EXPEDITION REPORT

Expedition dates: 10 – 17 January 2015

Report published: September 2015

Ways of the desert: conserving Arabian oryx, Gordon's wildcat and other species of the Dubai Desert Conservation Reserve, United Arab Emirates.

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Abstract

The successful collaboration between Biosphere Expeditions and the Dubai Desert Conservation Reserve (DDCR), initiated in 2012, continues. Citizen scientists collected data on nine target species, namely the Arabian oryx (*Oryx leucoryx*), Gordon's wildcat (*Felis silvestris gordoni*), mountain gazelle (*Gazella gazella*), sand gazelle (*Gazella leptoceros*), Arabian red fox (*Vulpes vulpes arabica*), sand fox (*Vulpes rueppellii*), Macqueen's bustard (*Chlamydotis macqueenii*), lappet-faced vulture (*Torgos tracheliotos*) and pharaoh eagle owl (*Bubo ascalaphus*) for a week from 10 - 17 January 2015. Data gathered alerted the DDCR management to several conservation issues and also allowed for informed, fact-based management decisions to be made in a showcase of how the work of citizen scientist volunteers can aid the efforts of conservation professionals.

258 oryx were counted in the reserve, most of them likely to be separate individuals. Oryx distribution in the reserve follows artificial feeding points. However, there are too many oryx in the reserve and their numbers must be reduced, amongst other things in order to discontinue artificial feeding, which is not in line with the DDCR's goal of non-interference in the reserve. This reduction in numbers will be achieved through natural processes by introducing a top predator (most likely the Arabian wolf) into the reserve as soon as fence upgrades have been completed. Biosphere Expeditions was an important part of the oryx population assessment and will continue to be essential in monitoring changes in oryx and wolf population dynamics, once the Arabian wolf has been introduced in the reserve.

At 218 individuals counted, the mountain gazelle is at healthy population levels. Its distribution follows habitat preference of vegetated dunes and areas of high vegetation and water around the Al Maha resort. Monitoring by the expedition will continue to track population dynamics for management purposes.

The sand gazelle population has grown and is successfully expanding in the reserve, showing new distribution hotspots that mirror its preferred vegetated sand dune habitats. Only 37 were counted by the expedition this year, but this is a reflection of expedition participants being busy with many other tasks. For this species too, monitoring by the expedition will continue to track population dynamics for management purposes.

Gordon's wildcats and sand foxes continue to be rare and elusive, with no live or camera captures this year. This is in contrast to red fox, which continues to be abundant, dominating camera captures alongside oryx. Tracking collars have been purchased to be fitted to Gordon's wildcats in order to glean data beyond live or camera capture. The expedition will play an important role in monitoring collared cats in the future.

Pharaoh eagle owls are in decline, probably due to low rodent prey availability because of a prolonged drought, and due to the abundance of red fox, which prey on the owl's ground nests. This is a concern, which needs to be addressed by management.

The Macqueen's bustard population continues to be small with low nesting incidences and success, despite favourable conditions. The reasons for this may be another area for the expedition to investigate.

The lappet-faced vulture has gone from rare to abundant and the DDCR is now the best place in Dubai to observe vultures. However, no nesting has been observed so far, despite favourable conditions. This conundrum may be another area for future expedition investigation.

A limited pilot rodent trapping effort in one habitat, yielding 13 individuals of one species (Cheesman's gerbil *Gerbilus cheesmani*), suggests that the rodent population has not suffered greatly from the recent drought and abundance of red foxes. This finding is in contrast to the pharaoh eagle owl decline, which suggests a decline in the rodent population. Rodent trapping efforts will be expanded during future expeditions to capture more species in a larger variety of habitats in order to corroborate or disprove the small decline hypothesis.

الملخص

مازال التعاون الناجح بين إدارة محمية دبى الصحراوية وبرنامج بعثات المحيط الحيوي مستمرا والذى بدأ منذ العام 2012م حيث أستمرت الدراسة بتجميع البيانات الحقلية بواسطة متطوعين من العامة لعدد تسع أنواع من الحيوانات البرية وهم (المها البرى، القط جوردون البري، الغزال الأدمي، غزال الريم، الثعلب الأحمر، ثعلب الرمال، طائر الحبارى، العقاب النوبي بالإضافة إلى البوم الصحراوي) وذلك لمدة أسبوع سنوياً وقد تمت في الفترة من 10 يناير إلى 17 يناير 2015م ولقد ساعدت البيانات المجموعة إدارة محمية دبي الصحراوية في اتخاذ قرارات بيئية ناجحة ساهمت في تعزيز التعاون المثمر بين المتطوعين المهتمين بالحياة البرية والعاملين المقيمين بالمحمية.

خلال فترة الدراسة تم تسجيل عدد 258 فرد من المها العربي بالمحمية حيث لوحظ أن توزيع المها العربي بالمحمية يتبع توزيع نقاط التغذية بالأعلاف، وبالرغم من ذلك تبين أن أعداد المها تزيد بصورة سريعة ويجب أن تتخذ المحمية إجراءات للحد من تلك الزيادة المضطردة حيث أن الاستدامة المطلوبة لأعداد الحيوانات البرية بالمحمية تتعارض مع ما يتم الان من إمداد الحيوانات الرعوية بالعلف الوفير مما يؤدى لتلك الزيادة الكبيرة في أعداد القطعان. من المقترح ان يتم التحكم في الأعداد المتزايدة من قطعان المها العربي عن طريق إدخال نوع مفترس لإيجاد التوازن الطبيعي المفروض والذي في الغالب سوف يكون (الذئب العربي) وذلك بمجرد الانتهاء من إنشاء وتحديث السور السلك حول حدود المحمية. سوف يشارك برنامج بعثات المحيط الحيوي في عمليات التقييم المتتالية عندما يكتمل إتمام هذا البرنامج.

وصلت أعداد أفراد الغزال الأدمي التي تم تسجليها خلال فترة الدراسة لحوالي 218 فرد ولوحظ أن الحالة الصحية العامة لأغلب القطيع ممتازة، ويغلب على توزيع أفرادها التواجد في المناطق الكثبان الرملية المغطاة بالنباتات وكذلك المناطق ذات الكثافة العالية من النباتات مع تواجد مصادر للمياه وذلك يكون في الأغلب حول منتجع المها الصحراوي، سوف يتم متابعة قياسات ذلك النوع لأغراض إدارة المحمية.

تواصل ازدياد أعداد أفراد غزال الريم بنجاح في المحمية حيث أظهر توزيعات لمناطق جديدة من محمية دبي الصحراوية لم تكن مسجلة بها مسبقاً متتبعة لبيئاتها المفضلة من الكثبان الرملية المغطاة بالنباتات البرية، تم تسجيل فقط عدد 37 في تلك السنة ولكن هذا العدد لا يعطى التقدير الحقيقي لأعداد الغزال بالمحمية حيث كان أعضاء الفريق منشغلين بتسجيل العديد من الأنواع الأخرى.

تواصل للسنة الثانية تسجيل أعداد قليلة من القط جوردون البري وثعلب الرمال مما يثبت أن تلك الحيوانات نادرة وبعيدة المنال، وهذا على النقيض من أعداد أفراد الثعلب الأحمر الصحراوي والتي مازالت أعدادها وفيرة بالمحمية من خلال تسجيلات كاميرات المصائد بالتوازي مع تسجيل افراد المها العربي. تم شراء عدد من أجهزة التتبع لاستخدامها مع القط جوردون البري من أجل استخلاص وجمع البيانات التي لا يمكن الحصول عليها من مصائد الكاميرات او المصائد العادية. وسوف يقوم برنامج بعثات المحيط الحيوي بمتابعة تلك الأجهزة في المستقبل.

تم ملاحظة انخفاض أعداد البوم الصحراوي ربما لانخفاض اعداد القوارض التي تتغذى عليها نظرا للجفاف الحالي بمنطقة الدراسة وكذلك للزيادة المضطردة لأعداد الثعلب الأحمر لكونه يقوم بافتراس نفس الطرائد التي تتغذى عليها البوم الصحراوي وكذلك يقوم الثعلب بافتراس صغار البوم من أعشاشها الأرضية، وتعتبر تلك الملاحظة من الأشياء التي يجب ان توضع في الاعتبار من جانب إدارة المحمية.

تم تسجيل أعداد قليلة من طائر الحبارى مع ندرة في تسجيل اعداد الأعشاش بالرغم من الظروف المناسبة لذلك، هناك احتمالية تواجد الحبارى بأعداد أكثر في مناطق لم يتم تغطيتها بواسطة الفريق البحثي.

تم تحويل حالة العقاب النوبي من نادر المشاهدة في التقارير السابقة إلى متوفر في تلك السنة وأصبحت محمية دبي الصحراوية من أفضل الأماكن في إمارة دبي لتسجيل ومشاهدة هذا الطائر، بالرغم من ذلك لم يتمكن الفريق من تسجيل أي حالة من حالات التعشيش بالمحمية بالرغم من الظروف المواتية. سوف يتم التركيز لحل هذا اللغز في الرحلات القادمة.

تم تصميم تجربة مبدئية مؤقتة باستخدام المصائد للإمساك بالقوارض الصحراوية اسفرت عن تسجيل عدد 13 فرد من نوع واحد (تشيزمن)، أثبتت النتائج المبدئية عدم تأثر القوارض الصحراوية بفترات الجفاف الطويلة وكثرة المفترسات من الثعالب الحمراء. وهذا على النقيض من انخفاض تعداد البوم الصحراوي نتيجة لما تم استنتاجه بانخفاض أعداد القوارض. سوف يتم تكرار نفس الطريقة العام القادم لتسجيل أنواع أكثر من القوارض الصحراوية في بيئات مختلفة لتوثيق أو لنفى الفرضية بانخفاض أعدادهم.

Contents

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1. Expedition review

M. Hammer
Biosphere Expeditions

1.1. Background

Biosphere Expeditions runs wildlife conservation research expeditions to all corners of the Earth. Our projects are not tours, photographic safaris or excursions, but genuine research expeditions placing ordinary people with no research experience alongside scientists who are at the forefront of conservation work. Our expeditions are open to all and there are no special skills (scientific or otherwise) required to join. Our expedition team members are people from all walks of life, of all ages, looking for an adventure with a conscience and a sense of purpose. More information about Biosphere Expeditions and its research expeditions can be found at www.biosphere-expeditions.org.

This expedition report deals with an expedition to the United Arab Emirates that ran from 11 to 18 January 2014 with the aim of assisting scientists of the Dubai Desert Conservation Reserve (DDCR) to gather scientific data on Arabian oryx, Gordon's wildcat, mountain and sand gazelle and Arabian red fox in order to gain a better understanding of their ecology so that informed management decisions can be made. Arabian oryx and Gordon's wildcat are on the IUCN Red list and the expedition's work will help to ensure the survival of the species in the wild. In gaining a better understanding of the Arabian oryx and Gordon's wildcat, through observations on their movements, habitat and food preferences and through their interaction with other species, this project is able to ascertain what the major threats are to their continued survival. Based on this, project scientists can then develop appropriate management plans that will provide a safe environment for the study species to thrive in.

1.2. Research area

The Dubai Desert Conservation Reserve (DDCR) is an area of 225 km² that comprises 4.7% of Dubai's land area. Conservation in this area started in 1999 when the Al Maha Desert Resort was opened within a protected area of 27 km² (Al Maha Reserve). One of the first conservation actions of the reserve was a wildlife reintroduction programme for Arabian oryx and the two indigenous gazelle species (sand as well as mountain gazelle), as well as programmes for the protection of other key components of the ecosystem, in particular the vegetation (close to 6,000 indigenous trees were planted in 1999 to create a natural seed bank which has now led to germination of indigenous plants). In 2001 the resort management began a major environmental audit of the surrounding area. Following this audit a proposal was submitted to the Dubai government on the formation of a formal national park. The proposal was accepted and sanctioned almost immediately and work began on protecting the area to be known as the Dubai Desert Conservation Reserve.

Figure 1.2a. Flag and location of United Arab Emirates and study site.

An overview of Biosphere Expeditions' research sites, assembly points, base camp and office locations is at Google Maps.

Today the DDCR is a representative of the Dubai inland desert ecosystem and is characterised by a sandy desert environment consisting of sand dunes interspersed with gravel plains. There is one rocky outcrop in the north of the reserve, which provides nesting sites for the desert eagle owl and two groves of rare Ghaf trees (*Prosopis cineraria*). The Al Maha Reserve (27km²) was the core area for the reintroduction of the Arabian oryx, mountain gazelle and sand gazelle. Currently the DDCR contains approximately 450 Arabian Oryx from the 100 that were originally re-introduced in 1999. Both the Arabian oryx and the gazelle species have expanded into the DDCR naturally as the amount of human activity has decreased and been controlled. Mountain and sand gazelle can now be seen throughout the DDCR.

1.3. Dates

The expedition ran from 10 - 17 January 2015 and was composed of a team of international research assistants, guides, support personnel and an expedition leader (see below for team details).

1.4. Local conditions & support

Expedition base

The expedition field base was composed of a Bedu style tent camp (of a Bedu mess tent and modern one and two person dome tents for sleeping in). Each person had their own dome tent to sleep in (larger tents for couples) and there were campsite-style showers and toilets. An expedition cook, kindly provided by Al Maha was with the team and cooked in the field. Vegetarians and other special diets were catered for.

Weather

The UAE has a subtropical, arid climate with sunny blue skies most of the year. Over the eight days of the expedition the weather was overcast most mornings, clearing up to the usual cloudless sky later in the day. The mean low and high temperatures during the expedition were 8º and 32º C.

Field communications

There was an (emergency) telephone close to base and mobile phones will largely worked in and around camp and around the study site. In the field, two-way radios and mobile phones were used for communication between research teams.

The expedition leader also posted and expedition diary on Biosphere Expeditions' social media sites such as Facebook, Google+ and the Wordpress blog.

Transport and vehicles

Team members made their own way to the Dubai assembly point in time. From there onwards and back to the assembly point all transport and vehicles were provided by Biosphere Expeditions and the DDCR for the expedition team, for expedition support and emergency evacuations.

Medical

The expedition leader was a trained first aider, and the expedition carried a comprehensive medical kit. A network of first-rate private and government hospitals in Dubai provided further medical support. Safety and emergency procedures were in place. There were no medical incidences during the expedition and none of the medical support network or safety procedures were called upon.

1.5. Scientist

The expedition's field scientist is Stephen Bell. Born in South Africa, he graduated in Biology in 1996, with a bachelor's degree from the University of Witwatersrand, South Africa. Stephen spent most of his career guiding throughout South Africa and Zambia in private game lodges. He was also a trails guide in the greater Kruger National Park where he conducted 5 day walking safaris. Stephen fell in love with the fauna and flora of the Arabian desert whilst he spent six years guiding in the area at the Al Maha Desert Resort & Spa. Stephen joined the DDCR as a Conservation Officer in 2009 and works closely with on-going conservation projects on the reserve. Stephen has a passion for birding and is always keeping an ear out for the odd bird call. Stephen has always had a keen interest in wildlife from a young age he was always found playing with all sorts of creepy crawlies. During his off time Stephen can be found with mates diving around the world.

1.6. Expedition leader

Malika Fettak is half Algerian, but was born and educated in Germany. She majored in Marketing & Communication at the University of Frankfurt, which led her to jobs in PR & Communications. She has travelled widely, especially in Africa and Northern Europe. Her love of nature and the outdoors, and taking part in a few Biosphere expeditions, persuaded her that a change of career was in order and here she is since 2008, leading expeditions and making herself useful around the office. Malika is a keen sportswoman - triathlon, skiing, volleyball, etc. and enjoys the outdoors.

1.7. Expedition team

The expedition team was recruited by Biosphere Expeditions and consisted of a mixture of all ages, nationalities and backgrounds. They were (in alphabetical order and with countries of residence):

Jim Blomgren (USA), Neil Goodall (UK), Stephanie Grant (UK), Melanie Hitchcock (USA), Katie Lu Qi (USA), Andre Meine (Germany), Semra Sakarya (UAE), Jörg Töpfer (Germany).

1.8. Partners

The main partner on this expedition is the Dubai Conservation Board, a government-appointed organisation concerned with the conservation and protection of the Dubai inland desert. Other partners include the National Avian Research Centre. Corporate support was gratefully received from Arabian Adventures for hosting the team at one of their camps on the final night of the expedition, as well as Al Maha, Desert Resort & Spa, who provided the expedition food.

1.9. Expedition Budget

Each team member paid towards expedition costs a contribution of £980 per seven-day slot. The contribution covered accommodation and meals, supervision and induction, all maps and special non-personal equipment, all transport from and to the team assembly point. It did not cover excess luggage charges, travel insurance, personal expenses such as telephone bills, souvenirs, etc., as well as visa and other travel expenses to and from the assembly point (e.g. international flights). Details on how these contributions were spent are given below.

Income	£
Expedition contributions	10,460
Expenditure	
Staff includes local & international salaries, travel and expenses	3,040
Research includes equipment and other research expenses	93
Transport includes car hire, fuel, taxis and other local transport	1,535
Base includes food and camping fees	373
Team recruitment Arabia as estimated % of PR costs for Biosphere Expeditions	6,525
Income – Expenditure	**- 1,106**
Total percentage spent directly on project	**111%***

*This means that in 2015, the expedition ran at a loss and was supported over and above the income from the expedition contributions and grants by Biosphere Expeditions.

1.10. Acknowledgements

This study was conducted by Biosphere Expeditions, which runs wildlife conservation expeditions all over the globe. Without our expedition team members (listed above) who provided an expedition contribution and gave up their spare time to work as research assistants, none of this research would have been possible. The support team and staff (also mentioned above) were central to making it all work on the ground. Biosphere Expeditions would also like to thank the DDCR and its staff, Al Maha, Arabia Adventures and the Friends of Biosphere Expeditions for their sponsorship and/or in-kind support.

1.11. Further information & enquiries

More background information on Biosphere Expeditions in general and on this expedition in particular including pictures, diary excerpts and a copy of this report can be found on the Biosphere Expeditions website www.biosphere-expeditions.org.

Copies of this and other expedition reports can be accessed via at www.biosphere-expeditions.org/reports. Enquires should be addressed to Biosphere Expeditions via www.biosphere-expeditions.org/offices.

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2. Desert species surveys

2.1. Introduction and background

The United Arab Emirates, and Dubai in particular, is well known for its rapid development over the past 40 years, as well as for the mega-construction projects such as the Palm Islands and the Burj Khalifa (the world's tallest building). Less well known is the diversity and beauty of the natural environment, from the dugongs and corals in the Arabian Sea, the flamingos in the khors (inlets) of the coastline, the rugged Hajar mountain range, to the serene splendour of the sandy dune inland desert. Also little known is that the largest piece of land given to any single project in Dubai was for the establishment of the Dubai Desert Conservation Reserve (DDCR), at 225 km² or 4.7% of Dubai's total land area.

Arabian oryx (*Oryx leucoryx*) is one of four oryx species, all of which are adapted to arid and semi-arid environments. Locally known by its Arabic name of Al Maha, the Arabian oryx was first described in 1777. Endemic to the Arabian Peninsula, the Arabian oryx's historical range was across Oman, Saudi Arabia, Jordan, United Arab Emirates, Yemen, Kuwait and Iraq, but the advent of firearms saw their rapid decline due to hunting all across Arabia. Since 1986 the Arabian oryx has been classified as "Endangered" on the IUCN Red List, but was already "very rare and believed to be rapidly decreasing in numbers" in 1965. The Arabian oryx is the largest of the antelopes in the region and it is very well adapted to the extremely arid environment. It is culturally significant in Arabia, revered for its beauty, common in poetry and as a woman's name, Maha. Re-introduced into the DDCR in 1999, the population has steadily grown from the original 100 individuals to over 400 today.

Figure 2.1a. Arabian oryx (photo courtesy of S. Bell).

The Arabian oryx is a medium-sized antelope with a distinct shoulder bump, long, straight horns, and a tufted tail; it is a bovid, and the smallest member of the oryx genus, native to desert and steppe areas of the Arabian Peninsula. The Arabian oryx was extinct in the wild by the early 1970s, but was saved in zoos and private preserves and reintroduced into the wild starting in 1980. Arabian oryx prefer to range in gravel desert or hard sand, where their speed and endurance will protect them from most predators, as well as most hunters on foot. In the DDCR they are found in the hard sand areas of the flats between the softer dunes and ridges. The diet of the Arabian oryx consists mainly of grasses, but they will eat a large variety of vegetation, including trees, buds, herbs, fruit, tubers and roots. Herds of Arabian oryx are known to follow infrequent rains to eat the new plants that grow afterward (Talbot 1960).

The **Gordon's wildcat (*Felis silvestris gordoni*)** is the same size as a domestic cat. The background colour of its coat ranges from reddish to sandy yellow to tawny brown to grey, and is typically marked with faint tabby stripes and spots. Its preferred habitat is the vegetated dunes, gravel plains and mountains, in which it hunts a mainly carnivorous diet at night. It is thinly distributed throughout the Nubian, Saharan and Arabian deserts, where it is generally restricted to mountains and dry watercourses. The biggest threat to the survival of the Gordon's wildcat as a species is the interbreeding with feral or domestic cats, which could lead to its extinction as a distinct species. Very little is known about the Gordon's wildcat population within the DDCR. The last population estimate was done in 2004. The expedition has enabled DDCR scientists to update information on population size and distribution as well as conduct a DNA study of the species; information that is important for informed management decisions to be made and threats to be averted.

Figure 2.1b. Gordon's wildcat (photo courtesy of P. Roosenchoon).

The **Arabian or mountain gazelle (*Gazella gazella*)** has a delicate body of 10 to 14 kg and can reach speeds of 65 km/h if it needs to escape danger. The mountain gazelle has a pure white belly with a dark to black stripe on its flanks that changes to dark beige or brown on the back, the neck and the head. The facial markings consist of various shades of brown with two white stripes extending from the eyes towards the nostrils. Females can give birth to a single fawn during any month, but with natural peaks in spring and autumn. Most grazing activity takes place at dawn and dusk. It rests during the hottest hours of the day under any shelter available, which may be a cave for those that inhabit the mountains. Usually moving in small groups of four to six animals, the species is highly territorial, with the dominant male continuously marking its territory with a wax-like substance, which it produces in glands below the eyes. The substance is deposited by rubbing its head against a bush, a branch or a stone. The group also maintains several places within its territory, which they establish as "toilets". The animals usually only defecate and urinate at these sites. As with oryx and sand gazelle, mountain gazelles do not need to drink water, but will readily do so if water is available (Grubb 2005).

Figure 2.1c. Mountain gazelle (photo courtesy of S. Bell).

The **sand gazelle's (*Gazella leptoceros*)** elegantly curved horns of both males and females are considerably longer than those of other gazelles occurring in the area. The animals are very light in colour, the head completely white in older animals, with back and flanks light beige. The belly is white and there is no darker stripe between the white underside and the beige flanks and back of the gazelle. Contrasting with the overall pale body, are the black eyes, nostril and mouth. Their colouring is obviously an adaptation to the habitat they favour, which are the open sands. They are absent from the mountains. The sand gazelle is the only antelope in this area that regularly gives birth to twins, and this usually in spring and autumn. The young spend their first days in shallow scrapes, or under a small bush, until they are strong enough to move with the adults (UAEInteract 2012).

Figure 2.1d. Sand gazelle (photo courtesy of G. Simkins).

The **Arabian red fox (*Vulpes vulpes arabica*)** is widespread in the region. Highly adaptable, it inhabits virtually every environment and lives in the cities along the coast, the desert and the mountains. However, it does not seem to penetrate areas such as the Liwa with soft sand and high dunes. An omnivorous animal, it will eat almost anything, from dead fish on the beach, to dates, carrion and of course small mammals and birds, which it actively hunts during the night. The cubs, numbering up to six per litter, are raised in a burrow that the vixen excavates herself and often uses year after year. Cubs are born in early spring, fully furred but blind and their eyes open after about 10 days. At the age of four weeks they start taking solid food and this is also the time when they begin exploring the surroundings of their burrow. Soon after this they follow the vixen on short hunting trips. As it lacks the long dense fur of the European fox, Arabian fox appears to have a thin body and long legs, but proportionally they are the same, with the exception of the ears. These are larger and have thousands of tiny blood vessels that help the Arabian fox to maintain its body temperature. Reddish to sandy-brown, its colour has adapted to the environment in which it is living (Harrison and Bates 1991, Hellyer 1993).

Figure 2.1e. Arabian red fox (photo courtesy of J. Babbington).

The **sand fox (*Vulpes rueppellii*)**, also know as Ruppell's, Rueppell's or Rüppel's fox, is a species of fox living in North Africa and the Middle East, from Morocco to Afghanistan and the southwestern parts of Pakistan. It has an average life expectancy of up to six or seven years in the wild, but can live longer in captivity. Sand foxes are about 40-52 cm long and have an average weight of 1.7 kg. It is a very small canine, and is considerably smaller than the red fox. It is sandy in colour and has black patches on the muzzle, as well as a white-tipped tail. The sand fox relies on scent glands for many activities. It uses them to mark territories as well as to spray at unwanted predators, similar to the behaviour of the skunk. The female sand fox uses her scent glands to mark the cubbing den. Another use for the scent glands is to greet each other. Sand foxes can bark, in a way similar to a dog. During the mating season, they travel in monogamous groups, or a male and a female, but after the breeding season, the fox reportedly moves in family groups of 3-15 individuals. One animal occupies about 50-69 km^2 of territory, with the male's territory larger than that of the female. The sand fox is nocturnal and gregarious. Animals change dens often, and will abandon a den if there is a dangerous disturbance in the area. Most dens are dug under rocks or under trees.

The sand fox was pushed to living in the desert biome due to competition with its larger cousin, the red fox. It is known as being an extremely good survivor. It is preyed upon only by the steppe eagle and the eagle owl. A solitary forager and omnivore, it will eat almost anything that crosses its path. Mostly, it is an insectivore, but its diet also consists of tubers and roots, as well as small mammals, reptiles, eggs, and arachnids. The female sand fox has a gestation period of around 51–53 days. She has 2-3 offspring, and each is born blind. They are weaned at 6–8 weeks of age. They are born underground as protection from predators.

Figure 2.1f. Sand fox (photo courtesy of G. Simkins).

The **Macqueen's bustard (*Chlamydotis macqueenii*)** is a large bird in the bustard family. It breeds in southwestern Asia, in deserts and other very arid sandy areas. It is brown above and white below, with a black stripe down the sides of its neck. In flight, the long wings show large areas of black and brown on the flight feathers. Sexes are similar, but the female is smaller and greyer above. The Macqueen's bustard has recently been split as a separate species from the Houbara bustard (*Chlamydotis undulata*) of the Canary Islands and North Africa. These two species are the only members of the *Chlamydotis* genus (Ali 1993). The dividing line between the two species is the Sinai Peninsula. The Macqueen's has a greater tendency to wander than the more sedentary Houbara bustard. Both species have been hunted to near-extinction. Conservation efforts by the late Sheikh Zayed bin Sultan Al Nahyan in the UAE have given some hope for the future of the Macqueen's bustard.

Figure 2.1g. Macqueen's bustard (photo courtesy of S. Bell).

The **lappet-faced vulture (*Torgos tracheliotos*)** is a mostly African Old world vulture belonging to the bird order Accipitriformes, which also includes eagles, kites, buzzards and hawks. It is usually found in undisturbed open country, at elevations from sea level to 4,500 m (Ferguson-Lees & Christie 2001), with a scattering of trees and apparently prefers areas with minimal grass cover. While foraging, it can wander into denser habitats and even into human habituated areas, especially if drawn to road kills. The species is fairly rare in the UAE, but good sightings have been made in the DDCR and it is the best place in the UAE to find the species. It is hoped it will start to nest in the DDCR in the near future.

Figure 2.1h. Lappet-faced vulture (photo courtesy of G. Simkins).

The **pharao eagle owl (*Bubo ascalaphus*)** or desert eagle owl was heard every evening around the camp. These owls can be found in rocky deserts and semi-deserts, gorges, cliffs, rocky mountain slopes. During the day they are mostly seen sleeping under fire bushes (*Leptadenia pyrotecnica*) and will take flight if disturbed.

Figure 2.1i. Pharaoh eagle owl (photo courtesy of G. Simkins).

2.2. Methods

Expedition participants assisted DDCR scientists in three important surveys: Gordon's wildcat live capture and camera trapping, as well as Arabian oryx monitoring. In addition to these surveys the expedition members were tasked to record any species while in the field. After a training period that lasted one and a half days, participant were split into three groups to conduct the various surveys, in three separate zones of the DDCR, namely a North Zone, Central Zone and South Zone (see Figure 2.2a). Each zone comprised of fourteen 2 x 2 km quadrants. These 42 quadrants together represented 168 km² of the 225 km² of the DDCR (or 75%). The area included all key habitats of vegetated dunes, sand dunes and gravel plains.

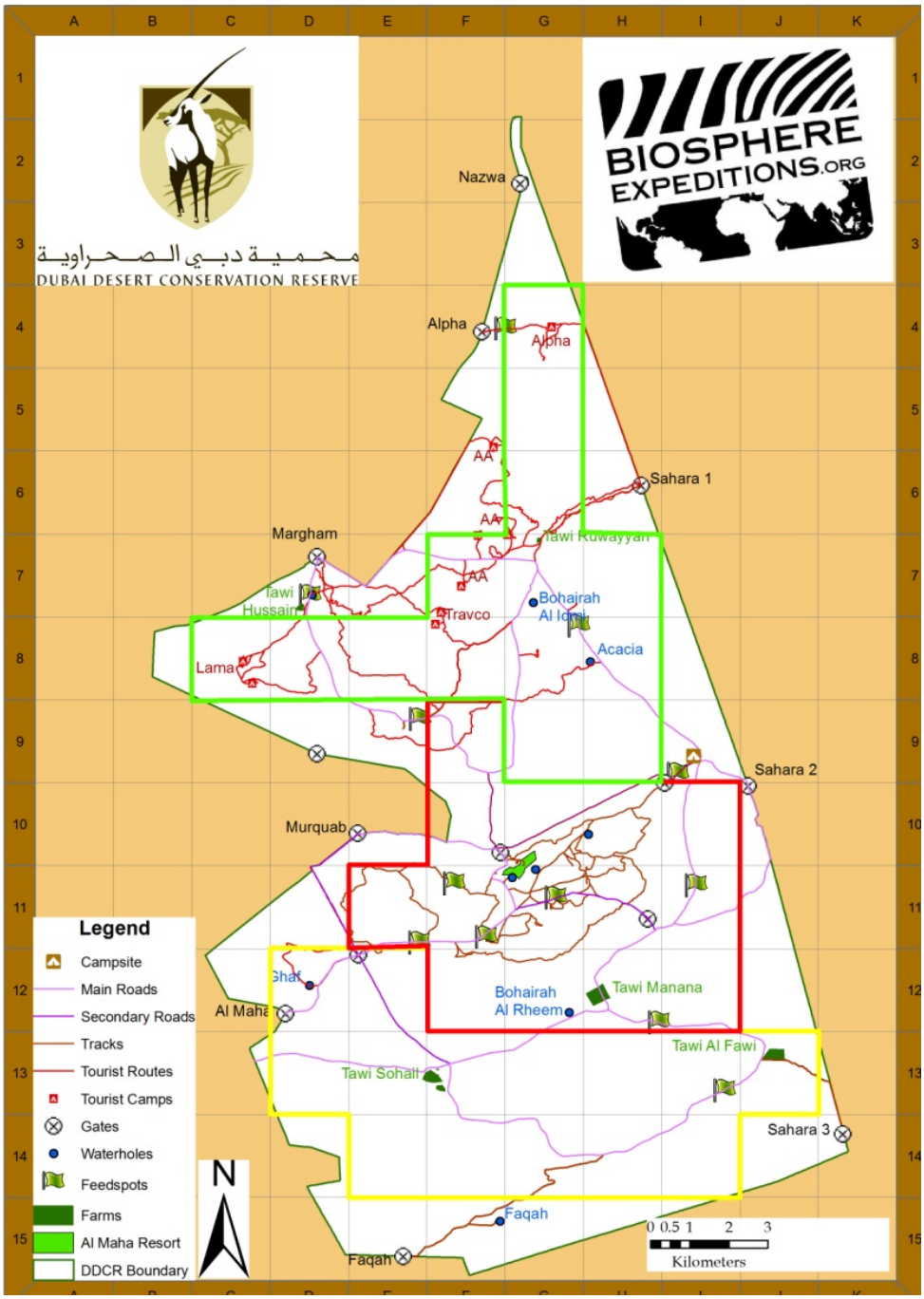

Figure 2.2a. The DDCR and its survey zones (North = green, Central = red, South = yellow).

Expedition participants were split into three groups and each person moved between zone survey groups so as to experience all habitat types of the reserve. Every day each group was tasked to survey three quadrants or 12 km². 180 km² were covered in this way during the expedition. During surveys any target species encounters were recorded in the relevant datasheets.

Species encounters

Target species as described above and encountered during the surveys were recorded in the datasheets as follows: species name, position of researcher when the species was first seen, distance and bearing from researcher to target species, time of day when the species was observed, ecological information such as number of animals, sexes etc., additional comments. Duplicate counts of individuals were avoided as much as possible by sending survey teams into different cells in the allocated zones.

IDW (Inverse Distance Weighted Interpolation)

Interpolation is a procedure used to predict the value of cells at locations that lack sampled points. One of the most commonly used techniques for interpolation of scatter points is inverse distance weighted (IDW) interpolation (ESRI 2009). Inverse distance weighted methods determine cell values using a linear-weighted combination set of sampling points and are based on the assumption that the interpolating surface should be influenced mostly by the nearby points and less by the more distant points. The interpolating surface is a weighted average of the scatter points and the weight assigned to each scatter point diminishes as the distance from the interpolation point to the scatter point increases.

IDW was used as a method to predict the specie distribution patterns of species recorded in the DDCR during the expedition's surveys. Abundance counts over the study area were used as input and predictions were applied to all the species recorded using ESRI® Arc Map 10.0 spatial analyst extensions.

Live traps for medium-sized animals

Ten Tomahawk live traps were used during the expedition for the purpose of capturing Gordon's wildcat. At the beginning of the expedition, each survey group was given three live traps to place within their allocated zones. In each zone, three pre-allocated quadrants were given to each group to decide where within the quadrants they should place each live trap. Each group marked the position of the live trap in the GPS. The live traps were baited with tinned sardines and left out in the field for five nights. The bait was placed right at the back of the trap (using an extendable reacher/grabber) (see Figure 2.2c) so the target species is forced to step onto a pressure plate. The pressure plate was covered with sand to give the trap a more natural feel and to ensure that the target species is at ease when entering the trap.

Each morning groups set out into their zones to check each of their three live traps. This involved checking the surroundings of the traps for a possible presence/absence around the trap and to see if the trap had been disturbed or investigated by a Gordon's wildcat or a feral cat. Where necessary, traps were re-baited.

Figure 2.2b. Bating a live trap.

Live traps for small-sized animals

A total of 15 rodent traps were used at three different locations. At each location the team members set five traps along a 100 metre transect line, the spacing between each trap was 20 meters. Each site was predetermined by a visual signs survey of rodent activity in the area. Trap lines were set for a period of five nights at each site to allow the traps to be accepted by animals in the area. Traps used consisted of custom made mesh traps 40x10x10cm, with a nest box built in at the rear of the trap (see Figure 2.2c).

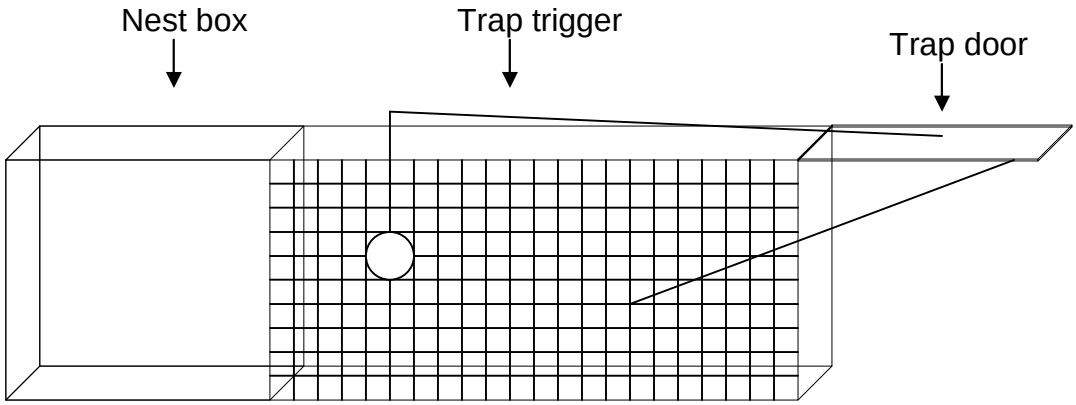

Figure 2.2c. Rodent trap.

A standard bait of crushed barley, bird mix, quail mix, seeds and peanut butter was used to bait the traps. Rodent species trapped in each plot were identified in the field with the help of reference guide and the following measurements were taken: Weight (g), total length (mm), tail length (mm), hind foot length (mm). Each captured rodent was marked with a marker pen on its tail to identify recaptures.

Camera trapping

As many species in the desert environment are both nocturnal and elusive, it is difficult to gather reliable information on their populations. A camera trap triggers when an animal passes in front of and infrared and/or motion detector. This has the advantage of detecting, with equal efficiency both nocturnal and diurnal activities with minimal environmental disturbance. The camera trap survey aims to record the presence (or absence) of elusive and nocturnal species, in particular the smaller carnivores, within the DDCR.

Figure 2.2d. Setting a camera trap (photo courtesy of Wouter Kingma).

Eight camera traps (five Reconyx RC60 and three Reconyx Hyperfire) were used during the expedition, two or three in each zone. Predetermined quadrants in each of the zones were chosen for the survey groups to set their camera traps in, close to water sources. The traps were baited on the first day with quail guts and left out in the field for five days. All camera traps were collected on the last day of the expedition.

Diversity indices

The Shannon diversity index is a very widely used index for comparing diversity between various habitats. It assumes that individuals are randomly sampled from an independently large population (Peet 1974).

The Brillouin diversity index is used when diversity of non-random samples or collection is being estimated. As the Shannon diversity index, Brillouin is type I index, which means it deals with the rare species in the community (Peet 1974).

The Simpson diversity index is a type I index and as such gives more weight to the abundant species in the sample. It takes into account the number of species present, as well as the abundance of each species. The index represents the probability that two individuals randomly selected from a sample will belong to different species. The value ranges between (zero and one), and the greater the value, the greater the sample diversity (Peet 1974).

2.3. Results

Species encounters

Table2.3a Species encountered during the expedition. Species shaded in grey are expedition target species. S = sighting, L = live trap, C= camera trap.

Common name	Latin name	Common name	Latin name
Birds		**Mammals**	
Grey Francolin S	*Francolinus pondicerianus*	Arabian Oryx S C	*Oryx leucoryx*
Little Grebe S	*Tachybaptus ruficollis*	Arabian Hare S C	*Lepus capensis*
Mcqueen's Bustard S C	*Chlamydotis macqueenii*	Arabian Red Fox S C	*Vulpes vulpes*
Black-winged Stilt S	*Himantopus himantopus*	Mountain gazelle S C	*Gazella gazella cora*
Red-wattled Lapwing S	*Vanellus indicus*	Sand Gazelle S	*Gazella subgutturosa marica*
Wood Sandpiper S	*Tringa glareola*	**Reptiles**	
Laughing Dove S	*Spilopelia senegalensis*	Spiny-tailed Lizard S	*Uromastyx leptieni*
Pharaoh's Eagle Owl S	*Bubo ascalaphus*	White spotted Lizard S	*Acanthodactylus schmidti*
Indian Roller S	*Coracias benghalensis*	Sandfish S	*Scincus scincus*
Eurasian Hoopoe S	*Upupa epops*	Desert Monitor Lizard S	*Varanus griseus*
Lesser Grey Shrike S	*Lanius minor*	**Rodents**	
Brown-necked Raven S	*Corvus ruficollis*	Cheesmans Gerbil S L	*Gerbillus cheesmanni*
Crested Lark S	*Galerida cristata*		
White-eared Bulbul S	*Pycnonotus leucotis*		
Arabian Babbler S	*Turdoides squamiceps*		
Black Redstart S	*Phoenicurus ochruros*		
Desert Wheatear S L	*Oenanthe deserti*		
Purple Sunbird S	*Cinnyris asiaticus*		
White wagtail S	*Motacilla alba*		
Lappet faced Vulture S C	*Torgos tracheliotos*		
Long-legged Buzzard S	*Buteo rufinus*		
Green Bee-eater S	*Merops orientalis*		
Chestnut-bellied Sandgrouse S	*Pterocles exustus*		
Feral Pigeon S	*Columba livia*		
Rose-ringed Parakeet S	*Psittacula krameri*		
Southern Grey Shrike S	*Lanius meridionalis*		

The 2015 expedition observed 258 oryx individuals, 37 sand gazelle individuals, 218 mountain gazelle individuals.

Live traps for medium-sized animals

Ten live traps were set: four in the North, three in the Central and three in the South zone. Out of the ten traps set, only one trap in the North was triggered with a capture of a feral cat. No Gordon's wildcats or sand foxes were caught in the traps. Both cat and fox tracks were seen around the traps (Fig 2.3a), but is almost impossible to tell whether they were from feral or Gordon's or from red fox or sand fox tracks. Trapping success and observations were very similar in 2014 with also a single feral cat capture and no Gordon's wildcats.

Table 2.3b. Results of trap checks.

Triggered without species	1	
Triggered by non-target species	1	Desert wheatear
Triggered by fox or cat	1	Feral Cat
Not triggered	57	

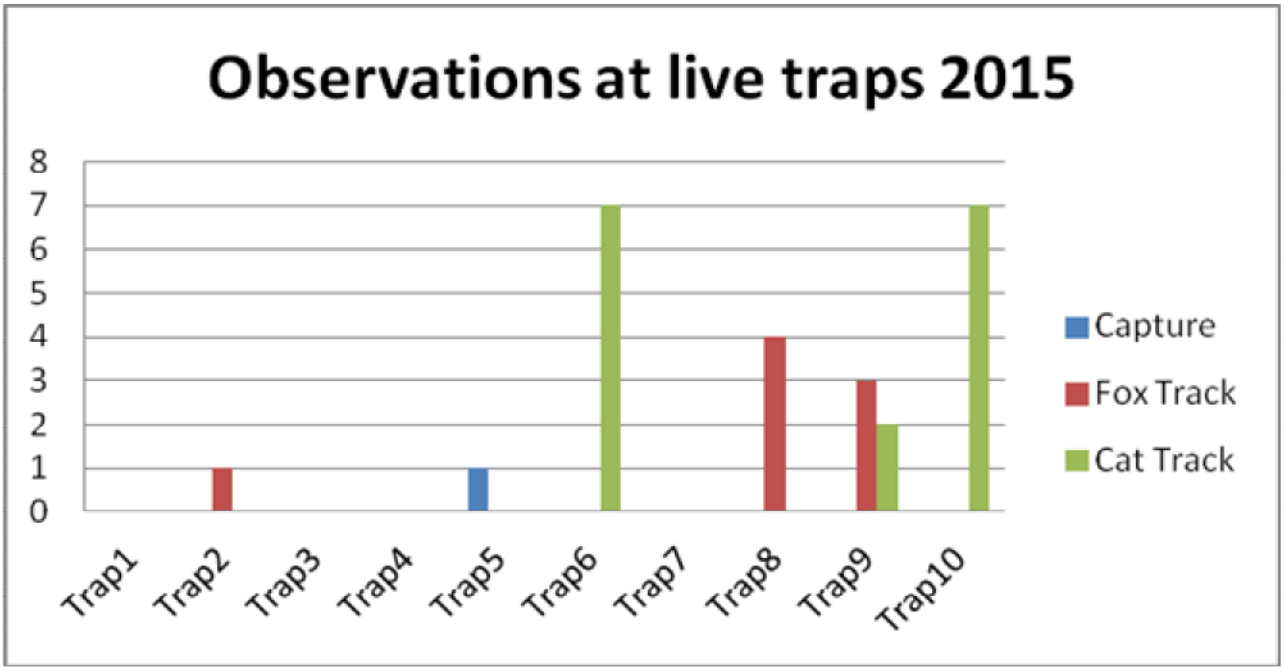

Figure 2.3a. Tracks seen at trap sites

Live traps for small-sized animals

Out of the six rodent species found within the DDCR, only Cheesman's gerbil (*Gerbilus cheesmani*) was captured. 13 separate individuals (two males, five females, six unknown sex) were captured without recaptures. Traps were triggered without a target species 29 times and not triggered 42 times, which gave a trapping success of 1.7863. The moon phase during the six nights of trapping was the last quarter, which represented fairly dark nights, which is good for rodents as they are more concealed by the darkness of the moon.

Camera trapping

During the five nights of camera trapping, a total of 2883 pictures were taken by eight camera traps. Camera 3 in the North zone took 1779 pictures, which were mainly of oryx, mountain gazelles and humans. As regards target species, 77 pictures were taken of Maqueen's bustard, followed by six lappet-faced vulture pictures. No Gordon's wildcats, feral cats or sand foxes were recorded.

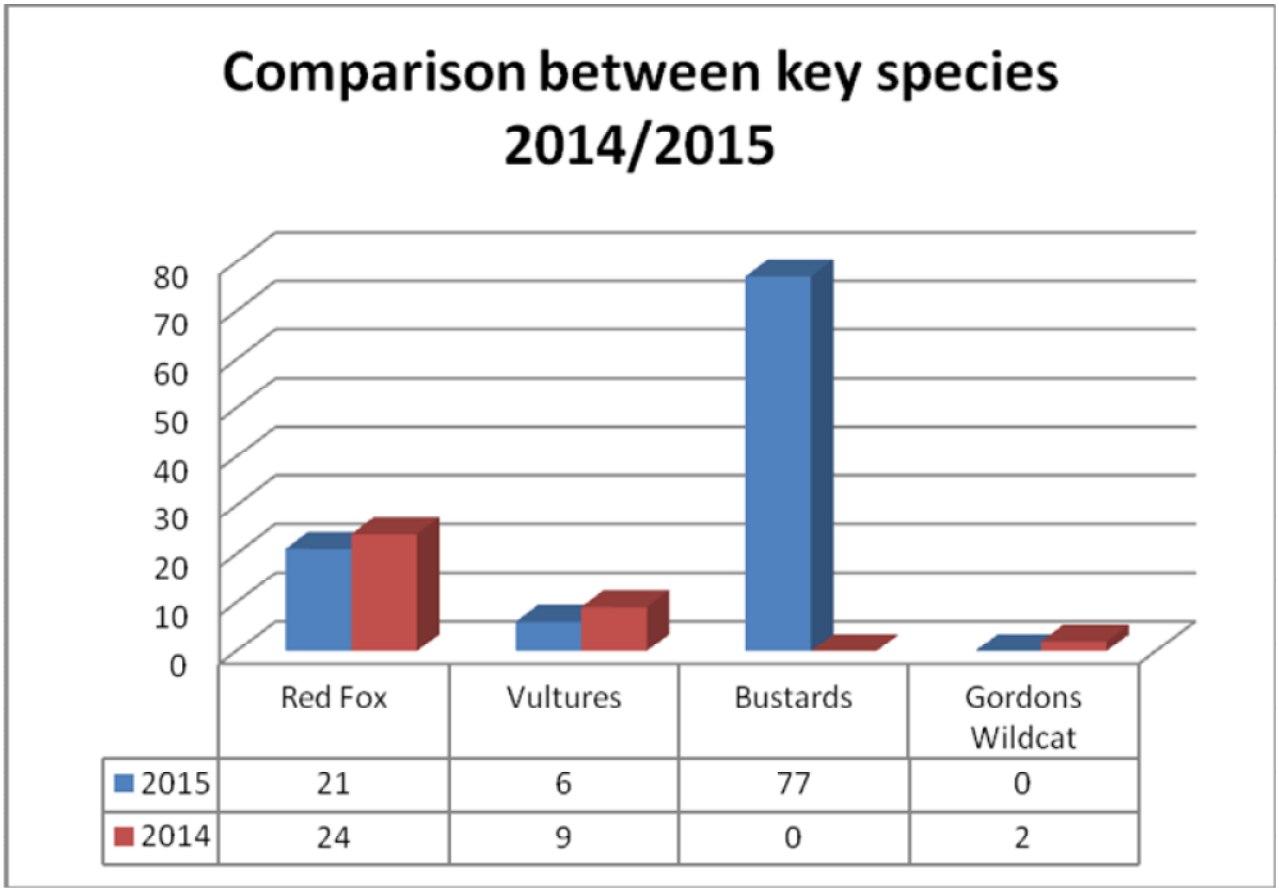

Figure 2.3b. Camera trapping results in 2014 and 2015.

2.4. Discussion and Conclusion

Species encounters – oryx

Observed oryx numbers were very similar to 2014 (Fig 2.4b) with a total of 258 individuals observed during the expedition and throughout the reserve. The distribution hotspots, however, did change slightly as compared to 2014, as a result of the DDCR moving the feeding stations to different locations and therefore the oryx moving to where the food source can be found. The DDCR management frequently moves the feeding stations to ensure the oryx do not congregate in one particular area and cause over-browsing on the little natural vegetation that the DDCR supports. The main goal of the DDCR is to be self-sustaining, in other words no feed supplementation. A comparative predicted distribution will only then become truly beneficial to the reserve as a realistic view of any potential over-browsing hotspots.

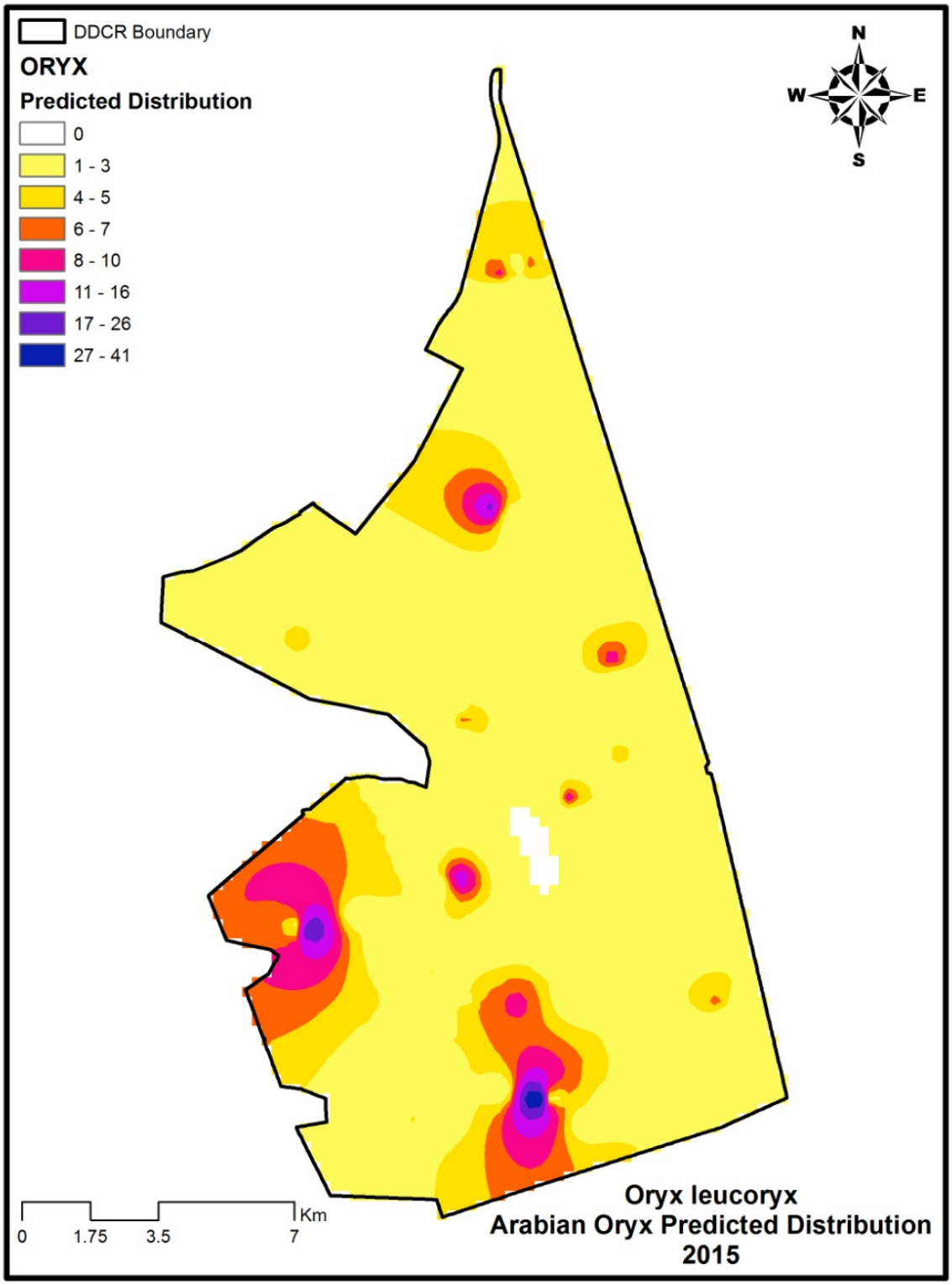

Figure 2.4a. Oryx distribution. Predicted distribution calculations for oryx are based on sighting data only.

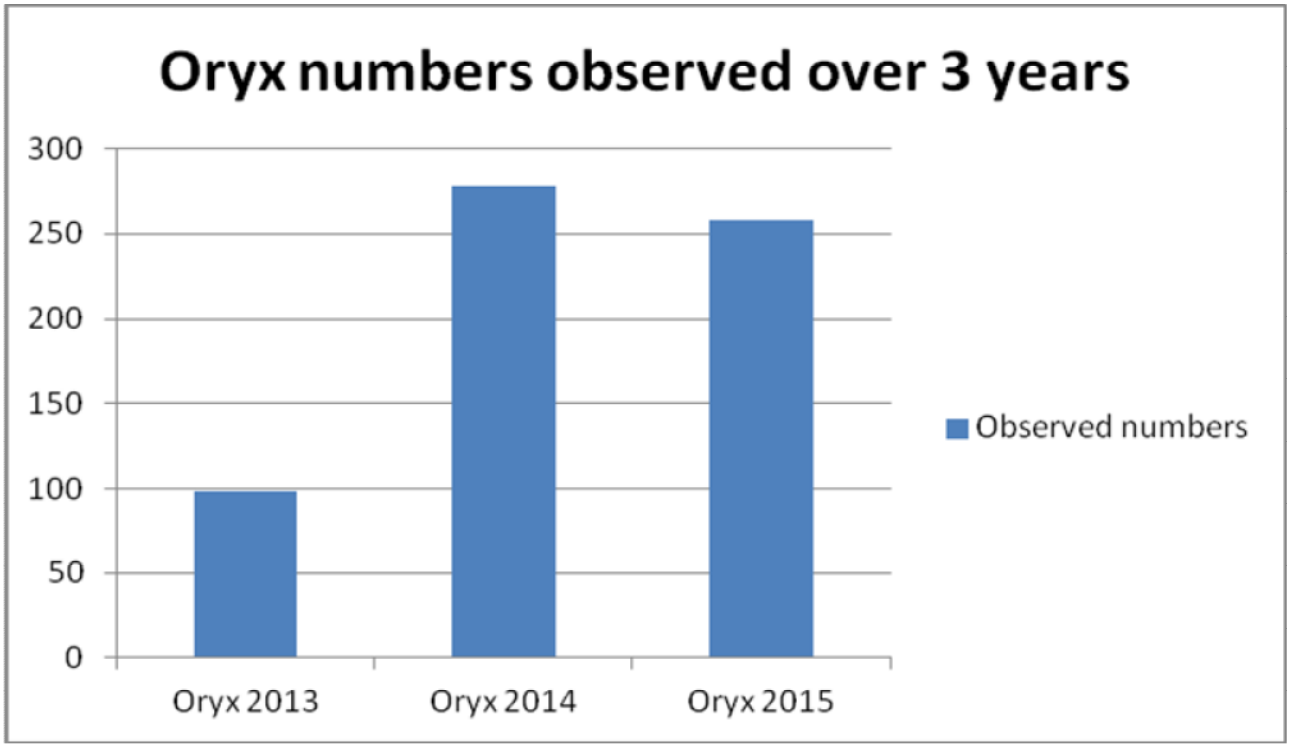

Figure 2.4b. Oryx encounters 2013-2015.

The Arabian oryx encounters once again show high numbers, which are unsustainable. Numbers are slightly down from 2014, but this is within standard error limits. Moreover, over 50% of females this year are pregnant, so with the expected birth of all the new oryx, the numbers will be alarmingly high. The DDCR long-term goal has always been to establish a viable, sustainable and self-sufficient population. In order to move towards this stated aim, an apex predator such as the Arabian wolf or hyaena will be introduced to apply top-down pressure to the antelope population. The approval for this has been granted and the likely predator will be the Arabian wolf. Introduction will begin when the perimeter fence has been upgraded. Once the Arabian wolf has been introduced, citizen science will again play an important role in monitoring predator presence and population dynamics.

Species encounters – mountain gazelle

The mountain gazelle has always been the DDCR's dominant gazelle. It is widespread and consistently found in most parts of the reserve (Fig. 2.4c). Unlike in previous years, the Southern corner of the reserve yielded no sightings this year. The western hotspot represents the entrance road to Al Maha Resort and Spa, where there is plenty of browsing and adequate shelter. The centre of the reserve has a fairly large hotspot area. This is the hotel with well-established gardens and lawns, and large water holes. The hotspots north of the hotel are oryx feeding points or ghaf tree congregations, both of which attract gazelles. The hotspot in the far northern zone is unique as the habitat is totally different there. The rocky outcrop in this area is not found anywhere else in the reserve. This area is starting to attract more and more mountain gazelles, probably because the rocky outcrop serves as shelter from the elements and because there is also a fair amount of natural vegetation and an artificial watering hole. Directly below are three additional small hotspot nuclei. These areas are all gravel plains, areas where the ground gives firm footing and there is an abundance of natural vegetation.

The majority of mountain gazelles were seen in the Central zone and there is a definite trend starting to emerge if we compare data from previous years. The dominating habitat is vegetated dunes with small pockets of gravel plains on the fringes. These vegetated dunes show high densities of *Leptadenia pyrotechnica* (fire bush), which favours sandy plains and low dunes. The mountain gazelle feeds on the fire bush's yellow flowers, which flower between November and June. The base of the plant is used for shelter and protection from the harsh sun.

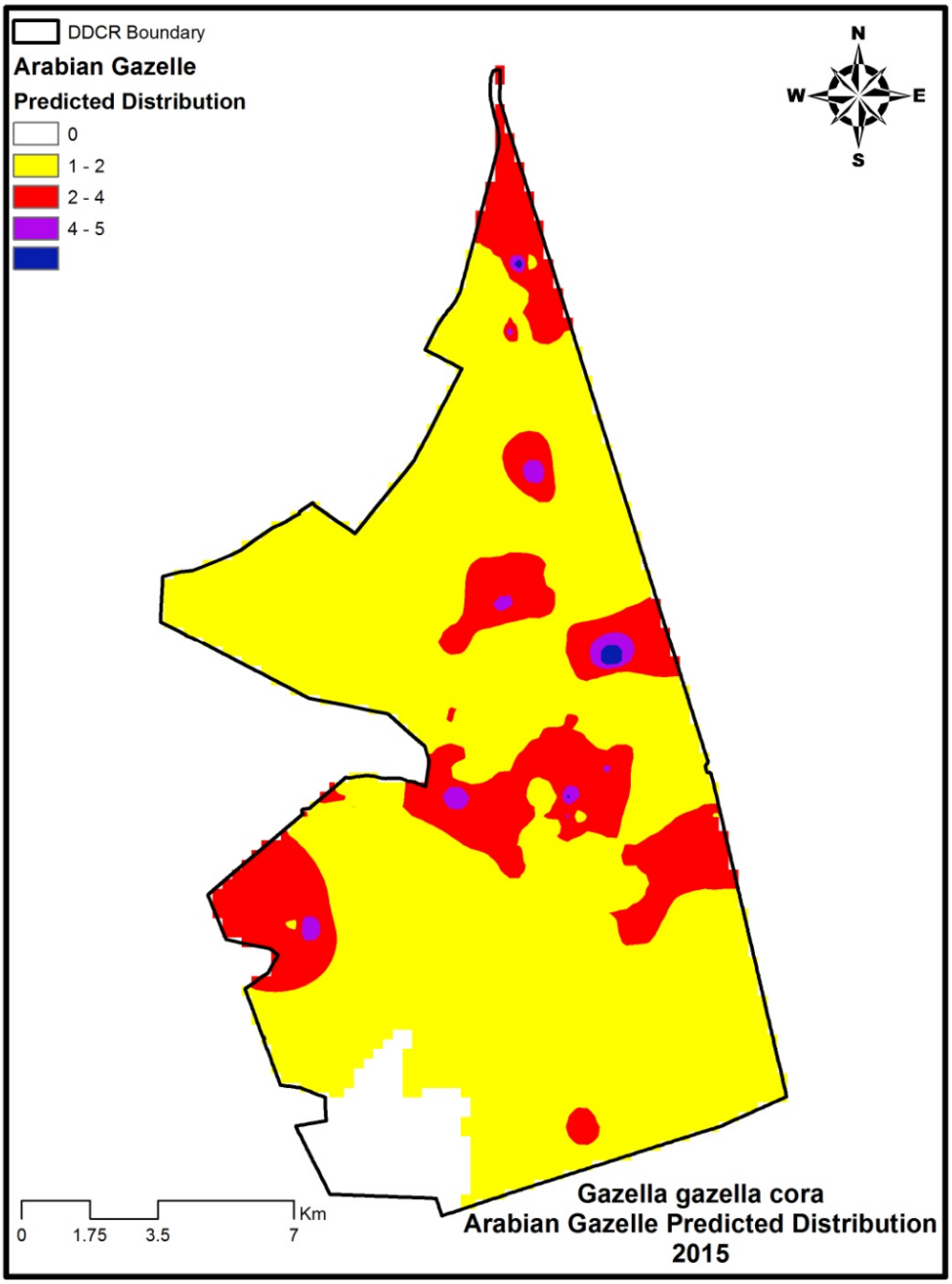

Figure 2.4c. Mountain gazelle distribution.
Predicted distribution calculations for mountain gazelle are based on sighting data only.

Species encounters – sand gazelle

The DDCR started off with only a handful of sand gazelles and over the years their numbers have risen steadily. Small groups were seen in the past in the South zone, as this area has always been their stronghold. The Southern zone is the quieter part of the reserve in terms of human activity and when sand gazelles were introduced, this was the area where they could be seen. It is also the area dominated by sand dunes, which, as the species name suggests, is the preferred habitat of the sand gazelle. Over the last ten years we have seen a very positive shift of the species moving into the Central and Northern zones. The hotspot that has developed in the upper Central zone is an area of dunes and vegetation. It has developed because sand gazelle numbers are increasing, forcing animals to colonise new suitable habitat within the reserve.

This year only a very low number of 37 animals were recorded. However, it is known from previous expedition and DDCR staff counts that the true number of individuals in the reserve is about 150, so this low number is most likely a sampling artefact deriving from the short sampling period and lack of focus on counting only sand gazelle, but also many other species whilst being occupied with various tasks.

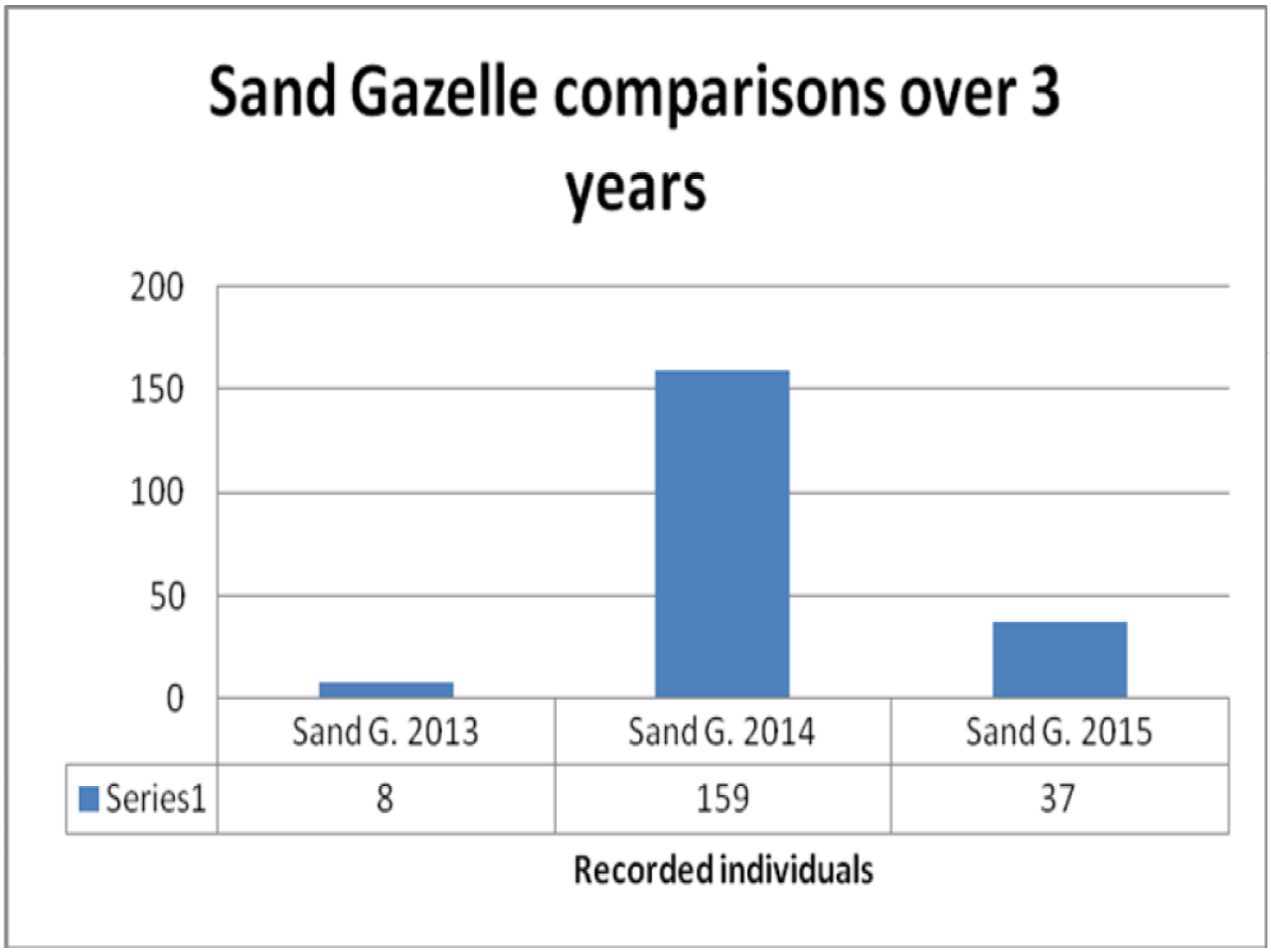

Figure 2.4d. Sand gazelle encounters 2013-2015.

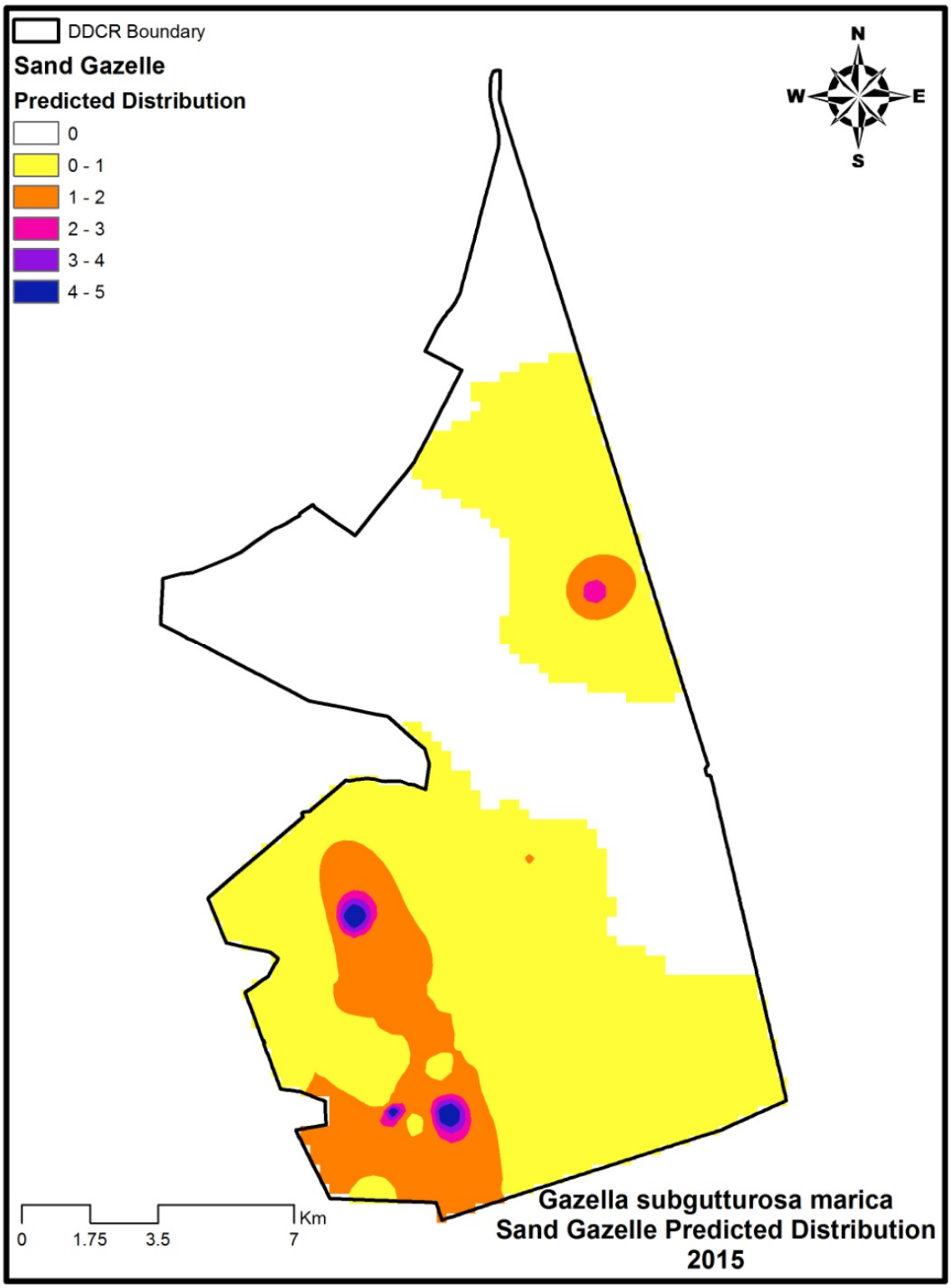

Figure 2.4e. Sand gazelle distribution.
Predicted distribution calculations for sand gazelle are based on sighting data only.

Species encounters – predators

Gordon's wildcat once again eluded the teams as none were captured in the live traps or recorded on camera traps. A single feral cat was caught in one of the live traps in the northern area and removed from the reserve as hybridisation with domestic cats is one of the most serious threats to Gordon's wildcat survival as a species. The reserve has purchased five cat collars for the sole purpose of monitoring the species. Once Gordon's wildcats are fitted with collars, citizen science will play a major role in conservation in following and observing this elusive species. For the expedition in 2016 we will adopt a new trapping method, which will hopefully lead to successful captures. Old fox dens, utilised by Gordon's wildcats as refuges during the day, will be pinpointed and these locations will be monitored and trapped by means of live traps and camera traps.

Arabian red foxes were seen by team members and were captured on camera trap as this species is abundant and the dominating predator of the area. The smaller of the two fox species, the shyer sand fox was not seen even though great efforts were made to capture the species either by live trap or camera trap. As a rare species, numbers are low. Continued trapping efforts will hopefully ensure a capture, so that local and citizen scientist can continue to monitor this elusive species.

Species encounters – birds

Pharaoh eagle owls have been in decline over the past two to three years and are a concern. Two major factors influencing this decline is firstly the scarcity of rain over the past few years, which has affected the vegetation and thereby rodent populations, which are down and the owl's primary food source. Secondly, there is a sizeable population of red foxes in the reserve. Red foxes will prey on eggs at nest sites, which are easy to reach as the pharaoh eagle owl nests on the ground, usually within a fire bush.

The Macqueen's bustard population is very small and is confined to specific areas of the DDCR, by and large former date farms, which have been given back to the reserve. Drip line irrigation has been installed in these areas to try and regenerate natural growth, which is working well and is also attracting the species to these areas. Currently all the bustards on the reserve have been re-introduced and the goal is for these birds to produce hatchings to form wild populations. Over the past two years there has only been one recording of chicks. The chicks were only seen once and the chances of them having survived is very slim.

The lappet-faced vulture is a success story. Rarely seen in the past, today lappet-faced vultures are fairly common in the DDCR. Indeed, the DDCR is regarded by birding experts as the best place to see vultures in Dubai. To date no nesting has been observed, but we are hoping that the undisturbed areas with adequate trees for nesting present in the reserve will attract nesting activity in the future.

Live traps for small-sized animals

This was the first year that rodent trapping was incorporated into the expedition. 13 individuals of only one species (Cheesman's gerbil *Gerbilus cheesmani*) were captured in all tree zones. This is because traps were only set in one habitat only: former farms with current irrigation. The pilot trapping programme was a success with relatively high rodent densities found in all three trapping sites. Therefore more rodent trapping will be incorporated into future expeditions, expanding into all three main habitats: vegetated dunes, shifting dunes and gravel plains. This will ensure that we get the best possible chance of capturing other species, as the different rodent species are very habitat-specific.

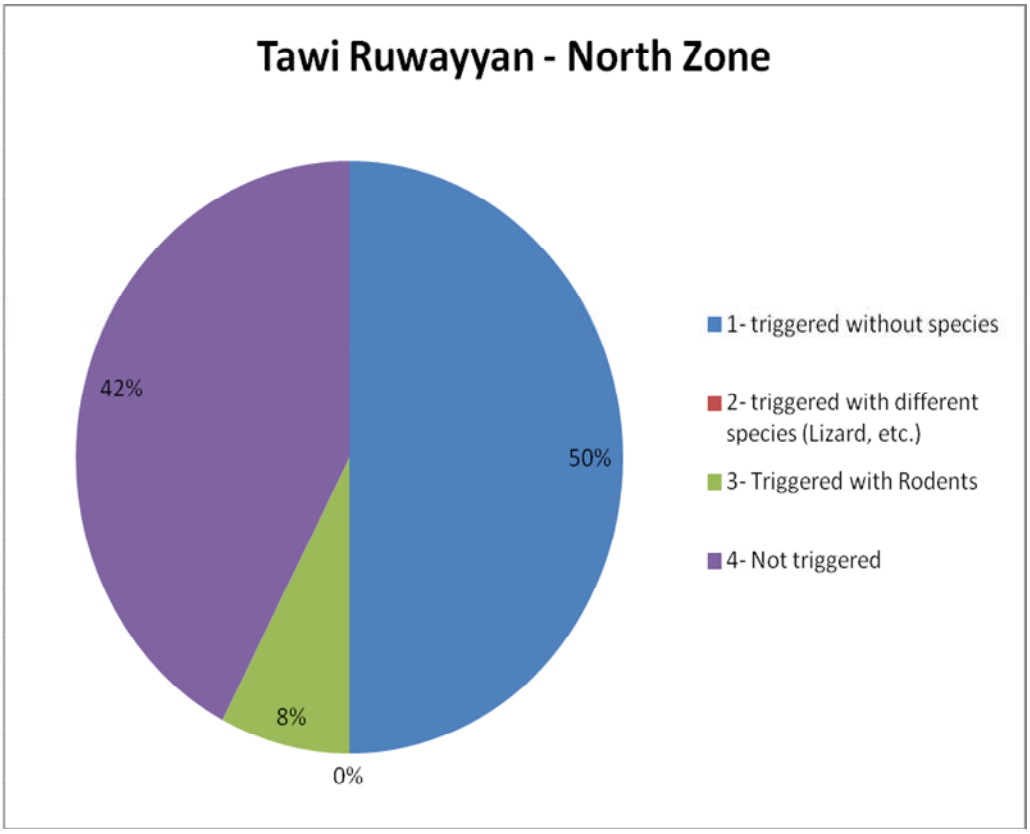

Figure 2.4f. Trapping success North zone.

Results for Tawi Ruwayyan were interesting as more rodents of more species were expected to be captured. The habitat type in the area is perfect for rodents: stable ground for burrows and an abundance of vegetation for seed collection. However, only two rodents of only one species were caught. The likely reason for this was the presence of a feeding station for Arabian oryx not far from the rodent trap line. After looking at and analysing the camera trap data in the same location, we realised that the oryx were more active at night around the feeding station. This site generated 1779 pictures showing that the area had too much disturbances from other mammal species for it to be a good area for rodents.

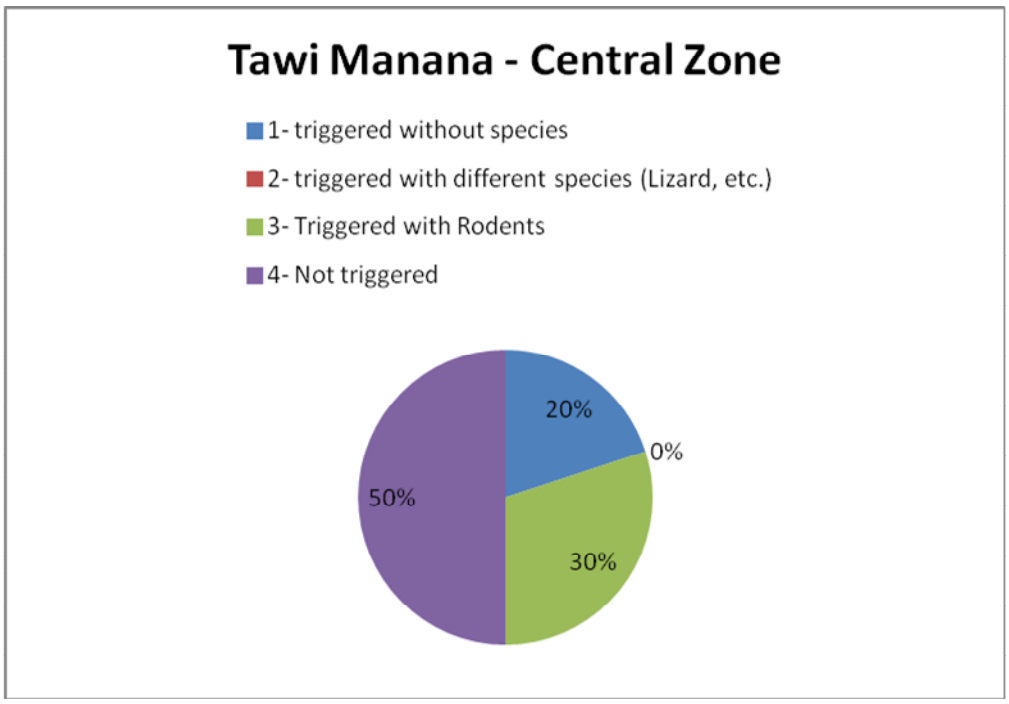

Figure 2.4g. Trapping success Central zone.

Tawi Manana was the most successful site out of the three sites with nine Cheesman's gerbils caught. The area had good vegetation with ample amounts of seeds. The area had also been artificially irrigated with drip lines to promote vegetation growth, resulting in a high density of rodent burrows in the area. Unlike the site in the North zone, this site did not have a feeding station for oryx nearby, which also aided in the capture of rodents.

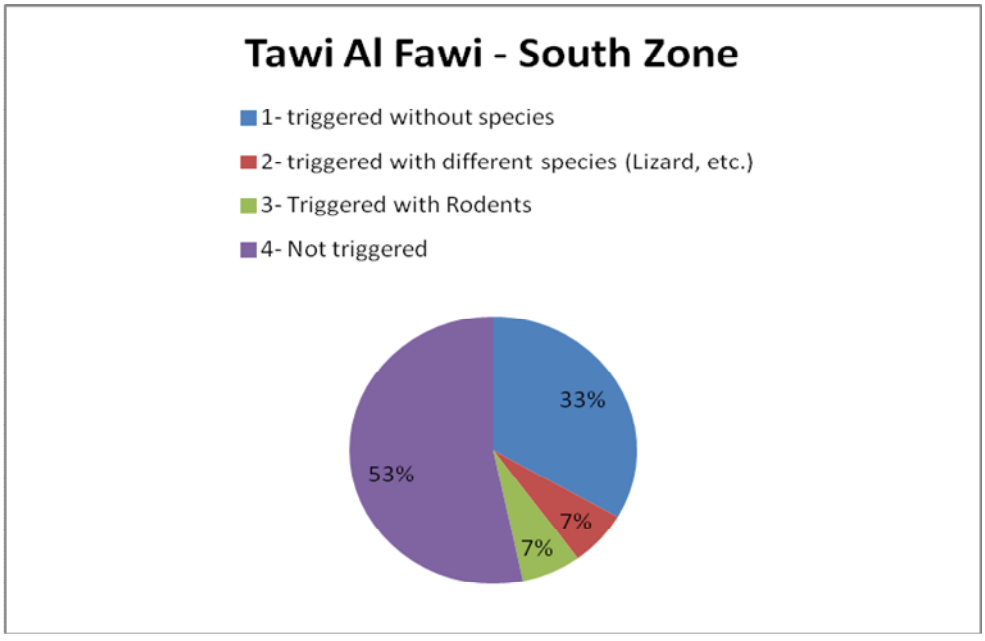

Figure 2.4h. Trapping success South zone.

The vegetation at Tawi Al Fawi was not as good as the other two sites. It was an area with scatted vegetation and no artificial drip lines, so the habitat was much closer to true desert habiat. As seed availability was far lower than in the other two sites, the low number of rodents captured (two Cheesman's gerbils) comes as no surprise.

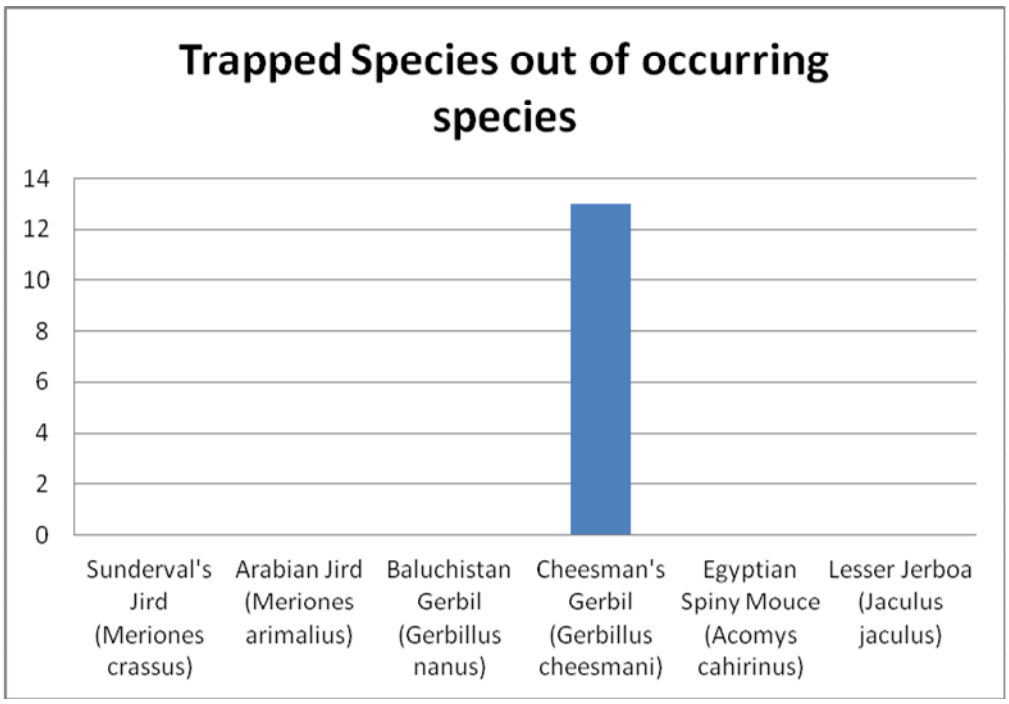

Figure 2.4i. Species of rodents known to be present in the DDCR and capture success.

Figure 2.4i does not represent a true reflection of species distribution in the DDCR, as trapping was conducted only for a limited period of time (six nights) and in only one habitat (irrigated former farms). Most rodents are very habitat-specific. For example, the Egyptian spiny mouse prefers rocky outcrops, Sundervals and Arabian jirds gravel plains and Jerboas sand dunes. The Cheesman's gerbil is the most common rodent in the reserve (Bell and Khafaga 2012) and was chosen as an indicator species to elucidate whether rodent population levels have decreased due to the recent drought and high red fox numbers. In contrast to the pharaoh eagle owl decline, which is thought to be due to drought-induced rodent decline, this rodent trapping pilot study suggests that the rodent population is relatively unaffected. Trapping will be expanded during future expeditions to ascertain population levels and trends of other rodent species in other habitats too, in order to elucidate whether there is a decline, as suggest by the pharaoh eagle owl, or not, as suggested by the trapping results..

Summary, recommendations and further expedition work

Oryx distribution in the reserve follows artificial feeding points. However, there are too many oryx in the reserve and their numbers must be reduced, amongst other things in order to discontinue artificial feeding. This reduction in numbers will be achieved through natural processes by introducing a top predator (the Arabian wolf) into the reserve as soon as fence upgrades have been completed. Biosphere Expeditions was an important part of the oryx population assessment and will continue to be essential in monitoring changes in population dynamics once the Arabian wolf has been introduced in the reserve.

The mountain gazelle is ubiquitous at healthy population levels and its distribution follows habitat preference of vegetated dunes and areas of high vegetation and water around the Al Maha resort. Monitoring by the expedition will continue to track population dynamics for management purposes.

The sand gazelle population has grown and is successfully expanding in the reserve, showing new distribution hotspots that mirror its preferred vegetated sand dune habitats. For this species too, monitoring by the expedition will continue to track population dynamics for management purposes.

Gordon's wildcats and sand foxes continue to be rare and elusive, with no live or camera captures. This is in contrast to red fox, which continues to be abundant. Tracking collars have been purchased to be fitted to Gordon's wildcats in order to glean data beyond live or camera capture. The expedition will play an important role in monitoring collared cats.

Pharaoh eagle owls are in decline, probably due to low rodent prey availability because of a prolonged draught, and due to the abundance of red fox, which prey on the owl's ground nests. This is a concern, which needs to be addressed by management.

The Macqueen's bustard population is small with low nesting incidences and success, despite favourable conditions. The reasons for this may be another area for the expedition to investigate.

The lappet-faced vulture has gone from rare to abundant and the DDCR is now the best place in Dubai to observe vultures. However, no nesting has been observed so far, despite favourable conditions. This conundrum may be another area for future expedition investigation.

A limited pilot rodent trapping effort in one habitat suggests that the rodent population has not suffered from the recent drought and abundance of red foxes. Rodent trapping efforts will be expanded during future expeditions to capture more species in a larger variety of habitats in order to corroborate or disprove this hypothesis.

2.5. Literature cited

Ali, S. (1993). The Book of Indian Birds. Bombay: Bombay Natural History Society, Bombay.

Bell, S., M. Hammer and A. Stickler (2013) Ways of the desert: conserving Arabian oryx, Gordon's wildcat and other species of the Dubai Desert Conservation Reserve, United Arab Emirates. Expedition report available via www.biosphere-expeditions.org/reports.

Bell, S. and M. Hammer (2014) Ways of the desert: conserving Arabian oryx, Gordon's wildcat and other species of the Dubai Desert Conservation Reserve, United Arab Emirates. Expedition report available via www.biosphere-expeditions.org/reports.

Bell, S, and T. Khafaga (2015) Assessment of terrestrial small mammals in Dubai Emirate's inland desert. Wildlife Middle East 7(2), 5.

BirdLife International (2013) Species factsheet: *Buteo rufinus*. Downloaded from http://www.birdlife.org on 17/02/2013. Recommended citation for factsheets for more than one species: BirdLife International (2013) IUCN Red List for birds. Downloaded from http://www.birdlife.org on 17/02/2013.

El Alqamy, H. (2010) Body condition score evaluation for Arabian oryx. 11th conservation workshop for the fauna of Arabia. Biodiversity Management Sector, Environment Agency – Abu Dhabi.
http://www.biodiversityconference.com/pdf/1923dcadae56e9a99be5875b5e5387aa.pdf
ESRI® (Environmental Systems Resource Institute) (2012) ArcMap™ 10.1. Copyright © 1999-2012 ESRI Inc., Redlands, California. USA.

Ferguson-Lees, J. & Christie, D. A. (2001) Raptors of the World. Houghton Mifflin Hartcourt, London.

Grubb, P. (2005). "Gazella gazella". In Wilson, D. E.; Reeder, D. M. Mammal Species of the World (3rd edition). Johns Hopkins University Press. pp. 637–722. ISBN 978-0-8018-8221-0. OCLC 62265494. http://www.bucknell.edu/msw3/browse.asp?id=14200571.

Harrison, D.L. and P.J.J. Bates (1991) The Mammals of Arabia (2nd edition). Harrison Zoological Museum Publications.

Hellyer, P. (1993) Mammals. Tribulus 3(1): 29.

Jongbloed, M. (2007) Return to the wild of the Arabian Oryx. Al Shindagah 76. From http://www.alshindagah.com/shindagah76/En/Return.htm

Khafaga, T (2009) Comparative study of vegetation structure and regeneration between two monitoring surveys in Dubai Desert Conservation Reserve. DDCR internal report.

Peet, R. K., (1974). The measurement of species diversity. Annual Review Ecologial Systems 5: 285-307.

UAEinteract [internet]. 2012 [cited 2014 September 1]. Available from: http://www.uaeinteract.com/nature/mammal/mam02.asp

Wikipedia; 2014 [cited 2015 June 16]. Available from: http://en.wikipedia.org/wiki/R%C3%BCppell%27s_fox

Talbot, L. (1960) A look at Threatened Species. The Fauna Preservation Society. pp. 84–91.

Appendix 1: Camera trap pictures

Arabian oryx

Lappet-faced vulture 1

Lappet-faced vulture 2

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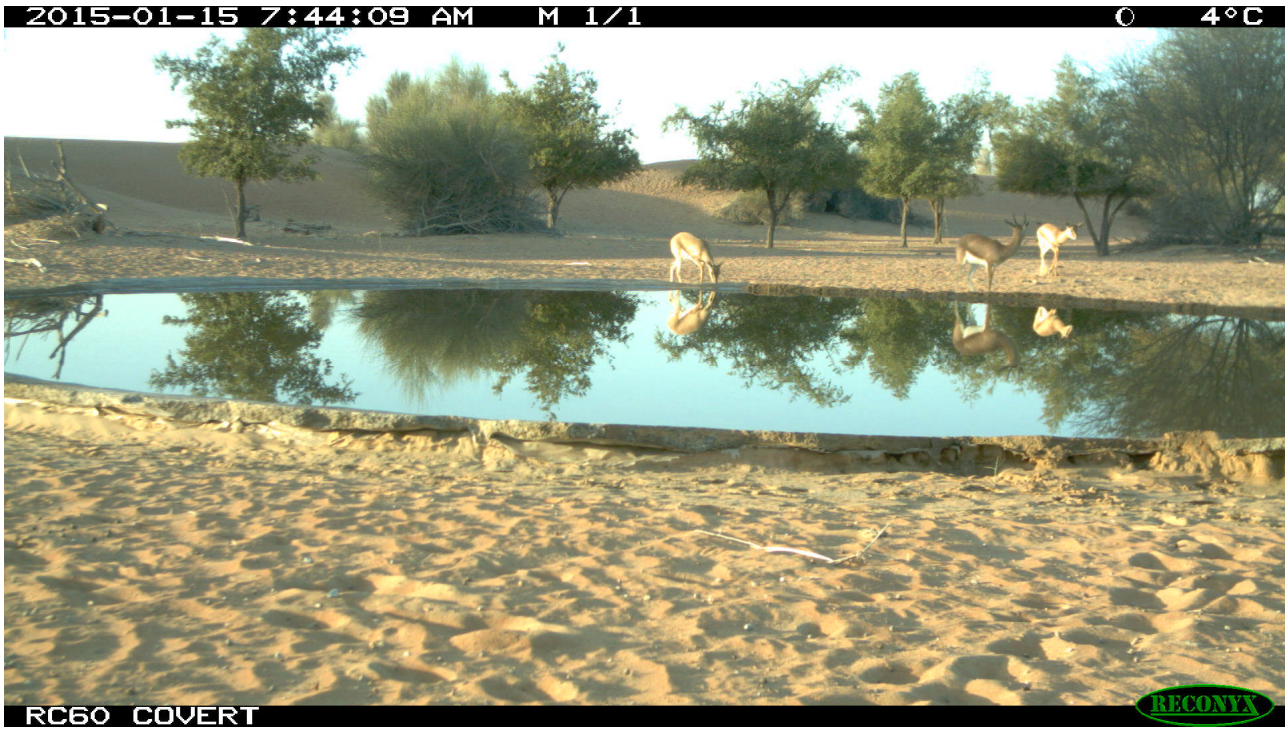
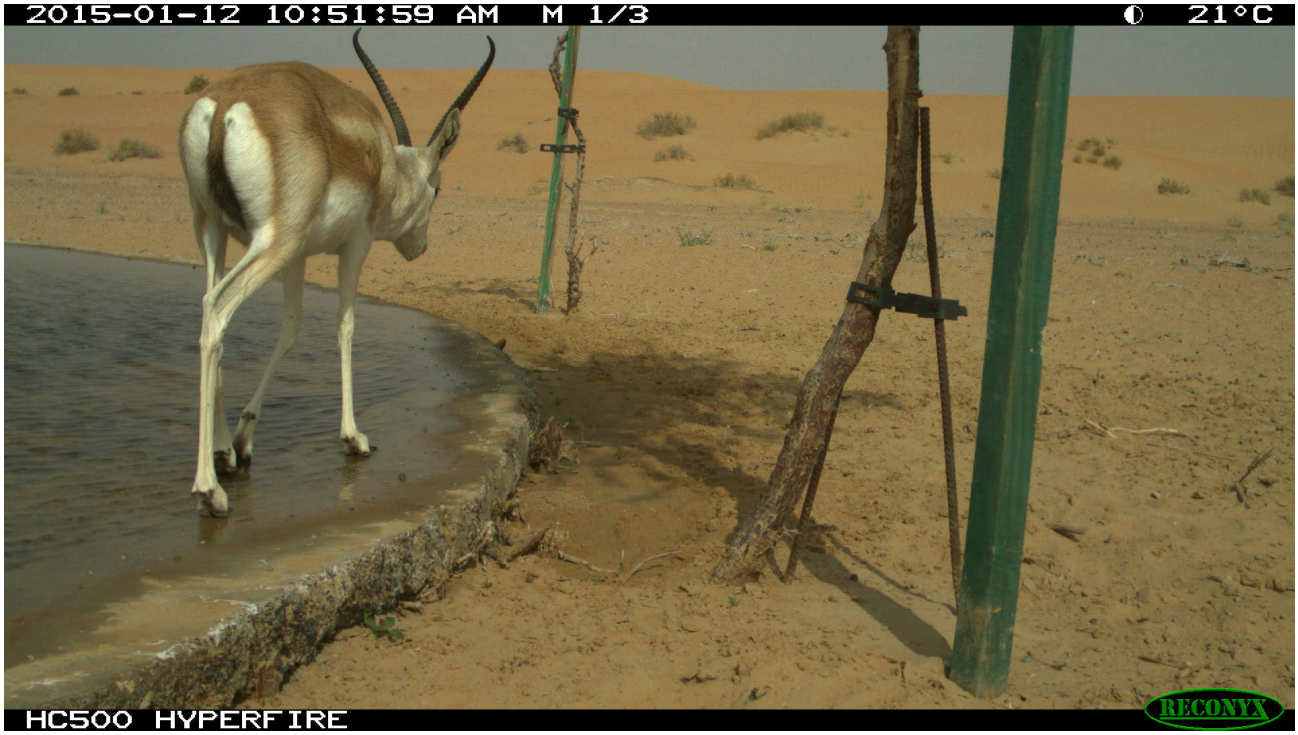
Lappet-faced vulture 3

Lappet-faced vulture 4

Mountain gazelle 1



Mountain gazelle 2



Sand gazelle 1

Arabian red fox 1

Arabian red fox 2

Appendix 2: Expedition diary & reports

A multimedia expedition diary is available on http://biosphereexpeditions.wordpress.com/category/expedition-blogs/arabia-2015/

All expedition reports, including this and previous expedition reports, are available on www.biosphere-expeditions.org/reports.