EXPEDITION REPORT

Expedition dates: 9 – 16 January 2016

Report published: December 2016

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

EXPEDITION REPORT

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

Expedition dates:
9 – 16 January 2016

Report published:
December 2016

Authors:
Gregory Simkins & Stephen Bell
Dubai Desert Conservation Reserve

Matthias Hammer (editor)
Biosphere Expeditions

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 9 - 16 January 2016. 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.

The 2016 expedition observed the following number of target species during the quadrant surveys: 498 Arabian oryx, 181 mountain gazelle, 71 sand gazelle, 38 lappet-faced vultures, 8 Mcqueen's bustards, 2 red fox, 1 Arabian hare (*Lepus capensis*) and 1 Pharaoh eagle owl. The improved survey methodology of circular observations within each quadrant significantly improved the data quality, thereby improving predicted species distributions.

Live trapping was carried out for small- (rodents) and medium- (wildcat and fox) sized mammals over a trapping effort of 72 and 83 trapping nights respectively. Trapping success was very low, with only three Cheesman's gerbils (*Gerbilus cheesmani*) captured. In order to gain more meaningful data, the trapping effort would need to be greatly increased to cover all areas and habitats within the DDCR.

The red fox den survey revisited 161 den sites and identified seven new dens. In the five year period between surveys, the number of active dens has not decreased significantly, although only 34% of den status remained the same as in 2011. Twenty-five inactive dens became active and 24 active dens became inactive. Only 18% of active dens were abandoned, whereas 47% of inactive dens were abandoned. The survey was considered a success and future annual monitoring of red fox dens by the expedition will assist DDCR management in gaining an understanding of den site use within the reserve.

For this expedition it was decided no longer to bait camera traps, because during previous expeditions baiting had predominantly attracted red fox to the sites, thereby reducing the probability of capturing the smaller and scarcer species, such as the sand fox, and to a lesser degree the Gordon's wildcat. Although this strategy did not have the desired effect of capturing the more elusive species in 2016, its lack of success was also impacted by the fact that only four out of the eight camera traps worked properly. However, the camera traps did capture 12 Arabian oryx, 4 Arabian Gazelle and 1 Arabian hare. Future expeditions will increase the trapping effort through an increase in the number of camera traps, as well as increasing the survey length, in an effort to increase the likelihood of capturing rare Gordon's wildcat and sand fox.

The expedition survey results since 2012 have shown an increase of all the reserve's ungulate species and the management of the DDCR is well aware that in order to achieve the stated aim of herd self-sustainability, the size of the ungulate populations will have to match the carrying capacity of ungulates for the DDCR as provided by the natural vegetation. A long-term study is ongoing to determine the carrying capacity of the reserve. DDCR management suspects that the current population exceeds carrying capacity, especially during extended dry periods. To achieve self-sustaining herds, management will in all likelihood need to include a combination of an apex predator re-introduction, species re-location and utilisation. Results would need to be monitored carefully ecologically and socially and include a high level of adaptability to respond to monitoring results to ensure the continued success of the protection of the DDCR ecosystem.

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 ولقد تمت الدراسة الاخيرة في الفترة من 9 يناير إلى 16 يناير 2016م 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 498 فرد من المها العربي، وعدد 181 من الغزال الإدمي، وعدد 71 من الغزال الريم، بالإضافة إلي تسجيل عدد 38 طائر العقاب النوبي، وكذلك عدد 8 طيور الحباري، وتم رصد عدد أثنين من الثعالب الحمراء وفرد واحد من الأرانب البرية وفرد واحد من البوم الصحراوي. ساهم تعديل منهجية تجميع البيانات بطريقة تجميع المشاهدات فى مواقع البحث والتى تم تمثيلها عن طريق الدوائر فى تحسن نوعية البيانات المستخرجة وبالتالي تحسن إستخراج توزيع الأنواع المتوقعة.

تم الإستمرار فى إستخدام المصائد للإمساك بالقوارض الصحراوية بإجمالي عدد 72 مصيدة لكل ليالي الدراسة والثدييات الصغيرة مثال القطط البرية والثعالب الصحراوية بإجمالي عدد 83 مصيدة لكل ليالي الدراسة. لوحظ بعد نهاية الدارسة ان معدل تسجيل القوارض والثدييات الصغيرة كان منخفض جدا خلال ايام الدراسة حيث تم تسجيل فقط عدد ثلاث افراد من النوع (تشيزمن). ولقد أستنتج من تلك النتائج انه من أجل الحصول على بيانات أكثر وضوحا يجب ان تتم الدراسة فى المستقبل بصورة أكثر شمولية حتى يتم تغطية مناطق اكثر من المناطق التى تم دراستها فى المرات السابقة وكذلك يجب ان تعتمد فكرة توزيع المصائد على التنويع فى البيئات التى يتم تمثيلها فى محمية دبي الصحراوية.

وفيما يخص دراسة توزيعات جحور الثعلب الأحمر، تم إعادة الزيارة للجحور المسجلة من الدراسات السابقة وعددها 161 جحرا بالإضافة لتسجيل عدد سبعة جحور جديدة لم تشملها الدراسات السابقة. في فترة الخمس سنوات الماضية وبالمقارنة للدراسات الاستقصائية المتتالية، لوحظ أنه لم ينخفض عدد الجحور النشطة إلى حد كبير، على الرغم من أن 34٪ فقط من الجحور المسجلة بقيت على حالها كما تم تسجيله في عام 2011. لوحظ ايضا ان هناك خمسة وعشرون جحرا كانت غير فعالة وفى المقابل تغير 24 جحرا من كونه جحرا نشطا إلي غير نشط. وجد أن نسبة الجحور التى تحولت من كونها جحور نشطة إلي جحور مغلقة تماما هي حوالي 18٪ ، في حين أن النسبة بالنسبة للجحور الغير نشطة تحولت إلى جحور ملغية تماما هي 47٪. اعتبرت الدراسة ناجحة ومع إستمرار الرصد السنوي في المستقبل لجحور الثعالب الحمراء من قبل البعثة سيساعد إدارة محمية دبي الصحراوية في اكتساب فهم أوسع لتوزيع جحور الثعالب داخل المحمية.

تم الإستقرار على إلغاء فكرة وضع بعض أنواع الطعام امام افخاخ الكاميرات والتى يتم إستخدامها لتسجيل المشاهدات للحيوانات البرية الصحراوية حيث وجد من خلال الملاحظات والنتائج المسجلة فى الأعوام السابقة أنه بوضع طعام أمام الكاميرا فإن ذلك يجتذب في الغالب الثعلب الأحمر إلى تلك المواقع مما يقلل من احتمالية تسجيل الأنواع الأخرى الصغيرة والنادرة التواجد مثل الثعلب الرملي والقط جوردون البري. بالرغم من ذلك وجد أن هذه الاستراتيجية لم يكن لديها التأثير الإيجابي المطلوب فى التقاط الأنواع الأكثر ندرة في عام 2016، حيث تم تسجيل مشاهدات نشطة للحيوانات الصحراوية فى أربعة فقط من فخاخ الكاميرا الثمانية والتى عملت بشكل صحيح. ومع ذلك، فلقد ألتقطت الكاميرات عدد 12 من المها العربي، وكذلك عدد 4 من الغزال الإدمي وعدد واحد من الأرانب البرية. سوف يقوم فريق متطوعي بعثات المحيط الحيوى فى المستقبل بالتعاون مع فريق محمية دبي الصحراوية إلى زيادة أعداد الكاميرات، فضلا عن زيادة مدة وضع تلك الكاميرات ومساحة التغطية وذلك فى محاولة لزيادة احتمال تسجيل الانواع النادرة من القط جوردون البري وكذلك ثعلب الرمال.

أظهرت نتائج المسح السابقة والحالية والتى بدأت منذ عام 2012م زيادة إجمالية مضطردة لقطعان المها العربي والغزال بنوعيه ولذلك تدرك إدارة محمية دبي الصحراوية أنه من أجل تحقيق الهدف المعلن للمحمية بالوصول إلي التوازن البيئي الطبيعي يجب أن تتناسب أعداد القطعان المسجلة بالمحمية مع قدرة تحمل الغطاء النباتي الطبيعي ليتسني توفير الغذاء الطبيعي الكافي لتلك القطعان وبالتوازي مع تلك الدراسة يوجد بالمحمية حاليا دراسة طويلة الأمد مستمرة منذ فترة لتحديد القدرة الاستيعابية من الغطاء النباتي بالمحمية حيث هناك بعض الشكوك تشتبه إدارة محمية دبي الصحراوية أن أعداد القطعان الحالية يتجاوز القدرة الاستيعابية، وخصوصا خلال فترات الجفاف الطويلة. لتحقيق التوازن المثالي لأعداد القطعان بالمحمية، تري إدارة المحمية انه يجب الاخذبعين الإعتبار إدخال إعداد قليلة من الحيوانات المفترسة وكذلك إمكانية نقل أعداد من القطعان لخارج المحمية بالتنسيق مع العديد من الجهات المحلية والدولية. يجب ان تتم تلك العملية بصورة دقيقة وتحت الإشراف والتحكم الكامل بيئيا واجتماعيا وتشتمل على مستوى عال من القدرة على التكيف للاستجابة لنتائج الرصد لضمان استمرار نجاح حماية النظام البيئي محمية دبي الصحراوية.

Contents

Please note: Each expedition report is written as a stand-alone document that can be read without having to refer back to previous reports. As such, much of this section, which remains valid and relevant, is a repetition from previous reports, copied here to provide the reader with an uninterrupted flow of argument and rationale.

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 9 to 16 January 2016 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 9 - 16 January 2016 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. All meals were provided by a catering company.

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 12º and 26º C. On the first two days of the expedition there was fog cover in the morning, which lifted by 09:30.

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 Ford and the DDCR for the expedition team, for expedition support and emergency evacuations. Ford Middle East kindly provided two F150 trucks.

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):

Laura Burggraf (Germany), Mary Chard (UK), Jud Dowgill (UK), Caroline El-Tibi (UAE), Janna El-Tibi (UAE), Lea El-Tibi (UAE), Gary Hogben (UK), Sandra Hogben (UK), David Moore (France, Biosphere Expeditions staff), Lloyd Murray (UAE), Susanna Murray (UAE), Margit Schäfer (Germany), Sigrun v. Kienle (Germany), Tariq Zeyad Subhi Shaar (UAE)*.

*placement kindly sponsored via the GlobalGiving fundraising campaign

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 Platinum Heritage for sponsoring and hosting the team at one of their camps on the final night of the expedition, as well as Ford Middle East, which kindly provided two F150 trucks.

1.9. Expedition Budget

Each team member paid towards expedition costs a contribution of £1,240 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	14,832
Expenditure	
Staff includes local & international salaries, travel and expenses	2,642
Research includes equipment and other research expenses	452
Transport includes car hire, fuel, taxis and other local transport	221
Base includes food and camping fees	757
Administration includes local sundries, fees and miscellaneous expeditions	11
Team recruitment Arabia as estimated % of PR costs for Biosphere Expeditions	6,430
Income – Expenditure	**4,319**
Total percentage spent directly on project	**71%**

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, Platinum Heritage, Ford Middle East 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.

Please note: Each expedition report is written as a stand-alone document that can be read without having to refer back to previous reports. As such, much of this section, which remains valid and relevant, is a repetition from previous reports, copied here to provide the reader with an uninterrupted flow of argument and rationale.

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.

Previous work 2012 – 2015

Biosphere Expeditions and the DDCR first considered working together in 2011 and the first joint expedition was run in 2012 in what has become an annual survey expedition each January.

The aim in **2012** (Bell et al. 2013a) was to conduct the first systematic survey of Arabian oryx (*Oryx leucoryx*) and Gordon's wildcat (*Felis silvestris gordoni*) in the DDCR. This was achieved through three main survey activities: Gordon's wildcat live capture survey and camera trapping as well as Arabian oryx monitoring. In addition the expedition team also recorded any other species observation or encounters while in the field.

The live capture survey of 48 trap nights resulted in one capture of a feral hybrid cat. The camera traps recorded 316 pictures over 56 camera days at a capture rate of 2.46. Fourteen oryx herds where surveyed, which gave a male:female sex ratio of 2:3 and an average condition score of 2.81. In conjunction with the camera trap and Arabian oryx monitoring data, the species encounters data provided a snapshot of species distribution and diversity, which served as a comparative baseline for future expeditions data.

In **2013** (Bell et al. 2013b), species studied included the Arabian oryx (*Oryx leucoryx*), classified by IUCN as vulnerable, and other antelope species (sand and mountain gazelle, *Gazella leptoceros* and *Gazella gazella*), Gordon's wildcat (*Felis silvestris gordoni*), as well as some major bird and reptile species. A grid methodology was adopted and fourty-two grids 2 x 2 km in size were surveyed within the 225 square km area of the DDCR. Sample methods included encounter surveys, camera and live trapping and body scoring (for oryx). It was found that mountain gazelle (87 encounters), sand gazelle (26 encounters), Arabian red fox (24 camera trap pictures) and Arabian oryx were common throughout most of the study area. Gordon's wildcat was not documented by camera or live traps, but only by tracks, which can be misidentified. Because of this result, the DDCR made plans to enhance the population through the re-introduction of genetically pure, captive bred, Gordon's wildcat.

The body condition scoring for oryx revealed malnutrition and supplementary feeding was increased by DDCR management. The expedition found that oryx distribution had largely shifted to the north of the reserve as a result of a sustained drought, but a few hardy and now largely independent herds persist in the south. Sand gazelle populations shifted northwards within the reserve as a result of expanding populations needing to establish new, if less favourable territories. Nine lappet-faced vultures (*Torgos tracheliotos*), rare in the United Arab Emirates, were recorded, showing that the DDCR is likely to be the best habitat for this species in the UAE.

In **2014** (Bell & Hammer 2014), 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*). 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.

The expedition body scored 278 Arabian oryx for herd health again, resulting in an average score of 2.9, which is just below the fit and healthy score of 3.0. After the feed increase based on the 2013 expedition results, this was a highly satisfactory management result.

A total of 206 mountain gazelles and 159 sand gazelles were counted during the expedition. Since the majority of these are likely to have been separate individuals, the numbers found for both species were considered to be alarmingly high. It was evident that under current conditions the reserve could not sustain the present oryx and gazelle populations without significant supplementary feeding. Furthermore, previous vegetation surveys showed that the DDCR vegetation was already showing clear signs of overgrazing. Therefore the expedition concluded that a major management concern was the establishment of a gazelle carrying capacity for the DDCR, as well as self-sustaining control measures. Such control measures may include the removal of antelopes from the reserve through translocation and the introduction of an apex predator such as the Arabian wolf or hyaena to apply top down pressure to the antelope populations.

There were no live captures of Gordon's wildcats or feral cats during this expedition and no Gordon's wildcats were photographed by camera traps. However, there was a possible presence observed during the expedition in terms of tracks. The expedition concluded that it is difficult to assess whether the DDCR's Gordon's wildcat population is stable, increasing or declining and more trapping is needed to assess this. Major threats to the Gordon's wildcat in the DDCR were likely to be the availability of food, as well as hybridisation with feral cats.

A rare sand fox was caught by the expedition for the first time in the history of the DDCR, As a result of this capture, it was concluded that further expeditions should start targeting this species in an attempt to obtain more information about it.

Population modelling using the IDW (Inverse Distance Weighted Interpolation) and diversity indices methods showed distributions in accordance with feed points and habitat preferences. Oryx populations were found to be concentrated around the feed points, as were gazelles. Mountain gazelle distribution was found to follow their preferred stony/rocky habitat distribution.

The Macqueen's bustard population was found to be small and very confined to specific areas of the DDCR. A small increase in numbers was noticed. The lappet-faced vulture was seen fairly regularly as there is a good food source on the DDCR for them. The goal for both species is to have them breed in the reserve in future. Pharaoh eagle owl was a concern and numbers appeared to be on the decline, probably due to the scarcity of rain over the past few years, which affected the vegetation and thereby rodents, which are the owl's primary food source.

In **2015** (Bell & Hammer 2015), citizen scientists continued to collected data on the nine target species of 2014 (see above).

258 oryx were counted in the reserve, most of them likely to be separate individuals. Oryx distribution in the reserve followed artificial feeding points. However, there were found to be too many oryx in the reserve and it was recommended that their numbers 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. The expedition report argued that this reduction in numbers could be achieved through natural processes by introducing a top predator (most likely the Arabian wolf) into the reserve as soon as fence upgrades were completed.

At 218 individuals counted, the mountain gazelle was at healthy population levels. Its distribution followed habitat preference of vegetated dunes and areas of high vegetation and water around the Al Maha resort.

The sand gazelle population was found to have grown, successfully expanding in the reserve and showing new distribution hotspots that mirror its preferred vegetated sand dune habitats. Only 37 gazelles were counted by the expedition, but this was a reflection of expedition participants being busy with many other tasks.

Gordon's wildcats and sand foxes continued to be rare and elusive, with no live or camera captures in 2015. This is in contrast to red fox, which was abundant, dominating camera captures alongside oryx.

Pharaoh eagle owls were found again to be 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 was found to be a concern, which needs to be addressed by management.

The Macqueen's bustard population was found to be small again with low nesting incidences and success, despite favourable conditions. The reasons for this may be another area for future expeditions to investigate.

The lappet-faced vulture was found to have gone from rare to abundant and the DDCR is now the best place in Dubai to observe vultures. However, no nesting was observed, despite favourable conditions. This conundrum was suggested to 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*), suggested that the rodent population had not suffered greatly from the drought conditions and abundance of red foxes. This finding was in contrast to the pharaoh eagle owl decline, which suggested a decline in the rodent population. It was argued that rodent trapping efforts should 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.

Background on species under investigation

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. Arabian gazelle (photo courtesy of G. Simkins).

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 R. Ingram).

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 **pharaoh 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 four important surveys: live trapping (targeting Gordon's wildcat and small mammals), fox den survey, camera trapping and ungulate monitoring (Arabian oryx, Arabian gazelle, sand gazelle). In addition to these surveys the participants 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).

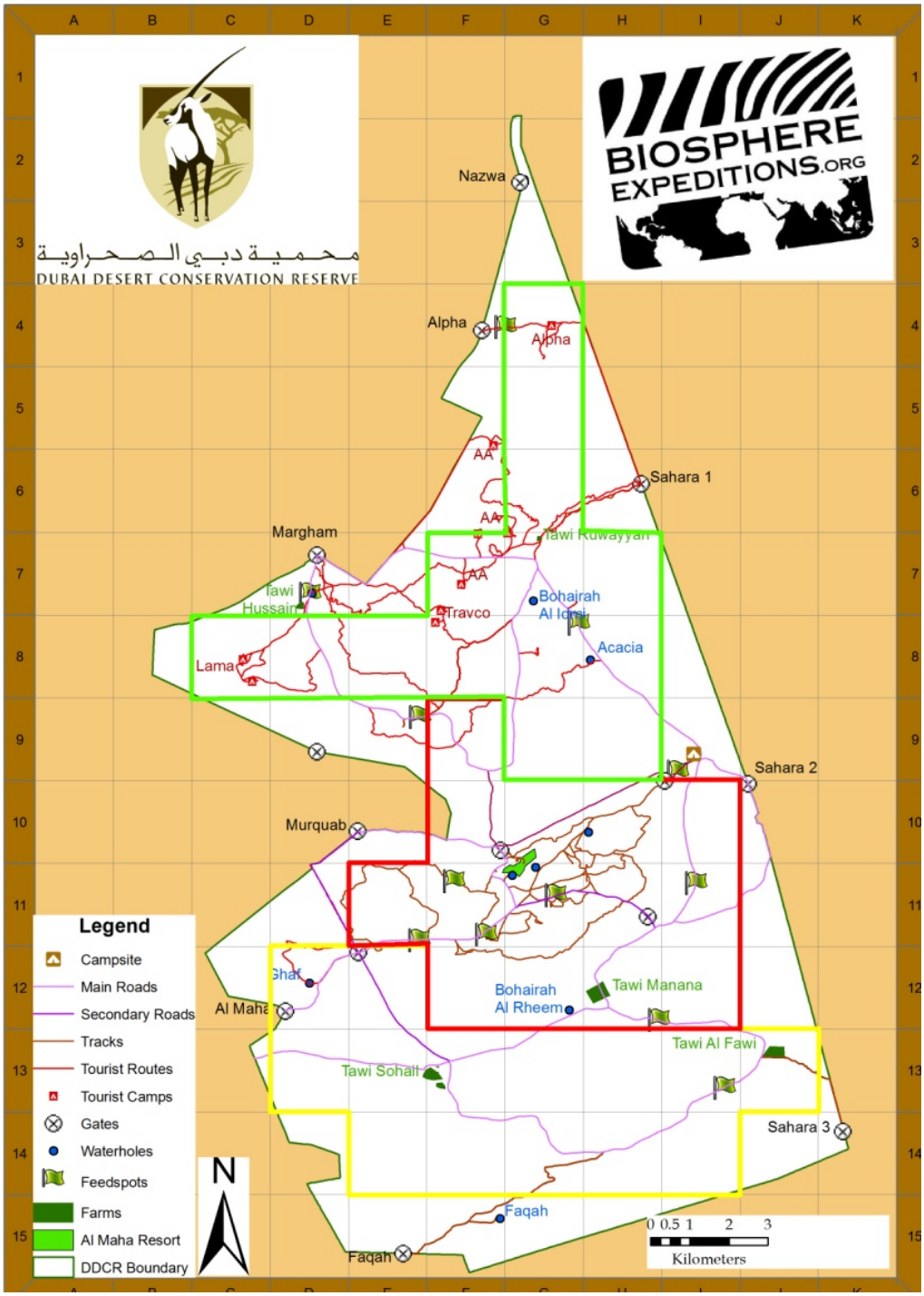

Figure 2.2a. The DDCR and its survey zones (North = green, Central = red, South = yellow).

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.

Expedition participants were split into three groups and every day each group was tasked to survey three quadrants or 12 km². A total of 37 quadrants (148 km²) were surveyed in this way during the expedition. During surveys any target species encounters were recorded in the relevant datasheets.

Target species quadrant survey

A more structured approach to the target species survey was implemented by this expedition. It involved the selection of one observation point per quadrant at which a circular observation of the surrounding area was carried out by four participants with binoculars for 30 minutes.

Target species as described above and encountered during these 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.

During analysis, IDW (Inverse Distance Weighted Interpolation) was used to predict the value (abundance and distribution of species sampled at each cell) of cells at locations that lack sampled points (ESRI 2009). Inverse distance weighted methods determine cell values using a linear-weighted combination set of sampling points and 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. 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

Twelve 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 four live traps to place within their allocated zones (four each in North, South and Central zones). This year traps were placed close to abandoned fox dens (Figure 2.2b) in the hope of achieving capture success, as this is where Gordon's wildcats are known to take up residence. 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, resulting in a total of 60 trap nights. The bait was placed right at the back of the trap (using an extendable reacher/grabber) (see Figure 2.2c), forcing the species to step onto a pressure plate to trigger the trap. 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 record from tracks around the trap 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.

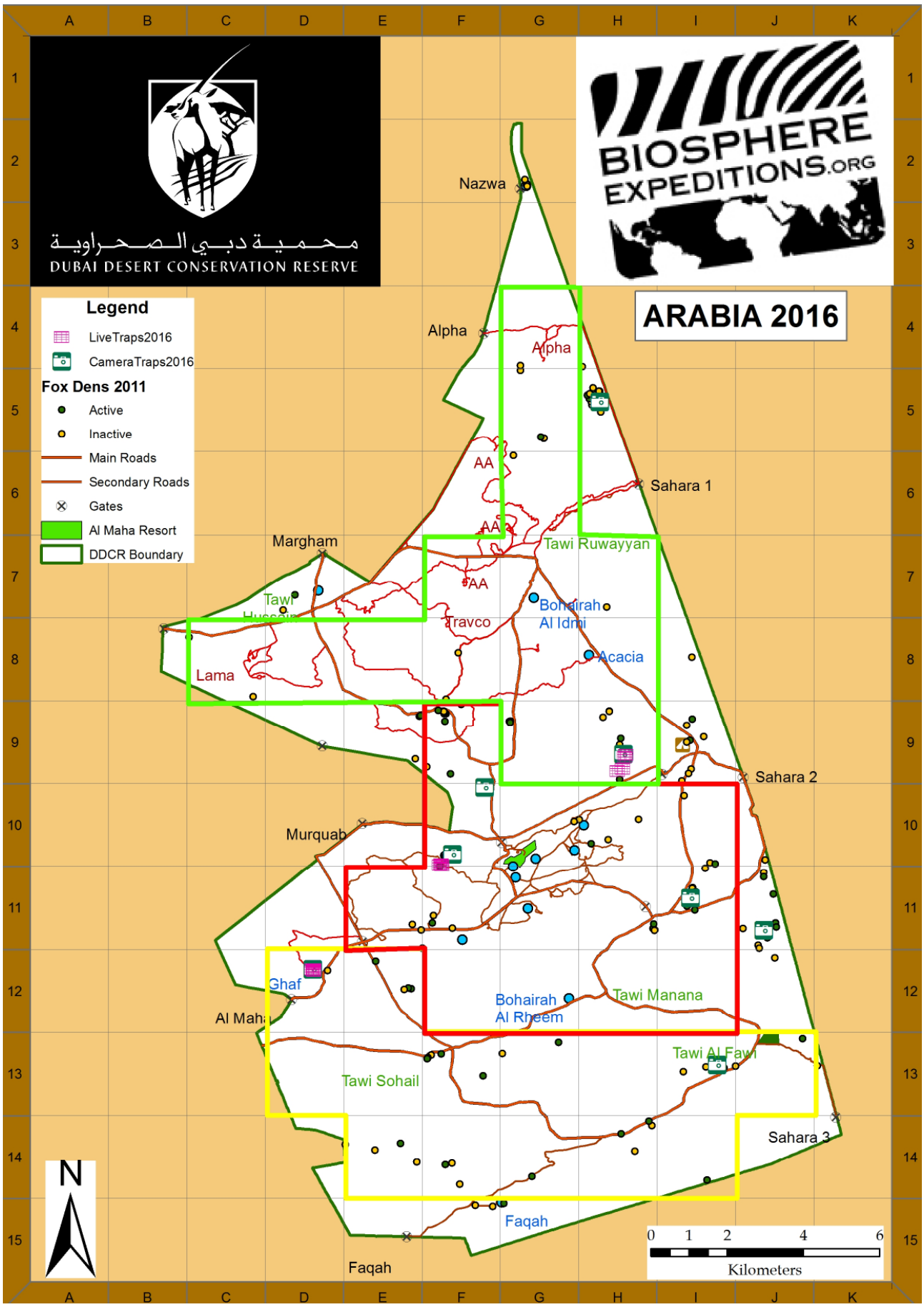

Figure 2.2b. Fox den points surveyed by the expedition, as well as positions of live and camera traps.

Live traps for small-sized animals

A total of 18 rodent traps were used at three different locations. At each location the team members set six 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 and resulting in 90 trap nights. Traps used consisted of custom made mesh traps 40x10x10cm, with a nest box built in at the rear of the trap (see Figure 2.2d).

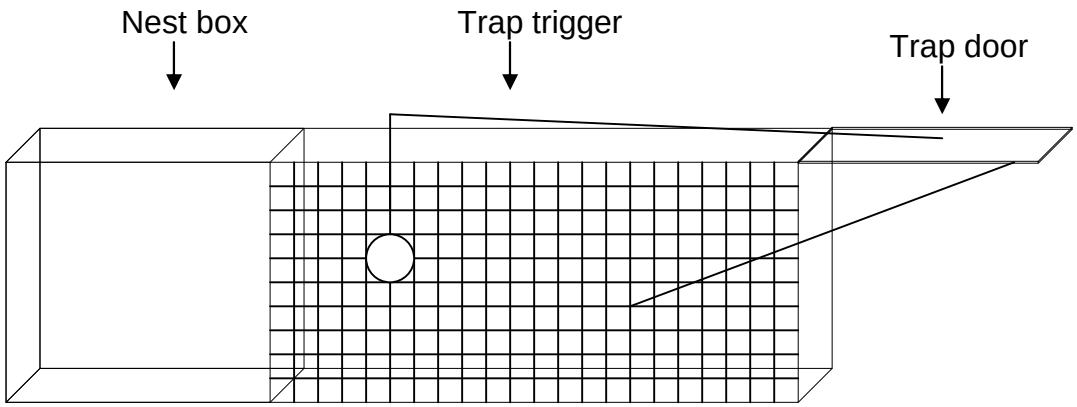

Figure 2.2c. Rodent trap.

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 tentatively identified in the field with the help of a 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.

Arabian red fox den survey

The Arabian red fox is the largest predator within the DDCR, so it is important to monitor its population. The red fox is both a nocturnal and cryptic species, so direct counts are unreliable. A better method of monitoring the population is through a count of their dens. This was initially done by DDCR staff in 2011 when all dens were classified as either active or inactive, based on signs of fox activity such as tracks, fresh digging, prey remains and fresh scat.

During the 2016 expedition all dens sites were re-visited and once again classified based on signs of fox activity with an additional classification of abandoned when the den had filled in with sand. In addition any new dens found were classified and recorded.

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.

Nine camera traps (four Reconyx RC60 and five Reconyx Hyperfire) were used during the expedition, 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. Unlike in previous years, the traps were not baited (as this tended to attract red foxes, probably keeping Gordon's wildcats away as a result) and left out in the field for five days, resulting in 45 trap nights.

Figure 2.2d. Setting a camera trap.

Diversity indices

Diversity indices are used to asses quantitatively the diversity of faunal communities and to compare different habitats. Many quantitative indices (see examples below) have been developed by landscape ecologists to measure the spatial and temporal changes of species and habitat richness and biodiversity.

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

Table 2.3a Species encountered during the expedition. 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	*Chlamydotis macqueenii*	Arabian Red Fox S	*Vulpes vulpes*
Black-winged Stilt S	*Himantopus himantopus*	Arabian gazelle S C	*Gazella gazella cora*
Red-wattled Lapwing S	*Vanellus indicus*	Sand Gazelle S	*G. 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 L	*Gerbillus cheesmanni*
Crested Lark S	*Galerida cristata*		
White-eared Bulbul S	*Pycnonotus leucotis*		
Arabian Babbler C	*Turdoides squamiceps*		
Black Redstart S	*Phoenicurus ochruros*		
Desert Wheatear C	*Oenanthe deserti*		
Purple Sunbird S	*Cinnyris asiaticus*		
White wagtail S	*Motacilla alba*		
Lappet faced Vulture S	*Torgos tracheliotos*		
Long-legged Buzzard S	*Buteo rufinus*		
Green Bee-eater S	*Merops orientalis*		
Chestnut-bellied Sandgrouse	*Pterocles exustus*		
Feral Pigeon S	*Columba livia*		
Rose-ringed Parakeet S	*Psittacula krameri*		
Southern Grey Shrike S	*Lanius meridionalis*		

Of the target species, the 2016 expedition observed 498 Arabian oryx, 181 mountain gazelle 71 sand gazelle, 38 lappet-faced vultures, 8 McQueen's bustards, 2 red fox, 1 Arabian hare and 1 Pharaoh eagle owl.

Oryx

The number of oryx surveyed this year nearly doubled from 2015. In 2015 258 oryx were observed while in 2016 this number rose to 498. Although an increase in oryx numbers was expected due to their much improved body condition score in 2015, which has resulted in improved calving and survival, the magnitude of the increase (240 oryx) can be attributed to an improved survey effort through the circular observation methodology. Over the same period the reserve's regular feed station monitoring showed an increase of 109 oryx.

Although there does seem to be some correlation between the distribution hotspots and the feeding stations, the majority of feeding stations are not in the centre of the hotspots and it is rather a combination of food availability, shelter in the form of shade-giving trees and bushes and the proximity of water that determines the distribution of oryx across the reserve.

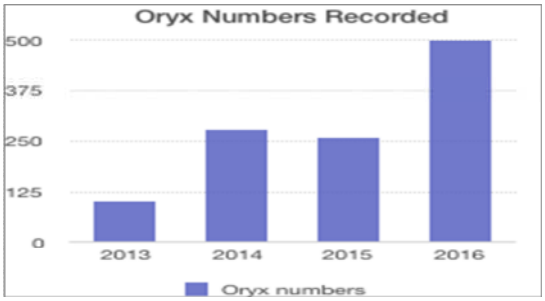

Figure 2.3a. Oryx numbers recorded by the expedition over the years.

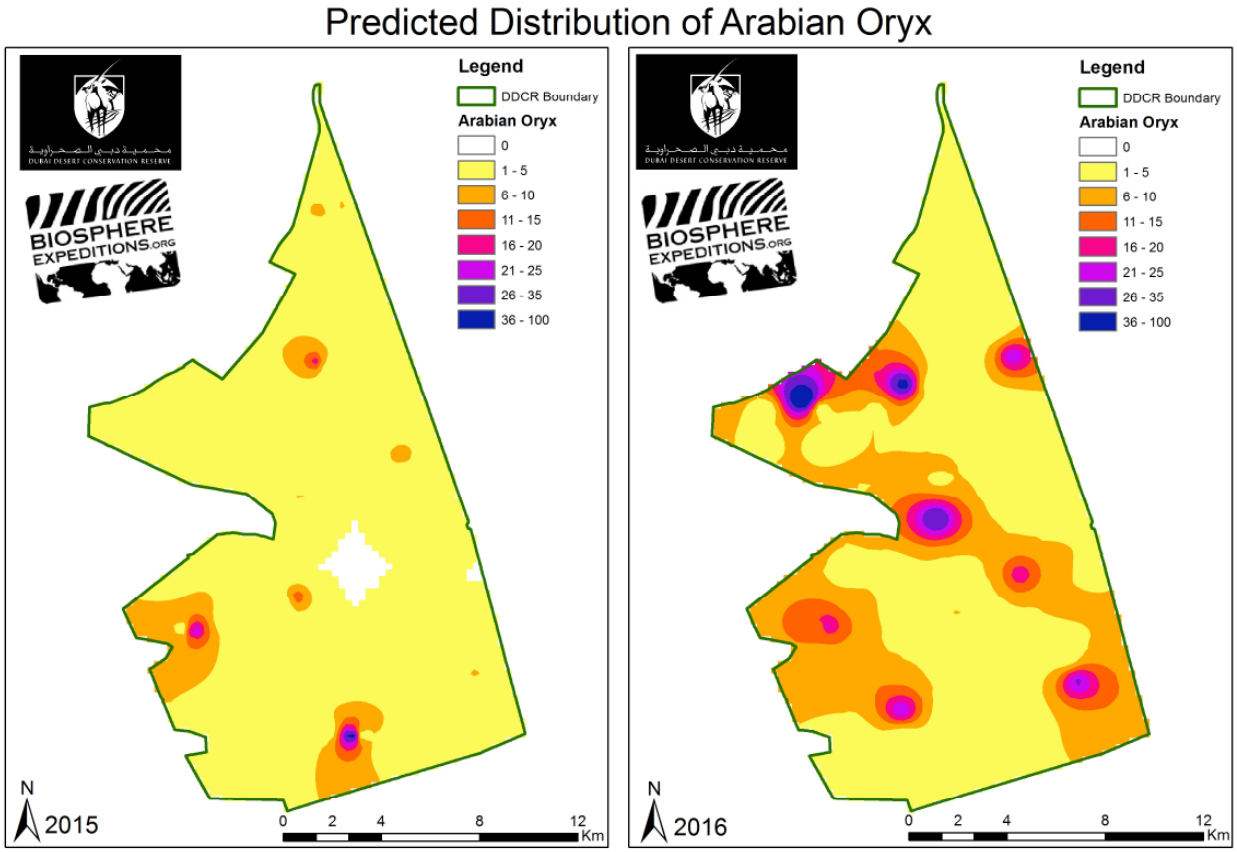

Figure 2.3b. Arabian oryx distribution 2015 vs. 2016. Predicted distribution calculations are based on sighting data only.

Arabian gazelle

Interestingly, despite the improved survey techniques, the Arabian gazelle count of 2016 (118) was significantly lower than the previous year (218). This is not consistent with other monitoring that is conducted year-round on the reserve. However, the predicted distribution map shows an extension of the areas in the reserve with family-sized groups of 4-6 individuals, as well as a significant hotspot near the centre of the DDCR. This would suggest that although the survey observed fewer individuals, there was an increase of breeding groups and offspring.

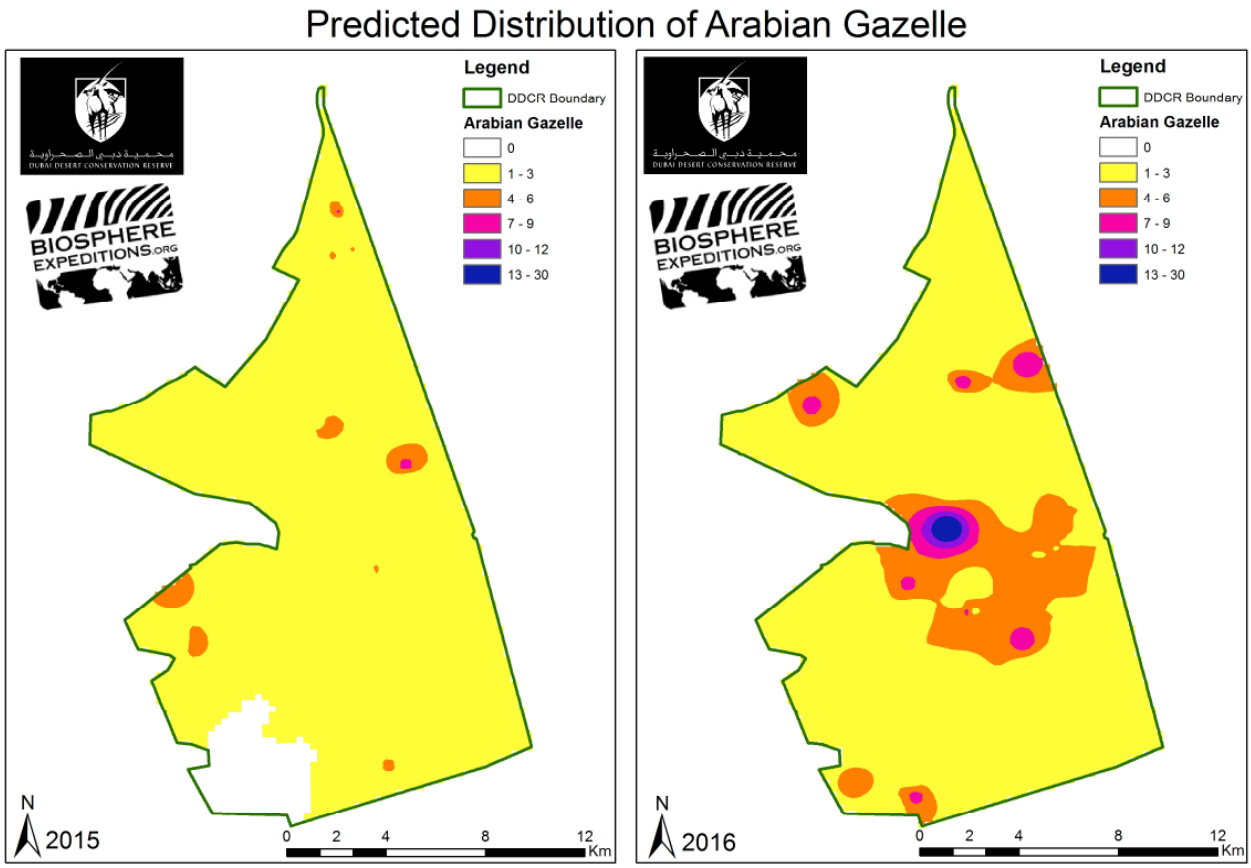

Figure 2.3c. Arabian gazelle distribution 2015 vs. 2016. Predicted distribution is based on sighting data only.

Sand gazelle

The data collected on the sand gazelle clearly shows the changing dynamics of their population within the DDCR. The number of sand gazelle observed by the expedition has increased from 37 in 2015 to 71 in 2016. Regular monitoring within the reserve has shown the same trend during this period. However, even more significant has been the change in the predicted distribution of these gazelle. Their range has expanded from a core in the south of the DDCR to encompass the whole of the DDCR, including an increase in the number of hotspots showing a population concentration.

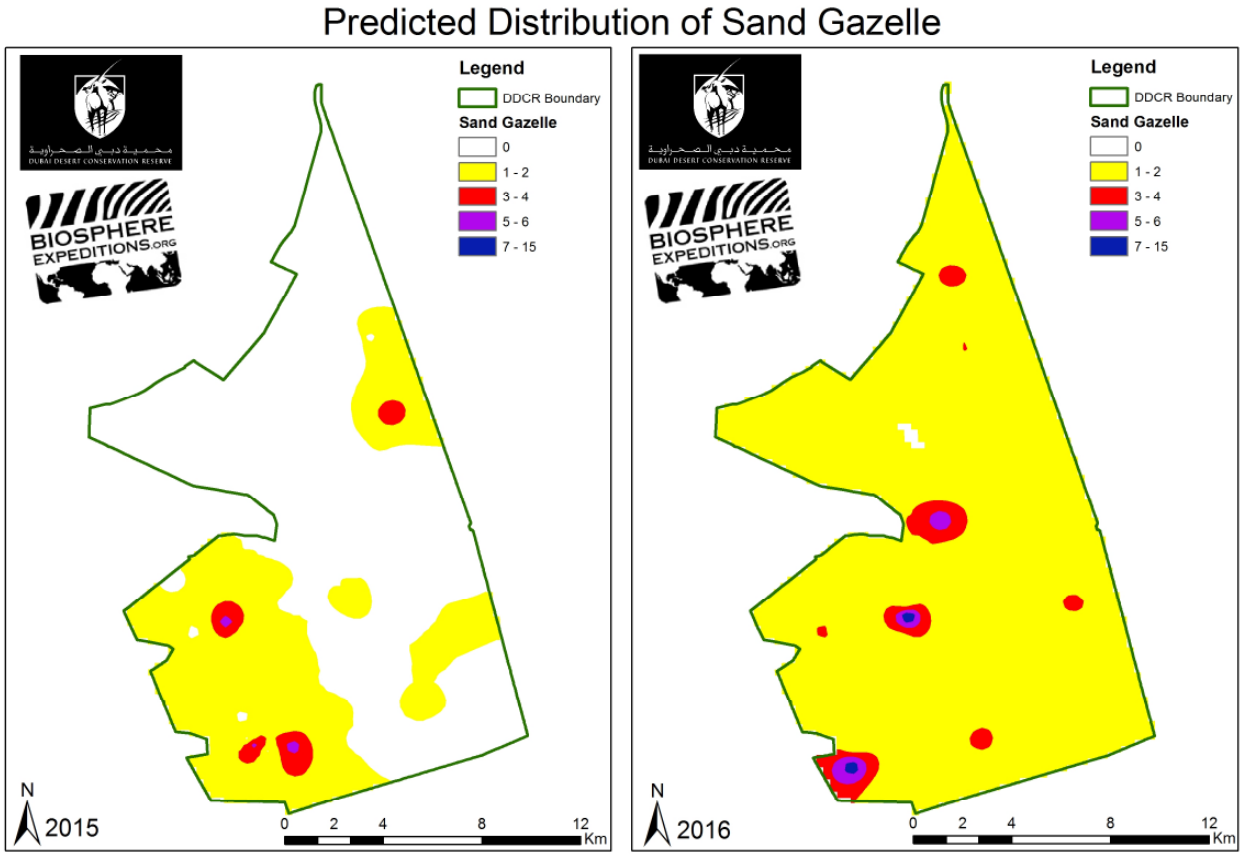

Figure 2.3d. Sand gazelle distribution 2015 vs. 2016. Predicted distribution calculations are based on sighting data only.

Live traps for medium-sized animals

Table 2.3b. Results of medium-sized animal traps in 2015 and 2016.

	2015	2016
Triggered without species	1	0
Triggered by non-target species	1	1
Triggered by fox or cat	1	0
Not triggered	57	71

Out of the twelve traps set, only one trap in the North zone was triggered with a bird capture. No Gordon's wildcats or sand foxes were caught in the traps. There was a presence in the form of fox tracks at six of the 12 trapping sites.

Live traps for small-sized animals

Table 2.3c. Results of small-sized animal traps in 2015 and 2016.

	2015	2016	
Triggered without species	29	2	
Triggered by non-target species	1	0	
Triggered by rodent	13	3	All Cheesman's gerbil
Not triggered	42	78	
Trapping success	1.78	0.14	

Compared to 2015, the small-sized trapping results were poor, with only three individuals of Cheesman's gerbil (*Gerbillus cheesmani*) captured. This gerbil is one out of the six rodent species found within the DDCR. In 2015, 13 separate individuals (two males, five females, six unknown sex) were captured without recaptures.

The North zone was the only site with positive captures. There the trap location was good, as the area had plenty of dune grass, which helps with soil stabilisation for rodent burrows. It also had the best vegetation out of the three sites, with overall poor vegetation cover.

Out of the three trap locations the Central zone had the least success. The area was better suited for one of the larger species of rodents found in the area (Sundevals jird, *Meriones crassus*) with gravel plains surrounded by vegetated dunes. In this area individual traps were not even triggered.

The most South zone in the past yielded Cheesman's gerbils and jird captures. This year no species were captured. The vegetation for the area is in a poor condition with no evidence of recent rodent burrows or tracks.

Arabian red fox den survey

Results of the survey can be found in Table 2.3d. In the five year period between surveys, the number of active dens has not decreased significantly, although only 34% of den status remained the same as in 2011. Twenty-five inactive dens became active and 24 active dens became inactive. Only 18% of active dens were abandoned, whereas 47% of inactive dens were abandoned.

Table 2.3d. Results of the Arabian red fox den surveys in 2011 and 2016.

	Status 2011	Status 2016
Active	66	59
Inactive	95	52
Abandoned	0	57
Total	161	168

Status change	Dens
Unchanged	55
New active dens	4
Inactive > active	25
New inactive dens	3
Active > inactive	24
Active > abandoned	12
Inactive > abandoned	45

The density estimates of red fox dens in the DDCR (Fig. 2.3e) were calculated using ArcGIS software tools based on Kernel density estimates. High den densities were, as expected, within relatively well-vegetated areas, dominated by large shrubs, in particular *Leptadenia pyrotechnica,* which meet the habitat requirements of providing a stable soil substrate supported by the shrub's root system.

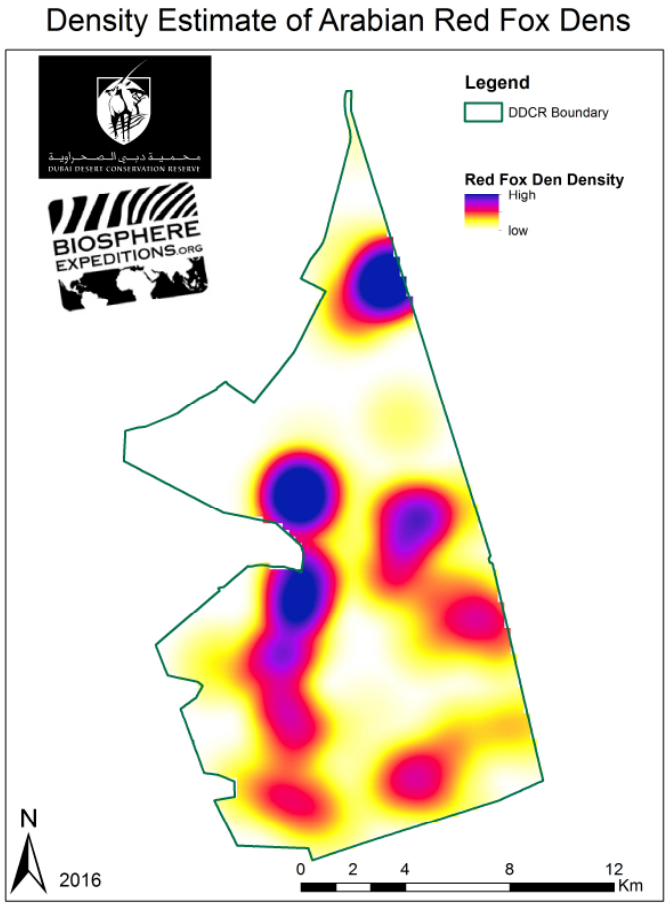

Figure 2.3e. Arabian red fox den distribution in 2016.

Camera trapping

Table 2.3e. Results of camera trapping 2014 - 2016.

Target species	2014	2015	2016
Red fox	24	21	0
Vultures	9	6	0
Bustards	0	77	0
Gordon's wildcat	2	0	0

Table 2.3e shows that in 2014 and 2015 camera traps have captured one or more of the expeditions target species. However, in 2016 it was decided no longer to bait the camera traps, because baiting had predominantly attracted red fox to the sites, thereby reducing the probability of capturing the smaller and scarcer species such as the sand fox and to a lesser degree the Gordon's wildcat. Although this strategy did not have the desired effect of capturing the more elusive species in 2016, its lack of success was also impacted by the fact that only four out of the eight camera traps worked properly. However, the camera traps did capture 12 Arabian oryx, 4 Arabian Gazelle and 1 Arabian hare.

2.4. Discussion and Conclusion

The citizen science efforts instigated by Biosphere Expeditions in the DDCR are ideally suited to research projects that require a large area to be surveyed in a short period of time. Data gathered by the expedition 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. The conclusions reached with the aid of the expedition data are as follows:

DDCR ungulates (Arabian oryx, Arabian gazelle, sand gazelle)

One of the stated aims of the DDCR is to have self-sustaining herds of ungulates. However, it is important to remember that this should not be achieved at the expense of animal welfare, nor should it have a detrimental effect on other aspects of the ecosystem. As such supplementary feeding will continue for the time being, especially because there has been a prolonged dry period, which has had a detrimental effect on the natural vegetation. Having said this, the management of the DDCR is well aware that in order to achieve the stated aim of herd self-sustainability, the size of the ungulate populations will have to match the carrying capacity of ungulates for the DDCR as provided by the natural vegetation. A long-term study is ongoing to determine the carrying capacity of the reserve. DDCR management suspects that the current population exceeds carry capacity, especially during extended dry periods. This will be taken into consideration when making management decisions.

Live traps for medium-sized animals

The limited success of the trapping for medium-sized mammals is expected over the short period of the expedition and as such is unlikely to reflect the status of the targeted species, Gordon's wildcat and sand fox, within the DDCR. However, the data collected from any capture, including size, weight and sex add to the growing database of these target species within the DDCR, and as such live trapping is during the expedition is a useful sideline of the expedition.

Live traps for small-sized animals

Traps were triggered without a target species 29 times and not triggered 42 times, which gave a trapping success of 1.7863. Trapping success tends to peak on days three, four and five and then drop again after this time. The results for last year were better, as the locations were chosen based on previous rodent surveys. This year, three random sites were chosen, one in each of the three zones. In addition, poor vegetation conditions due to a prolonged dry period are likely to have contributed to a reduction in the rodent population, leading to lower trapping success.

Due to the small size and duration (low trapping effort) of this survey, the results only provided data on the presence/absence of the known DDCR rodent species at each of the selected sites. This yielded no further insights into rodent distribution across the reserve, habitat preference or population dynamics. To gain a better understanding of the population size and dynamics, a much larger scale survey, beyond the scale a citizen science expedition, would need to be conducted in all habitat types within the reserve.

Red fox den survey

The Red fox den survey conducted in 2011 provided a baseline of fox den distribution and utilisation. The survey by the expedition in 2016 provided first insights into the changes taking place. To gain a better understanding of the dynamics of this population of predators, which are a vital component of the ecosystem, dens need to be monitored on a more regular basis. Biosphere Expeditions teams provide a good opportunity to conduct this survey on an annual basis, while the collection of additional information, such as plant species identification surrounding dens, as well as prey remains at den sites will greatly add to our knowledge of red fox in the DDCR.

Camera trapping

The change in methodology (i.e. not baiting the camera traps) meant a greatly reduced volume of photos and no success with target species. Although this may appear to be a failure, the focus of the camera trap monitoring is on rare and cryptic species. The Arabian red fox, which was attracted by the bait that previous camera-trapping efforts used, is relatively abundant within the DDCR and its population can be monitored through the den survey. Future expeditions will increase the trapping effort through an increase in the number of camera traps, as well as increasing the survey length, in an effort to increase the likelihood of capturing rare Gordon's wildcat and sand fox.

Management considerations

The need to reduce ungulate population within the DDCR is a complex issue that needs to take into consideration a number of ecological and social factors, which in turn determine which methods can be chosen by the DDCR to manage the ungulate population with the aim of achieving a self-sustaining herd.

Ideally, the re-introduction of an apex predator (such as the Arabian wolf) would restore natural ecological processes, putting top-down pressure on the ungulate population. Similar re-introductions elsewhere have also had numerous other benefits to the function of the eco-system (see Berger & Joel 2002, Weis et al 2007). However, socially the re-introduction of an apex predator will face strong resistance and will require approval from the highest levels of government. DDCR management is currently seeking such approval.

Relocation of ungulate species to other protected areas is another method of reducing populations, however, in many ways this is only a temporary solution, as it would need to be repeated periodically and the number of areas willing or able to except animals is finite. The sustainable use of animals is the final alternative for reducing the ungulate populations.

The ultimate solution for achieving the goal of self-sustaining ungulate populations will in all likelihood include a combination of all of the above and would need to be carefully monitored ecologically and socially and include a high level of adaptability to respond to monitoring results to ensure the continued success of the protection of the DDCR eco-system.

Recommended activities and actions for the 2017 expedition

Based on the experiences and results detailed in this and previous expedition reports, the following activities will be carried out by the 2017 expedition:

- Continue the quadrant survey with the circular observations, as this provides DDCR management with valuable data on the size and distribution of many species across the entire reserve.

- Repeat the red fox den survey as its annual data yield will enhance the DDCR's knowledge of the changes in den use, den preferences, habitat selection and prey remains at den sites.

- Expand camera trapping to include both more traps, as well as an extended trapping period of at least one month. As waterholes are a focal point for wildlife and they are spread across the DDCR, efforts will be concentrate on these.

- Continue live trapping in an effort to capture Gordon's wildcat as well as sand fox with an emphasis on collecting morphological data of individuals captured.

2.5. Literature cited

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

Bell, S., P. Roosenschoon, G. Simkins, M. Hammer and A. Stickler (2013a) Ways of the desert: conserving Arabian oryx, Gordon's wildcat and other species of the Dubai Desert Conservation Reserve, United Arab Emirates. Expedition report 2012 available via www.biosphere-expeditions.org/reports.

Bell, S., M. Hammer and A. Stickler (2013b) Ways of the desert: conserving Arabian oryx, Gordon's wildcat and other species of the Dubai Desert Conservation Reserve, United Arab Emirates. Expedition report 2013 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 2014 available via www.biosphere-expeditions.org/reports.

Bell, S. and M. Hammer (2015) Ways of the desert: conserving Arabian oryx, Gordon's wildcat and other species of the Dubai Desert Conservation Reserve, United Arab Emirates. Expedition report 2015 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.

Berger, J. (2002) Wolves, landscapes, and the ecological recovery of Yellowstone. Wild Earth 2002 (Spring): 32–7.

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.

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

Weiss, A., T. Kroeger, J. Haney, N. Fascione (2007). Social and ecological benefits of restored wolf populations. In Transactions of the North American Wildlife and Natural Resources Conference (Vol. 72, p. 297). Wildlife Management Institute.

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

Appendix 1: Expedition diary & reports

A multimedia expedition diary is available on http://biosphereexpeditions.wordpress.com/category/expedition-blogs/arabia-2016/

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