriculture. On the south-eastern border there is more influence from Gumuz groups who are heavily involved in charcoal production on the dry savanna. The southernmost tip of the park, finally, is said to be more rocky and hilly, in contrast to the rest of the park which is mostly flat. Felata with their herds of cattle are nomadic and can be anywhere, but tend to come into DNP mostly from the North.

DNP has developed in relative isolation for decades, perhaps not unexpected considering the wider political context of Sudan. As a consequence, conservation practice and conservation academia appear to be locally grounded but are not necessarily in synchrony with international best practice. A park like this in any other country in the Sudan-savanna belt would have attracted a lot of attention, participation and investment. DNP is currently a 'secret treasure' with a much higher potential; it could be a major destination for tourism, research and international cooperation.

Discussion and recommendations

With these field surveys we have confirmed undisputable evidence of lion presence in ANP and DNP. The size of the lion population in ANP could not be determined, but the second survey gave additional arguments to confirm the previously suspected speculative population size of ~200 lions (Bauer et al., 2016). Viability of the lions and other species in ANP is boosted by connectivity with DNP where populations appear to be more robust; dependence in the reverse direction is likely only for the leopard.

We make the following recommendations for the Dinder-Alatash transboundary ecosystem:

- 1. Promote further cooperation between the two countries, aiming at harmonisation of management, particularly in terms of infrastructure development, law enforcement and ecological monitoring;
- 2. Seek joint dialogue with stakeholders, especially Felata communities;
- 3. Actively seek international financial support for this important area.

Recommendations for ANP, Ethiopia:

- 1. Promote increased law enforcement efforts. Scouts spend most of their time at home, and none of the outposts are regularly used. All outposts should be permanently used by scouts on a rotational basis, as base for their patrols;
- 2. There is some infrastructure in the northern half of the park, but the southern half is neglected. Since surface water is available in the southern half and wildlife densities could be higher, we recommend focusing more attention on this area;
- 3. Implement the park management plan. There is a comprehensive management plan, but we could not get hold of a copy and it does not seem to be operational. Presumably it addresses issues like tourism development, staff training, infrastructure and monitoring in a strategic and comprehensive framework.

Recommendations for DNP, Sudan:

- 1. A continuation of current good management practices with a strong emphasis on law enforcement; Sudan deserves recognition for the conservation efforts and achievements so far;
- Instigate a lion call-up survey for a more accurate population estimate in the shortterm, and in the medium-term promote a full field research project using a suite of methods including collars and camera traps;
- 3. Carry out wildlife census by straight line foot transects in stratified randomly sampled grid cells using distance sampling with correction for imperfect detection to calculate abundance of prey species;
- 4. Promote greater awareness for this area, within Sudan and internationally, starting with a good website including professional pictures and video clips.
- 5. Special attention should be given to the status of the Heuglin's gazelle;
- 6. An aerial survey is needed specifically targeted at confirming presence or absence of elephant, tiang and tora hartebeest;
- 7. Gradual improvement of tourism development, community development, fire management, ecological monitoring, introduction of SMART and other technologies;

- 8. An institutional review of park management by the police and the potential role of other stakeholders to support further park development;
- 9. While the wildlife sector in Sudan has a long tradition, it has also been in isolation for a long time; overall capacity development of all stakeholders is highly recommended.

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Annex 1: Camera trapping grid



N.B. Red cross indicates a grid cell without a camera trap.

Annex 2: Additional pictures



Figure 2: camera traps attract people's curiosity



Figure 8: honey badger



Figure 6: oribi



Figure 9: ostrich



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Figure 7: genet



Figure 10: African civet



Figure11: Serval

Figure 12: Aardvark





Figure 14: Alatash team photo (week 1 and week 2)

Figure 33: Dinder team photo



Figure 45: captive striped hyaena, Dinder town



Figure 56: captive subadult lion kept in terrible conditions in unsuitable facility, Dinder town



Figure 67: fish diversity and availability inside DNP



Figure 78: buffalo in 'maya'



Figure 89: large herd of buffalo (500+)



Figure 20: female lion observed behind Gelego camp