



الأمانة العامة لصون المحصا العربي General Secretarlat for the Conservation of the ARABIAN ORYX

The General Secretariat for the Conservation of The Arabian Oryx

MIDDLE EAST ARABIAN ORYX DISEASE SURVEY

3rd Edition

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The General Secretariat for the Conservation of the Arabian Oryx (GSCAO) was established in 2000 as a regional initiative with a key role of supporting all efforts to protect and conserve the Arabian Oryx, to agree regional criteria and standards, and to coordinate efforts between range states.

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ABBREVIATIONS

AO: Arabian Oryx BTV: Blue Tongue Virus CCPP: Contagious Caprine Pleuro Pneumonia EAD: Environment Agency - Abu Dhabi EHDV: Epizootic Hemorrhagic Disease Virus FMD: Foot and Mouth Disease GSCAO: General Secretariat for the Conservation of the Arabian Oryx KWRC: King Khalid Wildlife Research Center NWRC: National Wildlife Research Center OIE: Office International des Epizooties = World Organisation for Animal Health PPR: Peste des Petits Ruminants TB: Tuberculosis UAE: United Arab Emirates

DEFINITIONS

The below definitions were developed and included to serve the purposes of the questionnaire.

Reintroduced herd into the wild

- The herd is free-ranging.
- The herd lives on natural resources and does not require supplementation.
- The herd's diet is not supplemented with food artificially.
- It occurs in its natural habitat within the historical distribution range of the particular species.
- The particular species' social requirements are met at all times.

Managed population

- It is free-ranging (managed wild population) or semi free-ranging.
- It lives on food from natural resources which may require supplementation.
- It occurs in its natural habitat within the historical distribution range of the particular species.
- The particular species' social requirements are met at all times.

Captive-bred population

A population bred under controlled unnatural conditions is considered to be captive bred.

Dystocia

Dystocia is a pathologic or difficult labor, which may be caused by an obstruction or constriction of the birth passage or abnormal size, shape, position, or condition of the fetus. This condition usually requires human intervention.

Stillbirth

Stillbirth is a delivery of a fully formed dead neonate.

Abortion

Abortion is a premature expulsion from the uterus of the products of conception; termination of pregnancy before the fetus is viable. Most of the time, an early abortion will not be noticed at all. When an abortion occurs during the last stage of pregnancy it can be confused with a stillbirth. Some abortions can also cause dystocia, for instance when the fetus is decaying within the uterus and becomes swollen.





SUMMARY OF KEY FINDINGS

- The response rate for this third edition of the Middle East Arabian Oryx Disease questionnaire was 88%, with a total of 26 collections participating in the survey, sites.
- A total of 12,879 Arabian Oryx across the range states were covered in this disease survey. The numbers of Arabian Oryx recorded in the UAE represented 79.24% of the total numbers of Arabian Oryx covered in this survey.
- Forty nine (49%) of the recorded Arabian Oryx in this survey are categorized as captive-bred, while 23% are considered managed populations and 28% as released into the wild.
- As far as record keeping is concerned, Excel is the most common system used by Arabian Oryx collections (20 out of 43) covered in this study.
- Traumatic injuries, old age, mismothering and an outbreak of enterotoxaemia in a single location, were the reported principal causes of death.
- Limited numbers of Arabian Oryx survyed are vaccinated. Twenty eight percent (28%) of the survyed Arabian oryx are vaccinated against Foot and Mouth disease and Enterotoxemia and 24% percent of them receive some sort of vaccination against PPR (FIG). Oryx that are released in the wild are left unvaccinated.
- Veterinarians and collection managers are encouraged to share information, and help increase the understanding and knowledge of those diseases affecting wild animal collections whenever possible.

1. INTRODUCTION

The General Secretariat for the Conservation of the Arabian Oryx (GSCAO) supported by the Environment Agency - Abu Dhabi (EAD) initiated this third edition of the regional disease survey of the Arabian Oryx following very positive responses from the 2011 and 2013 editions of this survey (published in 2013 and 2015 respectively) and the excellent support from the range states. Previous editions of Arabian Oryx disease surveys can be found and downloaded at www.arabianoryx.org.





Epidemiological challenges require a multidisciplinary holistic approach including but not limited to: emerging diseases threat, epidemiological networks (National Governmental entities and International Organizations: World Organization for Animal Health -OIE), interactions between livestock and wildlife, etc.

Notification of infectious diseases to competent national authorities is a precondition for any successful animal disease control plan at national and international levels. This survey supports knowledge sharing and communication in an effort to control and manage common conditions and diseases to ensure the welfare and conservation of this iconic species.

The information contained in this report is based on the responses submitted by each private or government-owned Arabian Oryx collection. The responses have been reviewed and analysed by a team of experts and veterinarians working with and supporting the General Secretariat for the Conservation of the Arabian Oryx. This report would not have been possible without the interest and contribution from the participating collections across the range states. We hope that veterinarians and non-veterinarians will find this report informative and helpful to promote best practices in veterinary management of Arabian Oryx in the range states.



2. SURVEY METHODOLOGY

The survey questionnaire was designed to collect as much information as possible about the Arabian Oryx diseases for the period from January to December 2015. It was sent to different collections in the range states through GSCAO's national focal points and conservation managers of wildlife collections. It was circulated as an electronic format via e-mail and as a hard copy through the post. The questionnaire consisted of three key sections that included demographic information on the Oryx population in the collection, information on infectious and noninfectious diseases as well as prophylactic procedures. It was found that many veterinarians and conservation managers prefer to have the questionnaire in a Word format to complete the questionnaire.

The questionnaire was sent in June 2016 to focal points in relevant organizations and institutions across the Middle East. The goal was to reach a maximum number of collections, both governmental and private, holding Arabian Oryx. The last response was received in late 2016. This report was based on the direct answers from the veterinarians and collections. managers of participating Oryx institutions.

Obtaining an up-to-date full list of collections continues to be a key challenge, as there is usually a lack of basic information such as the location of the collection and contact details of the collection managers.

An important number of collections remain unknown or hard to reach, with no manager / veterinarian. perhaps without a record keeping system in place. and no background information on founders (history of the collection) or veterinary aspects. The GSCAO is continually enhancing its efforts in identifying previously unknown collections, irrespective of the herd size. Arabian Orvx collections in the range states were encouraged to participate in this survey and in other information-sharing initiatives, in order to provide the necessary data for coordinating a regional conservation approach and ensuring the welfare and genetic diversity of the species.

Small collections can be of high genetic value as they might hold genetically diverse animals. One of the main tasks and goals of the GSCAO is to enhance communication across member states, expand the conservation network and coverage and identify all collections of Arabian Oryx in the region.

Receiving responses from collections can be challenging and requires frequent follow up. During this third edition of the survey, approximately 6 months were required to allow collections sufficient time to provide their responses. In the future, the GSCAO is aiming to partner up with collections to implement an annual reporting mechanism to improve information sharing on a regular and consistent basis. and maintain an up-to-date record and documentation of collections and collection managers.

In some cases, it was difficult to distinguish between a collection and a site. Collection refers to a common management system while sites refer to geographically separated herds, under the same management. This distinction was clarified through greater communication and coordination with collections managers to more accurately determine to which site or collection the response referred to. Whenever the answers to the questionnaire were referring to enclosures belonging to the same site, they were merged together and considered as one site in Table 1 for clarity and consistency with previous surveys.

In some cases, one single questionnaire was completed for multiple sites falling under the same management. Those sites should be in the future considered as separate collections, and have their own questionnaires answered separately. Whenever a single completed questionnaire covering several sites was received, the information provided in the response was applied to all sites or collections covered by the same survey form, unless details were provided specifying the differences amongst various sites (such as the owner, individual marking of the Oryx, record keeping, distance to livestock, etc...).

In the present survey, the aim was to provide information at the site level as it is the most relevant way of gathering accurate data, through considering

each separate site as an entity on its own. Whenever details were missing, the information was applied to the overall collection level.





3. SURVEY OBJECTIVES

The third edition of the regional Arabian Oryx disease survey was reinitiated upon recommendations of the Arabian Oryx workshops held throughout 2015-2016, following requests from collection managers and veterinarians confirming the benefit and utility of sharing information on common conditions and diseases and recommended screening and treatment protocols.

The key objectives of this regional disease survey are to:

- Maintain a network of people involved in the conservation of this species and draw up an exhaustive list of the Arabian Oryx collections in the Middle East
- Obtain an updated and accurate total number of Arabian Oryx throughout the Arabian Peninsula, along with demographic parameters
- Help to improve the genetic diversity of captive or semi-captive populations by promoting and facilitating animal exchange
- Limit the risks associated with zoonotic diseases and other infectious diseases affecting this species, by helping and supporting the establishment of guidelines and protocols
- Conduct a gap-analysis on the veterinarian aspects of Arabian Oryx management

- Assess the risks that could compromise the long term sustainability and conservation of this emblematic species
- Review the literature to provide updated information on the topic.



4. RESPONSE RATE

Thirty-three questionnaires were sent across the Middle East and 29 answers were returned. The return rate was therefore excellent at 88%.

This survey covered eight countries (Bahrain, Jordan, Oman, Saudi Arabia, Syria, United Arab Emirates and Yemen), with 30 collections and 57 sites. This represents a 20% increase in participation compared to the previous edition, when 25 collections representing 54 sites responded to the survey.

Two new collections that were not surveyed previously are now included in this report.

Table 1 shows the list of collections and related sites that participated in the survey.



Table 1

List of collections and sites which participated in this 3rd edition of the regional Arabian Oryx Disease Survey

COUNTRY Bahrain	COLLECTION Supreme Council for Environment	SITE Al Areen Wildlife Park 1 Al Areen Wildlife Park 2 Have Icland
Jordan	Royal Society for the Conservation of Nature	Shaumari Wildlife Reserve
Oman	Office for Conservation of Environment. Diwan of Royal Court = Al Wusta Wildlife Reserve (WWR)	WWR Jaaluni - enclosures WWR Jaaluni - reserve
	Omani Wild Animals Breeding Center- Royal Court Affairs	Open Site
	Wildlife Rehabilitation and Breeding Center - Barka	Wildlife Rehabilitation and Breeding Center
Saudi Arabia	Saudi Wildlife Authority Private Collections	King Khalid Wildlife Research Center (KKWRC) - Thumamah Mahazat as - Sayd Protected Area Prince Saud Al-Faisal Wildlife Research Center (PSFWR) - Taif Private Collection Unit (PCU) and Wildlife Rescue Center (Thumamah) Uruq Bani Ma'arid Protected Area Private Collections
Syria	General Commission for Badia Management and Development and Protection-Homs-Palmyra	Al Talila Natural Reserve



United Arab Abu Dhabi Emirates Emirate Al Ain Z Al Ajban

Al Reef Arabian

Arabian Mansou Bani Yas

Bida Bin EAD - Fo

EAD - E

EAD - P

Mawario (Manago

Telal Re Wrsan V





SITE

00	Al Ain Zoo
n Desert Safaris - Sweihan	Al Ajban Al Khazna
	Al Reef
Oryx Collection - Barari	MBZO - Al Ain Captive bred MBZO - Al Ain Managed population
Oryx collection of HH Sheikh r bin Zayed - Al Khatim	Bu Deeb
s Island - Barari/TDIC	Arabian Wildlife Park SBY/ 3 enclosures
Ahmad Farm - Barari	Bida Bin Ahmad Farm
prestry management	Al Kabshya Al Ojair Forest Al Wadehi Forest Bu Hiran Forest Ghantoot 1 forest
x Situ Conservation	Al Faya Deleikha
rotected Areas Department	OAPA Umm Al Zomoul Qasr Al Sarab Protected area
i ement for Nature Conservation)	Abu Al Abyad Al Ain Al Wathba
sort	Bu Arta / Al Naam Holding Facility
Vildlife Division - Ajban	6 enclosures

COL	JNTRY	COLLECTION	SITE
United Arab	Dubai Emirate	Al Nakhli	Al Nakhli
Emirates		Al Marmoum Reserve	Reserve *
		Dubai Desert Conservation Reserve	DDCR
		Lehbab Conservation	Lehbab Conservation *
		Wadi Al Safa Wildlife Centre - Dubai	Al Awir (AA)/2 enclosures MUG-DP Wadi Al Safa (WAS)/ 3 enclosures
	Sharjah Emirate	Al Bustan Zoological Centre - Sharjah	Zoo
		Breeding Center for Endangered Arabian Wildlife - Sharjah	Bachelor Herd Dhuleiman Display Camp
Yemen		San'a Zoo	Zoo

* not surveyed before



5. SURVEY RESULTS

5.1 TOTAL NUMBER & REGIONAL DISTRIBUTION

The total number of Arabian Oryx surveyed was 12,879 individuals, compared to 9706 Oryx in the previous edition of the survey, representing a 33% increase in the total number of individual Oryx included in this disease survey. According to GSCAO's own records versus those provided in previous surveys, the number of both individual Arabian Oryx and number of collections surveyed increased consistently through the different editions of the survey since it was first initiated in 1999 (Fig.1). The increase in the number of animals is due to new collections participating in the survey as well as the successful breeding of Arabian Oryx within the collections. The majority (79.24%) of Arabian Oryx in the region are found in the United Arab Emirates.



Figure 1 – Number of Arabian Oryx surveyed in the different editions of the disease surveys between 1999 and 2015.



Country	Number of Arabian Oryx recorded during the 2015 disease survey
UAE	10205
Saudi Arabia	1379
Oman	1033
Bahrain	171
Jordan	60
Syria	30
Yemen	1

Table 2. Total population sizes of the Arabian Oryx collections surveyed in this edition



5.2 POPULATION CATEGORIES

The definitions of different population categories were described in the questionnaire as per the below table, differentiating the various management approaches and collection types amongst surveyed collections in the region. Figure 2 represents the percentage of Arabian Oryx in each management category as per the data provided in this edition of the survey.

Reintroduced Herd into the wild

- The herd lives on natural resources and does not require supplementation.
- The herd's diet is not supplemented with food artificially.
- It occurs in its natural habitat within the historical distribution range of the particular species.
- The particular species' social requirements are met at all times.
- The herd is free-ranging.

Reintroduced Herd into the wild

Al Marmoum Reserve in the UAE, Al Wusta Wildlife Reserve in Oman, Urug Bani Ma'arid Protected Area in Saudi Arabia are collections that considered themselves as being released into the wild, with a total number of 3575 Arabian Oryx (28% of all surveyed Oryx).

lanaged Population	Captive-bred
It is free-ranging (managed wild population) or semi- free ranging. It lives on food from natural resources which may require supplementation. It occurs in its natural habitat within the historical distribution range of the particular species. The particular species' social requirements are met at all time.	A population bred under controlled unnatural conditions is considered to be captive bred.

Managed Population

Twelve collections managing a total of 19 sites described themselves as managed populations with a total number of 2963 individuals (23% of all Oryx numbers in total). Arabian Oryx in these collections are housed in semi-wild conditions with food and water provided either on a daily basis or during drought.

These collections include:

Abu Dhabi Forestry (5 sites), Telal Resort, MBZO Arabian Oryx collection, Sir Bani Yas Arabian Wildlife Park, Lehbab Conservation, CCDR, in the UAE; AI Areen Wildlife Park 1, Hawar Island in Bahrain; Mahazat as Sayd protected Area in Saudi Arabia; Shaumari Wildlife Reserve in Jordan; Al Talila Natural Reserve in Syria. The average size is 174 Arabian Oryx per site in this category, ranging from 4 to 835.

Captive-bred

A total of 6341, representing 49% of the total number of Oryx recorded in this survey, are captive-bred individuals. This represented 21 collections managing a total of 31 different sites.



Captive bred = Managed population Into the wild

Figure 2 - Percentage of Arabian Oryx in each management category (n=12879)

5.3 SEX AND AGE RATIO

Within the adult population of known sex, the sex ratio is 83 adult males per 100 adult females. The juvenile population represents 11.66% of the population of known age (Fig 3).





Figure 3 – Distribution of male to female and adult to juvenile Arabian Oryx in the 2015 population.



5.4 RECORD KEEPING

The two record keeping systems used the most remain Microsoft Excel and ZIMS, Excel having over twice as many users as ZIMS (Fig 4). Nineteen collections out of 30 are using only one type of record keeping system, six collections are using 2 systems, one collection 3 systems and one collection 4 record systems at the same time.



Figure 4 - Number of collections using several record keeping systems.



6. REPORTED PATHOLOGIES IN 2015

6.1 Bacterial Diseases

Subcutaneous Abscess

Forty eight cases of subcutaneous abscess were documented, leading to euthanasia in one case.

Only one bacterial culture was performed and Corynebacterium spp. was grown.

Anaplasmosis

One collection in Oman reported 2 Oryx affected by anaplamosis out of 27 animals, with one casualty.

Actinomycosis or Lumpy Jaw

One collection in the UAE reported one case confirmed by the culture of Actinomyces bovis.

Brucellosis

Brucellosis cases were reported in UAE:

Thirty individual cases were reported in 2 collections from the UAE: one collection reported 16% of their population being positive to Rose Bengal Test (RBT) and all those 29 animals were euthanized. The second collection reported one single positive RBT and brucellosis confirmed by ELISA.

On the other hand, there were reports of absence of brucellosis:

In Saudi Arabia, 77 animals were tested using Rose Bengal Test (RBT) and all came back negative,

without mentioning the percentage of animals tested in the collection.

Another two collections in the UAE tested 10 animals each (out of 20 in one case, but out of 113 in the other case that might not be considered as statistically relevant). Rose Bengal Test is the OIE reference test for international animal trade. It requires limited equipment, and is relatively inexpensive. The test is also available in some countries in the Middle East. Like with any other tests, the size of the population that is sampled is paramount and must be statistically significant. Nevertheless, it has some limitations:

The test might give false positive results due to cross reactions with other bacteria sharing the same LPS (Lipo Poly Saccharide) on their membrane among them the most common are: Yersinia sp, certain E.coli, certain Salmonella sp (Díaz et al., 2011). Confirmatory tests should therefore be performed whenever an animal is positive to RBT.

The test might also give false negative results in herds with elevated brucellosis prevalence, especially in sexually immature females.

Whenever possible, culture, isolation, sero- and geno-typing of the pathogen should be performed for the epidemiological information it will provide such as the species of brucellosis involved: B.abortus or B.melitensis. The genotype will give the ability to trace the source of infection and eventually shows where the bacterium goes.

The test and slaughter strategy to control the disease requires discussion when it comes to endangered species, and a proactive vaccination strategy might be preferred. As Godfroid wrote in (Godfroid et al., 2013) it is time to move away from improvisation. For instance, in domestic small ruminants, a prevalence higher than 2% will call for a control strategy based on vaccination. That said, it will be important to scientifically assess both the parameters of the tests in this species and the vaccines, for their effectiveness and the side effects they might have.

Brucellosis was described affecting the Arabian Orvx in (Ostrowski et al., 2002). Brucellosis is an OIE listed zoonosis, having debilitating effects on the people that might become infected.

Enterotoxaemia

A collection in Syria reported an outbreak affecting 120 animals leading to the loss of 72 animals, of which 21 were confirmed by an undocumented test. Four collections in the UAE reported a total of 13 cases where 2 cases were confirmed Type A. 2 cultures were positive for Clostridium perfringens, and 5 positive for Clostridium sp. Interestingly, not all 13 cases were apparently lethal.

Bovine Tuberculosis

There were reports from the UAE, where one collection mentioned finding a suspicious case based on post mortem that was not followed by a RT-PCR positivity, and another collection declared finding 9 reactors and 32 doubtful animals out of 127 animals tested, based on single comparative cervical intradermal test (SCCIT). It must be noted that this classification into non-reactor, doubtful and reactor is based on the difference in skinfold measurements before and 3 days after intradermal injection of avian and bovine tuberculin purified protein derivative (PPD). Four animals that reacted, were euthanized to carry out postmortem examination. The findings were consistent with early bovine tuberculosis infection, showing very small (between 1 and 3 millimeters) pulmonary lesions in very limited number, looking like small hemorrhages with a darker center or showing a pale gravish center. This report also mentioned that such small lesions required paying very close attention during the necropsy. RT-PCT was positive for Mycobacterium bovis but culture was unsuccessful. A third collection in the UAE reported testing three guarters of their Arabian Oryx collection (n=33) using skin test and serology with no positivity. This collection is also vaccinating against M. avium paratuberculosis that might interfere with the results and their interpretation.

There are very few reports of bovine tuberculosis in Arabian Oryx herds. The best known being the case that was documented in Saudi Arabia, showcasing a control plan based on hand rearing newborn Oryx right after birth (Greth et al., 1994). Another article **Necrotic Myositis** that was published at a later stage mentioned the The disease was reported in one collection in disease was due to Mycobacterium orvgis, also the UAE, killing 2 animals out of the 4 affected. called "oryx bacillus", technically different from Staphyloccus spp was isolated. Mycobacterium boyis (Pittius et al., 2012), (Mostowy et al., 2005) but still part of the "Mycobacterium Listeriosis tuberculosis" Complex (MTC) (Ingen et al., 2012) One collection in the UAE reported one case of death whose members share not only close genetic due to Listeria sp. confirmed by culture. material but also pathogeny.

Whenever possible, culture should be performed for the same epidemiological reasons as the ones already mentioned in the brucellosis chapter. Bovine tuberculosis is an OIE-listed disease.

Mycoplasmosis

Four cases of "mycoplasmosis" were reported in a collection from the UAE, with no further

detail on the bacteria species. The vaccine strain was suspected to cause the disease and the death. We do not have details on the Mycoplasma species

involved, or on the serological test used.

Contagious Caprine PleuroPneumonia (CCPP) was documented in the past in Arabian Orvx (Chaber et al., 2014) and there seems to be some issues with the commercial vaccines found against this disease (see later chapters in this report).

CCPP is an OIE listed disease.

Corvnebacterium

One collection in the UAE reported Corvnebacterium pyogenes and Corynebacterium renale, affecting 2 Orvx and killing 1.

Other Bacterial Diseases

Enteritis

Whether the diarrhea was from bacterial origin or not, "enteritis" was reported under "other bacterial diseases" across the region. One collection in the UAE reported "enteritis" under "other noninfectious pathologies". A total of 47 cases were recorded: 37 calves were affected in Oman and 12 died, and the UAE reported 10 cases. Salmonella enteriditis was cultured in one collection in the UAE. Whenever enteritis is affecting the calf population, further investigation to identify the pathogen would be recommended in order to establish tailored vaccination protocols for the pregnant females.



Septical Omphalitis: Three calves died in one collection in the UAE.

Pneumonia:

Three collections in the UAE reported pneumonia: one collection had 3 lethal cases, another one had one case (without reporting the death), and the third collection reported 3 animals affected with 2 dead, where Staphylococcus spp. was cultured. No further details on bacterial species, if any, were given. Pasteurella multocida, Manheimia hemolytica and Mycoplasma capricolum capripneumoniae are part of the differential diagnosis for pneumonia in this species.

Colisepticemia

The disease affected 4 animals in the UAF.

6.2 Viral Diseases

Foot and Mouth Disease (FMD)

Three FMD outbreaks affecting Arabian Oryx populations were reported in 2015:

One private collection in Saudi Arabia reported a FMD outbreak, affecting 32 animals and killing 21 (65% of the population). The diagnostic test used was ELISA.

Two outbreaks were reported in the UAE: one collection reported that all the 44 animals were affected and 12 died (27% of the population). The case was first confirmed by serology and PCR, followed by sero- and genotyping in OIE reference

laboratory (Pirbright, UK). The serotype was O, the most frequent in the region. Another collection holding 210 Oryx mentioned loosing 30 animals due to the disease (12.5% of the population).

From those reports, it appears that FMD is a deadly disease for the Arabian Orvx, with mortality rates ranging between 12.5 and 65% of the affected population. The epidemiological role of the Arabian Orvx is still unknown which calls for further studies.

It should be emphasized that the immunity provided by all commercially available FMD vaccines is short and protocols require a second injection after 3 to 4 weeks, followed by a biannual booster to be effective, considering the batch of vaccine injected was specific to the circulating strains but also scientifically assessed and approved beforehand by official bodies.

This makes it a challenge to effectively protect this wildlife species.

FMD is an OIF listed disease.

Lumpy Skin Disease and related

The disease was suspected in one single individual in the UAE.

No further details were provided.

Lumpy skin disease, sheeppox and goatpox infections are all OIE-listed diseases.

6.3 Parasitic and Fungal Diseases

Helminthiasis

Helminthiasis was reported in several countries and a fourth collection claimed 70% of positivity but information is sometimes difficult to extract. based on fecal flotation. For instance, in the UAE, one collection reported one case of infestation by Nematodirus sp, Entamoeba another collection reported 2-3% of animals infested by Strongyloides and a third collection One single fatal case was reported in one collection declared 70% positivity on fecal flotation. in the UAF. without mentioning the parasite species involved. In This case would be interesting to document as Oman, 22 cases were infested by helminths.

Hvdatidosis

One collection in the UAE reported one case of hydatidosis found during necropsy.

While this term is specific to the infestation due to Echinococcus sp. there was no mention of the species and it could well have been Taenia saginata. Distinction between those two parasites is important as one uses members of the canid family as definite host and is a deadly disease for affected people, while the other tapeworm species will transmit through human's dejections to infest ruminants species. Hydatidosis is a zoonotic disease and an OIE-listed disease.

Coccidiosis and Cryptosporidiosis

In Oman, 18 cases were reported with 5 dead calves. One collection in Saudi Arabia tested 77 animals and found coccidia in 4 fecal samples (5%).

In the UAE: one collection reported 2 cases of coccidiosis and one case of cryptosporidiosis. A second collection mentioned one fatal case, a third collection experienced 5 deaths due to Eimeria sp.;

Entamoeba is a common parasite of primates (both human and non-human), less frequent in dogs and cats, and rare in other mammals.



Warble Fly or Hypodermosis

Hypodermosis was reported in 3 collections in the UAF: one collection had 2 cases and the other two collections experienced the disease in 5% of their population. One collection in Oman also suspected the disease to affect the calves after the rain.

One collection in the UAE reported having external signs compatible with hypodermosis, in a large portion of its Arabian Oryx population, in the October-November months, but after chemical immobilization and shaving the skin areas, no subcutaneous or cutaneous lesion was observed. leading to say that external observation is not sufficient and those reported cases could have been mistakenly attributed to hypodermosis while they were not and might simply be related to annual winter moulting.

Lice

Twenty seven cases were reported in Oman.

Myasis

One collection in Oman reported 17 cases. In the UAE, one collection reported 2 cases of myasis while another case in another collection was specifically attributed to Chrysomya bezziana.

Mange

Fifty two cases of mange were reported in Oman, and one case in the UAE.

Ticks

Ticks were observed on 16 Arabian oryx in Bahrain, 35 in Oman (Hvalomma sp.), 5 in Saudi Arabia (Hyalomma dromaderii, H. schulzei) and 5 in the UAF.

Bahrain also reported 7 fatal cases but we don't know whether those animals died of tick infestation or if ticks were found on dead animals that died due to unrelated causes.

Toxoplasmosis

One abortion due to Toxoplasma gondii was reported in one collection in the UAE. No further details were provided.

Fungal Diseases

A collection in the UAE declared culturing Mucor sp and Rhizopus sp. with no further details, both fungus are ubiquitous mold species.









Figure 6 - Shaved hair on the same animal showing no evidence of subcutaneous and cutaneous lesion, hypodermosis was therefore not suspected.

Figure 5 - External observation of a young Arabian Oryx suspected of suffering from skin lesions that could have been attributed to hypodermosis (warble fly).



6.4 Other Pathologies

Metabolic Diseases

No cases of metabolic diseases were reported.

Nutritional Disorders

"Nutritional disorder" usually refers to a disease following an excess or a lack of certain nutrients. such as hypovitaminosis, etc. There were several reports falling under this category: Oman reported 5 bloated animals with one death.

6 cases of "nutritional disorder" were reported in a second collection in Oman with no mention of what the disorder was.

One collection in the UAE reported one case of malnutrition and 4 cases of diarrhea.

Ruminal Acidosis

Acidosis was reported to cause the death of 5 Oryx in one collection in the UAF.

Stress Mvopathv

Two collections in the UAE reported 5 cases and 2 fatalities, one collection in Oman reported one death out of 3 cases.

Trauma

Bahrain: 3 unspecified with no mortality. Oman: 48 Orvx affected, 22 deaths.

Saudi Arabia: 4 animals with fractures. 2 of them died.

UAE: 71 Oryx were affected by trauma, causing 22 deaths due to fight, 2 due to stress, and 21 were not specified.

Reproductive Tract Disorders

In the UAE, one collection reported 2 cases of foetal mummification. Another collection reported 3 causalities without further details.

Uterine inertia

No cases were reported.

Dvstocia

In Oman 2 cases were reported with no causalities on the dams, and the UAE reported 11 cases of dystocia out of 8 were fatal.

Abortion

One case of full term abortion was reported in one collection in the UAE due to Toxoplasma gondii.

Retained Placenta

No cases of retained placenta were reported from the range states.

Foreign Bodies

Sixteen cases of digestive foreign bodies were reported across the UAE, mentioning all sorts of plastic material including shopping bags and ropes. It is assumed that they were all discovered during necropsy investigation but there is not confirmation on whether they were accidental findings or that they caused the death of the animals. One case of muscular foreign body was reported in the UAE, with no further details.

Skin Disease

Five cases of recurrent dermatitis were signaled in Four animals have died of unknown reasons in one collection in the UAF. Bahrain, 7 in Oman, 8 in the UAE.

Mismothering

Two cases of mismothering were reported in Bahrain, 4 in Oman, 4 in the UAE. It is probable that the number of cases reported were dead calves. Details are lacking on whether the calves were suffering from a primary disorder causing weakness that induced the so called mismothering, or the mismothering happened in the first instance.

Old Age

Bahrain reported 8 deaths due to old age, while Oman had 39 cases, of which only 3 died. In the UAE, 13 animals were considered to be suffering from old age and 9 died because of it.

Neoplasic Disorder

One case of osteosarcoma was reported in the UAE.

Heatstroke

Heatstroke was mentioned as cause of death for 3 animals in one collection in the UAF.

Anesthetic Related

One animal died during general anesthesia. No further information was provided.

Unknown

Others

Five Oryx died due to predation by foxes in Oman, where "weakness" affected 7 orvx and killed 2.



6.5 Pathologies not reported in the survey

Paratuberculosis

No clinical cases were reported in the period.

Two collections in the UAE tested serologically 33 and 10 Oryx out of 44 and 87 respectively, with no positivity. No further information was provided on the test used.

O-fever

A collection holding 87 Oryx in the UAE tested 10 animals with no positive result. No further indications on the test were provided.

Q-fever is a globally spread disease whose presence in Arabian Oryx in the region was serologically assessed and confirmed in the past. A recent study (Chaber et al., 2012) mentioned 7 positive sera out of the 170 Arabian Oryx tested (4%)

Other

The following diseases were included in the guestionnaire but no information was provided on them from

respondents in the present survey:

- Anthrax
- Babesiosis
- Blackleg
- Blue tongue
- Botulism
- Caseous Lymphadenitis (Pseudotuberculosis)
- Chlamydiosis
- Leptospirosis

- Lyme disease
- Tetanus
- Leptospirosis
- Pasteurellosis
- PPR
- Rabies
- Rinderpest

7. PROPHYLACTIC PROCEDURES, ROUTINE **MEDICATIONS AND VETERINARY TESTS**

7.1 Vaccination

Quantitatively. Limited numbers of Arabian Orvx surved are vaccinated. Twenty eight percent (28%) of the survyed Arabian oryx are vaccinated against Foot and Mouth disease and Enterotoxemia and 24% percent of them receive some sort of vaccination against PPR (FIG 7). As expected, Oryx that are in the wild are left unvaccinated.





Figure 7 – Percentage of vaccinated Oryx in 2015 and vaccines used, on surveyed populations.



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Out of the 31 sites where the Arabian Orvx is bred in captivity, three guarters are using FMD vaccine, two thirds PPR vaccine and half of them enterotoxaemia vaccine, the other vaccines are used in less than 5% of the captive bred sites.

Only strong vaccination protocols will confer levels of immunity compatible with herd protection. Such protocols must involve prior quality control of each batch of vaccine that will be used.

Considering the batches are tested and comply with their intended use, and the strain of the vaccines are compatible with the one circulating in the region, the protocols will mainly depend on whether the vaccine is live attenuated or inactive. Commercially available PPR. Capripox and Para-Tuberculosis vaccines fall under the first category while Foot-and-Mouth Disease. Enterotoxaemia, Pasteurellosis and CCPP are all inactivated vaccines.

Most collections that vaccinate are doing it on a yearly basis, which might be satisfactory for live vaccines, where only unvaccinated animals could be injected, but certainly not for FMD vaccines that require a second injection after 3 to 4 weeks followed by biannual booster.

PPR vaccines are known to provide a long lasting immunity following a single injection in domestic species (Saravanan et al., 2010), (Bidieh et al., 1994). The same might happen in this species unfortunately the basic epidemiological knowledge still remains undocumented, such as scientifically-sound evidence that the species is sensitive to the disease.

- Capripox vaccines are also thought to give a lifelong immunity. Sensitivity of the Arabian Orvx to the disease was established by (Greta et al., 1992). Only a very small number of Oryx are vaccinated against this disease in a region where the disease in enzootic.
- FMD vaccines do not confer long lasting immunity and must therefore be repeated very frequently. Added to the apparent high mortality this disease will induce in a herd of Oryx, this disease must be considered as an important threat.
- Nothing has been written on the FMD vaccine used in Arabian Orvx since (Kilgallon et al., 2008).
- Only one site in the whole region reported carrving out a FMD booster every 6 months, 5 sites answered doing 2 injections 3 to 4 weeks apart, followed by an annual booster, 21 sites conduct it once a year, one site has it once in an Oryx lifetime, while one site conducts it whenever "possible" and another site mentioned having it but with no further details.
- One might consider the vaccine as a tool to be used in case of emergency to control an outbreak whenever an outbreak is happening in the neighborhood. That would mean the outbreak is known, identified and notified and this approach does not take into consideration the extremely high infectious rate of this virus, and by the time efforts would start to capture

and vaccinate the herd, the virus would be more likely to have spread to the entire collection already.

- Arabian Orvx is sensitive to CCPP (Chaber et al., 2014) and commercial vaccines exist. Effective inactivated vaccines were developed. unfortunately we have reports of total lack of effectiveness in other species or severe side effects following the injection of current commercial vaccines. These issues must be addressed by the manufacturers, quality control along with inocuity tests should be performed.
- Paratuberculosis vaccination must correspond to a very specific case and must be done under strict veterinary control and supervision. It has been used by one single collection since this survey was initiated.

There is still a world of assumption and lack of scientific evidence in the field of wildlife species vaccination that should be addressed and organized at the regional level in order to develop effective control and/or eradication programs for infectious diseases. The effectiveness of vaccination for Arabian Orvx bred in captivity should be scientifically evaluated. The epidemiological role of the species for each of these diseases should also be studied and documented in international peer-reviewed journals.



7.2 Routine Veterinary Screening

None of the populations released into the wild undergo regular veterinary testing.

Fecal analysis is the most performed test with 37% of the surved sites are doing it. It is performed once a month in one site or every 3, 6 or 12 months for others. Figure 8 shows the veterinary tests carried out by surveyed sites to maintain the health of the Arabian Oryx populations.



Figure 8 - Number of sites doing tests (n=51).

The Brucellosis test is performed in a limited number of places, on statistically questionable populations:

Only 22% of the "captive bred" sites and 10% of all results were negative. One site mentioned using the "managed population" sites are carrying out Ziel-Neelsen stain and ELISA test for this purpose. some sort of Brucellosis surveillance. When done, it is done yearly and the Rose Bengal Test is the **Q Fever** was tested in 3 sites only. most used, cELISA coming second. Please refer Haemoparasite, CBC, blood chemistry, "blood to the "Brucellosis" paragraph in the "Reported **sample analysis**" are also performed, sometimes on Pathologies" chapter for more information. a yearly basis, sometime on an ad-hoc basis.

Bovine Tuberculosis is assessed by intradermal test vearly in not more than four sites that are housing a total population of fifty Arabian Oryx. One other site mentioned testing not regularly or routinely, just to assess the situation. Nine animals were considered reactors and thirty two doubtful to the Single Intradermal Cervical Comparative Test (SICCT) (please refer to the bovine tuberculosis chapter for further information).

Three of those 4 sites are also investigating this disease by serological test and results were still pending at the date of the guestionnaire.

Both Brucellosis and Bovine tuberculosis might affect people and they are enzootic in the region. Passive surveillance is less than adequate for those diseases. and active surveillance and proactivity are strongly recommended.

Paratuberculosis status is assessed yearly in 8.3 and 5.3% of captive bred and managed population sites respectively. No information was provided on the statistical significance of the tested population, but

Karyotype was performed at one site and is worth mentioning as some individuals showed Robertsonian translocation, as described by (Cribiu et al., 1991).



8. EPIDEMIOLOGICAL RISKS

Presence of other wild ungulate species in Arabian Oryx collections

Only one collection, having one site, mentioned housing no other wild ungulates. All the other sites are housing other wild ungulates species along with Arabian Oryx, in direct contact, in 37 sites. Twenty three sites are holding Sand Gazelles (Gazella marica) in direct contact with Arabian Oryx. The number of those gazelles ranged from 1 to thousands or were described as "numerous" and "plenty". Eighteen sites are housing Mountain Gazelles (Gazella gazella) in direct contact with Arabian Oryx and sixteen sites are housing those three species in direct contact from each other. A long list of other ungulate species, sometime exotic, was also recorded, in more limited number, and in fewer collections.





The vast majority of sites (63%) were reported to be 1 to 15km away from domestic livestock (Figure 9), 21% of the sites are located less than 500m to livestock. 7% of the sites are 500 to 1000m away from livestock.

On the other hand, only 3.5% of the total numbers of sites are further than 15km away from domestic livestock. None of the sites mentioned having a direct or a close contact with livestock.

It is not certain how those distances were calculated and reported as there are observations of Arabian Orvx separated from livestock by one single fence. making direct contact possible, without any fenced buffer zone. It is assumed that the distance was measured between the place where herds are most usually seen (usually around feeders and water troughs), without considering that the Orvx might move in all parts of the provided area, especially when patrolling the perimeter fence.

Collections or sites open to the public

Eleven sites are open to public and 46 are privately owned with no public access. Out of the 11 sites open to the public, 6 are captive bred populations and 5 are managed populations.



9. RECOMMENDATIONS

Control and eradications of infectious animal diseases (including zoonotic diseases) should be part of national and international plans. Wild animal populations can represent a reservoir for certain diseases. Veterinarians and collection managers are encouraged to share information, and help increase the understanding and knowledge of those diseases affecting wild animal collections whenever possible. Timely information sharing can help take appropriate decisions and avoid reactive emergency scenarios such as mass culling and ineffective disease control strategies. More data on epidemiological aspects of this species are needed to reduce the risks associated with diseases.

Based on the results of the survey, some of the key recommendations for improved veterinary and herd management are provided in the section below.

• Improving biosecurity measures

Only fenced buffer zones empty of ungulates can be considered effective to prevent contact between Oryx, other wildlife and livestock.

Introducing an animal into a collection, whether it is an Oryx or a different species, that might share common diseases with Oryx without first conducting a minimum health assessment should be avoided. If such introduction must be done, the risks must be studied and taken into consideration.



Animal exchanges for genetic diversity and resilience

Assess, improve and promote the genetic diversity of Arabian Oryx collections to enhance resilience, for instance by exchanging males of different lineages but with compatible health status.

Assessing the health status of the herd

The health status of a herd has to be evaluated for a percentage of animals that represents the herd as a whole. List and prioritise the pathogens that require control and eradication. Unless the different ungulate species are well separated within a collection, they will most likely share the same pathogens. Notify listed pathogens to an official body (OIE, national institutions, etc.).





Reduce the gaps in basic veterinary knowledge of this species

The epidemiological role the Arabian Oryx plays in ungulate infectious diseases is usually unknown or at best unclear in the region. The parameters of laboratory tests used for this species are not evaluated and the effectiveness and the side effects of vaccines, sometimes used in official control plans, are not assessed for the Arabian Oryx.

Those three key aspects suffer an important lack of scientifically sound information and as of today's date, we still rely mainly on assumptions. There is a clear discrepancy at the regional level between the efforts put in the conservation of this species, the resources allocated to breed the Arabian Oryx in captivity, and the amount of scientifically sound publications in the field of veterinary epidemiology for this species. Only peer-reviewed publications can guarantee both the quality of the work done, the longterm memory and the spread of information within the scientific community, in order to form and advise the development of effective veterinary protocols that ensure the welfare and conservation of the species in the long-term.



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- Nakhili Wildlife
- Breeding Centre for Endangered Arabian Wildlife Sharjah
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