## 2022 Annual Report

# Chad Oryx Reintroduction Project

**A joint initiative of the Government of Chad and the Environment Agency Abu Dhabi, implemented in Chad by Sahara Conservation**

Edited by Sahara Conservation


هـيـئـة الـبـيـئـة - أبـوظـبـي
Environment Agency - ABU DHABI

SAHARA CONSERVATION

ZSL Zoological Society of London

SMITHSONIAN'S NATIONAL ZOO & CONSERVATION BIOLOGY INSTITUTE

FOSSIL RIM WILDLIFE CENTER

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## Executive summary

This report provides an overview of activities and results through 2022 of the Scimitar-Horned Oryx Reintroduction Project taking place in the Ouadi Rimé - Ouadi Achim Wildlife Reserve, Chad. A joint-initiative of the Environment Agency Abu Dhabi (EAD) and the Government of Chad, this unique and highly ambitious program is implemented in-country by Sahara Conservation.
The report integrates data, information and observations collected by the project team, including valuable data on the behavior, social structure, calving performance and survival of the oryx reintroduced. It uses data inputs from all project partners, including EAD, the Direction de la Faune et des Aires Protégées (DFAP), Sahara Conservation, the Smithsonian's National Zoo & Conservation Biology Institute (SNZCBI) and the Zoological Society of London (ZSL).

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**Cover photo**: Reintroduced scimitar-horned oryx in Chad - © Jaime Dias / Wings for Conservation

# Acknowledgements

This project would never have happened without the vision, the resources, the animals and the skills of the Environment Agency - Abu Dhabi (EAD) and its leaders. The partnership between EAD, the Government of Chad and Sahara Conservation has insured the project's success to date in many ways both technical and administrative. The initiative is not only one of the most ambitious wildlife reintroductions ever undertaken but a glowing example of what can be done to save Africa's imperiled wildlife if we all pull together.

# Abbreviations and acronyms

| | |
|---|---|
| DFAP | Direction de la Faune et des Aires Protégées |
| DSA | Division de la Santé Animal (Animal Health Division) |
| DSV | Direction des Services Vétérinaires (Veterinary Services Department) |
| EAD | Environment Agency - Abu Dhabi |
| GPS | Global Positioning System |
| IRED | Institut de Recherche en Élevage pour le Développement au Tchad (Chad Livestock Research Institute for Development) |
| MEPDD | Ministère de l'Environnement, la Pêche et du Développement Durable (Ministry of the Environment, Fisheries and Sustainable Development) |
| OROAWR | Ouadi Rimé - Ouadi Achim Wildlife Reserve |
| Oryx | Scimitar-horned oryx |
| Oryx Project | Chad Oryx Reintroduction Project |
| POROA | Ouadi Rimé - Ouadi Achim Project (project to support the development of the Réserve de Faune de Ouadi Rimé - Ouadi Achim) |
| RZSS | Royal Zoological Society of Scotland |
| SC | Sahara Conservation |
| SNZCBI | Smithsonian's National Zoo & Conservation Biology Institute |
| UAE | United Arab Emirates |
| VHF | Very High Frequency |
| WFC | Wings for Conservation |
| ZSL | Zoological Society of London |

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# INTRODUCTION

The Ouadi Rimé - Ouadi Achim Wildlife Reserve (OROAWR), located in Central Chad, was created by decree No. 135/PR/EFP/PNR of 10 May 1969 to protect Sahelo-Saharan antelopes, cheetahs and ostriches. It covers a surface area of 7,795,000 hectares.
It straddles five Provinces: Batha, Borkou, Bahr el Gazel, Wadi Fira and Ennedi-Ouest.
Unfortunately, the years of conflict and drought that the country has experienced have had negative consequences on these species. The scimitar-horned (*Oryx dammah*) became extinct in the wild in the eighties, but the reserve is still brimming with a great many wild dorcas gazelles, bustards and dama gazelles (*Nanger dama*).
On 4 September 2014, the Chadian Ministry of Environment and the Environment Agency – Abu Dhabi (EAD) signed an agreement to reintroduce the scimitar-horned oryx into OROAGR. In this agreement, it is stipulated that the NGO Sahara Conservation is responsible for the oryx project in Chad. This agreement was renewed in October 2019, which has allowed addax (*Addax nasomaculatus*) to be reintroduced as well as scimitar-horned oryx.
The Ministry of Environment, Fisheries and Sustainable Development through the Directorate of Wildlife and Protected Areas (DFAP) plays the following roles:

- Ensure the protection of scimitar-horned oryx, addax and their habitat by implementing appropriate management of the reserve and maintaining strong cooperation between the various local players;
- Provide all the permits required for the arrival of the animals and the project's activities (CITES, veterinary, aircraft landing permits, planning permission, etc.);
- Provide and help to obtain any official permits for staff and operators working on behalf of EAD and Sahara Conservation (visas, residence permits, travel permits, etc.);
- Guarantee and protect the pre-release site chosen by the project team.

Through its technical departments, the Ministry of the Environment has carried out the different activities concerning these roles.

# Part I. *EX-SITU* MANAGEMENT OF THE ORYX

**Mohammed Manea Al Remeithi**

Senior Specialist, Wildlife Conservation, Terrestrial & Marine Biodiversity - Environment Agency – Abu Dhabi

# 1. Environment Agency Abu Dhabi

The Environment Agency – Abu Dhabi (EAD) is the leader and program sponsor in this major initiative to reintroduce the scimitar-horned oryx to its historical range in Chad. Inspired by the United Arab Emirates' founder, the late Sheikh Zayed, and his efforts to protect endangered species and sustain them in their natural habitat, the Scimitar-horned oryx Reintroduction Program was initiated on behalf of the UAE Government in close collaboration with the Government of Chad.

EAD has established new MOU's with its partners, which incorporate the additional species – addax and dama gazelle – into the conservation program and is taking the lead in managing the initiative. EAD is curating the "World Herd" of scimitar-horned oryx, and breeding addax and dama gazelles in Abu Dhabi (to ensure a genetically diverse source population is used for reintroduction or reinforcement) and providing additional technical expertise in wildlife management and veterinary services as well as arranging the cargo flights to translocate the animals and supplies.

EAD is communicating the project locally and internationally in a variety of conferences and workshops and the journey is being shared via the inspiring documentary film, "Back to the Wild" and captured in a 120-page book published in Arabic, English and French.

# 2. *Ex-situ* management of scimitar-horned oryx, addax, and dama gazelles

Throughout the year, the EAD team has positioned itself to build on all the previous efforts, knowledge and experience put forth by the reintroduction partners, including the Republic of Chad (Ministry of the environment, water and fisheries and the Directorate of Wildlife and Protected Areas) and Sahara Conservation.

The project partners had developed ambitious plans for 2022, with two translocations of scimitar-horned oryx and addax, along with the mission to capture wild scimitar-horned oryx and collar them for monitoring.

Unfortunately, due to a security incident in Chad in October 2022, the second translocation, initially planned for November had to be cancelled.

The team worked very closely with all the project partners to ensure the March translocation would be a success. In all, 20 scimitar-horned oryx, 25 addax and 5 dama gazelles were translocated during the year.

Milestones achieved during the year continue to contribute to the long-term goal of establishing sustainable populations of endangered species in the wild and this innovative, iconic conservation program is truly having a real and positive impact on the recovery and survival of several endangered species and their native habitats.

EAD is honored to be part of such an important wildlife conservation program and excited to continue to see the successful expansion of this inspiring species conservation model. All project partners are honored to have received accolades for our conservation work with the scimitar-horned oryx in Chad in the Journal of the Society for Conservation Biology in the article *"How many bird and mammal extinctions has recent conservation action prevented*?" (Bolam et al. 2020).

**This study determined that the combined conservation effort has significantly decreased the likelihood of extinction of the scimitar-horned oryx.**

There are a number of reasons this project is becoming a model for conservation reintroductions, including the adoption of world-class wildlife management and husbandry techniques at Deleika Wildlife Conservation Center, in Abu Dhabi. The completion of phase I of the master-planned, state of the art, wildlife conservation facility has made immense benefits in our ability to safely manage our collection. Included in the expansion are five purpose-built breeding complexes with built-in corridors leading to sorting alleyways which lead to a Tamer ungulate restraint device.

These facilities have greatly increased the ability to manage, selectively breed and efficiently prepare the animals for translocation to Chad. Phase II is currently under construction and will bring a comprehensive and fully functional veterinary facility, enabling the team to undertake research and practical day-to-day veterinary procedures in an efficient and professional manner.

# 3. Ensuring genetic diversity in the reintroduced population

In our efforts to maintain and increase the resiliency of our endangered species, and with the expansion of the reintroduction efforts to addax and the dama gazelle, we have increased the diversity and sustainability of these species by incorporating new animals into the breeding groups that will serve as source populations for reintroduction. The focus continues to be on building genetically diverse and resilient founder populations of all the species in the program for reintroduction in the wild.

The scimitar-horned oryx that were translocated from the US and Europe over the years have been a key element in building a diverse and resilient founder population, and continue to reproduce at a sustainable rate. These imported individuals continue to breed with the original Abu Dhabi animals and are ensuring that a genetically diverse, healthy population of scimitar-horned oryx is used for the reintroduction, representing the great majority of the genetic diversity available in the world.

To better understand the genetic makeup of the oryx, addax and dama gazelle population, we have continued the genetic analysis project with the Royal Zoological Society of Scotland. Their expertise and use of advanced genetic analysis techniques has helped to

make informed breeding decisions and allows the selection of the most appropriate individuals for reintroduction.

Additionally, the project with the University of Edinburgh to understand more about the functional diversity in the scimitar-horned oryx, through study of the complete genome, continues to progress. All animals that are sent for reintroduction are analyzed and the results show that the mitochondrial genetic diversity in the reintroduced population has increased by 2.2x (Figure 2). The genetic samples of most animals that have been translocated to Chad have been analyzed or are under analysis and the results show that there is a great deal of the world's available diversity represented in the reintroduced population and the mixture between original EAD animals and those imported is increasing the allelic richness significantly.

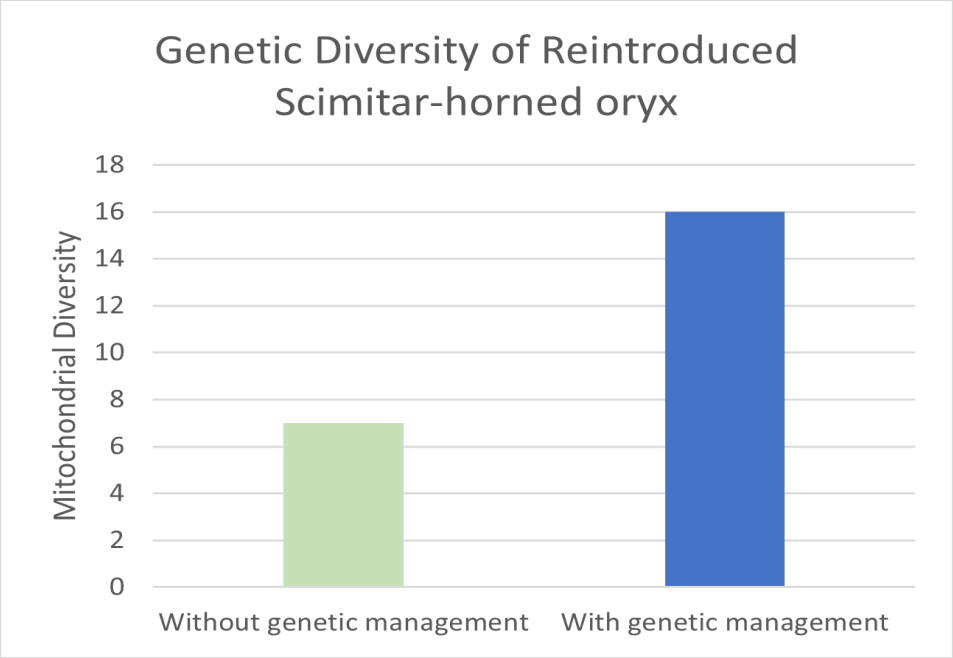



**Fig 1.** The mitochondrial diversity and the allelic richness of the reintroduced population have increased with the genetic management program in place.

# 4. Preparation of animals for reintroduction

While we continued to focus on increasing the genetic diversity of the world herd of scimitar-horned oryx in Abu Dhabi, there was a focus on selecting appropriate individuals that would make up the next reintroduction groups. During the year, 20 oryx, 25 addax, and for the first time, 5 dama gazelles were sent to Chad.

The EAD team worked very closely with project partners and experts in the field to ensure that the animals slated for reintroduction were well prepared for reintroduction as in the previous years. The vaccination protocol that was re-evaluated last year was kept the same for this year. All animals that are considered for the reintroduction are first given a thorough physical examination and screened for any pathogens including the following: Tb Test-

Intradermal comparative test (Avian/Bovine), Brucellosis Test (RBT and Skin), Blue Tongue Virus, BVD, QFever, prior to being considered for translocation.

In order for an animal to be chosen for shipment they first have to pass a physical examination, where their body condition, hoof condition, teeth, legs and joints are evaluated. Once the animal is chosen for reintroduction it is then given the following vaccinations: PPR using a live attenuated vaccine for Peste des Petits Ruminants; sheep and goat pox virus using a live attenuated vaccine for Goat pox; FMD using inactivated vaccine, multiple strains including "O", "A" and "SAT1"; Bar-Vac 10: (*Pasteurella multocida*, *Mannheimia haemolytica* and *Clostridium*), Rift Valley fever (OBP, S. Africa), Anthrax, *Pasteurella m.* (Farcha Lab, Chad), CCPP (Cirad Lab-Montpellier) and given an anti-parasite treatment.

After performing the screening and vaccinations, the animals are housed in the pre-shipment pens where all the final preparations for translocation take place. Each animal is individually identified with an ear tag and an intradermal microchip. At least two vials of blood are banked for each animal that is sent for reintroduction. All details concerning the animals' identification (ear tag, microchip, sex, age, origin) are recorded in a database and transferred to the team in Chad.

## 5. Translocation of oryx from Abu Dhabi to Chad

After the animals are prepared, a key component to the success of the project is always ensuring that all translocation logistics are carefully planned, which ensures a smooth transfer to Chad. This step is never taken lightly, and every effort is taken to adhere to best practice standards. The timing of translocations from the UAE to Chad, and the subsequent release of animals into the wild are timed to match the environmental conditions (temperature, seasonal ecology), to minimize stress and maximize survival.

All transportation crates were replaced this year with redesigned, heavier crates, as the previous ones were deteriorating. These specially designed crates have no sharp edges on the inside, plenty of ventilation, water provisions, access doors for observation/manipulation and a steel frame that will endure the tough journey.

The oryx and addax are selected, crated, and transported during the cooler months in the UAE (i.e., November-February), which also aligns with the cool, dry season in Chad. Animals are flown from Abu Dhabi to Abéché, Chad and then transported approximately 200 km by truck to the release site.

As per the previous shipments, the cargo plane and all ground and air logistics are coordinated well in advance of the shipment date. All documents required to send the animals from the UAE to Chad: health certificate, a CITES import permit from Chad, and a CITES export permit from the UAE, are obtained prior to travelling.

With each shipment of animals, the extra space was filled with as much food and supplies as could fit on the plane. On each of the two planes were three pallets of grass hay and

pellet concentrate (a total of 6 pallets of 600 kg each) which was meant to serve as a transition diet for the animals, as they started to eat the native grasses and locally available peanut leaves and cut grass. A transition diet plan was provided to the team at the pre-release pens to use as a guideline. In addition to the animal food material, there were also some needed animal capture supplies and general site supplies.

For each of the shipments, the process started as soon as the sun came up at the Deleika wildlife conservation center. After certifying that the oryx, addax and dama were fit to travel on the morning of the flight, the animals were individually loaded into specially designed crates (Fig. 3) and transported on trucks to the Al Ain Airport, about an hour away. After the customs and security clearance at the Airport, they were loaded onto a chartered Ilyushin 76 cargo plane, along with animal food and supplies.

**Fig. 2.** Addax in the process of loading into crate during translocation

The flight from Abu Dhabi to the airport in Abéché, Chad is about 7 hours, and the animals were checked often and given water. Upon arrival in Abéché, the oryx and addax are unloaded from the plane and loaded onto trucks with the help of local airport staff and elements of the French military stationed in Abéché.

After an eleven to twelve-hour drive through the night, the oryx convoy arrives at the pre-release facility. Prior to release from the crates, the animals are vaccinated for anthrax by pole syringe. When released, all animals in both groups were in good shape and had no ill effects from the journey. The first group of addax traveled very well and began grazing in the acclimation pens soon after release. The door-to-door time ranged from 28 to 30 hours per trip.

**Fig. 3.** Transport of the dama gazelles by plane Abéché-Oryx

This is an exciting time in the project as Phase II is further implemented. EAD is planning to send another 15 scimitar-horned oryx and 25 addax to the Ouadi Rimé-Ouadi Achim site in November 2023, and for the first time, 10 addax to a new site run by African Parks in the Ennedi region of north-east Chad.

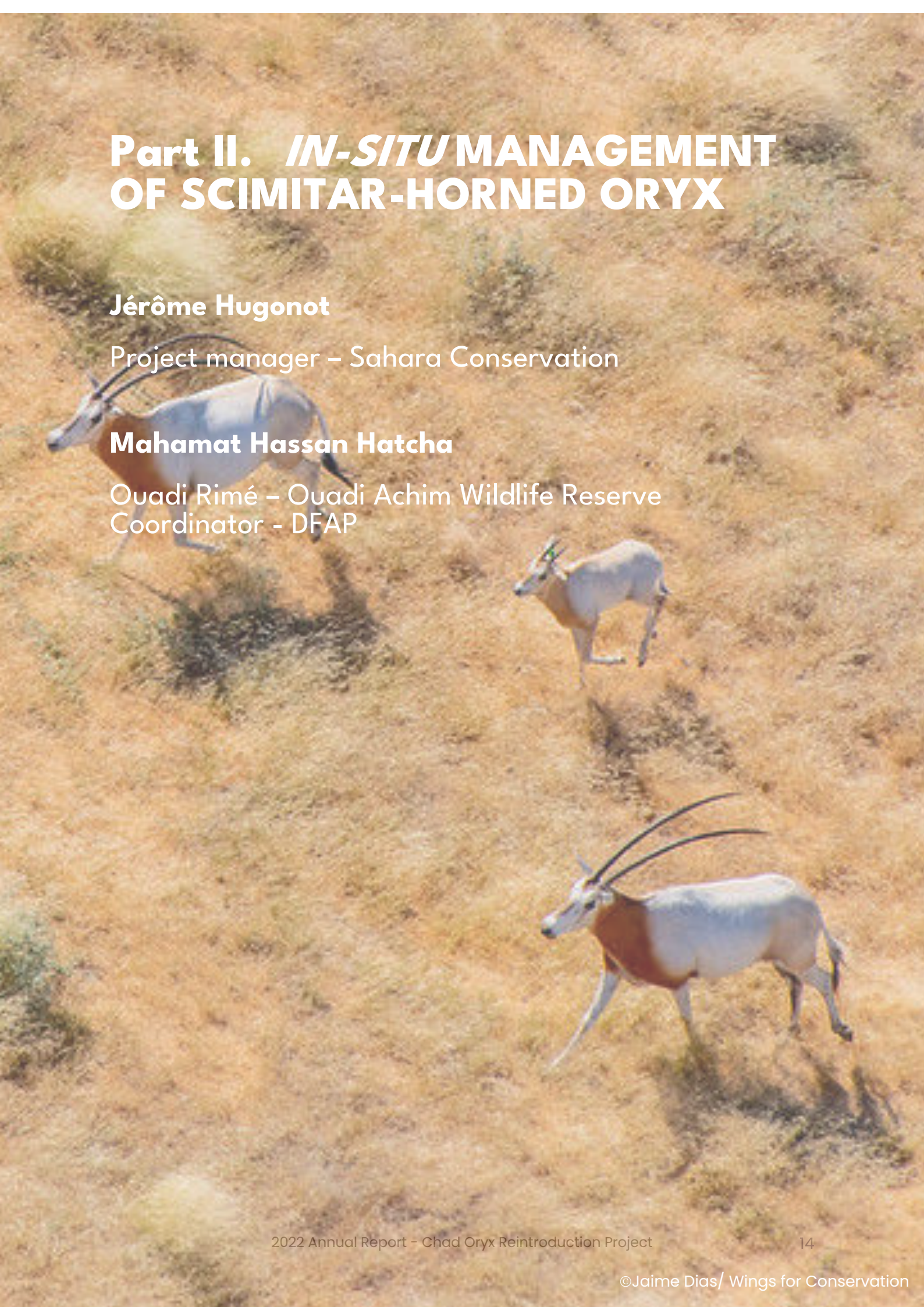
# Part II. *IN-SITU* MANAGEMENT OF SCIMITAR-HORNED ORYX

**Jérôme Hugonot**

Project manager – Sahara Conservation

**Mahamat Hassan Hatcha**

Ouadi Rimé – Ouadi Achim Wildlife Reserve
Coordinator - DFAP



# 1. Human resources

## 1.1 Staff

The Oryx Project is currently in its second phase (2019-2024). The activities have increased and diversified, leading to a greater demand for staff. Accordingly, 22 people currently work full-time for the project: 16 people on the reintroduction site and six people in N'Djamena. These permanent staff members also regularly receive support from Sahara Conservation's administrative and logistics cell based in N'Djamena.

The project manager Marc Dethier ended his contract in July 2022. Jérôme Hugonot, ALBIÄ project manager, deputized until 31 December 2022. The recruitment of a permanent project manager is underway.

In addition to the change at the head of the project, we were sad to lose Kallé Dakou, an animal keeper who died in December 2022.

| **Permanent staff December 2022** | | |
|---|---|---|
| **First name Surname** | **Position** | **Dates** |
| Marc Dethier | Project manager | 1 October 2015 – July 2022 |
| Jérôme Hugonot | Project manager (acting) | July 2022 – December 2022 |
| Firmin Dingamtebeye | Infrastructure maintenance manager | 1 November 2017 |
| Honoré Todjibaye Midjigue | Chef | 1 February 2017 |
| Dieudonné Kephas Doldiguim | Chef | 23 January 2020 |
| Evariste Djibkibeng Malbe | Mechanic | 7 September 2020 |
| François Madjitigal | Tractor driver/Driver | 1 February 2019 |
| Yacoub Hassaballah Hagry | Driver | 1 September 2021 |
| Mahamat Abdourassoul | Tractor driver | 7 March 2021 |
| Djiddi Aklabach Ali | Tractor driver | 13 December 2021 |
| Oumar Annadif | Head oryx keeper and ostrich monitoring | 8 November 2021 |
| Kalle Dakou | Oryx keeper | 1 March 2016 – December 2022 |
| Loutfallah Ali | Oryx keeper | 1 March 2016 |
| Caleb Ngaba Waye Taroum | Ecological monitoring manager | 1 August 2020 |
| Habib Ali Hamit | Ecological monitoring officer | 1 April 2016 |
| Taboye Abdelkarim | Ecological monitoring officer | 1 July 2021 |
| Hissein Gadeye | DCFAP permanent escort guard | 1 October 2017 |

| | | |
|---|---|---|
| Ahmat Anour | Driver | 1 February 2019 |
| Adam Tchang | Administrative assistant | 1 May 2021 to 31 March 2022 |
| Nathalie Kabria Aguidi | N'Djamena Sahara Conservation villa housekeeper | 1 July 2020 |
| Dana Mahamat | N'Djamena Sahara Conservation villa guard | 1 July 2020 |
| Debi Ali | N'Djamena Sahara Conservation villa guard | 1 July 2020 |
| Takadji Nanga Yanga | N'Djamena Sahara Conservation villa guard | 1 July 2020 |
| **Support staff** | | |
| Hiti Ngarya Nouba | Administrative and financial support | 2 years and 11 months |
| Kher Issackha | Deputy head oryx keeper and ostrich monitoring | 4 months |

## 1.2 Staff activities

The project manager primarily carries out his functions on the Oryx Base camp to support all the management activities associated with the base and the animals in the enclosures or animal monitoring. As Jérôme Hugonot is a veterinarian, he was able to provide additional assistance in terms of animal care and capture, particularly concerning the ostriches, for the GPS/VHF tag-fitting operations.
In N'Djamena, the project manager is assisted by the entire administrative and logistics team.

Firmin Dingamtebeye oversees the running of the base to maintain the different infrastructure elements and monitor the equipment and consumables. He carries out various tasks and work, is responsible for the logistics of staff travel and purchasing supplies at Biltine or Arada markets, and assists the different teams, whether feeding the animals in the enclosures or carrying out ecological monitoring of the wild species.

The animal keepers set off around 5 o'clock in the morning to the enclosures. They will close the drinking troughs there (which are only open overnight to avoid attracting other species of birds as well as jackals during the day). The keeper team also gives adequate food depending on the species to be fed: scimitar-horned oryx, addax, dama gazelles and North African ostriches. In the afternoon, from 3 p.m., they return there to open the drinking troughs, while remaining in attendance to chase away birds and distribute food. These members of staff also help to maintain the Oryx Base camp.

Honoré Todjibaye Midjigue and Dieudonné Kephas Doldiguim are the chefs on the base. They are also responsible for managing the food store by organizing the purchase of provisions in the town. They prepare the staff's daily meals. The presence of a second chef

should facilitate the work of the ecological monitoring team, allowing them to stay for several days in the field to observe the most distant animals, without having to continually come back to the base. The chefs also prepare all the meals when large teams are present on the Oryx Base camp, such as when staff from the Environment Agency – Abu Dhabi (EAD) and other partners are present, when animals from Delaika arrive.

The mechanics (Evariste Djibkibeng Malbe for small vehicles and François Madjitigal for tractors) maintain and repair the vehicles. The vehicles are taken to N'Djamena for a major service.
Ahmat Anour is the driver in N'Djamena, Abdoulrassoul Mahamat drives light vehicles and tractors, Yacoub Hassaballah Hagry is a light vehicle driver and Djiddi Aklabach Ali is solely a tractor driver.

Oumar Mahamat Annadif monitors the diet of the animals in the enclosures and is also responsible for monitoring ostriches in the wild.
Kher Issacka is the deputy head of ostrich monitoring and care in the enclosures.
Lout Fallah Ali and Kallé Dakou provide the animals in the enclosures with food and water on a daily basis. Djidi helps them from time to time.

Caleb Ngaba Waye Taroum, Habib Ali Hamit, Taboye Abdelkerim carry out ecological monitoring of animals in the wild. They are in constant contact with the teams from the Zoological Society of London (ZSL) or the Smithsonian's National Zoo & Conservation Biology Institute (SNZCBI) and go into the field every day to observe the behavior of the oryx and addax. In general, two outings a day are planned: one in the morning for the distant groups and the other in the afternoon for the closer groups.

In N'Djamena, under the supervision of Hiti Ngaryanouba, Sahara Conservation's administrative and financial manager, Adam Tchang Yakouma is the administrative officer (contract terminated in April 2022). Four people have been hired to guard and look after the Sahara Conservation villa/office: Ali Debi, Takadji Nanga Yanga, Dana Mahamat as guards and Nathalie Kabria Aguidi as housekeeper (until August 2022).

The staff members have the status of contractor and the contracts have been formalized by the National Office for the Promotion of Employment (ONAPE). The staff have been registered with the national social security fund.

The people on the Oryx Base camp are housed and fed. There is electricity, running water, an internet connection and television.

All the staff also take part in other activities, such as:

- extinguishing bush fires,
- the logistics of transferring oryx and addax between Abéché and the reintroduction site (for this report, in March 2022).

## 1.3 The rest period system

Given the staff members' distance from their home, a mode of operation has been set up to allow them to reunite with their families during their days off. Accordingly, as stipulated in the labor code, each Sunday worked is a Sunday gained.
After one month's presence on the site, staff from Arada or Biltine usually take 10 days off (3 extra days off granted from October 2022. Up to then, they were allowed 7 days off, not including the two days' travel time).
Staff from N'Djamena leave the Oryx Base camp after being present on the site for three months. This allows them to remain at home for four weeks (an extra week has been granted since October 2022).

## 1.4 The Directorate of Wildlife and Protected Area escort guard

For all journeys between N'Djamena and the Oryx Base camp, the guard Hissein Abderahim Gadaye, assigned to the project by the Ministère de l'Environnement de la Pêche et du Développement Durable (MEPDD) (Memorandum No. 004/PR/PM/MEP/SG/DPELCB/2017), escorts the vehicles.

## 1.5 Temporary staff

From October to December 2022, a team of 11-day laborers was formed to take charge of the fight against bush fires and create around 232 km of firebreaks.
Bush fires represent a major threat to the reserve's ecosystem and require a separate team to be set up, dedicated to fighting bush fires due to the extra workload, which can be extreme.
An extra driver was also hired from September to mid-November to meet the need of having to assign two permanent drivers to create firebreaks.

# 2. Infrastructure management and maintenance


**Fig. 1.** Aerial view of the reintroduction site's facilities. The base camp (on the left), the guards' camp (bottom right) and the pre-release enclosures (back). The closest town is Arada, 70 km to the east of the base camp.

## 2.1 Base camp management

Fig. 2. Oryx Base camp (photo taken by plane by African Parks Network)

### 2.1.1 Infrastructure management

Designed and built in 2016, the Oryx Base camp has undergone many developments, particularly the addition of extra staff and many activities, resulting in a constant increase in the number of visitors (consultants, official visits).
A review of the Oryx Base camp's reception capacity was conducted in 2022 and extension proposals are currently being studied.

The suggested layout presents:

- Two extra 20-foot containers beside the laboratory - accommodation
- An extra 40-foot container - housing
- Two extra 20-foot containers to double the size of the garage
- A 15,000-liter fuel tank beside the garage (carried out in December 2022).

With this arrangement, the containers are shared by a maximum of two people. A 40-foot container is left for visitors, divided into areas for men and women.

The current garage can only accommodate four vehicles. It is suggested to extend it according to the diagram so that all the vehicles (up to 8) are under the hangar. The fuel tank on its concrete base is located between the two garages.

**Fig. 3.** Garage extension project

A new access road will make it possible to reach the garage (orange arrow).

The current perimeter of the camp is 50 x 42 m. It is proposed to extend it to the south by 12 meters and to the west by 7 meters. A new gate will be installed on the western or the southern side (blue arrow).

A hangar should also be installed on the site of the enclosure for tractors and other equipment. Plans and an estimate have been obtained.

**Fig. 4**. Hangar enclosure project

Finally, equipping the DFAP camp with two extra 20' containers should be considered.

### 2.1.2 Water management

Two collapsible tanks totaling 500 m3 have been installed inside the Oryx Base camp. The water they contain is intended for the needs of humans and animals (in the enclosures).

In July 2022, an exceptional storm tore down the wind turbine, which perforated the 200 m3 tank as it fell. Due to their useful life, the decision was made to replace the two tanks (purchased in 2016). The two new tanks, received in December 2022, are identical to the previous ones, their reliability having been proven.

**Fig. 5**. Installation of the new water tanks.

In 2022, a 24 $m^3$ tank truck reprovisioned the Oryx Base camp twice, totaling 36 journeys (150 km round trip) between Arada and the Oryx Base camp.

Accordingly:

- In May 2022, 288 $m^3$ was delivered
- In December 2022, 456 $m^3$ was delivered (new tanks)

Monitoring water consumption at the Oryx Base camp shows that one person consumes on average 63 liters of water per day to cover all their needs.
The amounts consumed vary according to the time of year and the activities, such as the arrival of extra teams during reintroduction operations.

| Month | Jan. | Feb. | March | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total consum.** | 20,550 | 23,710 | 43,850 | 46,980 | 43,500 | 45,600 | 39,450 | 27,680 | 32,550 | 42,200 | 34,000 | 30,800 | **430,870** |
| **Human consum.** | 17,550 | 20,510 | 36,250 | 28,050 | 23,600 | 21,200 | 28,750 | 22,050 | 27,550 | 40,200 | 33,200 | 29,200 | **328,110** |
| **Cons. / liter/ person / day** | 48.54 | 51.62 | 55.71 | 74.16 | 73.78 | 65.92 | 67.49 | 82.66 | 66.55 | 67.34 | 54.83 | 49.57 | **63.18** |
| **Enclos. consum.** | 3,000 | 3,200 | 7,600 | 18,930 | 19,900 | 17,300 | 10,700 | 5,630 | 5,000 | 2,000 | 800 | 1,600 | **95,660** |

### 2.1.3 Electricity management

As soon as the Oryx Base camp was built (between January and April 2016), one of the operating aims was to use green energy for electricity needs. However, an 18 kva generator had been purchased as a back-up system.
On the date of the initial installation, the daily amount of electric power for the base was estimated at 57,046 Wh/day. Given the sunshine and wind speed in our area of activity, the initial installation included a wind turbine (3,000 w), 27 solar panels (27 x 250 W) and batteries that power the Oryx Base camp with electricity 24/7. At night, the wind turbine complements the batteries to cover the on-going needs, such as the refrigerator, internet, computers, and the fans to maintain an acceptable temperature in the equipment rooms.

With the arrival of the first ostrich chicks in March 2020, then in March 2021, an electricity supply was required in the enclosures to run an infrared radiator. This radiator operated at night to maintain an adequate temperature for the birds' development (thermostat was programmed so that the temperature did not drop below 23°C).

Due to the project's development, both in terms of technical aspects and human resources, the daily electricity production has proven insufficient. The electricity storage capacity of the initial batteries has also deteriorated. The destruction of the wind turbine in July 2022 created a serious electricity production deficit, leading to daily use of the generator.

A new study conducted in 2022, integrating future infrastructure developments, revealed that the daily electricity needs had risen from 57,046 Wh/day to 147,000 Wh/day.

An update of the system was approved to cope with this development. A new wind turbine (5,000 Watts) was ordered, the installation of which is scheduled for January 2023 (to replace the wind turbine destroyed by the violent storm in July 2022).

**Fig. 6.** Wind turbine replacement– Jan 2023

The future system (installation scheduled for August 2023 – the manufacturing timeframes for the panels and batteries are relatively long) will include:

- 93 panels with a power of 450 W
- 48 x 4420 Ah batteries

### 2.1.4 Internet connection management

VSAT is important for the project to run smoothly. It is essential for monitoring the animals fitted with GPS collars (oryx, addax). It is also the only means of communication available with the outside world.
For communication needs, we have chosen a bandwidth of 1024 kbps/512 kbps ratio 4:1 on the Africasat 1a satellite. The N'Djamena-based company Globaltech provides technical support. In August 2022, its use was restricted, with any connection other than for professional reasons (such as social media) being prohibited from 6 a.m. to 6 p.m.
The addition of animals fitted with collars will probably require an increase in the bandwidth.

### 2.1.5 Vehicles management

**Small vehicles**

The oryx reintroduction project has:

- 4 Toyota crew cab vehicles,
- 2 Toyota single cab vehicles,
- 1 Toyota V8 vehicle.

All these vehicles are in good working order and insured.

Fig. 7. Oryx project motor vehicle fleet

| VEHICLES | PURCHASE DATE | DESIGNATIONS | MILEAGE IN KM December 2021 | MILEAGE IN KM December 2022 | DISTANCE COVERED |
|---|---|---|---|---|---|
| 18C4107TT | August 2015 | Addax/ oryx/ ostrich ecological monitoring | 243,267 | 257,004 | 13,737 |
| 18C4213TT | January 2016 | Enclosed animal monitoring | 145,290 | 153,155 | 7,865 |
| 18C4328TT | August 2016 | Oryx/ addax/ ostrich ecological monitoring | 246,068 | 263,077 | 17,009 |
| 18C5206TT | May 2021 | Liaison Oryx Base camp / N'Djamena/ Abéché/ Ati/ Biltine/ Arada | 33,046 | 85,690 | 52,644 |
| 18C5207TT | May 2021 | Oryx/ addax/ ostrich ecological monitoring | 23,283 | 58,699 | 35,416 |
| 18C4484TT | July 2017 | Liaison Oryx Base camp / Biltine/ Arada/ N'Djamena/ Ati/ Abéché | 60,000 | | |

The Kawasaki mule came from Abu Dhabi in January 2017. It is used by the oryx keeper staff. It only carries out journeys between the Oryx Base camp and the enclosure. It has been out of action since 2020. We are still looking for the parts to repair the injection pump or even replace the engine. Contacts have been made with Kawasaki dealers in Europe and the United States. The entire engine cannot be changed. The cost of the injection pump is $4,500, not including shipping. As the injection pump was diagnosed locally, it seems risky to order such an expensive part without confirmation of the cause of the breakdown. Completely replacing the vehicle is under consideration.

These vehicles are also regularly reinforced by Sahara Conservation's vehicle, which is a Toyota crew cab based in N'Djamena.

Since the beginning of October 2021, each vehicle has been equipped with GPS/Inreach, which allows us to track their movements by providing a location every 10 minutes. The monitoring teams in the field can also receive the latest coordinates of the animals wearing

collars (oryx, addax, ostriches) more easily. It is also easy to communicate with drivers who are travelling in towns.
Up to now, the fuel has been supplied by a 1,000-liter tank transported by a pick-up truck from Abéché. A 15,000-liter tank has been acquired and deliveries are now made directly by the supplier on site. The tank is also equipped with a filter pump, greatly facilitating the distribution and handling of consumption and stock. This tank also makes it possible to store fuel for several months and does away with procurement constraints during the rainy season. A concrete slab has been built, adjacent to the garage, to hold the tank and its base.

**Fig. 8.** New diesel tank on slab and base + pump

### Tractors

Since January 2022, the project has had six tractors and ploughs for carrying out firebreak work and fighting bush fires. None of these was purchased by the oryx project. However, the project covers all the operational costs: fuel, maintenance, repair, etc.

- New Holland 75CV and tractor Mahindra 6500
- John Deere 6100 D
- John Deere 6100 D

In September 2021, the PREPAS project provided a John Deere 6100 D tractor with a 2x12 disc plough. This tractor and plough were returned to the governor of Batha (on his request) in September 2022.

- John Deere 5503

Two new ploughs were acquired in September 2022.

**Fig. 9.** Project oryx tractors

From the end of August 2022, i.e., after the heavy rains, and until early January 2023, these tractors were used to create firebreaks. They are also involved in fighting bush fires. Finally, they were used to level out the tracks most used by vehicles.

To improve the firebreak creation work, three Erdvark G40B graders were ordered in July 2021 in South Africa. The blade width of these G40 graders is 3.1 meters and the weight is 1,500 kg. They will be towed by tractors and used for firebreak creation and maintenance. These blades were assembled in August 2022.

**Fig. 10.** Grader blades

**Fig. 11.** Tractor equipment

### 2.1.6 Food management

We mainly buy food in Biltine and Abéché, and from time to time in N'Djamena, and fresh produce (fruit and vegetables) and meat (mutton, chicken) from the weekly markets in Arada (Thursday) and Biltine (Monday) or from nomads. This food is stored in the refrigerators and freezer installed in the kitchen.

On average, 12 people are present on the Oryx Base camp, with major variations when hosting various missions, such as the oryx and addax reintroduction phases.

### 2.1.7 Enclosure management

#### Oryx enclosure

The wide mesh of the fence for the "oryx" enclosure does not prevent jackals from entering it as they manage to slip in by jumping through the highest mesh.
While jackals are not dangerous for adult oryx, they can be predators for the newborns or ostrich chicks also found in the enclosure. In August 2021, 3,000 meters of fencing (reference 2096/3) was purchased from the South Africa-based company Bonnox. The fencing was delivered in April 2022 and will be installed in 2023.

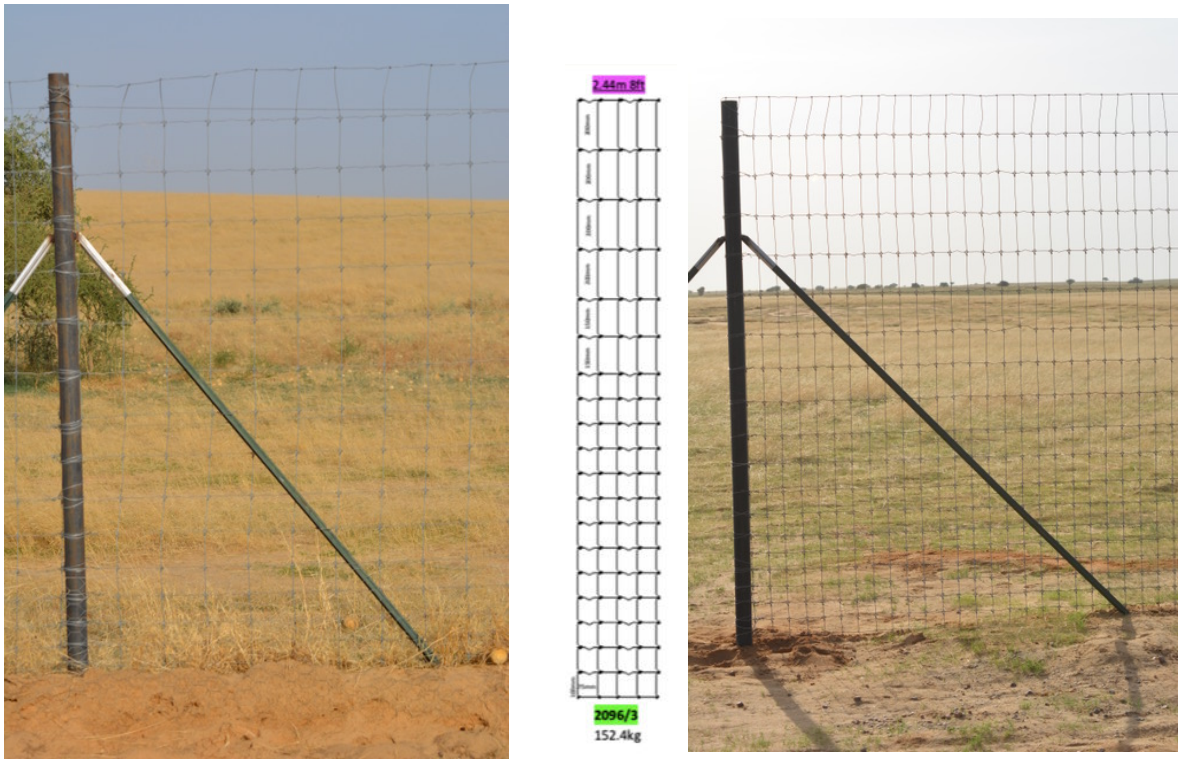



Fig. 12. Fencing to prevent jackals from slipping into the enclosures.

### 2.1.8 Management and maintenance of the landing strip

A landing strip has been created in OROAWR, 8 km to the south of the Oryx Base camp. Maintenance of the strip does not require too much work and consists of scraping the strip twice a season to remove grassy shoots and level out the hoofprints left by domestic livestock.

However, the strip cannot be used during the rainy season, unless there are at least two days between consecutive rain showers, which gives the strip time to dry.

The strip is 1,200 meters long. Aircraft such as Cessna 172 (Wings for Conservation (WFC)), Cessna 182 (APN, MAF) and Caravan (MAF, AVMAX) land there. The strip is equipped with a regulatory windsock.

## 2.2 Firebreak network maintenance

To protect the project's facilities, along with the reintroduced animals and their pastureland, we have opened a network of firebreaks.

In September and October 2022, four tractors were used to create 232 km of firebreaks, divided into:

- A circular firebreak centered on the Oryx Base camp and the enclosures (18 km)
- A firebreak along the first fraudsters' road (35 km)
- A firebreak along the second fraudsters' road (27 km)
- Two firebreaks in the west-east direction of 58 and 48 km compared to 50 km in 2021
- A firebreak along the western fraudsters' road of 46 km compared to 21 km in 2021

Fig. 13. Setting up firebreaks

### 2.2.1 Tractor fuel consumption on the Oryx Base camp

To carry out this work, the tractors consumed 4,673 liters of diesel. To weed it properly, a tractor has to pass over the same strip at least three times. The oldest tractors' mileage counters (New Holland and Mahindra) do not work. To create the 232 km of firebreaks, the tractors covered at least 696 km.

| MONTH | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PREPAS TRACTOR | | | | 60 | | 15 | | 483 | 913 | 500 | | |
| POROA TRACTOR | 100 | | | | | | | 110 | 490 | 280 | 200 | 150 |
| GFF TRACTOR | 20 | | | | | | 64 | 383 | 90 | 125 | 140 | 95 |
| MAHINDRA TRACTOR | | | | | | 20 | | 90 | 60 | | | 75 |
| NEW HOLLAND TRACTOR | | | | | | | | | | 130 | | 80 |
| TOTAL (liters of diesel) | | | | | | | | | | | | **4673** |

## 2.2.2 2022 firebreak network mapping

At present, we estimate the surface area protected by the firebreaks to be 2,668 km$^2$. Considering that 95% of the oryx occupy a 6,533 km area, this represents 40% of the surface area (20% in 2021).

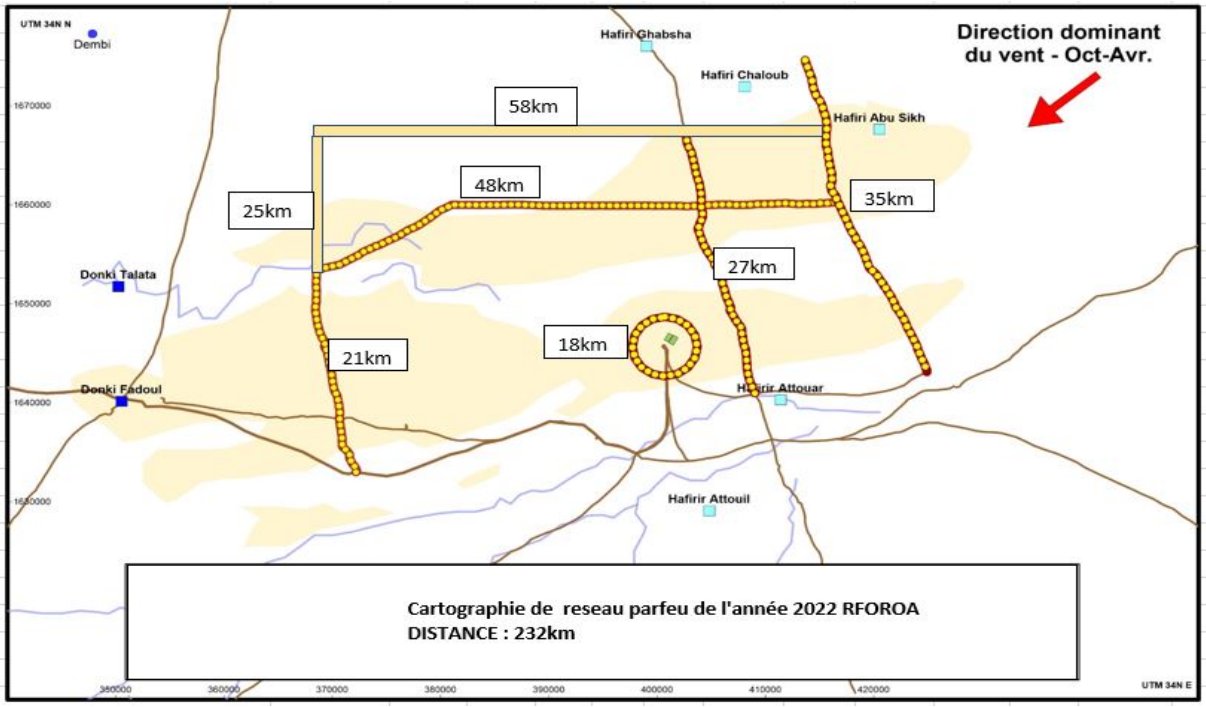



**Fig. 14.** Firebreak network mapping

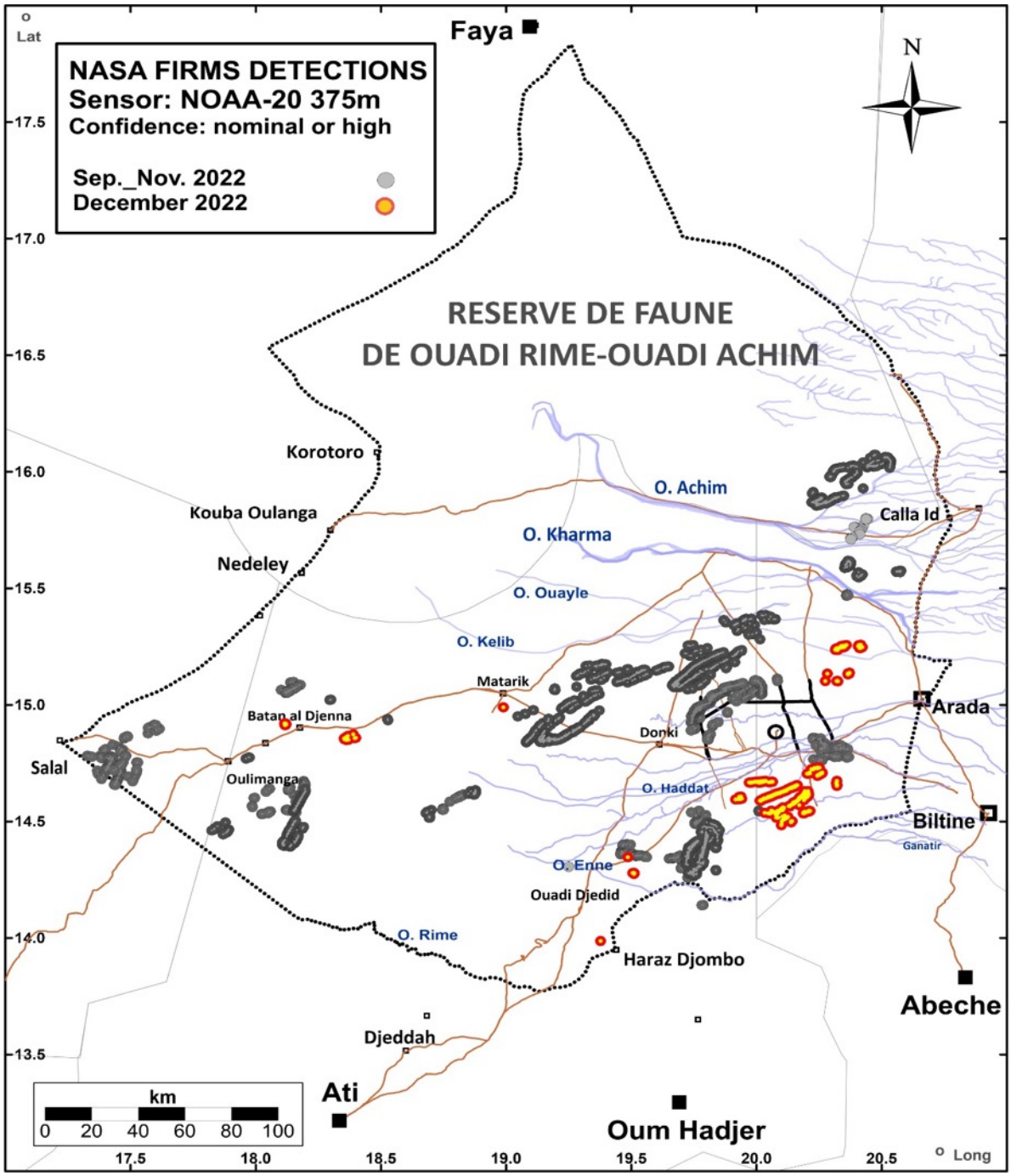



Fig. 15. Bush fire mapping in OROAWR 2022 (Tim Wacher)

# 3. The different species in the enclosure

During the course of 2022, we received oryx, addax and dama gazelles from Abu Dhabi.

## 3.1 Scimitar-horned oryx

On 14 March 2022, the eleventh group of 20 oryx from Abu Dhabi arrived in Abéché and was transferred during the night to the pre-release enclosure. These animals were not fitted with GPS collars, this operation took place later in 2022. The group was released on 17 August 2022. A female miscarried a fetus whose age was estimated at three months.

A second arrival scheduled for November 2022 had to be cancelled due to the security incidents that occurred in October 2022.

**As a reminder:**

| Date | Number of founders | Release date |
|---|---|---|
| 16 March 2016 | 21 | 14 August 2016 |
| 14 November 2016 | 14 | 21 January 2017 (14 released) |
| 18 January 2017 | 37 | 3 August 2017 (42 released) |
| 11 February 2018 | 24 | 6 August 2018 |
| 15 February 2018 | 25 | 6 August 2018 |
| 18 February 2018 | 24 | 6 August 2018 |
| 25 February 2019 | 23 | 17 September 2019 |
| 11 November 2019 | 25 | 17 December 2019 |
| 3 March 2020 | 25 | 22 September 2020 |
| 8 November 2021 | 25 | 5 December 2021 |
| 14 March 2022 | 20 | 17 August 2022 |

Fig. 16. Oryx release in OROAWR

## 3.2 Addax

On 7 March, a fourth group of 25 addax, not fitted with collars, arrived at Abéché. They were fitted with GPS collars in July and released in August 2022.

The second arrival scheduled for November 2022 had to be cancelled due to the security incidents that occurred in October 2022.

**As a reminder:**

| Date of arrival in Abéché | Number of founders | Release date |
|---|---|---|
| 13 November 2019 | 15 | January 2020 |
| 6 March 2020 | 25 | 7 September 2020 |
| 15 November 2021 | 25 | 12 December 2021 |
| 7 March 2022 | 25 | August 2022 |

## 3.3 Dama gazelles

**As a reminder:**

In January 2021, three dama gazelles were present in the enclosure: the **male Moussa**, the **female Becki** and their **daughter Sherka**. The three gazelles easily went through the gates to move from the capture zone to the large enclosure and vice versa. They were regularly observed resting under the shed in the capture area.
It is in this area that they received food (alfalfa pellets, wild melon) and water during the night.

In February 2021, two wild dama gazelles approached the enclosure. They were attracted by the captive gazelles. After discussion, we decided to try and capture them. On 4 March 2021, a (female) wild dama gazelle entered the enclosure next to the one with the captive gazelles. Frightened on the first day, it struck the enclosure fence several times, damaging one of its horns. This gazelle was named **Habiba.**
On 22 March, the female Becki, captured in Salal, gave birth to its second calf, a young female that we called **Hiti.**
In March 2021, there were therefore five dama gazelles in the enclosure.

### Dama gazelle diet

We offer the following amount of food to the five gazelles (3 adults and 2 calves) per day:

- 2.8 kg pellets from the white bag
- 1.4 kg pellets from the brown bag
- 2 portions of soapberry fruit. They very eagerly eat it.
- Hay from Abu Dhabi (but very little is eaten and it accumulates in the feed troughs)
- Bitter apple leaves and fruit, which is very much appreciated, given in the evening.

In May 2021, we saw that the male was extremely active in its attempts to mount the females, especially its daughter, the young female Shaika born on 24 August 2020 (8.5 months). It became increasingly important to partition the existing enclosure and separate the family.

From 7 to 21 July 2021, work was carried out in the dama enclosure to divide it into four enclosures measuring 200 x 200 meters. The work was finished at the end of August.

On 19 October 2021, the gates of the capture area were therefore opened to allow the dama gazelles to move into the part of the enclosure reserved for them. On 20 October, the dama gazelles had moved and the team searched the enclosure to see if there had been a birth, given the strange behavior of the female Habiba and the male. They discovered a young gazelle that was estimated to be 4 or 5 days old.

This female dama gazelle, called **Leilika**, was born of the female Habiba and the male Moussa.

On 9 November 2021, the third calf of Becki, the female captured in Salal, was observed in the enclosure. It is a male called **Kallé**, probably born on 8 November 2021.
On 16 December 2021, we saw another newborn in the enclosure. It was the son of Moussa and its daughter Shaika. The team placed a tag on this young **male 001**. Unfortunately, in the morning of 24 March 2022, we found it dead alongside the fence with a broken neck.
On 22 December 2021, Firmin Dingamtebeye managed to pen three wild dama gazelles (2 females and 1 male) in the enclosure, then another male on 7 January 2022.

By opening and closing the gates, we achieved the following distribution in the different parts of the enclosure:

- A single male Firmin (4 ha)
- A group formed by the old male Moussa and two new females (3 individuals) (4 ha)
- A group formed by a new male Andréa, the old females and their offspring (8 individuals) (8 ha)

Up to 14 March 2022, 12 dama gazelles were present in the enclosure.

## First translocation of dama gazelles to OROAWR

On 14 March 2022, an Ilyushin 76 coming from Abu Dhabi landed at Abéché airport at 15:52 with 20 oryx and 5 dama gazelles on board. The gazelles were unloaded at 16:10. However, although it had been planned that all the gazelles would travel by plane to OROAWR, only three gazelles were able to be anesthetized before the deadline when it would no longer be possible to land on the Oryx Base camp's unlit landing strip. At 16:52, MAF's Cessna Caravan took off for the Oryx Base camp with three dama gazelles and the Abu Dhabi and Fossil Rim Center experts on board.

**Fig. 17.** Transport of the dama gazelles by plane Abéché-Oryx

The other two dama gazelles made the journey by road to the Oryx Base camp in a lorry.

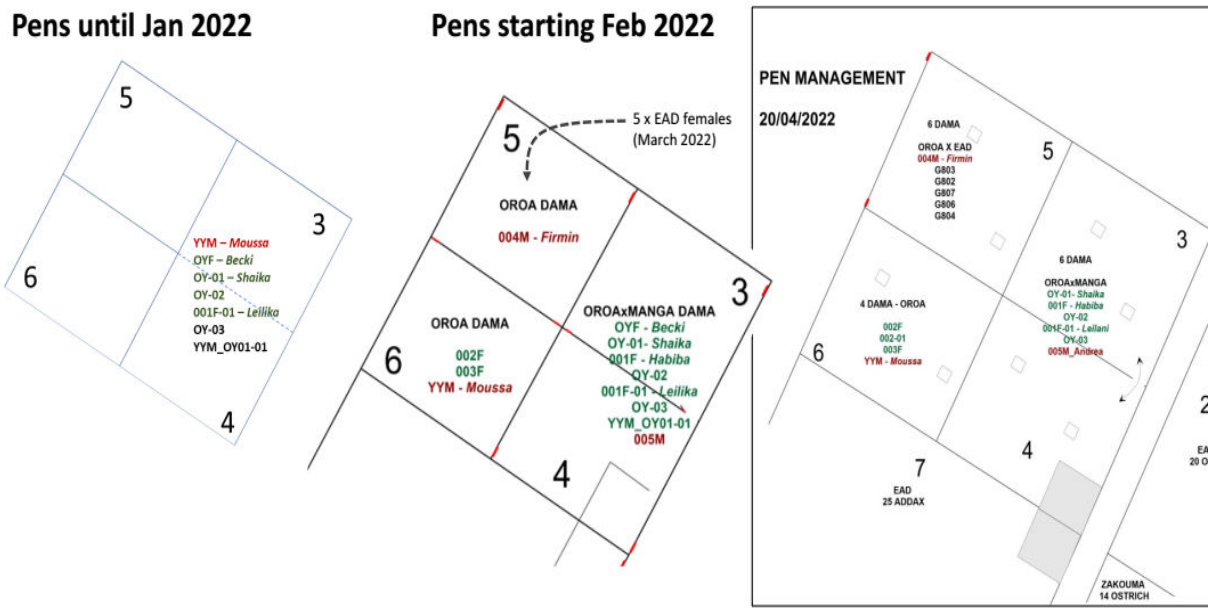
Initially placed for two days in a small temporary enclosure to closely observe their movements, on 17 March 2022, they were released and joined the male Firmin.
On 30 March, the dama female Becki, which came from Manga and had given birth to three young gazelles was seen to be ill and then died around noon. A necropsy was performed, and organs removed.

On 15 April, a female was born, the daughter of one of the females passively captured in December 2021. It is in the male Moussa's group. As gestation is 6 to 7 months, this male Moussa is not the father of this young dama, whose mother has been in the enclosure for 4 months.

16 dama gazelles are present in the enclosure on 15 April.

- Andréa group: 6 animals (2♂ (1 adult and 1 calf) and 4♀) – The two males were passively separated in August 2022
- Moussa group: 4 animals (1♂ and 2♀and a calf born on 15 April)
- Firmin group: 6 animals (1♂ and 5♀)

## Enclosures




It should be noted that since the last week of January, two other wild dama gazelles (1♂ and 1♀) have been approaching the enclosures, attracted by the dama in captivity. The male is present every day.

2022 saw a certain number of births and mortalities, whose chronogram and genetics are explained in another section, taking the total number of dama gazelles in captivity in the enclosures to **21 animals**.

The strategy of raising dama gazelles in enclosures has been the subject of an in-depth study, which is developed in a further chapter.

Due to the cancellation of the oryx/addax translocation operation in November 2022, a nutrition problem has arisen. The diet for the dama gazelles in the enclosure is primarily based on alfalfa pellets, which are dispatched directly from Abu Dhabi.
Similar products are not manufactured in Chad.
However, thanks to Planète Sauvage's generosity and support, along with the mobilization of a dozen European zoos, a supply of several pallets of pellets was able to be secured, offering a stopgap until the next delivery from Abu Dhabi scheduled for March 2023.


**Fig. 18.** Group of eight dama gazelles at the feed troughs

## 3.4 North African ostriches

Raising the second batch of ostrich chicks (see 2021 annual report) made it possible to raise 12 birds (6 females and 6 males).

An operation to fit GPS and VHF tags was carried out in July 2022: 6 birds (4 females and 2 males) were fitted. Dr Willem Burger was in charge of the operation and is also responsible for the veterinary aspect of the ostrich reintroduction program in Ennedi Natural and Cultural Reserve. Dr Willem Burger has been working with the ostrich reintroduction program in Ouadi Rimé - Ouadi Achim Wildlife Reserve since 2019.

**Fig. 19.** GPS/VHF tag fitting

Dr Willem Burger was assisted by all the staff on the Oryx Base camp throughout the operation. Unfortunately, there were five mortalities.

From the beginning of the operation, it was observed that the ostriches were very stressed when the capture team approached inside the enclosures. The animals' stress was reflected in their constantly fleeing. A second enclosure was thus opened along with the corridor separating the two large enclosures, to give the ostriches more space.
However, this did not succeed in calming the animals, which continued to flee, causing very high levels of fatigue and stress. One animal (a female) had difficulties during the anesthesia and died 30 minutes after being put to sleep.
The decision was then taken to stop the operation to allow the animals to rest until the next day. The operation resumed on 7 July, the animals were calmer and the operation took place under better conditions.

The operation finished on 8 July in the morning. Dr Burger decided to release the ostriches the next day. The gates of the enclosures were opened and the animals released passively without any human intervention. The animals left the enclosure by themselves.

On 12 July, a male was found dead around 30 kilometers to the west of the Oryx Base camp. The autopsy did not reveal any particular obvious cause.
The next day, a male was observed 25 kilometers to the west of the Oryx Base camp, living but not able to get up. It was brought back to the base to be looked after. Unfortunately, it was severely attacked by a jackal and we had to euthanize it.
On 14 July, two other animals were found dead, one to the north-west, the other to the south of the Oryx Base camp. The autopsies did not reveal the cause of death.
All the animals were aged around 18 months. They were born in captivity; their physical fitness was very good and the autopsies revealed no evidence of infectious disease. The animals also did not show any signs of poaching.
All wildlife species are liable to develop a common pathology called **capture myopathy** during capture operations.
During capture, the animals were subject to stress and relatively violent exertion. The pathophysiology of capture myopathy includes a muscle cell deterioration phase. This causes an excess of myoglobin in the blood, which in turn leads to renal failure. Capture myopathy also causes metabolic acidosis, which can lead to hyperthermia, a state of shock and cardiac and respiratory arrest.
During several interviews with Dr Willem Burger, it was estimated that capture myopathy was the most probable cause, as the animals had no other symptoms.
It is interesting to note that all the animals found dead are those that very quickly moved away from the base. It is highly likely that the additional effort made a few days after the first episode of stress, combined with the absence of water for the animals, which had always lived in an enclosure, led to their death.
Capture myopathy develops in a few hours to several weeks after a capture episode.
As the animals did not show any evidence of contamination, they were not buried.

A male and three females were kept in the enclosure. In December 2022, a nest was built, without, however, it being possible to determine the number of eggs in it.

Three nests belonging to ostrich 18F were observed in December 2022 around 53 km to the east of the Oryx Base camp.
The first nest contained one egg, as did the second nest, while the third nest had two eggs. According to the local populations, the ostrich does not frequent any of the nests but remains nearby.

# 4. The oryx and addax population in Chad in December 2022

Field activities and monitoring work were disrupted for several weeks by the security incident in October.

At the end of October, the oryx population in Chad was estimated at 500 animals and the addax population 134 individuals.
All these animals roam free in Ouadi Rimé - Ouadi Achim Wildlife Reserve.

# 5. Threats

## 5.1 Bush fires

Bush fires represent a recurrent threat that has been difficult to treat to date by the competent local authorities and administrations. These fires are responsible for the loss of considerable areas of pastureland, both for wildlife and livestock. They destroy perennial plants, microfauna and the nests of birds that nest on the ground – such as bustards – thus impoverishing OROAWR's plant biodiversity.

The fires are almost all started due to carelessness (cigarette butts, fire pits not extinguished properly, etc.) by "fraudsters", who are gold diggers or traders trafficking between the north (Libya, Sudan, etc.) and Chad towns further south. In order to avoid road checks on the national roads, they travel through the bush, including the wildlife reserve, from north to south and south to north.

The nomads passing through OROAWR also unintentionally cause fires. As there are no official regulations, certain nomads move into pastureland protected by firebreaks, sometimes starting a fire in these theoretically protected areas. This map shows the boundaries of OROAWR, the frequency of fires from 2001 to 2019, the oryx distribution area, the network of firebreaks to protect the project's infrastructure and the pastureland areas closest to the Oryx Base camp.

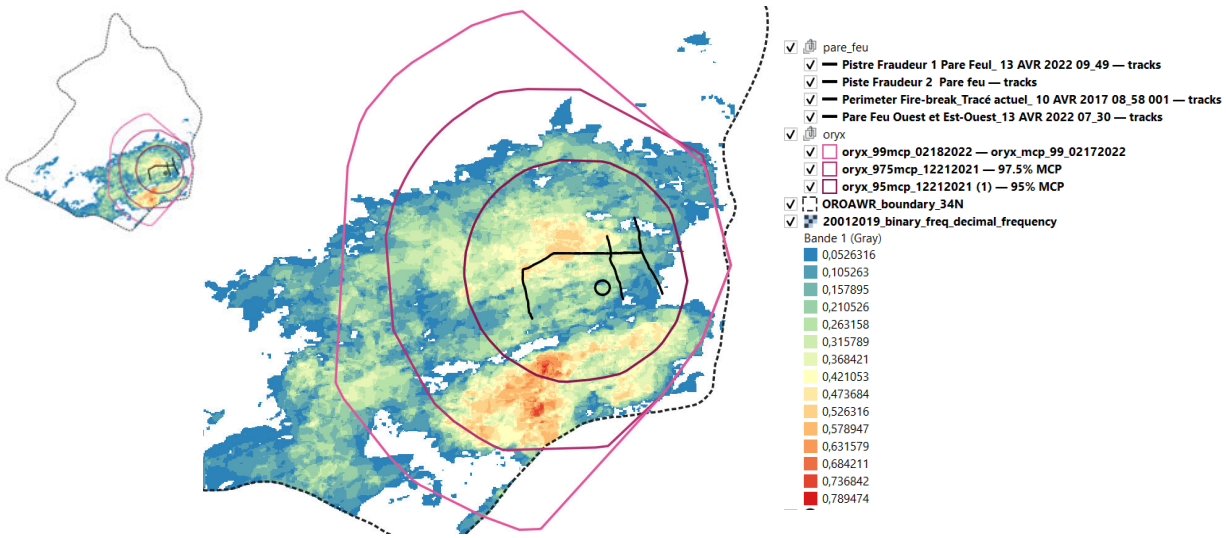



**Fig. 20.** Bush fire stopped by a firebreak.

## 5.2 Overgrazing

Livestock farming in Chad is the second largest economic activity. The country has around 115 million head of cattle. OROAWR represents a choice grazing site whose pressure fluctuates with the seasons and transhumance.

Within seven years, we have seen new ways of exploiting grassy areas that were previously not used much for grazing. Far away from watering places (the closest being Donki Fadoul 55 km from the Oryx Base camp), these areas were virtually inaccessible for ruminants, thus leaving broad feeding grounds for wildlife.

Recently, major livestock owners have been illegally providing their herds and flocks with water on a commercial basis by setting up water tanks. These water tanks are of all kinds and different capacities. They are regularly replenished by tankers that come from Biltine (120 km) or Arada (80 km). The previous absence of water largely helped maintain the ecosystem in these areas. Henceforth, these areas have become able to be used by farmers, leading to major deterioration of the ground (trampling) along with a reduction in the space hitherto reserved for wildlife.

Moreover, a business transporting water in cans by motorbikes has been set up from these water tanks, supplying the most distant farmers.

This system of setting up water tanks replenished by tankers allows commercial farmers to remain in place on good pastureland with livestock that under normal circumstances should not be found there.

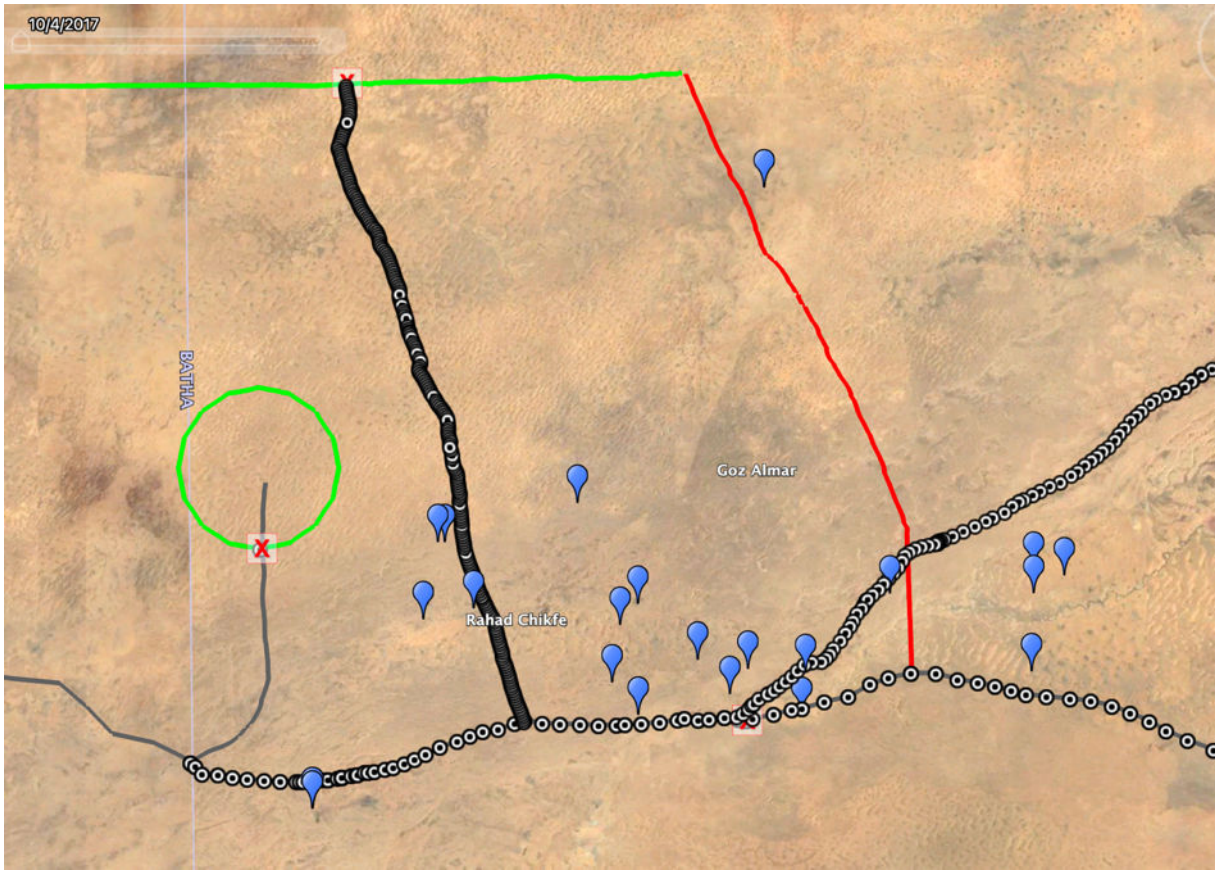



**Fig. 21.** Position of the 23 water tanks less than 20 km from the Oryx Base camp


**Fig. 22.** Proliferation of water tanks in OROAWR

In February 2022, during a flight with the NGO WFC, we observed a proliferation of water tanks next to the Oryx Base camp.

On 23 and 24 February 2022, OROAWR's team of guards removed 23 water tanks installed less than 20 km from the Oryx Base camp. Taking advantage of the firebreak network, the livestock owners enjoy pastureland protected against bush fires.
The solution negotiated was to move these tanks more than 30 km away from the Oryx Base camp.
Paradoxically, we now see motorbikes coming to stock up with water from these tanks to provide water for the livestock that has remained in the area less than 30 km away.

The presence of these permanent camps disrupts the environment and tranquility of the wildlife. While, from time to time, it is common to see dorcas gazelles not far from herds of

domestic animals and therefore to think that they tolerate their presence, analysis of the data from the survey carried out over a large area shows that they are much more numerous in areas where there is no livestock.
The increase in domestic livestock and the time that they spend in OROAWR is also becoming a real health problem. Many diseases are transmitted from these domestic animals to the wild animals, thus becoming a major risk factor in the success of the reintroduction project (cf. other section of this report).

The development plan (PAG) for Ouadi Rimé – Ouadi Achim Wildlife Reserve was completed in 2022. Since its creation in 1969, the reserve has never had this kind of management support tool. The PAG is based on zoning work for the reserve, drawn up ahead of the drafting of the PAG. This zoning allowed the creation of strict conservation areas in which grazing, farming and livestock watering activities are heavily regulated. In the future, this will give a legal basis to reduce anthropogenic pressure within these strict conservation areas and attempt to protect their ecosystems.

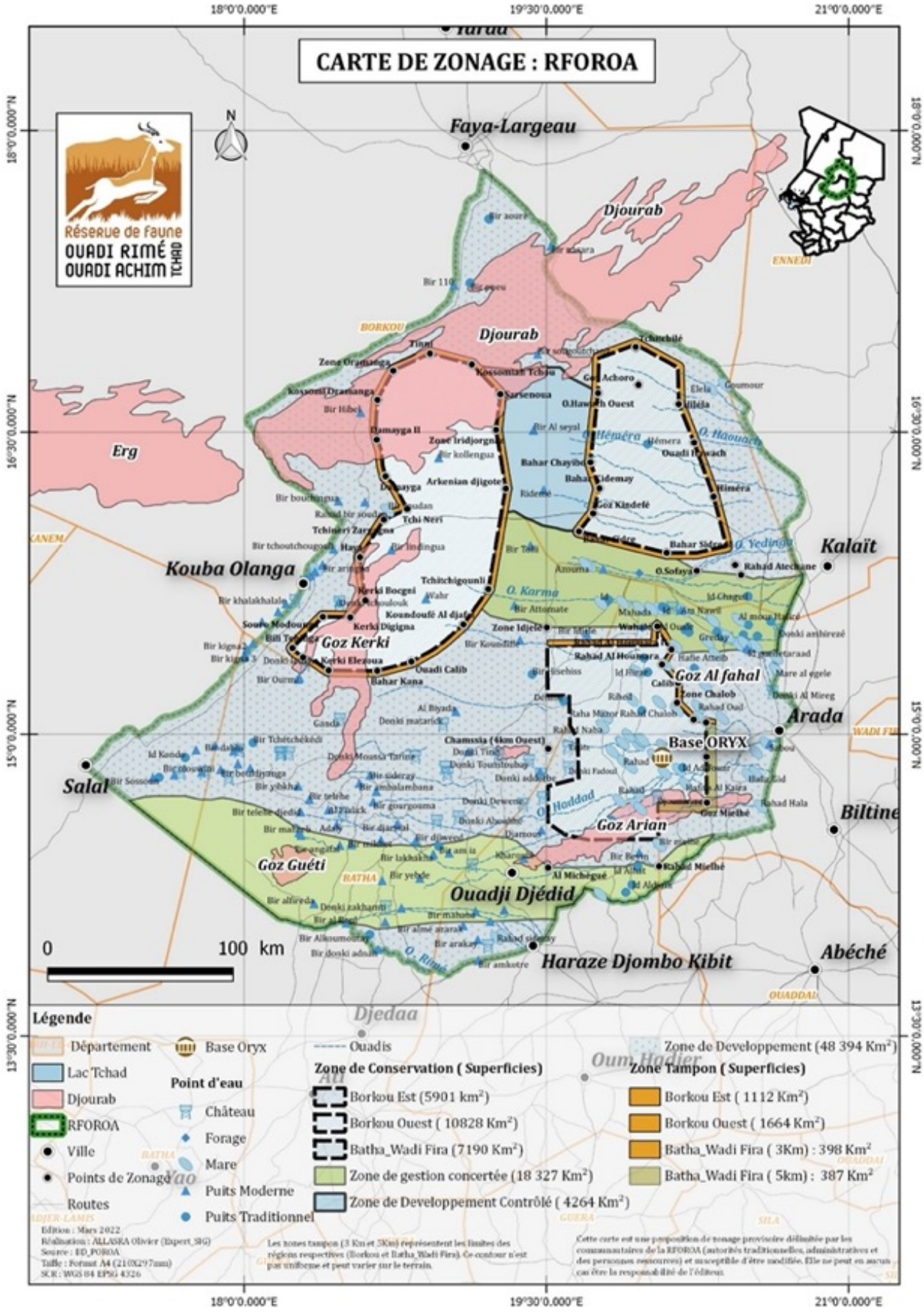



Fig. 23. OROAWR zoning

## 5.3 The presence of farmers near the pens

In the conclusions to his expert assessment on the mass mortality of oryx in 2018, Dr Philippe Chardonnet explained that the oryx that were in the worst general condition were affected by at least four diseases, which can be divided into different categories, according to their mode of transmission:

- 2 diseases transmitted by arthropods: babesiosis & Rift Valley fever (RVF),
- 1 disease promoted by arthropods: dermatophilosis,
- 1 opportunistic disease depending on the climate and the poor general condition of the animals: pasteurellosis,
- possibly, 1 disease transmitted by domestic livestock: PPR.

All these pathological problems encountered by the oryx are native to Chad and not the United Arab Emirates.

One of the recommendations was to safeguard the adaptation pen by protecting it from being approached by people, livestock and wildlife.

Currently, awareness-raising efforts are ineffective and the lack of enforcement of the law means that farmers continue to cross OROAWR, passing next to the enclosures. They even knowingly let their livestock enter the 3 km-radius circular area at night where the pastureland protected from bush fires is of good quality.

A “One Health” mission was organized in September 2022, whose content will be described in a later chapter.

**Fig. 24.** Nomads and their dromedaries passing next to the enclosures.

## 5.4 Interactions between wild animals and the animals in the enclosure

The wild animals released, whether oryx, addax or ostriches, return from time to time next to the enclosures and have contact with the enclosed animals.

Fig. 25. Interactions between the wild animals and the animals in the enclosure

The presence of dama gazelles in the enclosures also attracts wild dama gazelles (which, on three occasions, has made it possible to passively capture them).
From January to April 2022, two wild dama gazelles, one female and one male, were seen on a daily basis next to the enclosure. The male displayed territorial marking behavior and

fought against the enclosed males through the fence. However, these gazelles have not been seen again since August 2022.

Fig. 26 A male dama in the wild confronts a male dama in captivity.

Finally, the peaceful atmosphere that reigns around the Oryx Base camp and enclosures gives dorcas gazelles and jackals the opportunity to flourish. They regularly pass by along the enclosures.

## 5.5 Fight against poaching and law enforcement

The teams in charge of law enforcement are also in charge of the fight against poaching. Poaching is recognized against dorcas gazelles. However, since the beginning of the oryx reintroduction program in 2016, a single case of oryx poaching has been documented (leading to the perpetrator's arrest). No poaching of addax or dama gazelles has been documented to date.

Two cases of ostrich poaching have been recognized. The poached animals were in or near the millet field. According to the local population, the reason for the poaching was possible damage caused to crops.

Vulture poaching is suspected, but there is no tangible proof to date.

# 6. Security and project management

## 6.1 Project staff security

To ensure the safety of the project staff, a guard outpost with four guards was built beside the project's base camp.

After the kidnapping of the project manager in November 2022, the outpost was reinforced with eight guards and a vehicle. They are relieved every ten days by another team.

The guards are tasked with:

- escorting the project's vehicles when travelling between the towns and the base,
- escorting the ecological monitoring team whenever they go out,
- guarding the planes that arrive as part of the project's activities.

## 6.2 Law enforcement

The guards in the Northern and Southern sectors of the Reserve, and the new guards recruited, trained by POROA, carry out patrols in the central and north-eastern part of the reserve. The insufficient number of guards and vehicles makes surveillance of the entire expanse of the reserve difficult. Efforts have therefore been strengthened in the distribution area of the species reintroduced, the dama gazelle area and the Kharma and Hachim wadis.
During the different patrols over the past year, no incidences of poaching of the species reintroduced were recorded. However, four cases of poaching of dorcas gazelles with motorbikes and shotguns were noted.
The poachers arrested were handed over to the local authorities and legal action taken.

## 6.3 Fight against bush fires

At the end of each rainy season, bush fires break out, generally caused by human activities, such as vehicle tailpipes and farmers.
Along with the project teams, the reserve's guards took part in the fight against bush fires. This year the number of fires is down compared to the last two years. However, they continue to present a major challenge for the reserve.

## 6.4 Raising farmers' awareness

The reserve is a farming area par excellence; there are two categories of farmers:

- transhumant farmers who come from the South at the beginning of the rainy season and leave when the pools dry up,

- local farmers who live in the reserve throughout the year.

These different categories of farmers are made aware by the guards during the different patrols about the species reintroduced, the harmful effects of bush fires, wildlife poaching, and the proliferation of water tanks and boreholes.
The water tanks were removed in a 30 km radius around the base and the perimeter of a 3 km radius around the base was well controlled this year; no farmers camped in this area.

## 6.5 Other

- The reserve's guards helped to free the oryx project manager, in collaboration with the other defense and security forces.
- The guards benefited from training on fighting bush fires and judicial monitoring in Arada.

# Part III. FIELD-BASED POST-RELEASE MONITORING OF ORYX & ADDAX

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**Habib Ali Hamit**

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**Khalid Rahama Abderaman**

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**Taboye Abdelkerim Ben**

Ecological Monitoring Officer – Sahara Conservation

**Oumar Annadif**

Ecological Monitoring Officer – Sahara Conservation

**Kher Issakha**

Ecological Monitoring Officer – Sahara Conservation

# Introduction

Routine post-release monitoring of reintroduced oryx and addax populations was maintained in the field by the monitoring team throughout 2022, though security issues in October meant that monitoring work was disrupted for several weeks. External support to the team on data management, particularly supervision of breeding records and coordination of monthly report editing, was maintained remotely from ZSL through regular email contacts. ZSL staff joined the team at the Oryx Base camp from 06 March 2022 to 20 April 2022 and from 16 August to 6 October 2022, when data management updates, refreshment training, routine monitoring re-organisation and ground-based sample survey activities were conducted.

## 1. Staff and monitoring management

### 1.1 The staff

The field monitoring team comprised four members through most of the first part of the year; increasing to five from September to December, with six staff members involved in all:

- Caleb Ngaba Waye Taroum
- Habib Ali Hamit
- Khalid Rahama
- Taboye Abdelkerim Ben
- Oumar Annadif
- Kher Issakha

### 1.2 General management

The main change in management during the year was to integrate monitoring of all reintroduced species (oryx, addax and ostriches) into one program. From September 2022 the Cybertracker field data recording sequence was updated with an integrated module to record wild ostrich observations using similar methods applied to the reintroduced antelope. This enabled all the team members to record all reintroduced species encountered in the field. Revised weekly work plans were developed, based on searching systematically for priority satellite-tagged individuals. A system of automatically tagging the daily satellite collar coordinates of every individual to indicate quarter of the compass and distance from base camp (< or > 20km) was developed. This enables rapid sorting and identification of lists of oryx or addax that can be found in pre-defined search sectors nearer and further from base camp. When teams are at full capacity, two monitoring teams search for released individuals on 5 days of the week. Operations are coordinated by one team searching for priority satellite tagged individuals in a sector less than 20km from base and

a second team searches for individuals >20km from base. A monthly work plan identifies which team is operating 'near' and which team is operating 'far' for each patrol day. Time is built in each week to update a daily sighting record of all collared individuals in the population. This enables daily identification of which individuals have and have not been observed directly in the current month, guiding daily decisions on which individuals to prioritise.

### 1.3 Management of birth and death records

In addition to entering the details of field observations direct into Cybertracker, all births and deaths detected in the field additionally require completion of a separate birth or death record template (date, time, photo, estimated/known age, condition, tagged/not tagged, sex, location, evidence of cause of death where possible), which is emailed to ZSL and SNZCBI and incorporated into the relevant databases.

## 2. Oryx

### 2.1 Satellite collars

The number of oryx wearing satellite collars rose to 68 in mid-year following the release of a ninth group of 20 oryx (15F:5M) on 17/08/2022 after 155 days in pre-release. In revising the monitoring plan and working methods, the satellite collared oryx were divided in to 26 'priority' plus 42 treated as routine monitoring target individuals. By the end of the 2022, 57 of these collars were still reporting location within the previous 7 days. This compares to 44 functioning satellite collars on oryx at the end of 2021, confirming that the planned monitoring objective to maintain at least 50 satellite collars during phase 2 of the project was achieved during 2022.

The priority satellite collars in 2022 are allocated among three main categories, Table 1. The project is currently following 11 females of the first four release groups who were recaptured during three capture operations in 2020-2022 and fitted for a second time with satellite collars. The purpose is to enable detailed comparison of movement ecology and reproductive histories of individuals who carried satellite collars during their first two years adapting to a natural environment, with their behaviour and reproductive success once more experienced at 3-6 years after release.

A contingent of 7 calves born in Chad during pre-release form a second category augmented by three calves born in the wild and caught at 2-3 years of age in a third category provide equivalent data to compare performance of Chad-born oryx with founder oryx.

The 'routine' (with respect to monitoring team organisation) satellite collar group primarily represent the most recent two release cohorts, Group 8 and Group 9.

**Table 1**. Allocation of 68 satellite collars among male and female oryx by origin in September 2022, showing categories used to guide research and monitoring objectives.

| Priority Monitoring Categories | Group 1 | Group 2 | Group 3 | Group 4 | M:F | Total |
|---|---|---|---|---|---|---|
| Founders given a second collar | 0.4 | 0.1 | 0.3 | 0.3 | 0.11 | 11 |
| Pen born calves | | | 1.5 | 0.1 | 1.6 | 7 |
| Wild born calves collared at >2 yrs. | | | | | 2.1 | 3 |
| Group 6 | | | | | 1.4 | 5 |
| **Sub-total** | | | | | | **26** |
| **Routine monitoring categories** | | | | | | |
| Group 6 | | | | | 0.1 | 1 |
| Group 8 | | | | | 6.15 | 21 |
| Group 9 | | | | | 5.15 | 20 |
| **Sub-total** | | | | | | **42** |

## 2.2 Oryx calf detections – 2022

Birth dates of 111 calves detected by the monitoring team fall within the 12 months of 2022, bringing the total oryx births detected in Chad to 441 by the end of the year. As previously, births were recorded in every month of the year, Fig. 1. Wild-born calves were captured by hand for ear-tagging on 29 occasions in 2022, Table 2, bringing the total sample of tagged Chad-born calves in the population to 129 (includes 20 tagged calves among the 33 born in pre-release pens).

**Table 2.** Management information for 111 wild-born scimitar-horned oryx calves detected with estimated birth dates in 2022, OROAWR.

| | Male | Female | Not sexed | Total |
|---|---|---|---|---|
| **Ear-tagged** | 15 | 14 | 0 | 29 |
| **Not ear tagged** | 3 | 4 | 75 | 82 |
| **Totals** | **18** | **18** | **75** | **111** |

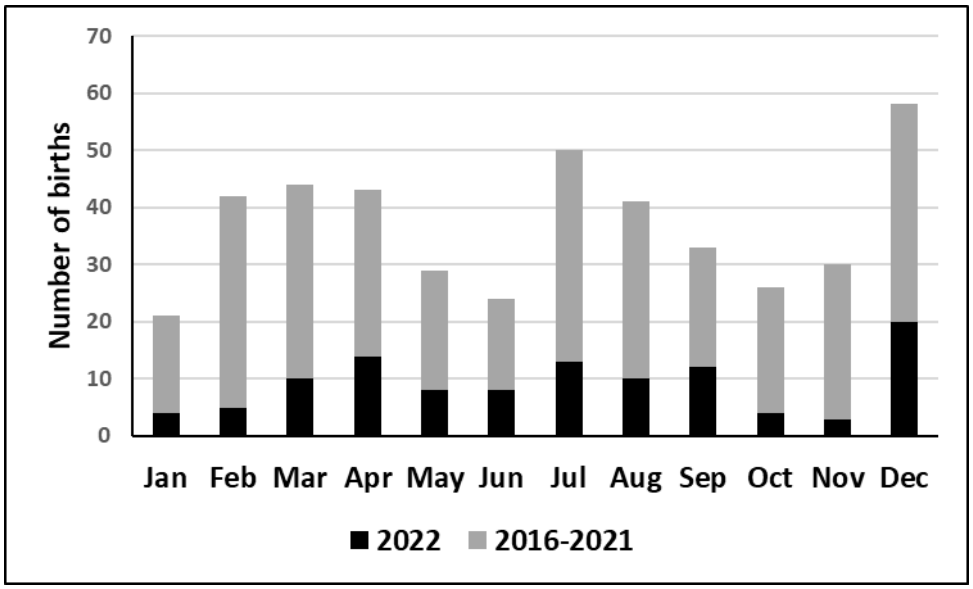


**Fig. 1**. Monthly distribution of 111 oryx births recorded in 2022 compared to monthly distribution of all 441 oryx births detected at Ouadi Rimé - Ouadi Achim Wildlife Reserve, 2016-2022.

A bias towards male calves was shown to be borderline significant in the 2021 tagging data, but the 2022 sex ratio among tagged calves is clearly very close to 50:50. Overall there remains a majority of males among all 129 wild calves handled for tagging to end of 2022 (58F: 71M) but this does not differ statistically from a 50:50 ratio ($\chi 2=1.31$, $P>0.05$).

## 2.3 Oryx mortalities

Nine deaths amongst oryx were reported in 2022. The backgrounds of all the individuals involved are given with notes on the circumstances in Table 3.

Notably in all cases there is no certainty as to the causes of death. This is mainly because carcasses are not discovered quickly, scavengers have been active and necropsies are not done because of the degraded status of the newly found carcasses. If necropsies were done, a designated analysis location has not been identified. It would nevertheless be valuable to increase training and capacity for field teams to perform basic assessments and/or necropsies in instances where useful information or material might be gained.

Overall, a seasonal pattern of mortality in the oryx is emerging, suggesting the long dry season is a major factor, though the timing of the 9 deaths in 2022 may not fit this pattern closely, Fig. 2. The exceptional events associated with the uniquely large numbers of oryx released together in September 2018 were extensively reviewed in veterinary reports and presentations at EAD in December 2018. [Note: Survival and mortality rate assessments currently underway treat September 2018 as a real case of a 'catastrophe' event (*sensu* Vortex population modelling software) and are calculated with and without the losses involved.]

All oryx who died in 2022 were young or in their prime; seven of the nine were relatively newly released, suggesting some individuals have difficulty with adjustment to the wild, Table 3.

In only one case in 2022 was there direct sign of human presence close to a carcass in the form of both a motorbike track and a 4x4 track within 25m of the fresh carcass of V08F. In two other cases absence of horns snapped off at the base was noted. Assessing evidence of human presence at a carcass ('no', or if 'yes' what evidence) is part of routine reporting.

## 2.4 Oryx population size

The oryx population has grown and dispersed over the reserve to the point where only sample survey estimates can be used for direct estimation of population size. Statistical confidence in the estimates is very low because although doing very well, oryx are still relatively rare, widely dispersed and in highly variable group sizes. This leads to low encounter rates in practical sampling designs and high coefficients of variation on the estimates. Two sample surveys conducted in 2022 indicate a population of c. 500 animals. Full details in Fig.6 & Table 8.

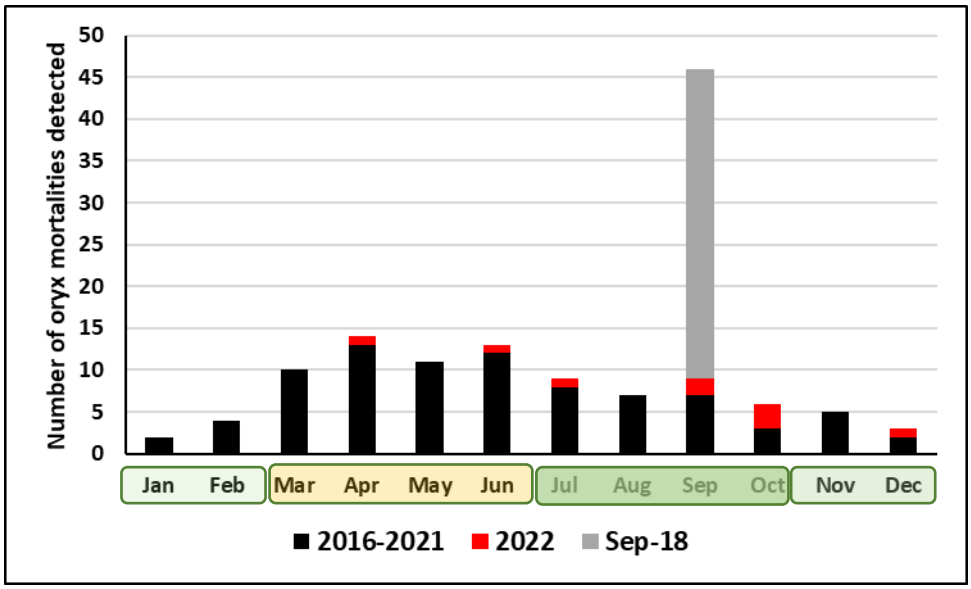


**Fig. 2** Monthly distribution of 9 deaths among oryx detected in 2022 (red), compared with the 84 deaths detected in 2016-2021 and 37 deaths recorded in September 2018 only (grey). Three main pasture growth seasons also indicated. OROAWR.

**Table 3.** Details of 9 oryx deaths detected by the monitoring team during 2022.

| Code No. | Release group | Date of birth | Release date | Days in pre-release | Age at release (Yrs.) | Duration collared (mths.) | Date death detected | Age at death (Yrs.) | Survived in the wild (mths.) | Carcasse status when found |
|---|---|---|---|---|---|---|---|---|---|---|
| G1304_R88FD | 4 | 16/02/2017 | 06/08/2018 | 171.0 | 1.5 | 53.2 | 24/12/2022 | 5.0 | 42.7 | Carcasse fresh when found but heavily impacted by scavengers; photo in excellent condition April 22 and condition classifed '7- Gras moyenne' when last observed alive 22/09/2023. |
| **R07_G40_99-04D** | Wild born | 14/01/2020* | Wild born | Wild born | Wild born | 6.1 | 10/07/2022 | 2.5 | 29.9 | Poor health noted; reported sick by a guard. Carcasse dry and old, horns (very long) intact when found 2km from base by monitoring staff on 17/09/2022. |
| V02M_B400 D | 8 | 06/01/2018 | 05/12/2021 | 26 | 3.9 | 11.1 | 02/10/2022 | 4.7 | 9.9 | Carcasse found , largely intact; horns in position; dry with most of the hair missing. Cause unknown. |
| V07F_B410D | 8 | 19/06/2020 | 05/12/2021 | 26 | 1.5 | 8.4 | 13/07/2022 | 2.1 | 7.2 | Carcasse 50% affected by scavengers; left horn missing, know to have been in poor condition at time of release. |
| B26F_B411D | 8 | 26/04/2019 | 05/12/2021 | 26 | 2.6 | 11.3 | 08/10/2022 | 3.5 | 10.1 | Found with both horns broken or possibly cut off and missing. Carcasse >50% affected by scavengers. |
| V19F_B426D | 8 | 01/11/2019 | 05/12/2021 | 26 | 2.1 | 7.7 | 21/06/2022 | 2.6 | 6.5 | Found 75% affected by scavengers but head, horns and collar intact. |
| V08F_B424D | 8 | 24/07/2019 | 05/12/2021 | 26 | 2.4 | 5.5 | 15/04/2022 | 2.7 | 4.3 | Found under Acacia in Acacia patch on burnt open plain. Clean hole between front legs oval and smooth edged, 15 x 10 cm; eyes pecked out. Rest of herd feeding nearby. Stinking, so likely dead all day at least. No human footprints close to carcasse, no exit wound apparent, but tracks of motorcycles and vehicle passing within 25m either side of tree. Cause of death not clear, but suspicious. Area well known for Dorcas hunting. |
| V26_O302F D | 9 | 14/02/2020 | 17/08/2022 | 155 | 2.5 | 2.5 | 02/10/2022 | 2.6 | 1.5 | Carcasse and horns intact. 50% affected by scavengers. |
| V46_O307MD | 9 | 23/04/2019 | 17/08/2022 | 159 | 3.3 | 2.4 | 19/09/2022 | 3.4 | 1.0 | Died at 125 km NE of base near O. Kharma in wet conditions. Photo of intact carcasse with horns from air 26/09/2022 & collar recovered 30/09/2022 |

# 3. Addax

## 3.1 Satellite collars

Following the release of a fourth group of 25 addax (17 female 8 male) on 24/08/2022 after 169 days in prerelease, the number of addax wearing satellite collars rose to 49 of which 45 were reporting location within the previous 7 days at the end of August 2022. By the end of the year there were 46 satellite collared addax of which 42 were reporting within the previous 7 days. These are primarily females 2 & 3 years old plus eight 4–7-year-old addax in a sex ratio of 32F: 10M among collared individuals, Table 4.

**Table 4.** Distribution of satellite collars among 42 founder addax at the end of 2022. OROAWR, Chad.

| Age yrs. | Female | Male |
|---|---|---|
| 2 | 14 | 2 |
| 3 | 13 | 5 |
| 4 | 2 | 1 |
| 5 | 1 | 1 |
| 6 | 2 | 0 |
| 7 | 0 | 1 |
| **Total** | **32** | **10** |

## 3.2 Addax calf detections - 2022

Birth dates of 40 addax calves detected by the monitoring team fall within the 12 months of 2022, bringing the total births detected in Chad to 74 by the end of the year. Births have been found in all seasons with a peak in the favourable early dry season, although it is not yet clear in the first stages of this reintroduction if this is an artefact of reintroduction management or a response to environment, Fig. 3.

Thirteen addax calves were caught by hand and ear-tagged, bringing the total wild born ear tagged sample to 39; just over 50% of all the births discovered. Resighting data from the tagged addax will be analysed to provide statistical survivorship and mortality rate estimates and enable a feed of real field data to population models such as Vortex and others.

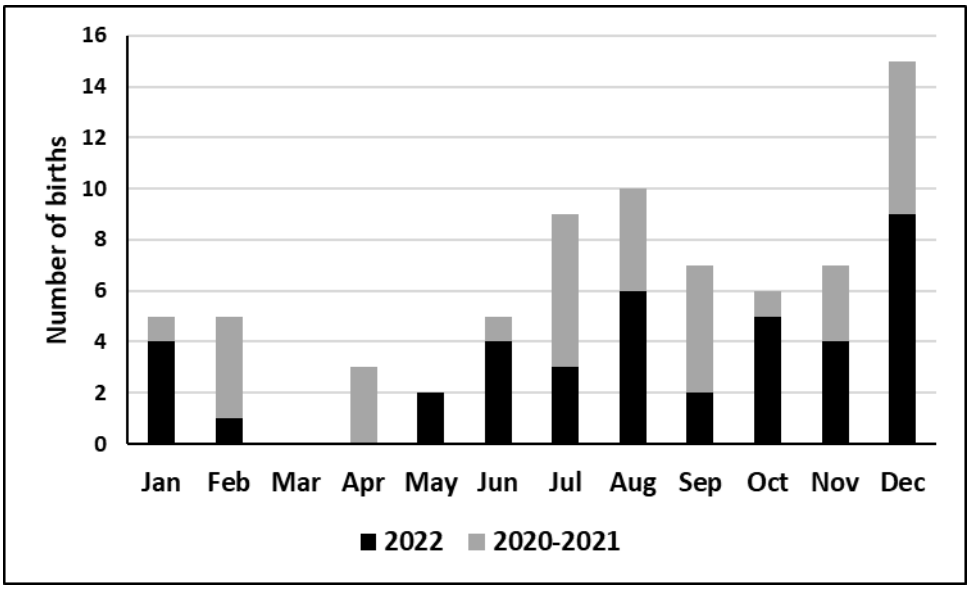


**Fig. 3**. Monthly distribution of 40 addax births recorded in 2022 compared to monthly distribution of all 74 addax births detected at OROAWR, 2020-2022.

## 3.3 Addax mortalities

Four deaths amongst addax were reported in 2022. The backgrounds of all the individuals involved are given with notes on the circumstances in Table 5. Two of them occurred within three months of release and two were attributed to known causes. The group 3 adult male AR22M was seen with a locally bloated lower gut and indication of a puncture wound four days before a mortality alert was received. Inspection of the fresh corpse, although affected by vultures, showed signs of peritoneal infection. The group 4 adult female AR80F was found two days before she died lying with very heavy blood loss around the perineum and refusing/unable to get up when approached to 10m. All carcasses were found with horns intact and no evidence of human involvement in any of these deaths was apparent.

The sample of 12 detected deaths in total since 2020 in this new population is too small to assess any seasonal pattern in mortalities at this stage, Fig. 4.

**Table 5.** Details of 4 addax deaths detected by the monitoring team during 2022.

| Code No. | Release group | Date of birth | Release date | Days in pre-release | Age at release (Yrs.) | Duration collared (mths.) | Date death detected | Age at death (Yrs.) | Survived in the wild (mths.) | Carcasse status when found |
|---|---|---|---|---|---|---|---|---|---|---|
| AR22_O240M | 3 | Not recorded | 10/12/2021 | 24 | >3 Adult | | 12/04/2022 | >3.3 | 4.0 | Seen with suspected puncture wound to lower gut on 08/04/2022; standing hunched and listless; found shortly after death already attacked by vultures, but signs consistent with peritoneal infection confirmed. |
| AR21_O322F | 4 | 14/03/2018 | 24/08/2022 | 169 | 4.4 | | 02/10/2022 | 4.6 | 1.3 | Found intact in upright lying position in long grass, head turned 180° against left shoulder, both front legs extended forward, most body hair missing. Collar in position. |
| AR80_O340F | 4 | 10/12/2016 | 24/08/2022 | 169 | 5.7 | | 16/09/2022 | 5.8 | 0.8 | Loss certainly associated with significant birthing difficulties observed shortly after release and before death. |
| AV32_O331F | 4 | 01/02/2018 | 24/08/2022 | 169 | 4.6 | | 19/12/2022 | 4.9 | 3.8 | Found intact in lateral position; 75% destroyed by scavengers; collar in position. |

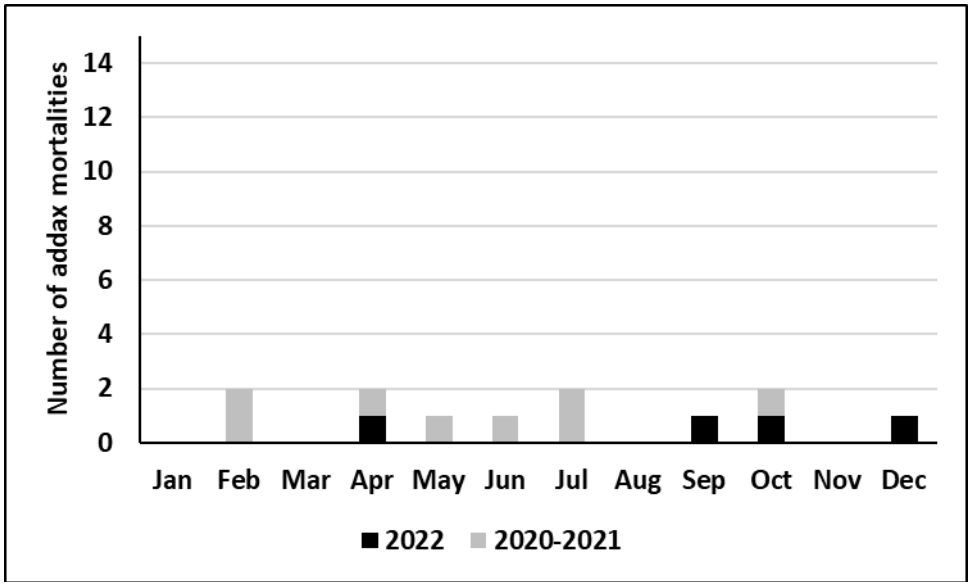


**Fig. 4** Monthly distribution of 4 deaths among addax detected in 2022, compared with the eight other deaths detected 2020-2021. OROAWR.

## 3.4 Addax population size

The naïve estimate of at the end of 2022 is obtained by simple addition of known releases and births and subtraction of known losses, Fig. 5. If it is assumed that 9 additional tagged individuals not confirmed dead but who had not been recorded for 12 months in December 2022, are actually lost, then a conservative estimate of c. 120-130 addax applies, allowing for losses among additional individuals not observed for less than 12 months. This still represents significant positive growth from the 90 founders released over three years.

To date addax encounter rate during transect sample surveys has been far too low to use for density or population estimation from direct observation. It is hoped, as with oryx, this

will improve as the population grows and become a method of choice for assessing oryx and addax numbers for local reserve managers. The resighting data will also be analysed to provide survivorship and mortality rate estimates, which combined with observed birth rate data can be incorporated in population modelling approaches as an alternative route to deriving population growth assessment.

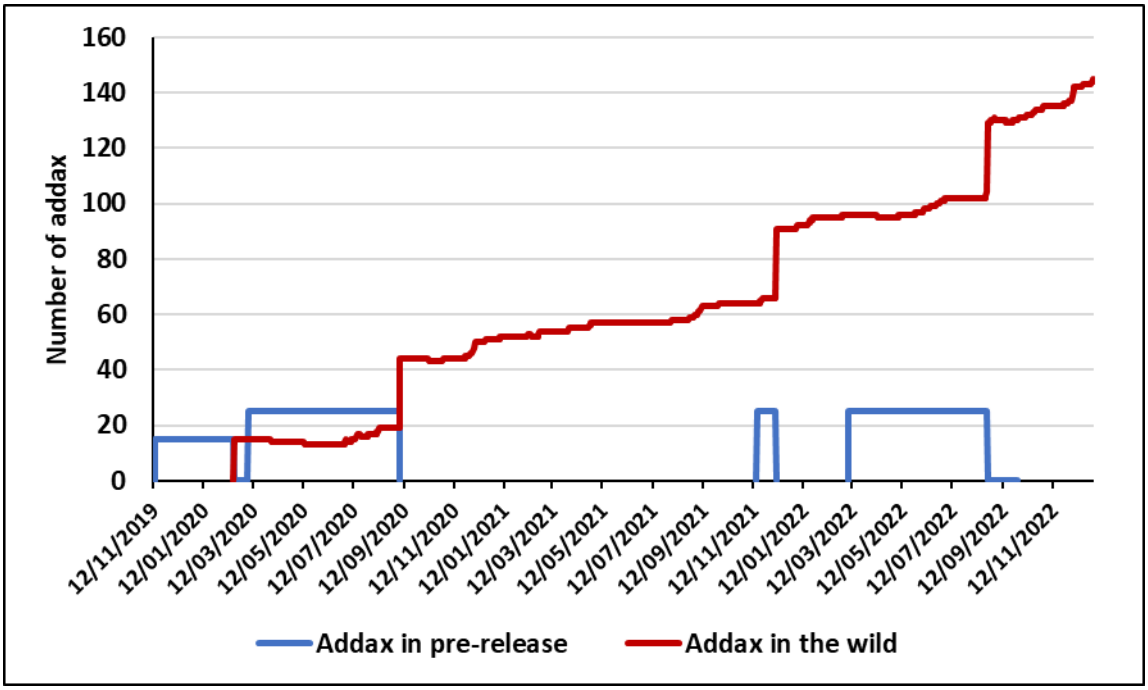


**Fig. 5** Naïve model of addax population growth at OROAWR showing temporal pattern of releases with daily records of detected births and deaths. If it is assumed that 9 tagged individuals not observed for 12 months in December 2022 are lost, the best estimate is c. 130 addax.

# 4. Dama gazelles

## 4.1 Captive breeding group

The management of the small population of captive dama gazelles at the Oryx Base camp is closely documented by the monitoring team and ZSL, Tables 6 & 7. A photo library recording all individuals in the in situ captive breeding project has been established. Photographic series of exactly known-age individuals from calving through to 2+ years of age have been created as standard reference for assessing age and sex of wild individuals. A draft management plan and summary management plan for the captive dama breeding strategy, proposing future breeding plans, potential re-enforcement releases and post-release monitoring was also produced, fulfilling recommendations in the IUCN/SSC Antelope Specialist Group: Dama Gazelle Conservation Strategy 2018-2028.

During 2022 the captive herd increased from 11 individuals to 21. This involved passive capture of one wild male (Andrea) into an empty pen in January 2022; transport of 5

females from EAD Deleika to the Oryx Base camp in March 2022; 10 births and 6 deaths, Table 6.

**Table 6.** Summary of captive dama herd dynamic through

| | Males | Females | Total |
|---|---|---|---|
| **Total 01/01/2022** | 4 | 7 | 11 |
| | | | |
| **Transport from EAD Deleika** | 0 | 5 | 5 |
| **Passive local capture** | 1 | 0 | 1 |
| **Adult deaths** | 0 | -2 | -2 |
| | | | |
| **Births** | 4 | 6 | 10 |
| **Calf deaths** | -3 | -1 | -4 |
| | | | |
| **Total 31/12/2022** | 6 | 15 | 21 |

**Table 7.** Organisation of the dama groups through 4 pens at the Oryx Base camp, OROAWR, 31/12/2022.

Key to origins: Blue = RFOROA; Red=Manga x RFOROA; Green=EAD; Magenta=EAD x RFOROA

| Pen 3 | Pen 4 | Pen 5 | Pen 6 |
|---|---|---|---|
| 005M_Andréa | OY01F_Shaika | 004M_Firmin | 002F |
| | 001F_Habiba | V803F | 003F |
| | OY-02F_Hiti | P011F_V803-01 | 003-01M |
| | 001-01F_Leilani | V802F | YYM_Moussa |
| | OY03M_Kalle | O10F_V802-01 | B013M-002-02 |
| | Y008F_001-02 | V806F | |
| | O009F-OY01-02 | V804F | |
| | G012F_0Y02-01 | | |
| **1M 0F** | **1M 7F** | **1M 6F** | **3M 2F** |

## 4.2 Wild dama

The monitoring team works in close collaboration with the aerial total counts conducted within the dama zone of the reserve by Jaime Dias, WFC, providing lists of recent sighting locations prior to each monthly (dry season) survey flight. Photographs of dama groups taken during the aerial surveys are scrutinised against images of known-age dama held in the captive group to classify the age and sex structure of the remaining wild individuals. This work will be reported on in full in 2023.

# 5. Vehicle-based line transect surveys March and September 2022

Line transect surveys with distance sampling have been conducted in the core area around the release site since 2011. During 2022 two further surveys were completed in March 2022 and an extended version to cover western areas supporting oryx in September 2022. These are the 6th and 7th transect surveys completed since oryx were first released in August 2016. Full reports were submitted separately. Three planned transect surveys were missed because of Covid in 2020.

Results show a steadily increasing mean estimate for oryx population size, but the very large statistical confidence intervals (c.v. close to 50%) stemming from low encounter rates and high group size variability, indicate this is not yet a tool for close monitoring of population change for oryx, Fig. 6 and Table 8. It is as yet even less effective for addax for which no population estimates can yet be obtained from this method.

To provide alternative estimates for oryx and addax, a population modelling approach is being developed (see 2021 annual report) based on the monthly resighting rate data from daily monitoring to estimate survival and mortality rates by age class and sex, coupled with analysis of observed calving rates in the wild. This is being extended to July 2023 to cover a full 7-year cycle of monitoring and will provide an independent estimate of population growth rate.

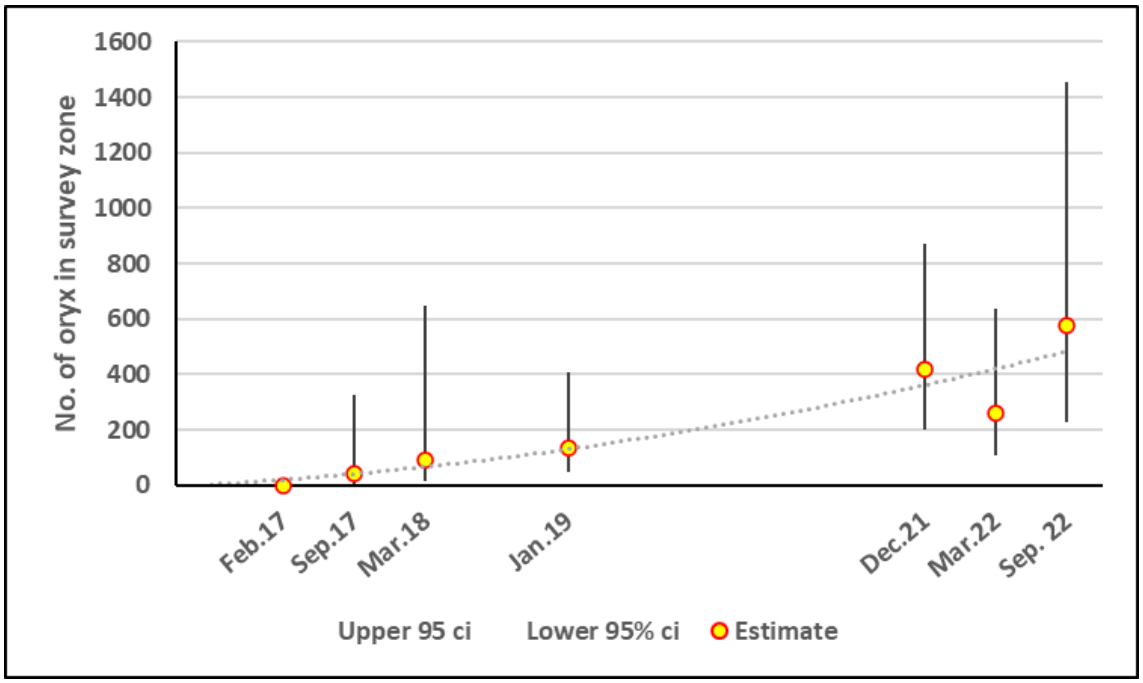


**Fig. 6** Provisional scimitar-horned oryx population estimates from seven line transect surveys conducted since oryx release in August 2016; OROAWR, Chad. [An estimate of zero in Feb.17 results from zero encounters when 24 oryx were present].

The line transect surveys are important for several other reasons.

- Provisions of good quality estimates of the numbers and distribution of dorcas gazelles, Table 9.
- Study of the spatial relationships between livestock, waterpoints and wildlife in the reserve and also between all elements and fire distribution. Figs. 7-9.
- Provision of reasonable estimates of the reserve's endangered large bustard (*Otidae*) population.
- The extensive outputs are achieved efficiently in a four-day program using two vehicles each manned by four trained staff of the oryx project and DFAP.
- There is opportunity to expand the survey area with training of additional staff.

**Table 8**. Oryx population size estimates within the line transect sample zone, comparing results of March and September 2022 with outcomes of previous line transect surveys since the first release in August 2016.

| Survey Date | Total distance (no. of transects) | Oryx density /km2 (95% c.i.) | Oryx population Estimate (95% c.i.) | % C.V. |
|---|---|---|---|---|
| Feb.17 | 345 (8) | **None seen** | **n/a** | n/a |
| Sep.17 | 350 (8) | **0.012** (0.001– 0.09) | **44** (6 - 324) | 105 |
| Mar.18 | 345 (8) | **0.026** (0.003 – 0.19) | **89** (12 - 648) | 105 |
| Jan.19 | 575 (15) | **0.04** (0.003 – 0.19) | **135** (45 - 406) | 57 |
| Dec.21 | 570 (15) | **0.12** (0.06 – 0.26) | **418** (200 - 873) | 38 |
| Mar. 22 | 570 (15) | **0.08** (0.03 – 10.19) | **261** (107 – 639) | 46 |
| Sep. 22 | 632.5 (21) | **0.18** (0.07 – 0.47) | **575** (227 - 1452) | 47.8 |

**Table 9.** Dorcas population size estimates within the line transect sample zones, comparing results of March and September 2022 with outcomes of previous line transect surveys since the survey program began in 2011.

| **Survey Date** | **Total distance km (no. transects)** | **Dorcas density/km²** (95% c.i.) | **Dorcas population estimate** (95% c.i) | **% CV** |
|---|---|---|---|---|
| Feb.11 | 222 (8) | **7.3** (5.5 - 9.5) | **8057** (6157-10543) | 12.67 |
| Sep.11 | 295 (11) | **6.8** (5.34 - 8.7) | **15160** (11867-19341) | 11.79 |
| Sep.13 | 240 (6) | **3.6** (2.05 - 6.3) | **8669** (4940-15211) | 23.36 |
| Sep.15 | 271 (7) | **3.4** (1.7 – 6.8) | **9321** (4733-18356) | 29.21 |
| Feb.17 | 345 (8) | **4.9** (3.8 - 6.5) | **17363** (13218-22808) | 12.71 |
| Sep.17 | 350 (8) | **1.7** (0.9 - 3.2) | **5968** (3221-11058) | 27.19 |
| Mar.18 | 345 (8) | **3.8** (2.5 - 5.9) | **13352** (8781-20301) | 18.62 |
| Jan.19 | 575 (15) | **5.3** (4.3 - 6.7) | **18724** (14980-23403) | 10.70 |
| Dec.21 | 570 (15) | **11.8** (9.4 - 14.7) | **39420** (315854-49199) | 10.65 |
| Mar. 22 | 570 (15) | **12.6 (9.8 – 16.3)** | **42399** (32999 – 54478) | 11.94 |
| Sep. 22 | 632.5 (21) | **6.5 (4.9 – 8.5)** | **20109 (15232 – 26548)** | 13.5 |

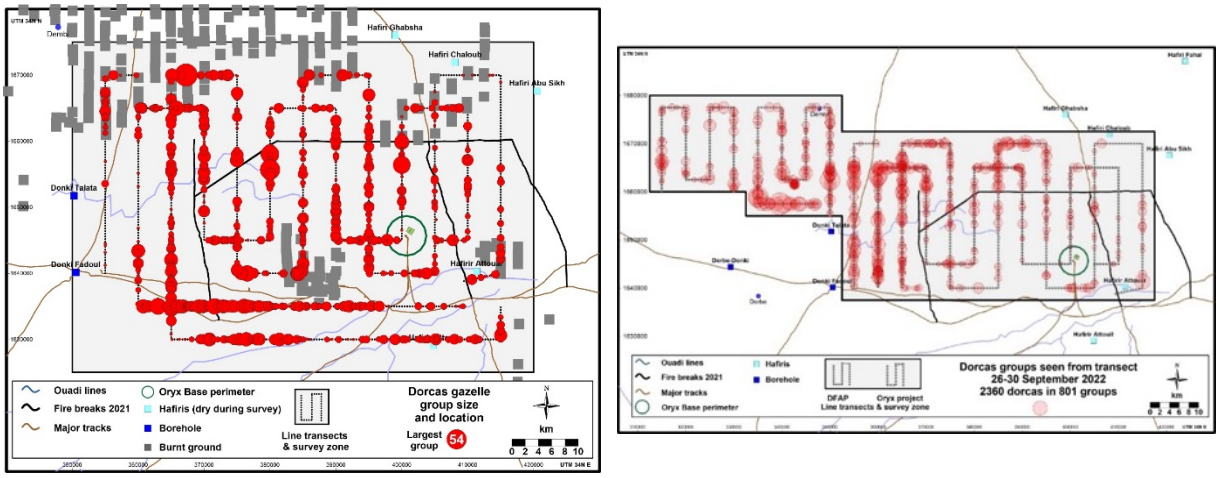


**Fig. 7.** Distribution of dorcas gazelles on line transects March 2022, (left, showing distribution of recent fire in grey) and in the enlarged survey zone of after the rains in Sept. 2022 (right).

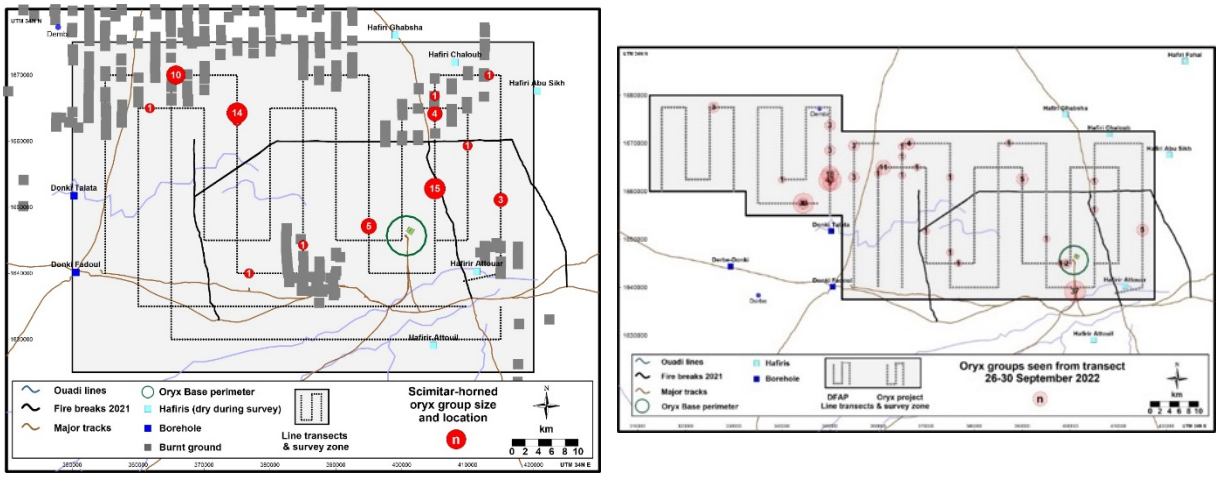


**Fig. 8.** Distribution of scimitar-horned oryx recorded on line transects March 2022 (left, showing distribution of recent fire in grey) and in the enlarged survey zone of September 2022.

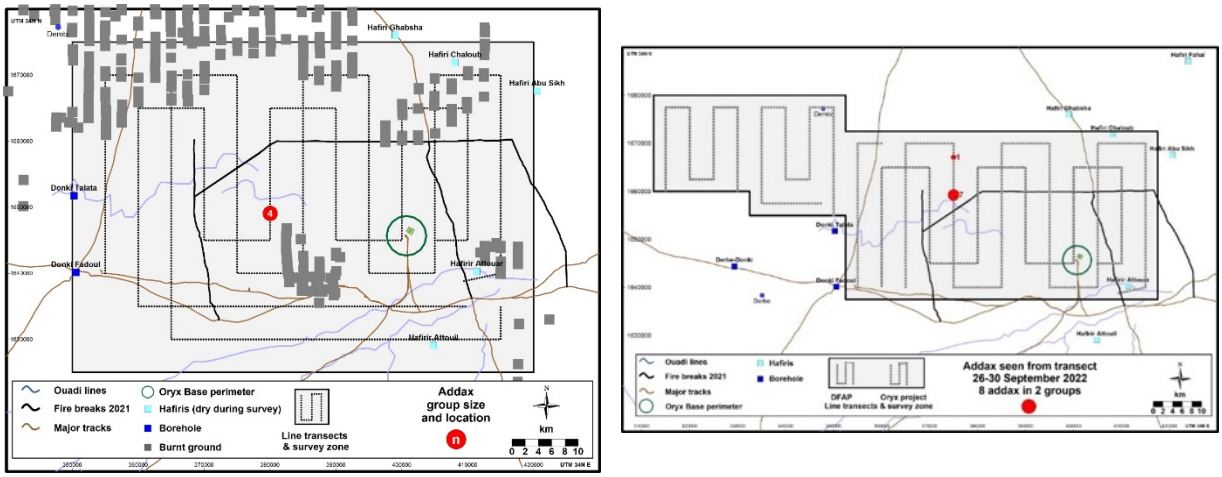


**Fig. 9.** Distribution of addax recorded on line transects March 2022 (left, showing distribution of recent fire in grey) and in the enlarged survey zone of September 2022 (right).

# Partie IV. REMOTE MONITORING OF ORYX

**Katherine Mertes**

Postdoctoral Research Fellow - Smithsonian Conservation Biology Institute

# 1. Status of the reintroduced oryx population

Of 263 founder oryx released into the RFOROA, 162 founders were observed alive between January – July 2022 (current end date of available CyberTracker data). Any founder oryx not observed in the past year is considered a possible mortality. Under this "minimum number known alive" approach, most releases of oryx exhibit a mean annual survival rate > 0.9 (Table 1), with slightly lower survival during the first year after release (paired t-test; p = 0.1). Release 4, which was affected by a massive mortality event in 2018, exhibited the lowest first-year survival rate across all releases.

**Table 1.** Founder survival for oryx releases 1-8

| Release | Time since release (yrs) | Released founders (m.f) | Known living founders (m.f) | Proportion known living | Year 1 founder survival | >Year 1 annual founder survival |
|---|---|---|---|---|---|---|
| **1** | 5.9 | 8.13 | 6.10 | 0.76 | 1 | 0.96 |
| **2** | 5.5 | 6.8 | 4.5 | 0.64 | 1 | 0.93 |
| **3** | 4.9 | 14.23 | 8.11 | 0.63 | 0.90 | 0.95 |
| **4** | 4.5 | 38.35 | 10.22 | 0.40 | 0.50 | 0.98 |
| **5** | 3.9 | 3.20 | 1.10 | 0.48 | 0.74 | 0.94 |
| **6** | 2.8 | 7.17 | 7.8 | 0.63 | 0.71 | 0.97 |
| **7** | 2.6 | 8.18 | 6.16 | 0.85 | 0.96 | 1 |
| **8** | 1.8 | 6.14 | 6.14 | 0.8 | 0.80 | NA |
| **9** | 0.5 | 5.20 | 4.19 | 0.92 | NA | NA |

All founder oryx are marked before release, allowing identification for up to 3 years after release by their GPS collar – and many more years by their ear tag (though some animals have lost ear tags after release). Unmarked Chad-born calves are extremely difficult to identify after they wean from their (marked) dams; thus, direct counts of living calves are likely under-estimates. However, since 2019, the project has marked nearly 150 oryx calves born in Chad with ear tags. SNZCBI personnel are collaborating with the Zoological Society of London (ZSL) and other partner organizations to estimate age-specific survival rates based on data exclusively from marked founders and Chad-born calves. The resulting annual survival rates for each age class will support population growth estimates with narrower confidence intervals than the current "minimum number known alive" approach.

In 2022, the project's monitoring team, Dr. Wacher, and SNZCBI personnel identified a group of "high priority" oryx, and developed a field monitoring regime to observe these individuals at least once each month. Marked, Chad-born calves comprise a large proportion of this group, in order to increase the data available to reliably estimate survival of founder oryx after release, and Chad-born oryx after weaning.

Based on births detected in the field, most releases produce 0.5 – 0.9 calves per surviving female each year, at least 70% of which survive. This production rate has led to a rapidly growing population of reintroduced oryx, divided relatively evenly among founders and Chad-born individuals (Figure 1).

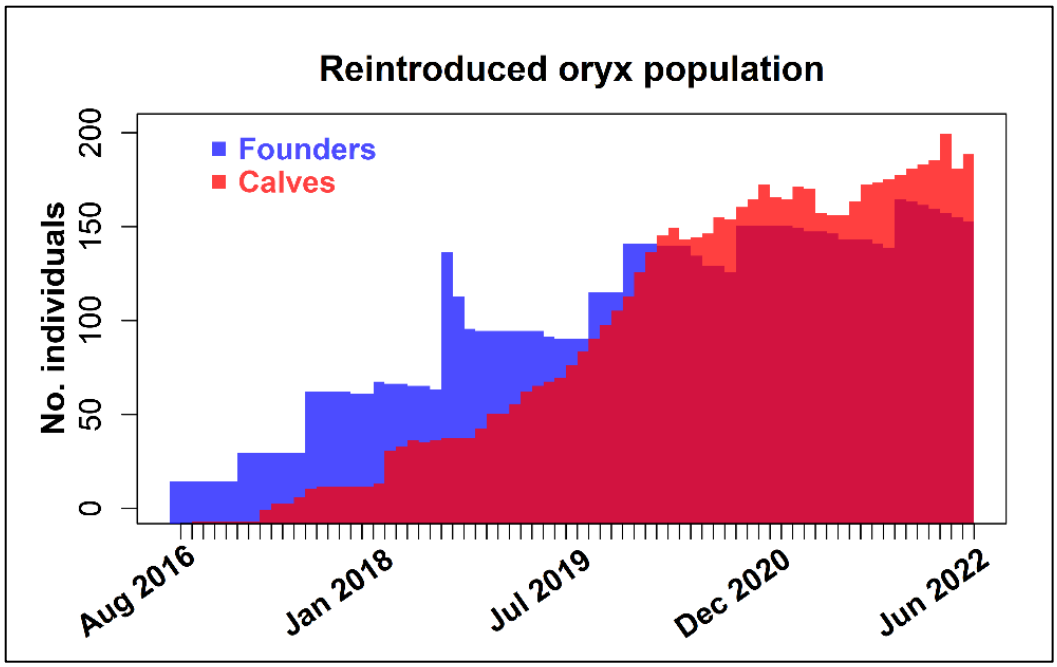


**Fig. 1.** Estimated number of founder and Chad-born oryx in the RFOROA from August 2016 to July 2022. These "minimum number known alive" population estimates are calculated monthly since the first oryx were released in August 2016, and consider any oryx not directly observed during the previous year to be a possible mortality.

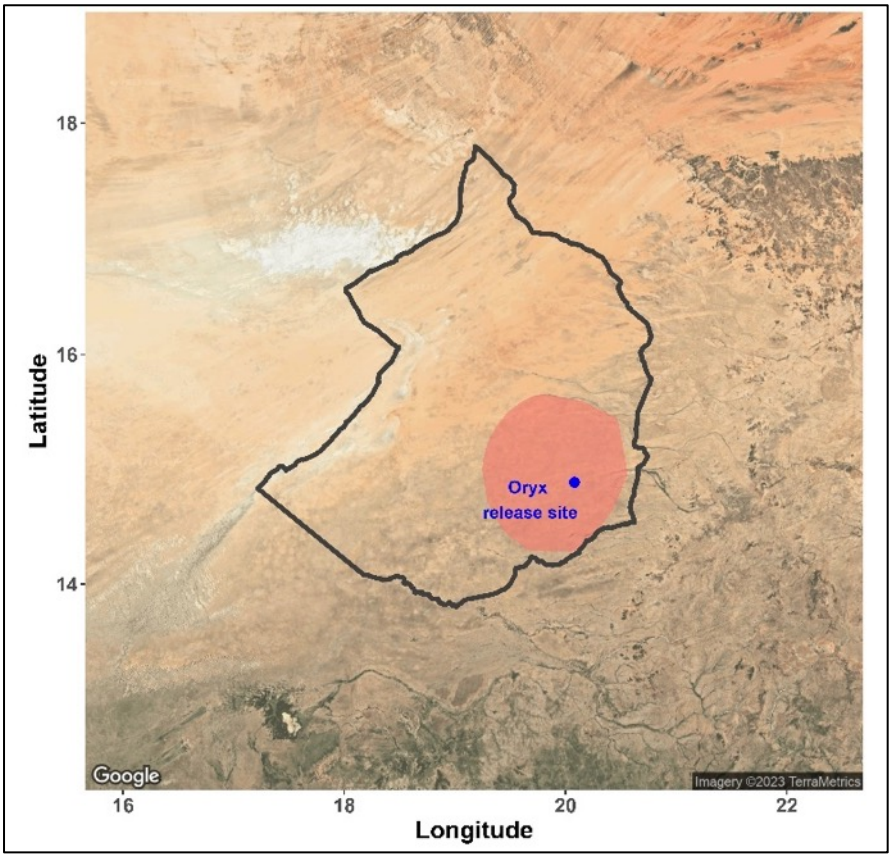


**Fig. 2.** Oryx movement area as of February 2023. Oryx reintroduced into the RFOROA since August 2016 regularly move across an area of nearly 17,000km$^{2.}$

Oryx reintroduced into the RFOROA since August 2016 regularly move across an area about 17,000km2 in size that is roughly centered on the release site (Figure 2). Oryx movements remain largely within the RFOROA, although at least eight animals have been recorded

outside the reserve boundary: B36F, B36_01, B72R35_W277F, N21F, N25F, R33F, and R91F (Figure 3). In most cases, these animals spent very little time outside the reserve, and these excursions were part of atypically long-distance (100-200km) movements.

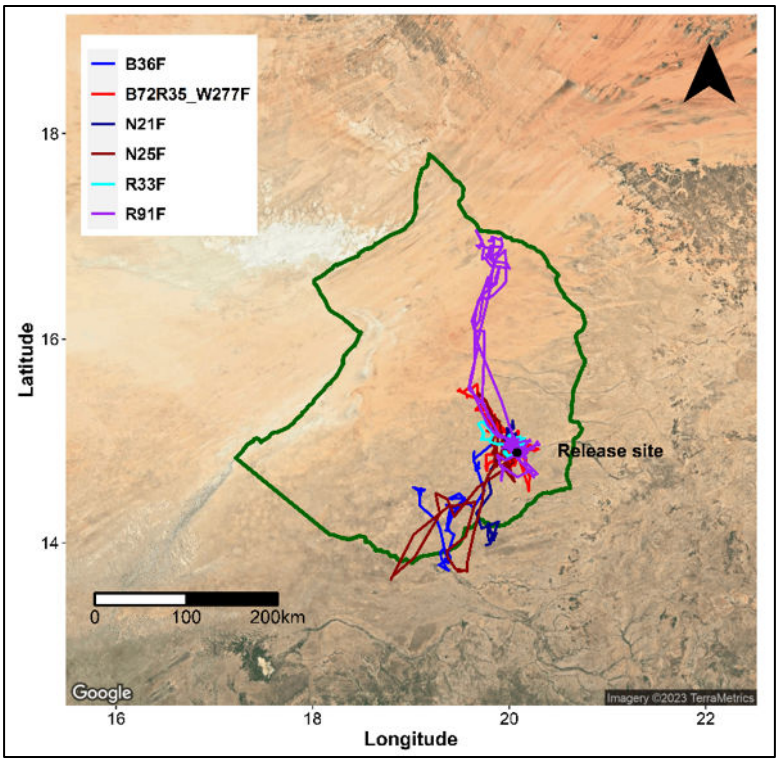


**Fig. 3.** Movements by reintroduced oryx who crossed the reserve boundary. Collar and field data show that eight oryx – B36F, B36_01, B72R35_W277F, N21F, N25F, R33F, and R91F – have ventured outside the reserve boundary to date.

As of March 2023, the Chad reintroduction project has tracked a total of 240 reintroduced oryx for between 4 and 1873 days (Figures 4 and 5) across eight years.

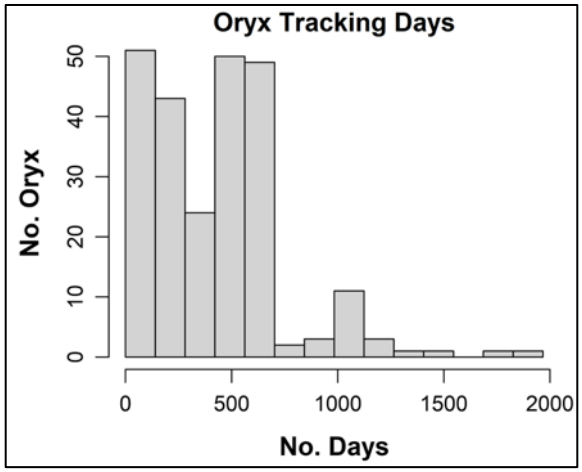


**Fig. 4.** Tracking durations for founder oryx fit with GPS / satellite collars. From 2016 to present, reintroduced oryx with completed deployments were tracked for a median of 475 days (range 4 – 1873 days)

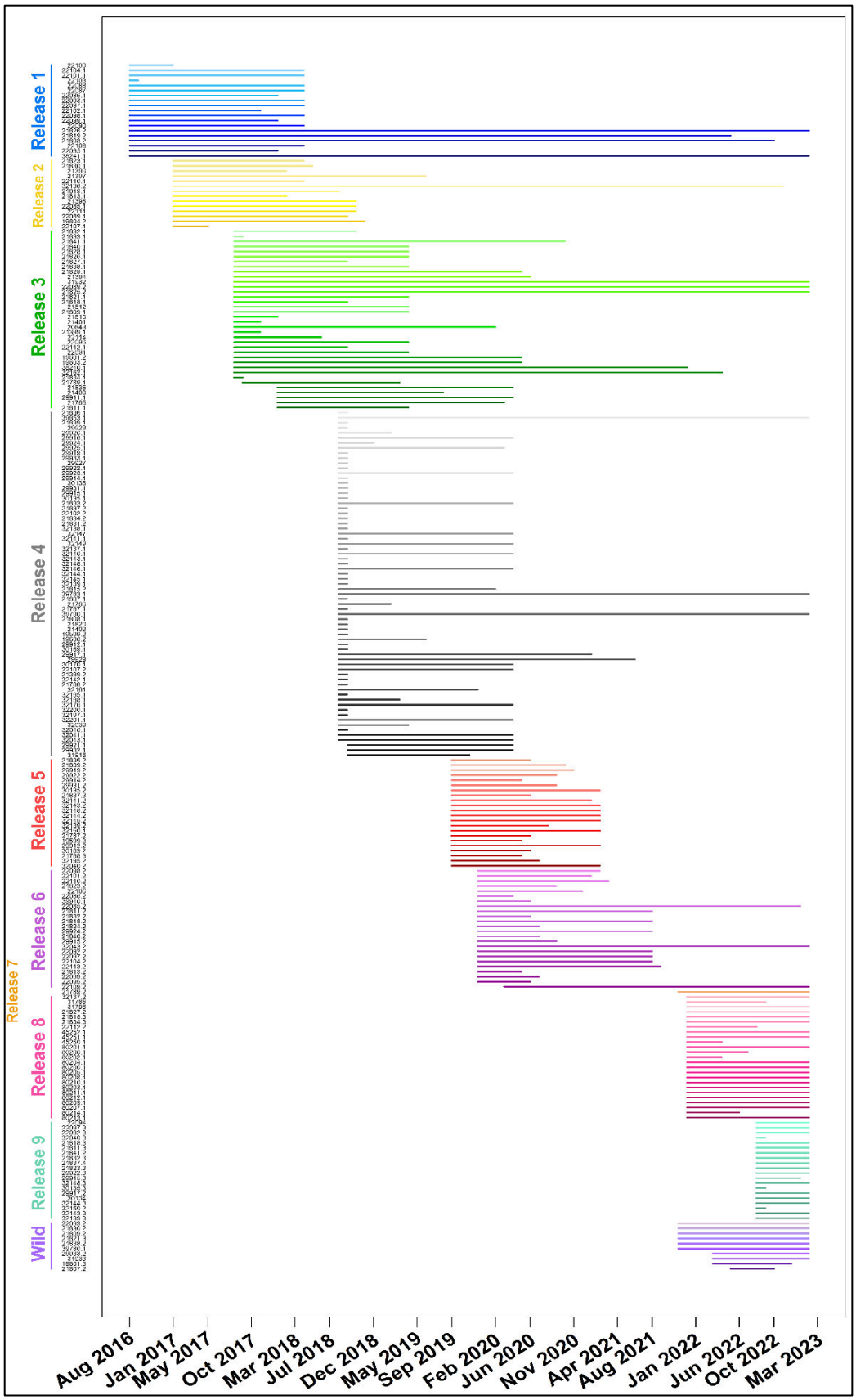


**Fig. 5**. Summary of individual oryx tracked to date.

# 2. Status of the reintroduced addax population

Of 90 founder addax released to date, 83 individuals have been observed in the past year. (Any founder addax not seen alive during the past year is considered a likely mortality.) Under this approach, two of four releases exhibit mean annual survival > 0.9, with slightly annual lower survival during the first year after release (Table 2). However, because addax released in 2020 were not fit with GPS collars, monitoring this group is particularly difficult, and the values shown in Table 2 are likely overestimates of adult survival and underestimates of calf production.

**Table 2.** Founder and calf survival for addax releases 1-4

| Release | Time since release (yrs) | Released founders (m.f) | Known living founders (m.f) | Y1 annual founder survival | >Y1 annual founder survival | Known living calves | Mean annual calf survival | Mean annual per capita production |
|---|---|---|---|---|---|---|---|---|
| **1** | 3.2 | 4.11 | 4.9 | 0.87 | 1 | 19 | 1.0 | 0.48 |
| **2** | 2.5 | 8.17 | 8.16 | 0.96 | 1 | 30 | 1.0 | 0.29 |
| **3** | 1.3 | 8.17 | 7.17 | 0.96 | NA | 4 | NA | 0.35 |
| **4** | 0.6 | 8.17 | 8.14 | 0.88 | NA | NA | NA | 0.94 |

The high founder survival observed across addax releases is promising. However, estimated calf production is lower, compared to reintroduced oryx. Difficulties monitoring addax from Release 2 may explain part of this variation. In addition, many addax in Release 1 exhibited extreme declines in body condition during their first dry season in the wild, potentially leading to aborted or abandoned calves. The number of founder addax is also still relatively small (Figure 6), potentially limiting mating opportunities. Additional monitoring, especially of Release 2 addax, is required to obtain more precise estimates of calf production and survival in reintroduced addax.

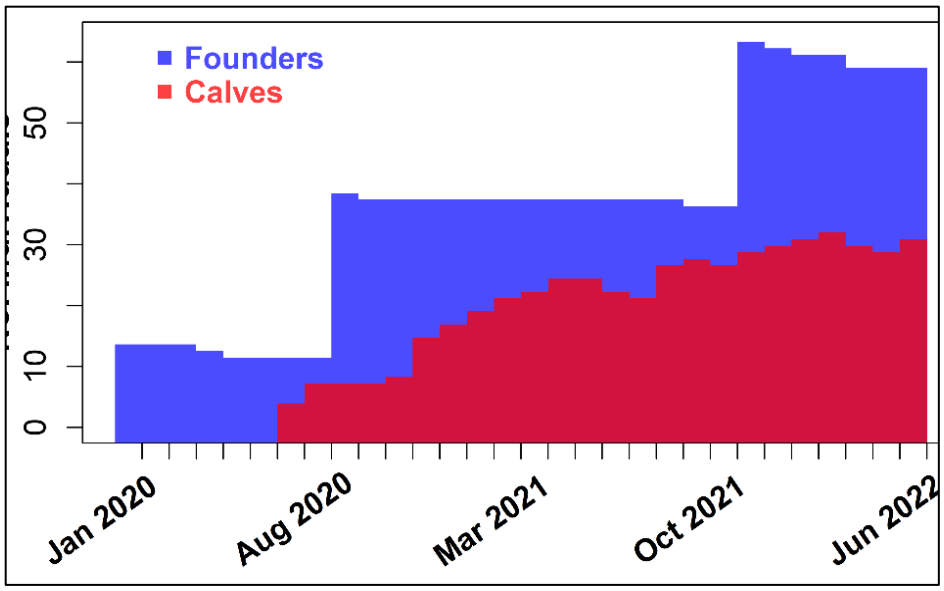


**Fig. 6.** Estimated number of founder and wild-born addax in the RFOROA from January 2020 to July 2022. These "minimum number known alive" population estimates are calculated monthly since the first addax were released in January 2020, and consider any addax not observed during the previous year as a possible mortality.

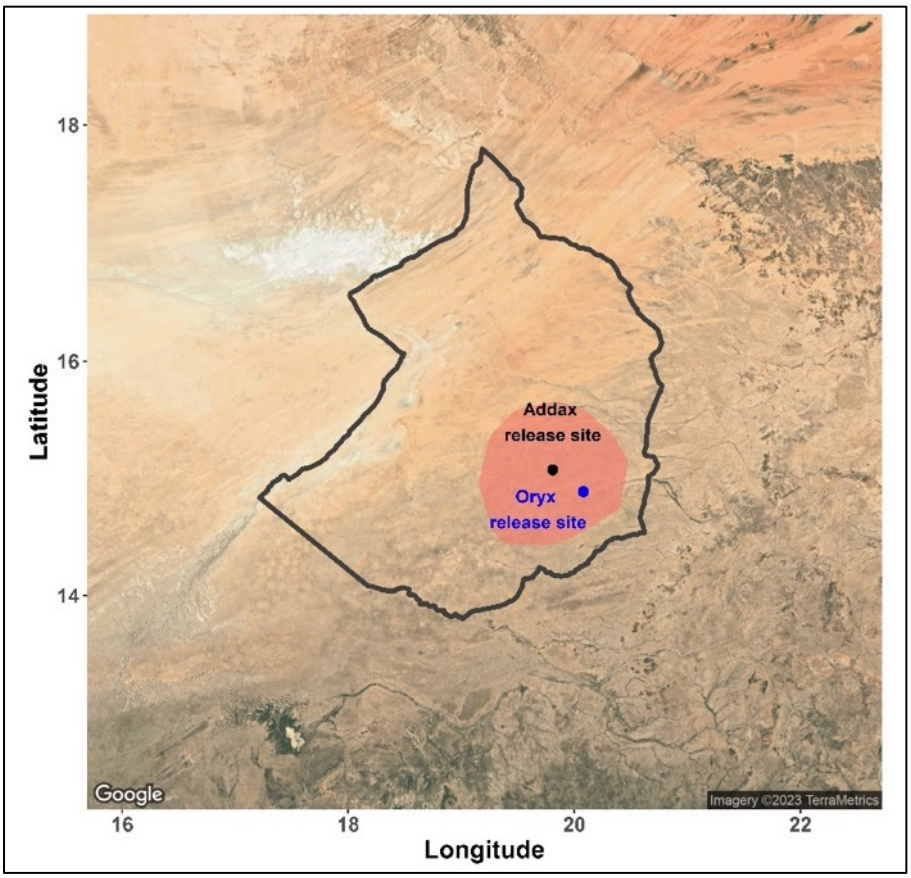


**Fig. 7.** Addax movement area as of February 2023. Based on a 97.5% minimum convex polygon approach, addax reintroduced into the RFOROA since January 2020 are regularly moving across a portion of the reserve ca. 14,000km$^2$ in size.

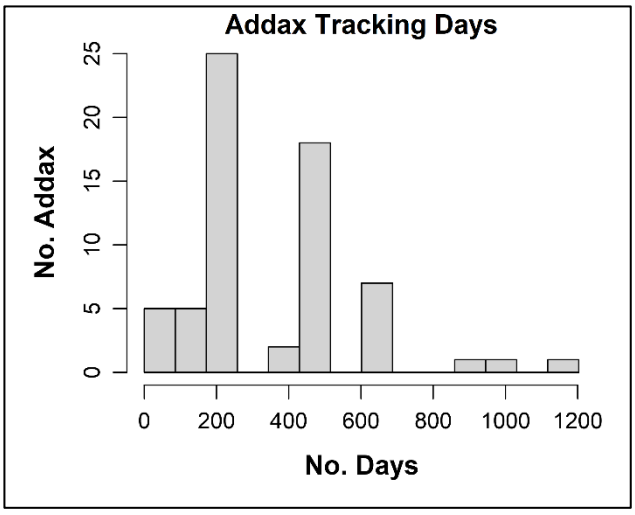


**Fig. 8.** Tracking duration for all reintroduced addax fit with GPS / satellite collars. Reintroduced addax with completed deployments were tracked for a median of 655 days (range 76 – 1146 days)

Based on GPS collars worn by reintroduced oryx during 2016-2019, SNZCBI personnel determined that a 4-hour fix interval was sufficient to estimate quantities important to the reintroduction project, such as seasonal space use and potential home range size, while maximizing tracking duration. Thus from January 2020 to present, reintroduced addax with completed deployments have been tracked for a median of 655 days (Figure 8).

# 3. Applications

- Collaborative research by Sahara Conservation (SC), ZSL, and SNZCBI personnel found that site fidelity did not depend on the amount of time oryx were held before release (Mertes et al. 2019). Instead, post-release experience, source population management, and season of release more accurately predicted oryx dispersal from the release site. This finding led the reintroduction project to initiate oryx and addax releases in the cool, dry season after a relatively short (ca. 1-month) acclimation period.
- SNZCBI personnel analyzed the steps that make up individual movement paths to identify the environmental conditions favored by reintroduced oryx. In this same analysis, we also explored whether (1) experience and (2) information from other animals affected their movement decisions.
    - During dry periods, reintroduced oryx responded negatively to short-term changes in vegetation productivity. They also preferred an intermediate level of long-term vegetation productivity. This pattern indicates that oryx do not spend time searching for (likely scarce) green vegetation at dry times of year. Instead, reintroduced oryx prefer sites where (even dry) vegetation biomass is usually available.
    - More experienced oryx appeared to tolerate higher temperatures during dry periods. However, this pattern is caused by oryx making faster, longer movements at night.

- Also during dry periods, oryx selected sites with higher elevation and lower topographic variation. This result suggests that – somewhat counter to historical observations – oryx did not depend on interdunal depressions at these times of year. Moreover, oryx with more experience showed weaker preferences for these variables, indicating that topography is less important to reintroduced oryx over time.
- In contrast, oryx preferred lower elevations and more complex topography, and showed comparatively stronger selection for short-term change in vegetation productivity and weaker selection for long-term productivity, during wet periods. Together, these results suggest that oryx use interdunal depressions intensively, and seek out green and growing vegetation, much more during rainy times of year.
- Oryx in larger social groups did not show substantially different habitat preferences. However, including the size of an oryx's social group improved overall model fit. This result indicates that oryx do use information from other animals in their social group.

- We conducted an equivalent analysis for addax released in January 2020.
  - Conversely to oryx, during dry periods reintroduced addax responded positively to current vegetation productivity. This relationship was driven by newly released animals: addax with more experience showed weaker selection for currently green vegetation.
  - Also in contrast to oryx, reintroduced addax responded negatively to long-term vegetation productivity during dry periods. However, this relationship was driven by more experienced animals, which showed a stronger negative response to long-term vegetation productivity.
  - Both newly released and experienced addax selected an intermediate level of short-term change in vegetation productivity during dry periods.
  - Along with their positive response to topographic variation during dry periods, these results indicate that addax continue seeking out patches with green vegetation, even at dry times of the year.
  - During wet periods, addax selected short-term increases in vegetation productivity even more strongly than oryx, and showed weak but positive selection for current productivity.
- These results highlight key differences between reintroduced oryx and addax:
  - Oryx generally prefer long-term vegetation productivity, conserve energy during dry periods by avoiding rough terrain and searches for vegetation patches, and maximize energy gain during wet periods.
  - Addax prioritize recent increases in vegetation productivity, searching topographically complex areas for vegetation patches during both dry and wet periods.
- These distinct habitat preferences also partially explain the apparent lack of competition between reintroduced oryx and addax to date.

- SNZCBI shared findings about oryx and addax seasonal space use and habitat preferences through a series of short reports and presentations during the development of the RFOROA management plan. This information was used to propose three "enhanced conservation zones" within the RFOROA that contain critical habitat and resources for oryx and addax in each season.
- Findings about addax habitat preferences, as well as estimated space use with time and population growth, will be used to select a release site for the planned reintroduction of addax into Ennedi Natural and Cultural Reserve.
- Findings about oryx habitat preferences were also published in the article "Experience and social factors influence movement and habitat selection in scimitar-horned oryx (Oryx dammah) reintroduced into Chad" by the journal Movement Ecology (Masolele et al. 2022).
- Collaborative work by POROA, ZSL, and SNZCBI personnel generated training and validation data that SNZCBI personnel used to develop a land cover classification of the RFOROA using multiple types of satellite data. In 2022-2023, the working version of this classification informed the identification of three "enhanced conservation zones" within the RFOROA, and was used to develop consensus with local communities for elements of the reserve management plan.

# 4. Oryx movement seasonality changes with experience

In 2019, the reintroduction project modified its monitoring strategy to assess whether (a) reintroduced oryx with more experience and (b) Chad-born oryx behave differently than recently reintroduced individuals. In 2020, the project began a campaign to capture 50 oryx – 25 founders and 25 Chad-born animals – in the field, collect biological samples from them, and fit them with (replacement) collars. In March 2020, a joint team of EAD, SC, ZSL, DFAP, Institut de Recherche en Élevage pour le Développement (IRED), and SNZCBI personnel

conducted the first field captures, successfully darting, sampling, and recollaring three female oryx released in 2016-2017. During field missions in 2021-2022, 24 additional oryx were captured in the field, sampled, and collared or recollared. Their collars are programmed to automatically detach after a deployment of ca. 3 years; thus, collars fit in March 2020 detached in February 2023. This project milestone offers a valuable opportunity to evaluate how oryx alter their movement behavior as they gain post-release experience.

Oryx reintroduced into the RFOROA gain valuable experience during their first years roaming across the landscape. Notably, after one year of post-release experience, most reintroduced oryx substantially alter their daytime movement rates across the extreme seasons characteristic of central Chad (Figure 9), moving more slowly during daytime hours during the hot, dry season (Mar 13 – July 10), and increasing daytime movement rates during the rainy season (July 11 – Oct 1).

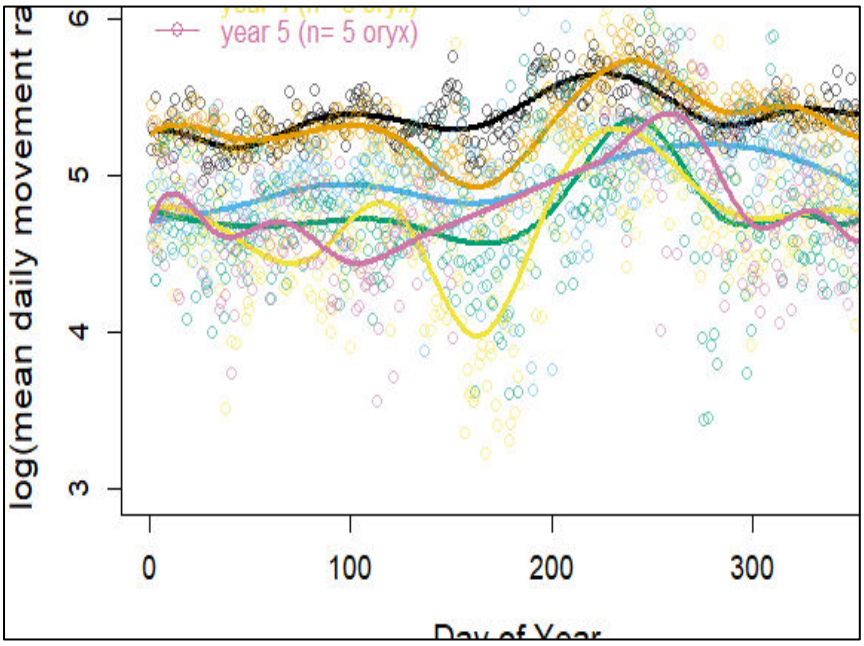


**Fig. 9.** Mean hourly daytime movement rates of reintroduced oryx by day of year and years of post-release experience. After one year of post-release experience, reintroduced oryx show markedly increased variation in movement rates across seasons.

Many reintroduced oryx also develop complex seasonal space use patterns over time. For example, the movements of oryx N23B28F, released as part of Release 1 in August 2016 and recollared in November 2021 (Figure 10), show the development of a seasonal movement pattern. During her first year after release, N23B28F largely remained within a relatively compact area, but engaged in multiple exploratory forays. Five years after release, N23B28F rotated through several seasonal "ranges" or use areas, making a rapid, directed movement to the southwest during the hot, dry season, and another to the northeast during the rainy season.

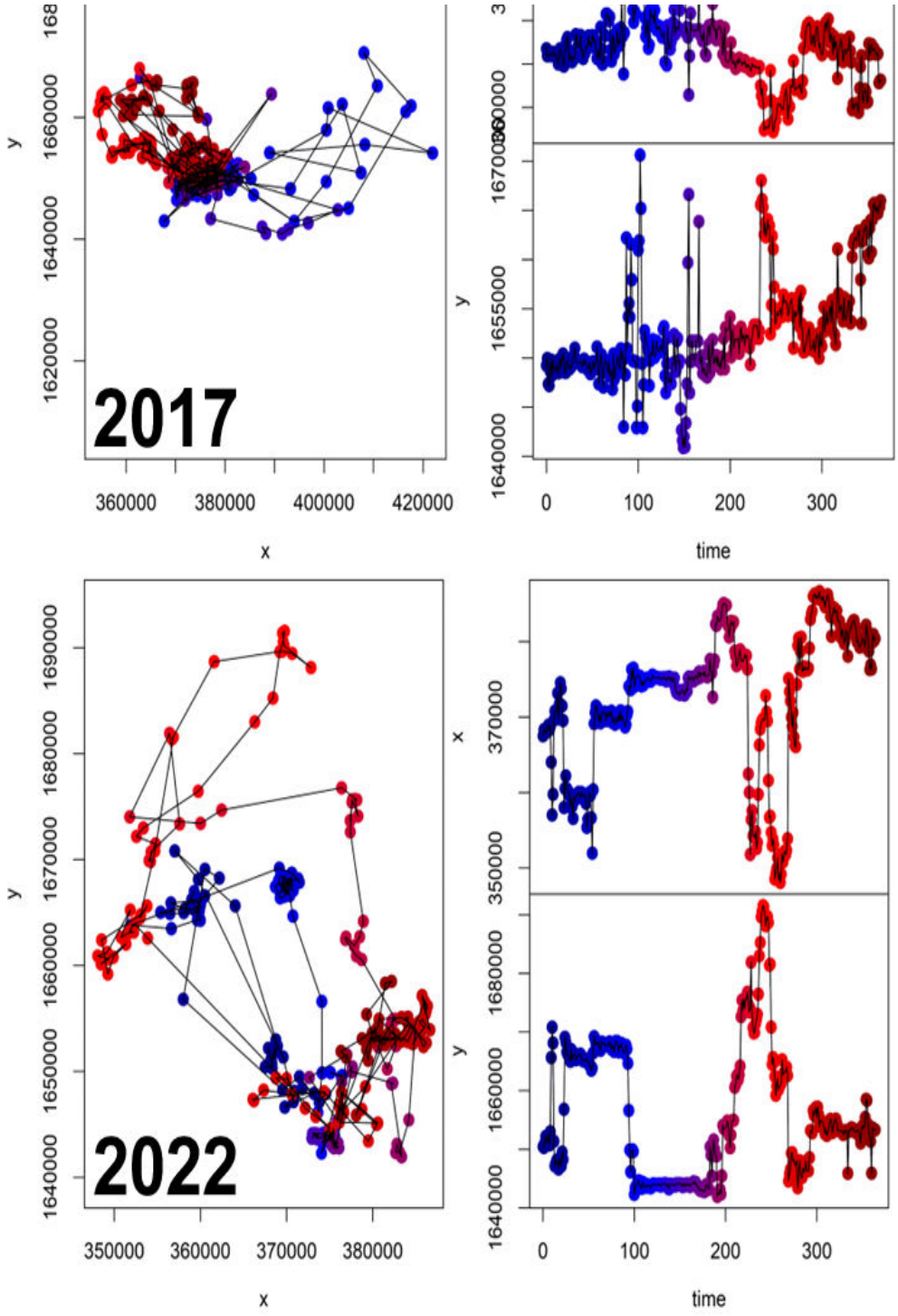


**Fig. 10**. Daily centroids for N23B28F during the first and fifth years after release. Colors indicate location timing during a single calendar year, from older (red) to more recent (blue). Left plots show the animal's daily location in geographic space, while right plots highlight rapid North – South or East – West movements.

Similarly, oryx R43M, released in August 2017, traversed a larger total area and developed quasi-seasonal "ranges" as he gained experience after release (Figure 11).

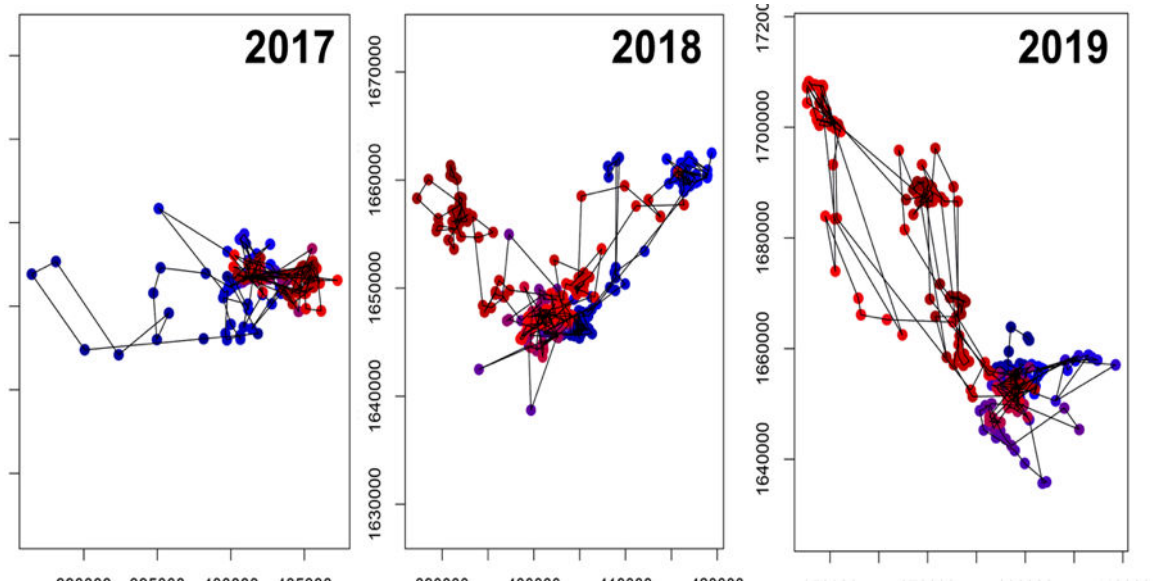


**Fig. 11.** Daily centroids for R43M across 3 years after release (2017-2019). Colors indicate location timing, from older (red) to more recent (blue) each year.

This seasonal variation in space use and movement characteristics is not unique to select individuals, but widespread across oryx with more than one year of experience. Based on the "range shift" methods developed by Gurarie et al. (2017), most oryx with one year of experience exhibit at least two seasonal use areas in a given calendar year, and shift between them relatively rapidly (1-5 days). Less experienced oryx move between seasonal areas in February (near the end of the cool, dry season), while more experienced oryx time their movements near the end of the hot, dry season, or during the early rainy season (Kruskal-Wallis test, $p<0.001$; Figures 12 and 13).

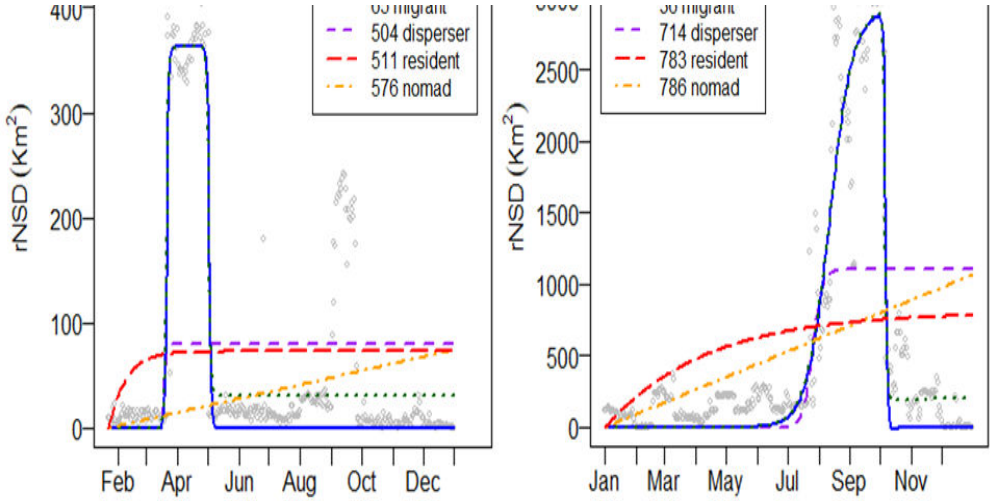


**Fig. 12.** Seasonal movement timing varies among animals with different amounts of post-release experience. Recently released oryx (such as oryx B07F / 21835, left) typically perform seasonal movements earlier in the year than oryx with greater post-release experience (such as oryx B32M / 21827.2, right)

In addition, more experienced oryx occupy seasonal areas significantly further away from the release site than less experienced oryx (Kruskal-Wallis test, p=0.014; Figure 14).

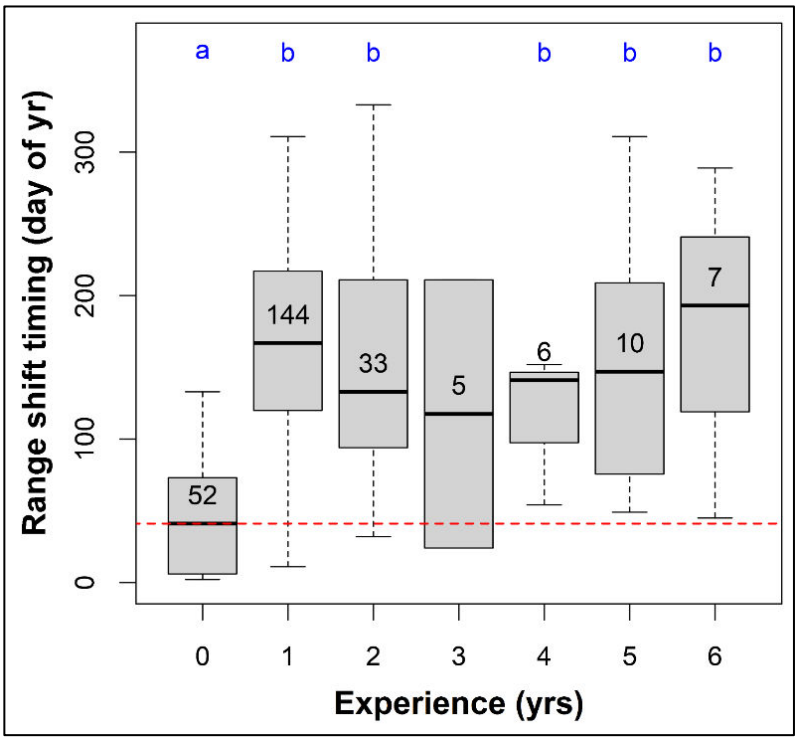


Fig. 13. More experienced oryx time movements between seasonal areas later in the year. Oryx with a maximum of one year of experience move between use areas around February (end of the cool, dry season), while oryx with more experience move between use areas during the late hot, dry or early rainy seasons. Letters indicate significant differences in movement timing by years of experience (Dunn's post-hoc test, $\alpha$ = 0.05, Bonferroni correction for multiple comparisons)

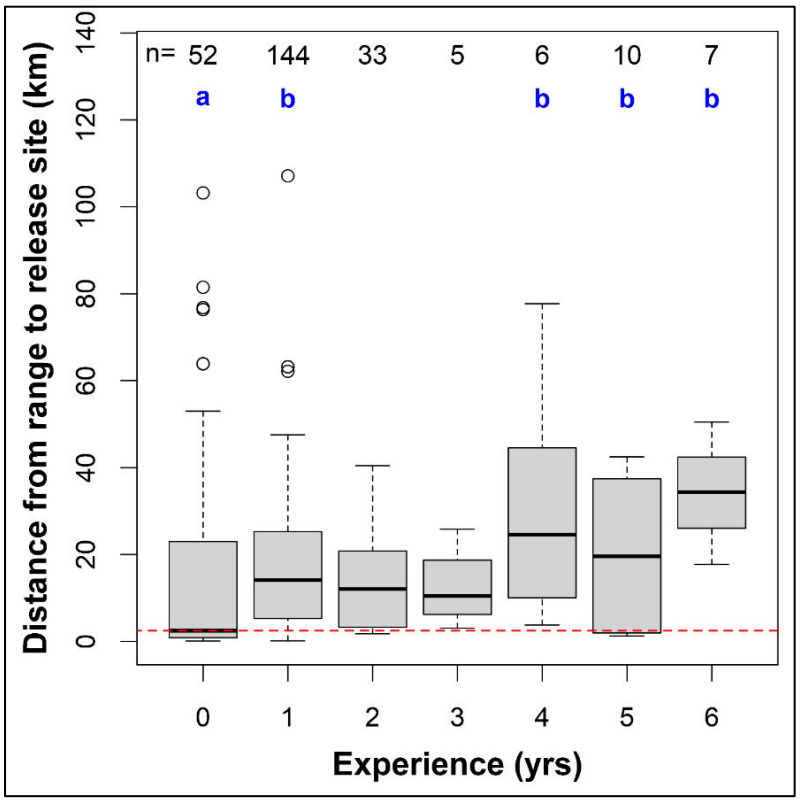


**Fig. 14.** More experienced oryx occupy seasonal use areas further from the release site. Values are straight-line distances between centroids of individual seasonal use areas and the release site. Letters indicate significant differences in distance from release site by years of experience (Dunn's post-hoc test, $\alpha = 0.05$, Bonferroni correction for multiple comparisons)

# 5. Comparative space use and movement behavior by reintroduced oryx and addax

Today, reintroduced addax move across an area about 14,000km2 in size (Figure 7), while reintroduced oryx move across about 19,000km2 (Figure 2). These "core" movement areas for each species remain roughly centered on the release site. While this spatial pattern cannot strictly be termed "site fidelity" – because individuals from each species regularly travel >50km from the release site, and many individuals never return to the release site – it supports the pre-release assessment of the release site as high-quality habitat. In addition, space use by each species has increased relatively similarly over time, and with additional releases of animals into the reserve (Figure 15).

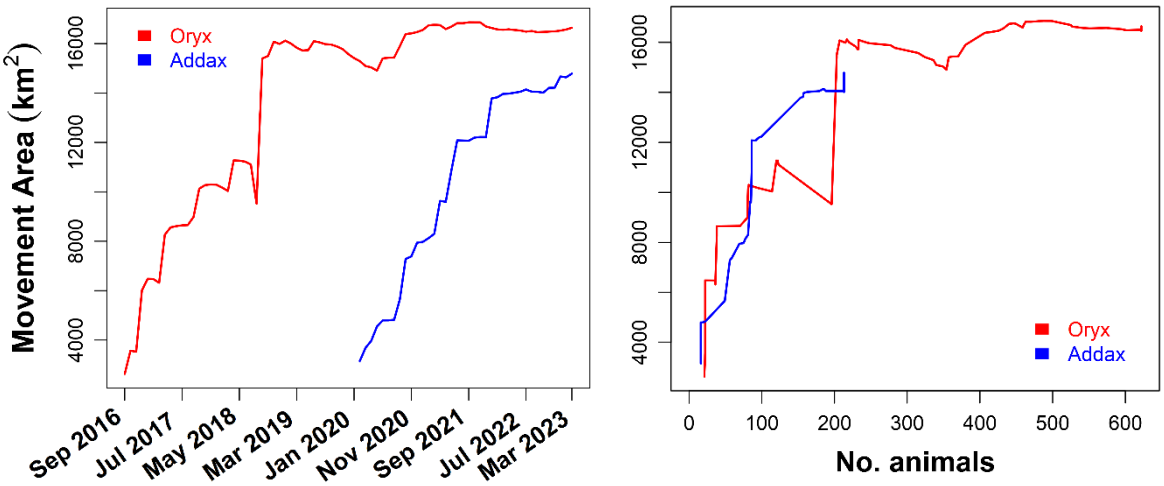


**Fig. 15.** Cumulative monthly space use by reintroduced oryx and addax. Lines show the area (of 97.5% minimum convex polygons) from both field observations and collar positions, cumulative over time (left) and the number of animals observed in the population (right). Oryx are shown in red and addax are shown in blue.

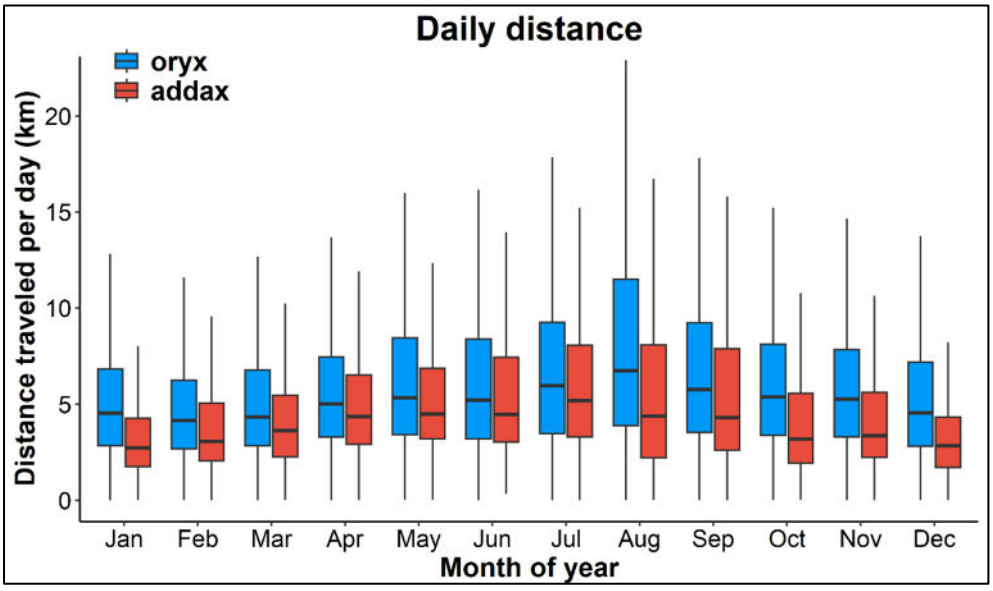


**Fig. 16.** Reintroduced oryx move further each day than addax. Input data include 5953-10220 (oryx) and 1378-2628 (addax) measurements of daily distance moved, as measured by GPS collars.

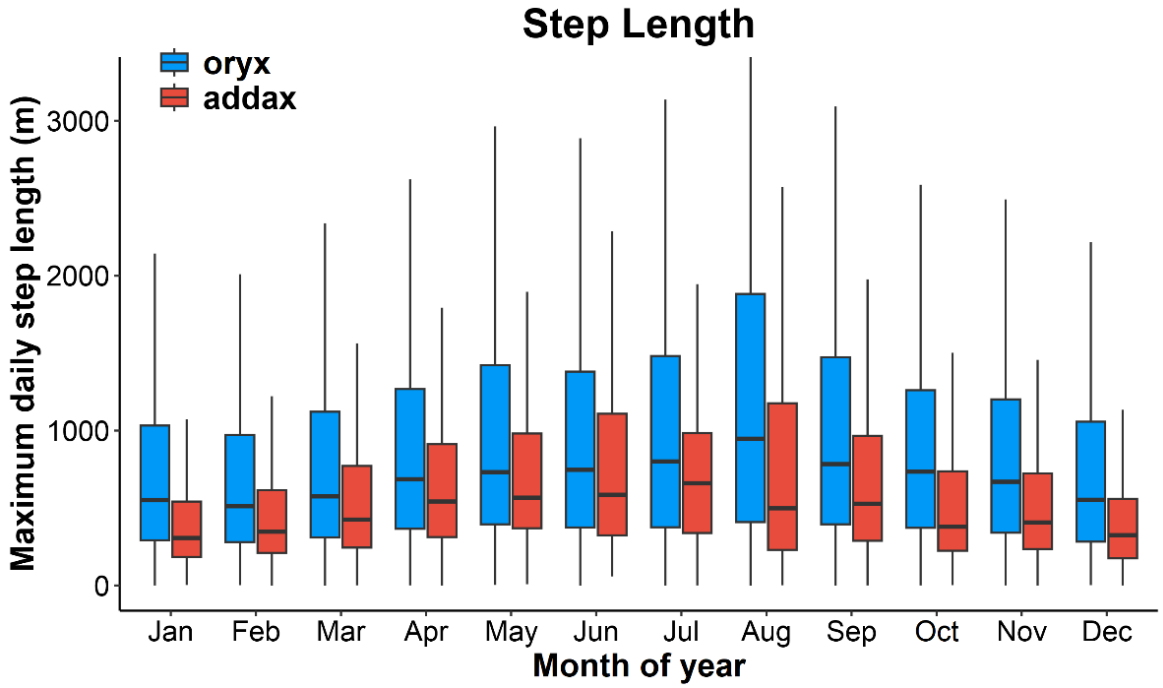


**Fig. 17.** Reintroduced oryx typically take longer steps than reintroduced addax. Data used to make this figure include 5953-10220 (oryx) and 1378-2628 (addax) daily measurements of individual movement steps, as measured by GPS collars.

In addition to differences in habitat preferences, reintroduced oryx and addax also show substantial differences in movement behavior. Across all months, reintroduced addax travel shorter distances (Figure 16; paired t-test $p<0.001$) and take shorter steps (Figure 17; paired t-test $p<0.001$) each day, compared to reintroduced oryx. In addition, reintroduced oryx cover more ground each day during the late rainy season and early cool, dry season, while reintroduced addax increase their daily distance traveled during the late hot, dry season and early rainy season. These results align with our step analysis, indicating that (i) oryx will move relatively great distances during the rainy season to maximize gains in body condition, and (ii) addax will seek out green vegetation, even at dry times of year.

# 6. Capture, sampling, and collaring activities in 2022

During July 18 - 21, 2022, a joint team of EAD, SC, DFAP, IRED, and SNZCBI personnel conducted brief veterinary exam and collar fit operations for 20 oryx and 25 addax that had been housed in the project's pre-release enclosures since their translocation from EAD in March 2022 (Figures 18-22).

**Fig. 18.** Joint team of EAD, SC, DFAP, IRED, and SNZCBI personnel conducting pre-release examination and collar fitting operation

**Fig. 19.** Telemetry training exercises in July 2022. Sahara Conservation ecological monitoring personnel Taboye AbdelKermin, Kher Issakha, and Oumar Mahamat operate a 3-element Yagi antenna and R-1000 receiver during a telemetry training exercise.

During these operations, SNZCBI personnel provided training on collar programming, fitting collars to oryx and addax, and conducting VHF telemetry to SC, DFAP, and IRED personnel (Figure 19). SC ecological monitoring team lead Caleb Ngaba assisted in fitting collars to more than half the animals collared in July 2022. All collars were programmed to take GPS fixes at 4h intervals, record accelerometry data at 8 Hz, and automatically detach after 147-170 weeks (most 156 weeks). Collared oryx had a median neck size of 54.5 cm (range 47–63) and addax a median of 55 cm (range 39–64). All neck measurements will be added to the SNZCBI neck size database to improve neck size predictions for future releases.

**Fig. 20.** SC and SNZCBI personnel after a planning meeting, July 2022

**Fig. 21.** Collared addax in pre-release pens, July 2022

**Fig. 22.** Collared oryx in pre-release pens, July 2022

# 7. OROAWR One Health project and field mission

After the massive mortality event that impacted oryx in 2018, SNZCBI initiated a collaboration with Sahara Conservation, the University of Edinburgh, IRED, the Veterinary Services Department (DSV), the Animal Health Division (DSA), and CIRAD to better understand the diseases circulating in wildlife and livestock in the OROAWR. In 2020, this collaboration obtained a grant to collect biological samples and perform disease testing. From September 23 to October 1, 2023, a joint team of personnel from IRED, DSV, DSA, the University of Edinburgh, and SNZCBI conducted a field mission in the OROAWR to collect biological samples from camels, cows, sheep, and goats.

In August 2022, the Community Sensitization and Education team (CSE) of the POROA project conducted advance visits to pastoralist communities in the OROAWR (Figure 23). During these visits, CSE personnel identified potential sampling sites and collected standardized information about herd size, herd composition, grazing practices, and livestock care practices. Based on this information, CSE and SNZCBI personnel selected three clusters of sampling sites that could be reached from the base oryx and the CSE headquarters in Arada: Missimeme, Al Argané, and Abu Naga (Figure 24).

**Fig. 23.** Advance meetings for the OROAWR One Health project field mission. Advance visits by the POROA CSE team with pastoralist communities are shown in the upper left, upper right, and lower right; a pre-mission meeting among field mission team members is shown in the bottom left.

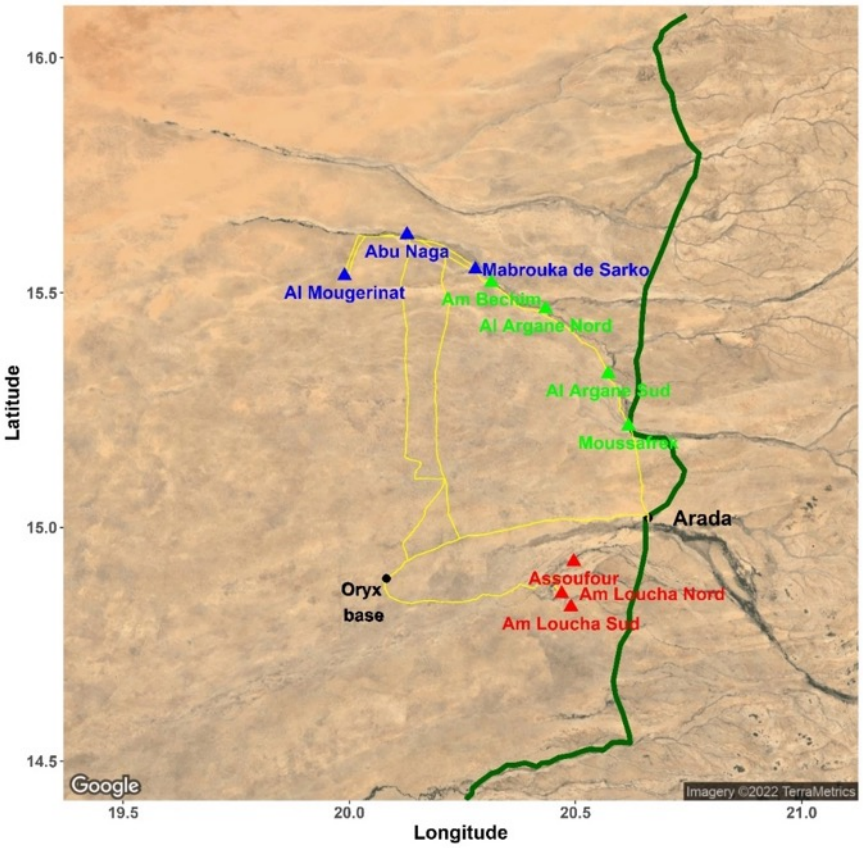


**Fig. 24.** Map of locations where samples were collected from livestock roaming the OROAWR. Each cluster of sampling sites is shown in a different color; driving routes are shown in yellow; the boundary of the RFOROA is shown in dark green.

Across three, three-day missions to each cluster of sampling sites, the field mission collected 396 sets of samples from camels (CM), cows (BV), sheep (OV), and goats (CP; see Table 3). The CSE team engaged members of local livestock development associations to assist in restraining animals, greatly increasing the animals that could be processed at each site. All livestock owners who opted to participate in the sampling activities received veterinary treatment for animals identified as ill (Figure 25).

**Fig. 25.** Veterinary treatment during the field mission. Left: veterinarian Dr. Mahamat Oumar, DSA, treats a camel with respiratory difficulties. Center: Tchari Ndoungous, IRED Director of Immunology and veterinary technician, and Dr. Stephanie Brien, University of Edinburgh PhD candidate and veterinarian, treat a sheep with an open wound. Right: Dr. Oumar and several treated camels

**Table 3.** Animals sampled during the OROAWR One Health field mission.

| *Species* | *Site 1* | | | *Site 2* | | | *Site 3* | | | ***TOTAL*** |
|---|---|---|---|---|---|---|---|---|---|---|
| BV | 8 | 16 | 9 | 8 | 8 | 12 | 0 | 16 | 8 | **85** |
| CM | 11 | 17 | 8 | 10 | 20 | 6 | 11 | 18 | 8 | **109** |
| CP | 3 | 13 | 11 | 9 | 21 | 10 | 8 | 24 | 8 | **107** |
| OV | 12 | 13 | 5 | 11 | 9 | 10 | 8 | 13 | 14 | **95** |

Each blood sample was centrifuged to yield serum, which was divided into 2ml aliquots stored in cryovials, and processed using hematocrit methods to yield sample of buffy coat stored on Whatmann paper (see Figure 26). Each sample of whole blood in EDTA was also aliquoted into 2ml cryovials after preservative absorption. One aliquot of each sample type was deposited with IRED; the remaining aliquots will be shipped to CIRAD in early 2023 for disease analysis. On October 5, 2022, IRED, SC, U of Edinburgh, and SNZCBI personnel presented a short report of the field mission to interested personnel from Chad-based agencies and projects, including DFAP, IRED, DSA, DSV, the University of N'Djamena, PRAPS, and PREPAS.

**Fig. 26.** Mobile field laboratory used to process samples collected during the field mission. Equipment included sampling supplies, portable centrifuges, portable freezers, portable generators, solar panels, and basic office supplies.

# 8. Conclusions and recommendations

## 8.1 Protect emerging seasonal habitats and movements

Many reintroduced oryx – especially more experienced individuals – are engaging in directed seasonal movements within the OROAWR. Reserve management policies should protect the areas oryx prefer in each season, as well as wide corridors for reintroduced oryx to move between them.

## 8.2 Continue toward a « long-term monitoring group" of 50 oryx

Based on a power analysis, 50 animals represent the minimum sample size to detect actual differences in survival across at least four oryx releases. In field missions in 2020-2022, teams efficiently captured, sampled, and collared 27 oryx. However, three collars from this group dropped in February 2023. Reaching a long-term monitoring cohort of 50 oryx will both standardize monitoring efforts and strengthen the project's ability to detect population and demographic trends.

## 8.3 Continue integrating multi-species monitoring efforts

Monitoring reintroduced oryx, addax, and ostrich has grown in complexity over time, and now requires detailed planning, strategic decision-making, and intensive data management. Quarterly meetings to assess whether the current field work strategy meet monitoring targets, and maintaining vehicles for multiple monitoring teams each day, are essential to achieve the proposed monitoring coverage for all species.

## 8.4 Focus monitoring effort on marked oryx

Because the reintroduced oryx population is growing so rapidly, and because unmarked juvenile and sub-adult oryx typically cannot be individually identified, observations of unmarked oryx provide relatively limited information. In contrast, every observation of a marked Chad-born or founder oryx contributes to a timeline of survival probability, space use, and social dynamics. Thus, focusing monitoring effort on groups of oryx that contain marked animals will be a more efficient strategy, and yield monitoring data of greater long-term utility.

## 8.5 Collect DNA samples from wild-born calves via buccal swab

The primary opportunity to collect biological samples from wild-born oryx and addax is soon after birth, when calves may be captured and ear-tagged by monitoring personnel. In March 2022, personnel from the University of Edinburgh demonstrated a protocol developed

by the Royal Zoological Society of Scotland (RZSS) that uses a buccal swab to collect DNA from an ear-tagged calf. DNA samples from Chad-born calves may provide insights on parentage, population genetics, and disease exposure. These analyses may also pave the way for future monitoring using non-invasive DNA samples.

## 8.6 Deploy camera collars on a subset of reintroduced oryx and addax

A previous collaboration among SC, Fossil Rim Wildlife Center, and SNZCBI showed that the additional weight of camera attached to a GPS / satellite collar (ca. 600g) does not negatively affect oryx health. In addition, mean activity budgets captured by camera collars were equivalent to those estimated by an external human observer (overall Wilcoxon signed-rank test, $p=0.24$). Camera collars thus represent a cost-effective tool to assess animal behavior after release, evaluate spatial overlap with livestock and wildlife – and thereby potential human-wildlife conflict – and identify gregarious individuals that may act as vectors for infectious diseases. Camera collar data may also be used to further develop accelerometry-based models of oryx behavior. Moreover, images and videos recorded by camera collars are extremely useful for outreach, communication, and other public-facing materials. We recommend that select oryx and addax in good body condition be fit with camera collars in 2023-2024.