

## Impact of Natural Reserves on the Rehabilitation of the Arabian Oryx in the Protected Areas of Mahazat as-Sayd and Uruq Bani Ma'arid, Kingdom of Saudi Arabia from 1980 until 2011

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**Abstract:** A limited number of studies have been conducted to evaluate the role of natural reserves in the conservation of the Arabian oryx in the KSA. The two reserves that accommodate the oryx in the country – Mahazat as-Sayd and Uruq Bani Ma'arid – have different environmental attributes, and so impact the species differently. To assess these impacts, five key steps were taken: 1) map-generation for the protected areas and of the Arabian oryx populations in GIS format to aid site and management evaluations; 2) a comparison of natality and mortality rates; 3) the identification of reasons behind the population trends in the two protected areas; 4) a brief investigation of the causes of the wild extinction of the oryx in the KSA; and 5) recommendations for future conservation, protection and management of the reserves and the species. It was revealed that natality and mortality rates in the two reserves are not directly comparable, since Mahazat as-Sayd is a fenced area, while Uruq Bani Ma'arid is a free-range region. It was expected that, in Mahazat as-Sayd, population growth would be a struggle, as this was the start-up location for the Arabian oryx rehabilitation project in the KSA. The lessons learned from the Mahazat as-Sayd project were applied to Uruq Bani Ma'arid, and this is one of the reasons why Uruq Bani Ma'arid has had a more stable population growth. At present, the challenge to the managers of the reserves, and the national government of the KSA, is how to manage conservation efforts for the species going forward, given drastic and extreme climate change. Global support in strengthening research innovations through study aids or grants is recommended at the international level, while the incorporation of nature and wildlife conservation into all levels of education curricula is recommended at the national level.

**Keywords:** Arabian oryx, Conservation, Mahazat as-Sayd, Uruq Bain Ma'arid, Climate change, Natality and mortality.

### Introduction

Natural reserves are sites designated for the preservation and protection of both faunal and floral species. They are limited to conserving such species, and are responsible for preserving the land (Eionet, 2011). Natural reserves must contain unique and/or vulnerable species, or ones that are close to extinction, that need to be preserved. Wild animal nature reserves take care of wild species that are near extinction, unique and have economic significance (Tibet Autonomous Region, People's Government Information Office 2003).

The KSA terrain is mainly rugged-landform desert in the south. It has an arid climate, and its interior experiences extreme temperatures (U.S. Department of State 2011). Temperature and humidity in the coastal regions are also high. The challenges faced in these regions include inadequate stable water bodies, underground water depletion, coastal pollution and desertification (U.S. Central Intelligence Agency 2011). The KSA government is committed to protecting all of the biodiversity of the kingdom in protected areas.

The barrenness of the desert makes the management of wildlife reserves relatively complicated. Arid nature reserves are exposed to various threats from human intervention and natural calamities. Due to their distinct environmental attributes, the Mahazat as-Sayd and Uruq Bani Ma'arid reserves present distinct species and impacts.

### **Aim of the study**

The main aim of this study was to assess the responsibilities of natural reserves in the protection of the Arabian oryx. It also explored the significance of the natural reserves in Saudi society. The objectives included, firstly, mapping of the protected areas, and plotting of the distribution of the Arabian oryx population in the KSA, using GIS. Secondly, the number of births and deaths were compared to provide information on the effectiveness of the reserves in species conservation. Thirdly, the causes of decreases and increases in Arabian oryx populations were identified in Uruq Bani Ma'arid and Mahazat as-Sayd. Fourthly, the reasons behind the wild extinction of the Arabian oryx were determined. Finally, this study addressed the future, providing predictions for changes in regional climate.

### **Data collection**

The data collected in this dissertation involved; the map of Saudi Arabia and a map of protected areas. Map collection was from the Military Commission of Saudi. The other data was the total Arabian Oryx to identify changes. Data collection was from the Wildlife Commission of Saudi.

### **Study area**

The study area included two Saudi protected regions, comprising Mahazat as-Sayd, which is situated in Makkah province and is represented by a sandy plain and relatively flat relief, and Uruq Bani Ma'arid, located in Najran, which is a natural reserve conserved for hunting purposes (Arabian-oryx.gov.sa).

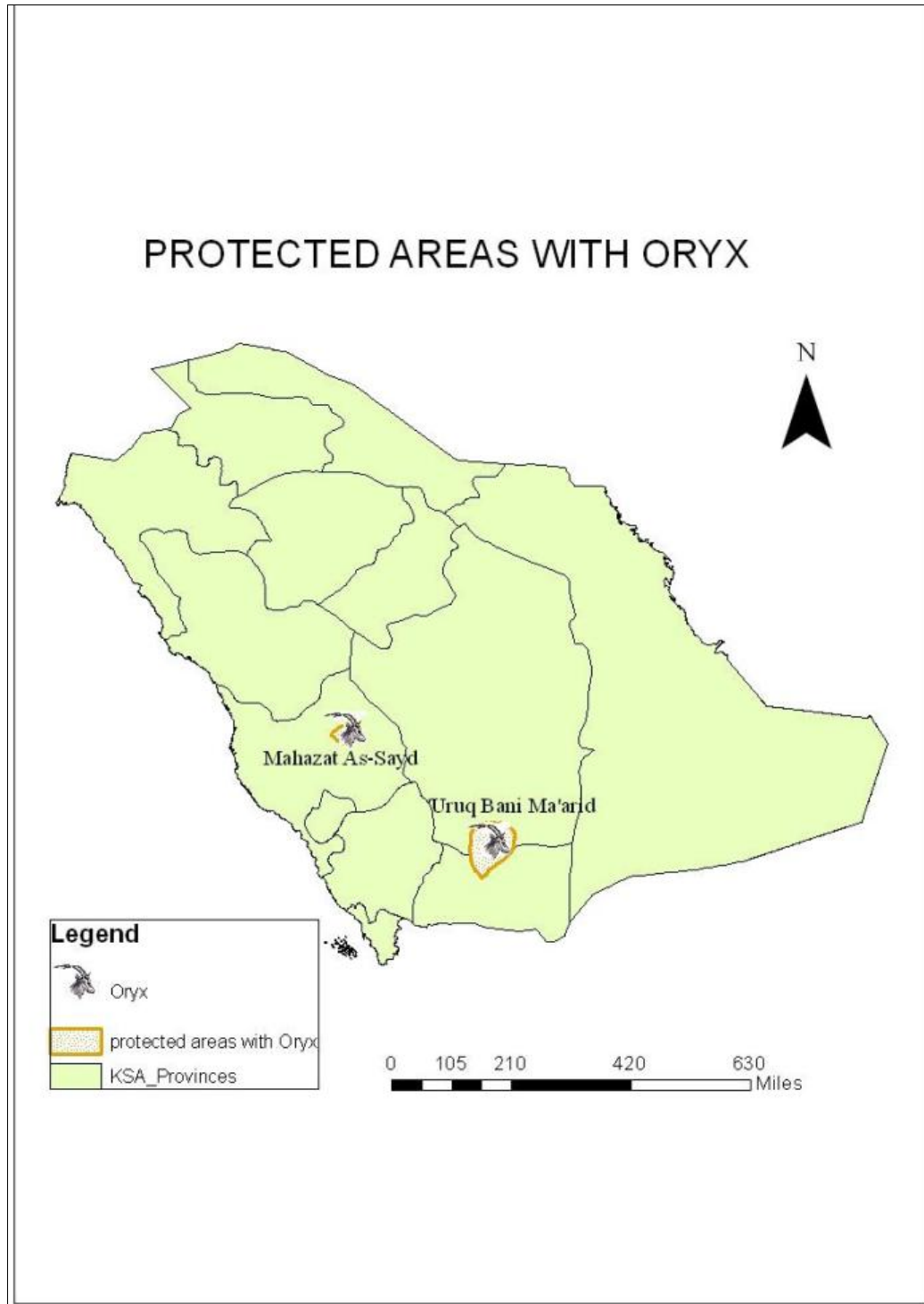


Figure (1) Map showing the two KSA protected areas

### Literature review

There is a wealth of literature on the Arabian oryx. Advances in science enable the identification of rare species, as well as promoting a raised consciousness about their conservation. From a review of such

literature, however, it was found that certain problems mean that there is no guarantee that the conservation of rare species will occur, due to various issues.

The reviewed literature highlighted that professionals have employed conservation for species in diverse areas for many years (Phillips 1976). Conservation strategies are important, and can include zoos and protected areas. The population decline in the Arabian oryx is due to hunting in protected areas. Protected areas have been characterised through their use by conservation groups and method conservationists. Zoos are also protected areas, and are essential because of their accessibility and visibility to people, such that they can be employed as a means of communicating with the public, creating awareness and garnering financial support (Kleiman et al. 2010).

Discussions regarding conservation strategies and rare species conservation are essential for understanding efforts to preserve the Arabian oryx, as well as literature dealing with the specifics of the subject (Saudi Aramco. 2009). There has been exhaustive literature on conservation, and the Arabian oryx in particular, since there has been an awareness of the decreasing population of the Arabian oryx; however, such studies often focus on conservation programmes from the perspective of increasing animal populations, after they were decreasing for some years. Further, there has also been research regarding aspects of reintroducing the Arabian oryx and its positive impacts on other (animal and plant) species that they closely interact with (Saudi Aramco. 2009).



Figure (2) Map showing the distribution of the Arabian oryx in the Arabian Peninsula.

**Previous studies on the Arabian oryx**

The white, or Arabian, oryx (*Oryx leucoryx*, from the Greek, meaning white antelope) is the smallest species in the *Oryx* genus, Table 1 shows the higher taxonomic information regarding the Arabian oryx (Simkins, 2008). In the 1970s, it became virtually extinct in the Arabian Peninsula, where it once flourished, forcing the Saudi community to begin working on its wild reintroduction, protection and restoration in the 1980s.

**Table (1) Higher taxonomy of the Arabian oryx**

<b>PHYLUM</b>	Chordata
<b>CLASS</b>	Mammalia
<b>ORDER</b>	Artiodactyla
<b>FAMILY</b>	Bovidae
<b>SUBFAMILY</b>	Hippotraginae
<b>GENUS</b>	<i>Oryx</i> Blainville, 1816
<b>SPECIES</b>	<i>leucoryx</i> (Pallas, 1777)
<b>SYNONYMS</b>	<i>asiatica</i> , <i>beatrice</i> , <i>latipes</i> , <i>pallasii</i>
<b>SCIENTIFIC NAME</b>	<i>Oryx leucoryx</i> (Pallas, 1777) [Oryx (Greek) a gazelle or antelope. Leukos (Greek) white]
<b>COMMON NAMES</b>	Arabic - Maha; Wudhaihi; Baqar al Wash, Boosolah Danish - Arabisk oryx Dutch - Arabische oryx English - Arabian Oryx; White Oryx Finnish - Valkobeisa French - Oryx blanc; Oryx d'Arabie German - Weiße Oryx Italian - Oryce bianco ; Oryce d'Arabia Spanish - Orix blanco; Orix de Arabia Swedish - arabisk oryx; vit oryx

The Arabian oryx was first described by Peter Simon Pallas, a zoologist, in 1777. It is described as a deer-sized mammal, having horns that are strong and straight (Stanley Price 2010). Its features include black markings on the face, the bases of the horns, the tip of the tail, and around the chest, and its legs are moderately long. They can walk on loose and flat terrain, due to their hooves that resemble cows' hooves, but they are not able to make sharp turns, perhaps due to low predation pressure for this desert species (Stanley Price 2010).

Arabian oryx calves have sandy-brown coats for the first two to three months after birth, which gradually becomes short and white, the sparse fur being capable of reflecting the sunlight (Flamand et al. 1994). The coat helps them be observable by the flock, whilst camouflaged from predators, depending on the direction of the sun.

Sexual dimorphism differences are small (Stanley Price 2010). In terms of ecology, they are believed to be among the mammals adapted to a desert environment (Estes 1991). They consume green and dry grass, and drink minimal water. Regarding auditory communication, the male oryx roars when fighting and chasing each other; they can also communicate through dung (Estes 1991). The reproduction process involves a 260-day gestation period, which can increase or decrease by 42 days (Vie, 1996

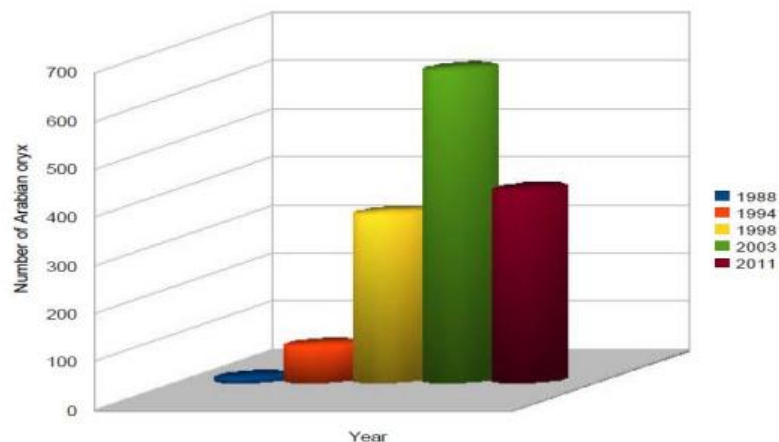
## Methodology

The focus of this study was to determine the population trend of the Arabian oryx. A qualitative research technique was used to achieve this, primarily involving a review of published data, followed by inductive analysis of generated maps and published reviews. An assessment of the protected areas was performed by reviewing the relevant research-based maps of the vicinity, and related literature.

Since this study involved a qualitative analysis, statistical tests were not necessary; instead, credible databases were employed in the study of data essential to the distribution, protection, preservation, conservation and population of the Arabian oryx. Further, the map creation was performed using the Geographic Information System software, ArcGIS (ESRI). ArcGIS software was also used in the creation of maps showing the conserved Saudi regions, the conserved Arabian oryx areas and the anticipated reintroduction sites of the Arabian oryx (see Appendix 1).

## Results

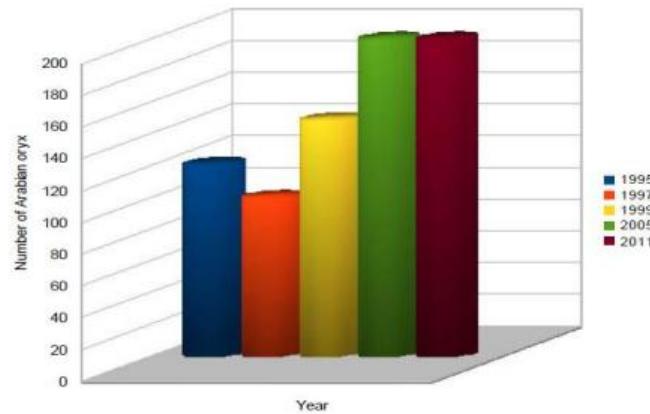
In 1988, nine oryx were reintroduced to the Mahazat as-Sayd reserve. Also, by the end of 1988, there was increased rate and retention of status until 2007 (Islam et al. 2011). Due to the increased population and dispersion of separate groups, monitoring and tracking became difficult on a daily basis.



**Figure (3) Arabian oryx population in the protected area of Mahazat as-Sayd**

The population in 1998 reached 350, which became constant because of deaths from drought (Mesochina et al. 2004). From 2011, the Arabian oryx counted around 400 in Mahazat as-Sayd, but the results indicate that population decline in Mahazat as-Sayd resulted from fencing of the entire reserve, which caused the oryx to surpassing the carrying capacity (IUCN 2011). This was exacerbated by insufficient rainfall, which

decreased the availability of forage for the oryx (Islam et al. 2011). The lists births were found to have occurred in 2008, and the deaths surpassed the current population. Figure 4 illustrates the Arabian oryx population in the protected area of Uruq Bani Ma'arid.



**Figure (4) Arabian oryx population in the protected area of Uruq Bani Ma'arid**

Data for the Arabian oryx population of Uruq Bani Ma'arid shows that, in 1995, 121 oryx were introduced (64 females and 57 males) (Animal Info 2007). There was a decrease in the population by 1997, to 100 individuals (Animal Info, 2007). The results also show that the lack of rainfall and poaching is what led to a fluctuating population by 2011; however, based on the birth and death statistics, five live births were recorded in 1995, 25 in 1996, and 32 in 1997. In addition, there were fewer deaths in the free-range Uruq Bani Ma'arid reserve.

The factors found to be the basis for the Arabian oryx deaths were mostly the same in Uruq Bani Ma'arid and Mahazat as-Sayd. Subcutaneous abscesses were found to be common in males because of fights, due to horn wounds, and jaw abscesses due to captive husbandry. Trauma was the other main factor, ascribed to fence entanglement, handling and the intraspecific conflict. Other factors include fights, starvation, insufficient stable rainfall and natural death due to disease, predation and environmental degradation (Ghandour 1987).

Reduced predation, due to iron fences around the protected regions of Mahazat as-Sayd, assisted in keeping the balance between feed vegetation and the oryx population as the oryx was save from any threat. Also, the protected areas helped the oryx getting any epidemic diseases. The results also indicate that neonatal mortality was observed at the start of the project. However, predation cases were found in the 1990s for young Arabian oryx in the protected area of Shaumari, Jordan.

In a survey on the death rate among oryx in the protected areas, it was noted that fights between reintroduced animals accounted for 37% of occurrences, starvation accounted for 25%, with 19% for other reasons, while lack of consistent rain accounted for 19% (Figure 5).

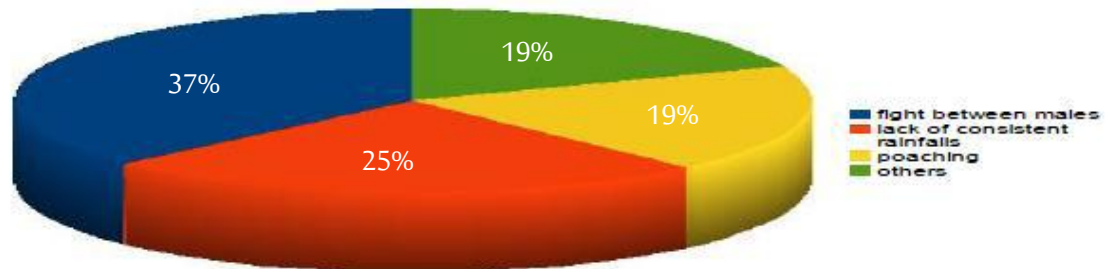


Figure (5) General rate of the causes of death among Arabian Oryx in both protected areast

## Discussion

After the release of Arabian oryx from the preserved places of Mahazat as-Sayd, they were reintroduced from America. The population of nine in 1988 increased to 67 individuals by 1994, and in that year, 76 individuals served as a positive response. In following years, from 1998 through 2003, the Arabian oryx was successful, with an increase in the population from 67 to 300, showing the oryx had adapted to the surroundings. Conversely, there was a steep population decrease from 2003 to 2011, by 400 individuals, due to natural factors, such as drought, which caused forage loss for the oryx. The sudden population decrease indicated that it had surpassed the maximum carrying capacity of the reserve, which could not sustain food enough for the entire population, including other species of wildlife in that location. Some research has claimed that the iron fence around the protected area caused the decrease in the oryx population.

Based on the Arabian oryx population of Uruq Bani Ma'arid, the 121 introduced oryx indicated success for Mahazat as-Sayd cause of some oryx coming from the reserve. The following two-year decrease was due to poaching, given the free-range aspect of the protected area. The decline could also have been due to a failure to adapt to the surroundings, as well as intraspecific fights. Nevertheless, the progressive population increase, from 1999 through 2005, showed a successful adaptation to the environment. The absence of a significant population decrease or increase from 2005 through 2011 might denote that an equilibrium state has been reached between the population and the environment. It may also mean that there is a slow rate of growth, which is difficult to predict and generalise over a short period. Furthermore, any



decrease or increase does not reflect undetected deaths, emigration patterns or the existence of wild-born oryx that were not surveyed.

Mahazat as-Sayd was found to be one of the most protected regions worldwide, the area being surrounded by a chain link fence approximately two metres high, and containing three sets of sharp wire. Its protection from any grazing has allowed the preservation and restoration of vegetation; harvesting of grass in the area had been found to be the cause of the decrease in productivity of the region.

From 1991 through 2009, the tropical reserves of Uruq Bani Ma'arid and Mahazat as-Sayd experienced minimum and maximum mean temperatures of 9 and 42°C. In Mahazat as-Sayd, the recorded mean humidity was 72% and 18% on the same conditions and range. Rainfall on the other side declined tremendously, having an impact on forage (Islam et al. 2011). On average, 7 mm rainfall per month was recorded from 1991 through 2009; between 2003 and 2007, it declined further, to 5 mm, and by 2009, it had fallen to 1.3 mm.

From 1990 through 2009, around 82 Arabian oryx, which had almost similar sex were released from reserves. The oryx were monitored continuously, and showed a steep decline at Mahazat as-Sayd. Deaths of the animals between 1998 and 2005 were found to be caused by the decreasing rainfall (Islam et al. 2010).

The Uruq Bani Ma'arid region is known to be the Earth's desert; it is the driest and has the biggest sand dunes worldwide, and has no steady water sources. The re-introduced oryx were given alfalfa, hay and water until they acclimatised to the surroundings. In 1995, 95 female and 79 male Arabian oryx were released from Uruq Bani Ma'arid. There was a further increase, by 200, in 2010, although this number then decreased due to increased poaching in the area (Mesochina et al. 2003).

Management and rehabilitation strategies have been aimed at re-establishing and protecting the Arabian oryx. Legislation related to improvements in the law covering the wildlife sector should be completed. The strict execution of regulations is essential in reducing poaching, among other human activities that add to the decline in animal populations (Environment Agency Abu Dhabi 2010).

Another significant issue that management strategies should focus on involves increasing and restoring the population of wild Arabian oryx. A different effective strategy in the Arabian oryx rehabilitation involved identifying new sites for their release; the focus of this is to support the strategy responsible for increasing collaboration between different nations (CHM Saudi Arabia 2010).

The Mahazat as-Sayd reserve was an open-range and fenced system that contributed to the deaths of several Arabian oryx, as well as a number of sand gazelles. Following the re-introduction programs, a total of around 560 oryx deaths were reported during the first summer; however, more death were reported between

2006 and 2009 (Islam et al. 2011). During droughts, there is a reduced capacity for reproduction due to the relationship between Arabian oryx reproductive behaviour and air temperature.

The reintroduced stock of Arabian oryx is currently more disease-free than other oryx due to the detention of infected animals, the provision of tuberculosis vaccines and genetic management. At the moment, the NWRC breeding program is capable of delivering oryx in large quantities across the Arabian Peninsula, and has introduced around 250 animals since 1994 (Arabian-oryx.gov.sa).

The committee responsible for protection of the Arabian oryx was appointed by the United Arab Emirates, as the nation chosen to chair the committee. In addition, the board has collaborated with the International Union for Conservation of Nature and the World Wide Fund for Nature; this decision assisted in improving the efforts of preserving the Arabian oryx in the several nations where they live. The committee's other objective involved reintroducing the oryx in the Arabian Peninsula and neighbouring countries (Abu Dhabi Government 2011).

Based on an analysis of the situation at Mahazat as-Sayd, problems can arise, such as the risk of eventual deterioration of the site and overgrazing, since the present population is more than the reserve's carrying capacity. Analysis has also shown that, in 1990, there was a local extinction event due to drought, with poaching also being a principal problem (Otrowski et al. 1998).

According to the 2010 Arabian Regional Conservation Strategy and Action Plan, the most common threats and problems have been classified into four categories: the wildlife population threat; threats relating to herd management; constraints; and gaps (Environment Agency 2010). Hunting has chiefly influenced oryx extinction, particularly in the free-range Uruq Bani Ma'arid reserve. Prevalent drought has forced the animals to go outside the boundaries, searching for food, leading to increased illegal hunting. There has also been habitat degradation and destruction by humans, including mining, which has affected the animals through a reduction in land area to roam in (Environment Agency 2010).

## **Summary**

The current distribution of Arabian oryx is in two conserved areas in the KSA – Uruq Bani Ma'arid and Mahazat as-Sayd. The oryx population in Mahazat as-Sayd is situated close to the fence or perimeter of the reserve, except for those in northeastern region. The distribution in Uruq Bani Ma'arid is close to the release site, and extending towards the northeastern part of the reserve.

The distribution patterns of oryx populations in the two reserves differ regarding the system and the environment. There is a fence system in the Mahazat as-Sayd reserve, and the oryx are clumped close to the fence because the oryx are attempting to escape in search of food. The free range situation in the Uruq Bani

Ma'arid system enables the oryx to move freely to other regions of the reserve, to take advantage of accessible sources of food.

The two reserves bred and raised there oryx differently. In Mahazat as-Sayd, oryx management was a struggle, since it was the first attempt at a restoration program, whereas the Uruq Bani Ma'arid management faced the problem of poaching. There was a steep increase in the Mahazat as-Sayd population up to 2003, after which it decreased to 2011. This population decline was caused by the effects of global warming and climate change, and the fact that the oryx were fenced in, so they could not move freely in search of food. Meanwhile, poaching is believed to have been the cause of the decreasing population of oryx in Uruq Bani Ma'arid. The population recovered up to 2005, but in 2011 there was a small decline. One outcome that can be demonstrated is that, from the increasing trends in Arabian oryx populations in the two protected regions, management has employed effective restoration and protective measures for the species. Based on the failures and successes in both reserves, they have overall succeeded because of the ability of the populations to maintain themselves through captive-breeding and reintroduction programs.

Species adaptation has led to increased populations in protected areas for the Arabian oryx; however, in Mahazat as-Sayd, increased mortality has led to a decreased population due to food shortages and poor habitat. Population is also dictated by the roles played by the different sexes; males can be injured/killed as a result of fighting, whereas females can be injured or die during pregnancy or giving birth, and both sexes succumb to old age. The death of calves can be due to malnourishment, attacks by males or extreme heat. Overall, drought is the primary cause of reduced populations since it hinders food availability.

This study, through its focus on animal populations, provides a foundation upon which future research regarding threatened and/or vulnerable species, and the role of critical habitats and ecosystems, biodiversity and natural resources, can be built. Analysis of population trends will help in the future protection, preservation and conservation of the Arabian oryx.

### **Recommendations**

Recommendations that can be derived from the analysis in this research are that, at the international level, the formation of panels, and intergovernmental negotiations, act as indispensable tools for attracting the support of global conservation organizations. They also reinforce innovations from research through the offer of grants or study aids. Performing research on the impacts of global warming on the Arabian oryx is necessary, given today's changing climate status.

From another perspective, at the national level, there should be an introduction of lessons on wildlife, focusing on endemic species, in the syllabuses of primary, secondary and tertiary educational programmes. Nature conservation involves habitats necessary to particular species, and teaching can promote this aspect,

whilst also providing knowledge on how to participate in protecting and preserving endemic species, such as the Arabian oryx.

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APPENDIX

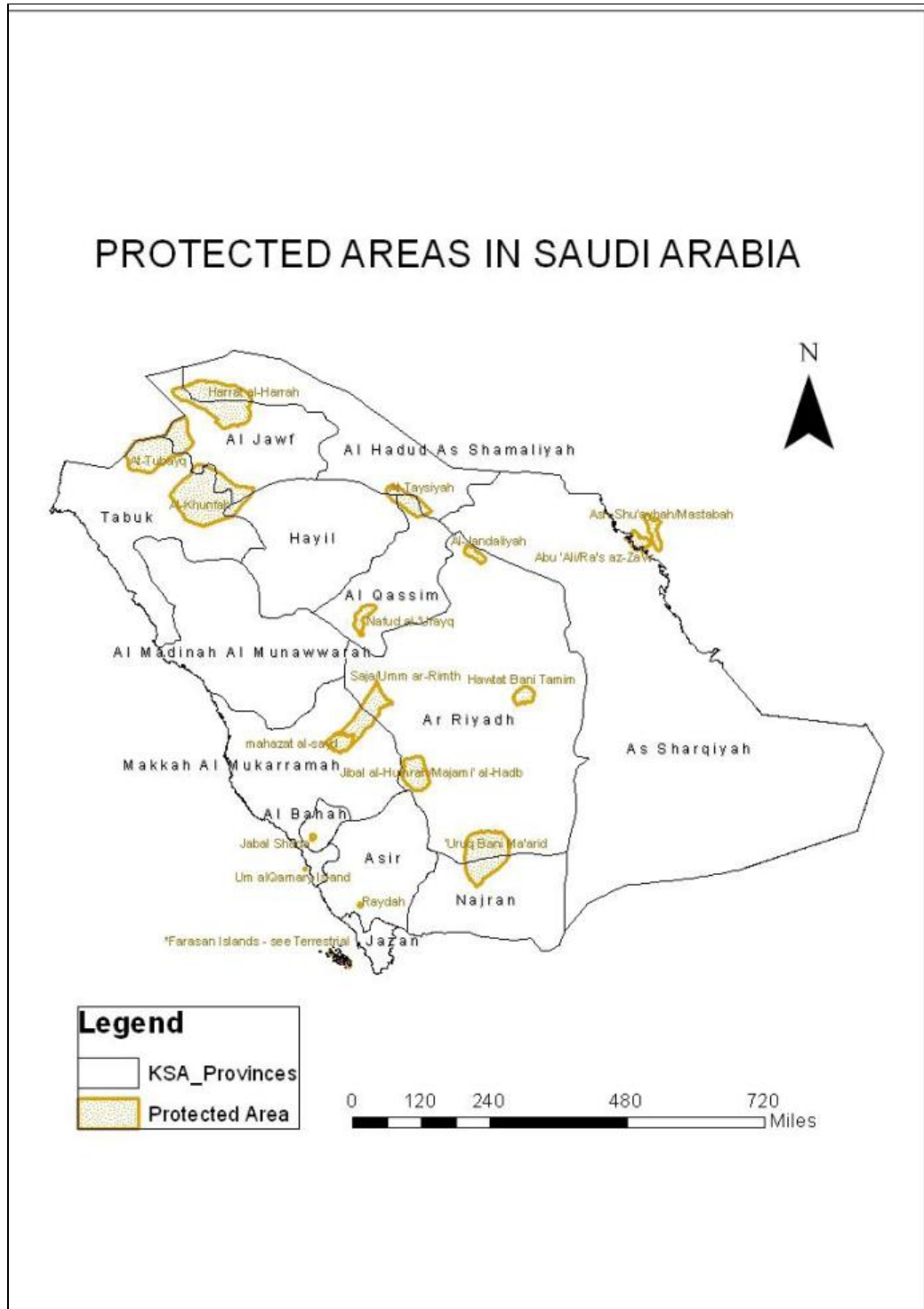


Figure (6) GIS-generated map of the 15 KSA protected areas (reserves)

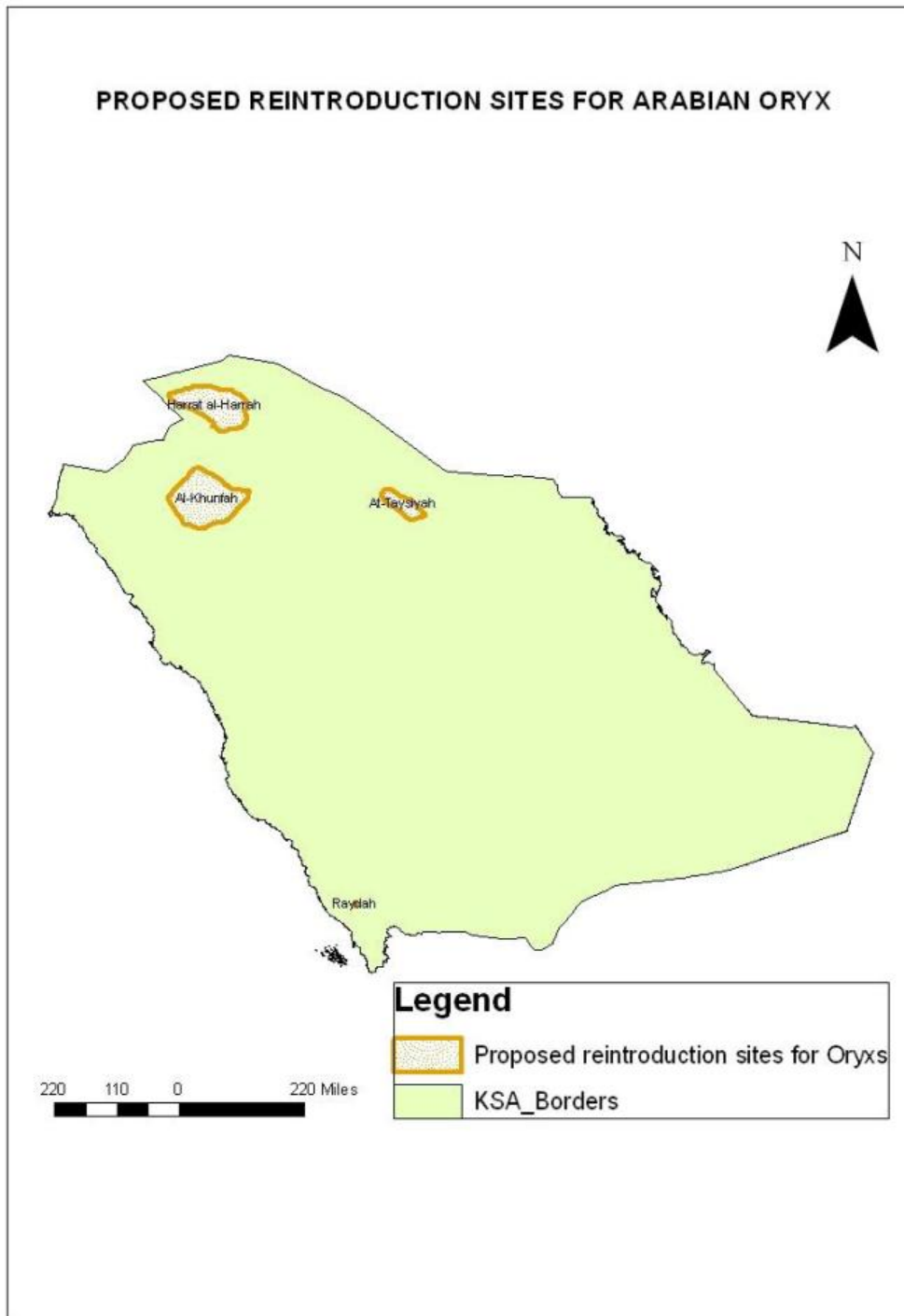


Figure (7) Map indicating proposed sites for Arabian oryx reintroduction

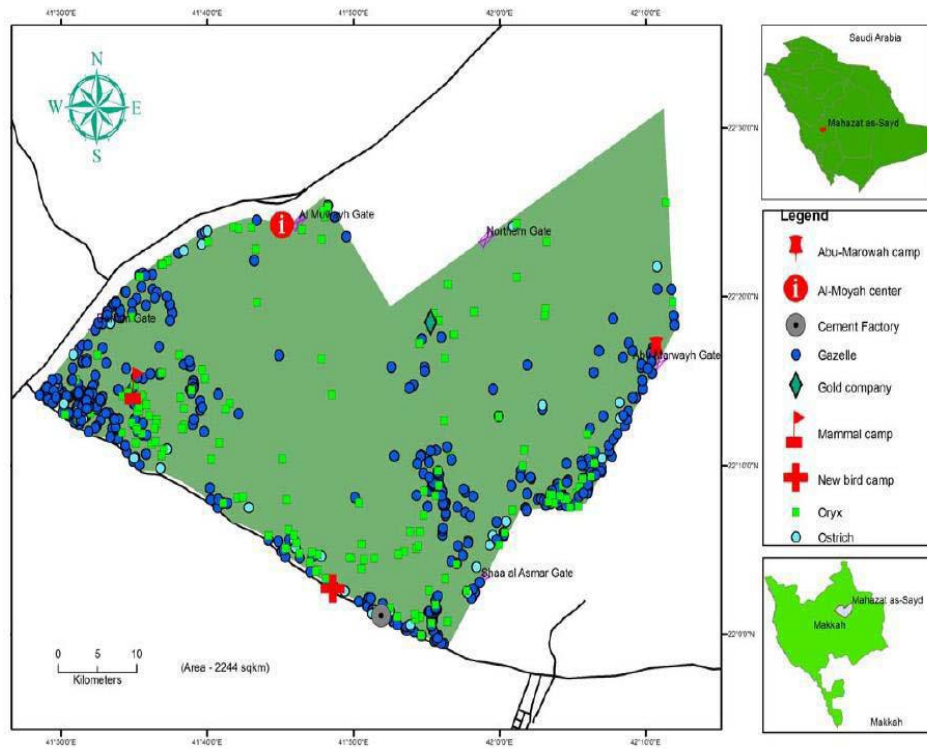


Figure (8) Mahazat as-Sayd protected area showing the distribution of live oryx and other wildlife in the reserve (after Islam et al. 2010)

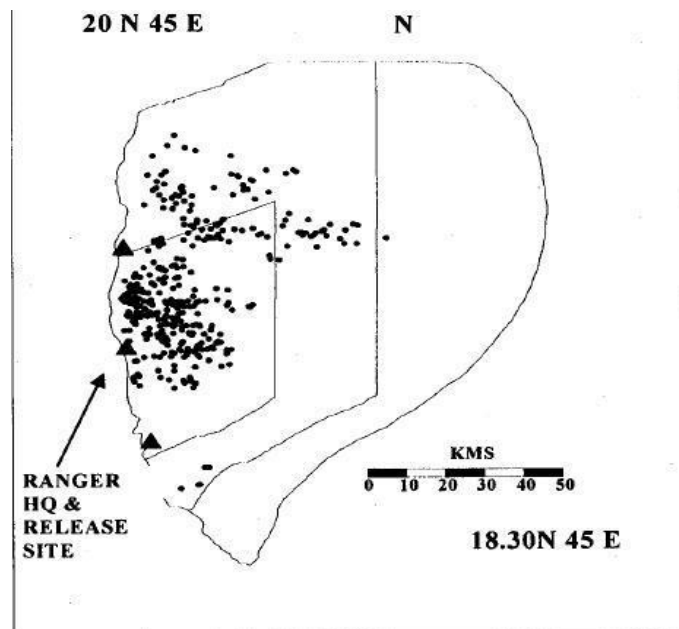


Figure (9) Arabian oryx distribution in the Uruq Bani Ma'arid protected area in 1997. Black triangles represent ranger camps (after Wachter, 1998)





Figure (10) A weak Arabian oryx in Mahazat as-Sayd reserve. Emaciation is commonly due to the scarcity of viable food sources (after Islam et al., 2011)



Figure (11) Arabian wolves (*Lupus canis*) are common predators of Arabian oryx in Uruq Bani Ma'arid (after arabian-oryx.gov).

Table (2) Reserves the Arabian oryx in Mahazat as-Sayd came from (after Lamarche, 1980)

Source of the Arabian oryx herd	Numbers in the herd
Gardens of San Diego, U.S.A.	23
National Center for Wildlife Research in Taif	39
Shumary protected area in Jordan	5
Areen centre in Bahrain	2

Source of the Arabian oryx herd	Numbers in the herd
Garden of Zurich, Switzerland	2
Garden of Berlin, Germany	1
<b>Total</b>	<b>72</b>

Table (3) Tally of deaths among Arabian oryx calves in Mahazat as-Sayd reserve (after Khairy, 2009)

Year	No. of mortalities	No. of calves
1993	9	32
1994	4	47
1995	7	65
1996	11	76
1997	9	86
1998	30	87
1999	34	40
2000	26	24
2001	35	94
2002	20	75
2003	37	61
2004	36	17
2005	13	81
2006	52	62
2007	71	8
2008	159	2

أثر المحميات الطبيعية على إعادة تأهيل المها العربي في محمية محازة الصيد وعروق بنو معارض  
في المملكة العربية السعودية من الفترة 1980 م إلى 2011 م.

الملخص: عدد قليل من الأبحاث قامت بتقييم دور المحميات الطبيعية في الحفاظ على المها العربي في المملكة العربية السعودية. تمتلك المحميتان التي تستوعب المها العربي في البلاد، محازت الصيد وعروق بني معارض، سمات بيئية مختلفة وبالتالي يؤثران بشكل مختلف على المها. لمعالجة المشكلة تم اتخاذ أربع خطوات رئيسية هي: إنشاء خرائط للمناطق المحمية ومجموعات المها العربية في برنامج للمساعدة في تقييم الموقع والإدارة؛ مقارنة معدلات المواليد والوفيات؛ تحديد الأسباب وراء التكاثر في المنطقتين المحميتين؛ دراسة موجزة للأسباب الكامنة وراء انقراض المها في المملكة العربية السعودية؛ توصيات للحفاظ في المستقبل، وحماية وإدارة الاحتياطي والأنواع. وقد تم الكشف على أن معدلات المواليد والوفيات في المحميتان لا يمكن مقارنتها حيث أن نظام محمية محازة الصيد هو نظام مسيخ، في حين أن نظام محمية عروق بني معارض هو نظام حرّ النطاق. كان من المتوقع أن يكون هناك نزاع في التكاثر في "محازة الصيد" حيث كان هو أول في إعادة تأهيل المها العربية في المملكة العربية السعودية. وقد تم تطبيق الدروس المستفادة من "محازة الصيد" في "عروق بني معارض وهذا هو أحد الأسباب التي جعلت التكاثر أكثر استقراراً. في الوقت الحاضر، يتمثل التحدي الذي يواجه المديرين والحكومة الوطنية في المملكة العربية السعودية في كيفية إدارة الجهود للحفاظ على الأنواع، بالنظر إلى التغيرات المناخية الشديدة والقاسية. وأوصى على المستوى الدولي بتقديم دعم عالمي لتعزيز الابتكارات في مجال البحوث من خلال المساعدات أو المنح الدراسية للدراسة، في حين أوصي بإدراج الحفاظ على الطبيعة والحياة البرية في جميع مستويات مناهج التعليم على المستوى الوطني.

الكلمات المفتاحية: المها العربي، المحميات، محازة الصيد، عروق بني معارض، التغيرات المناخية، معدلات الوفيات ومعدلات المواليد