



RE-INTRODUCTION OF GLOBALLY THREATENED ARABIAN GAZELLES *GAZELLA ARABICA* (PALLAS, 1766) (MAMMALIA: BOVIDAE) IN FENCED PROTECTED AREA IN CENTRAL SAUDI ARABIA

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Abstract: The Arabian Gazelle is a globally threatened antelope (Vulnerable) in Saudi Arabia. Small relict populations remain in limited areas, while historically Arabian gazelles occurred in Mahazat as-Sayd protected area in central Saudi Arabia but were exterminated by anthropogenic and other pressures, including habitat loss and hunting. Important habitat has been lost to agricultural developments, fencing of pasture for livestock and the construction of human settlements and roads. The reintroduction of Arabian Gazelles was undertaken in Mahazat during 2011–2014 to bring back this locally extinct species study its ecology and biology in a fenced protected area. We released a total of 49 (12 males, 37 females) animals. A year after release animals started breeding and six calves have been recorded so far with more to come. The gazelles prefer to use more rocky areas where shrubs and acacia trees occur in the reserve, and do not move long distances except for one individual that moved more than 50km. Mahazat is fenced, which prevents local people from entering the reserve to poach or otherwise disturb animals. Management lessons include the need for continued monitoring of reintroduced populations. Interactions between Arabian and Sand Gazelles (*Gazella subgutturosa marica*) and Arabian Oryx (*Oryx leucoryx*) were also studied.

Keywords: Arabia, gazelles, management, reintroduction, threatened.

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INTRODUCTION

The taxonomy of gazelles is notoriously complex, and several classifications have been proposed. Three species have been reported from Saudi Arabia: Saudi Gazelle *Gazella saudiya* (now extinct), Mountain Gazelle *Gazella gazella* (widespread in the Arabian Peninsula) and Arabian Gazelle *Gazella arabica* (known only from a specimen collected in the 1820s on the Farasan Islands in the Red Sea). Recent genetic research has questioned this arrangement. Lerp et al. (2013) indicated that *G. gazella* in fact consists of two clades, one in the north centred on the Golan Heights, and a southern clade covering the rest of the former range. Bärmann et al. (2012) demonstrated that *G. arabica* had been misidentified and the specimen was in fact *G. gazella*. These authors, therefore, proposed a nomenclatural change, preferring to use the name *G. arabica* for the southern clade of *G. gazella*. This arrangement is followed here for gazelles in Saudi Arabia, including the former subspecies *G.g. cora* and *G.g. farasani* (Thouless & Bassri 1991; Groves 1997; Flammand et al. 1998; Grubb 2005).

The former range of *G. gazella* included southern Turkey, Israel, Iran (Farur Island), Oman, United Arab Emirates, Yemen and Saudi Arabia (Mallon & Kingswood 2001; Kankýlýç et al. 2012). Occasional sightings have been reported from Egypt (Sinai), Syria, Lebanon and Jordan (Kingswood & Khairallah 2001; Saleh 2001; Masseti 2004). The range of *G. g. cora* (here referred to as the Arabian Gazelle *G. arabica*) occurred across most of the Arabian Peninsula from the Arava Valley in southern Israel, along the Hejaz and Asir Mountains in western Saudi Arabia (12–28 °N), through Yemen, Oman and into the Emirates (Shalmon 1987; Uerpmann 1987; Dunham et al. 2001; Insall 2001; Mallon & Al-Safadi 2001; Samour 2001).

In Saudi Arabia, Arabian Gazelle numbers have decreased dramatically throughout their range since the middle of the 20th century due to anthropogenic and other pressures including habitat loss and hunting. Important habitat has been lost to agricultural developments, fencing of pasture for livestock and the construction of human settlements and roads (Habibi 1986; Nader 1989; Thouless et al. 1991; Islam et al. 2010a,b). The IUCN Red List (IUCN 2009, 2014) currently ranks this species (as *G. gazella*) as 'Vulnerable' (A2ad). Small relict populations may still occur in Al Khunfah and Harrat al Harrah in the north of Saudi Arabia (Harrison 1968; Green 1986; Thouless et al. 1991; Habibi 1992; Wachter 1993; Seddon et al. 1997; Islam et al. 2012) and

on the Tihama coastal plain (Thouless et al. 1991, 1997; Magin 1993, 1996; Wachter & AlAgeel 2001a; Ahmed Boug pers. comm. March 1999, in Wadi Hali; Zafar-ul Islam pers. obs. 22 February 2009, 80km south of Al Qunfidah). On the Farasan Islands a strong population of about 1000 individuals has survived (Flammand et al. 1998; Cunningham & Wronski 2010), and Arabian Gazelles were released in two protected areas (Ibex Reserve, Uruq Bani Ma'Arif) from 1990 to 2007 (Islam et al. 2012; Wronski et al. 2012a,b,c). Most records of natural Arabian gazelle populations in Saudi Arabia originate from the western part of the Kingdom, i.e., the Asir, Sarawat and Hejaz Mountains (Thouless et al. 1991, 1997; Magin 1993, 1996; Al-Hazmi & Ghandour 1992; Magin & Greth 1994). Four populations are known from the northern Hejaz Mountains extending from Medina up towards the Gulf of Aqaba, namely Jibal Kallab, Harrat Uwayrid, Ras Suwaihil and Jibal Dakhkhan (Child & Grainger 1990; Thouless et al. 1991, 1997; Wachter & AlAgeel 1999; Wachter & Strauss 2000; Wachter 2001; Ahmed Boug pers. comm. March 1999, near Al Farah). The Hejaz Mountains are more arid than the southern Asir and Sarawat Mountains where permanent water is available throughout the year. In the Asir and Sarawat Mountains a number of gazelle populations were reported to survive in the foothills and in the eastern flanks of the Asir, where they are mostly associated with Acacia-lined wadis (Thouless et al. 1991). From 1990–2001, several surveys have focused on a number of populations in the Asir National Park (Al Khalili & Nader 1984; M.Z. Islam pers. comm. 2013) and other proposed protected areas in the region to confirm presence or absence of gazelles or to establish rough population estimates (Child & Grainger 1990; Magin 1993, 1996; Thouless et al. 1997; Wachter & Al Toum 1998; Wachter & AlAgeel 2001b). Since 2001 no confirmed observations of Arabian Gazelles in the Asir Mountains have been reported. Three observations were made by a local shepherd near Jabal Kabkab in Makkah in January 2014 (A. Boug and wildlife rangers pers. comm. 2014).

Historically, Arabian Gazelles occurred in Mahazat as-Sayd Protected Area in central Saudi Arabia but their loss was attributed to anthropogenic and other pressures (Child & Grainger 1990; Lewlin in press, Islam et al. 2010a,b). Since their presence was confirmed via interviews with local people and historical records (Magin 1996; Thouless et al. 1997; Islam et al. 2010a,b), the Strategy and Action Plan of the National Wildlife Research Center (NWRC) suggested the re-introduction of Arabian Gazelles (Islam et al. 2010a,b). This project is particularly significant as it is one of the first successful

releases for the species in over 20 years (Islam et al. 2011, 2012). After many years of dedicated work to identify and conserve different species of gazelles in Saudi Arabia, these elegant gazelles were successfully released. The release is part of the ongoing efforts in the Kingdom to conserve a variety of antelopes, an initiative that is strongly supported by the Saudi people (Magin 1996; Thouless et al. 1997; Islam et al. 2010a,b).

The need to reintroduce gazelles from captive bred populations was identified at an early stage by the Saudi Wildlife Authority and endorsed by an International Conference on Conservation of Arabian Gazelles (Greth et al. 1996). In line with conference recommendations, the IUCN guidelines for reintroduction were followed (IUCN 1998). Key subsidiary recommendations in this approach to reintroduction are that only appropriate taxa are released within their former historic range and that the original cause of extinction has been identified and controlled or eliminated. Gazelles reintroduced have all been placed into former range areas in fenced protected area. Extensive taxonomic research, including molecular genetic research, has been undertaken to ensure accurate identification in this difficult group (Greth et al. 1996; Hammond et al. 2001).

The reintroduction of the Arabian Gazelles was undertaken with the following goals: (a) to re-establish wild and self-sustaining populations of Arabian Gazelle in Saudi Arabia; (b) to study the most suitable habitats and establish protected areas in which vegetation can recover; (c) to manage the re-introduction of herds in protected areas; (d) to re-introduce in suitable habitats; and (e) to study the ecology and biology of gazelles in the protected area.

STUDY AREA

The Mahazat as-Sayd Protected Area (22°15'N–41°40'E) is located in west-central Saudi Arabia and consists of a gently undulating sand and gravel plain at about 900m altitude comprising dwarf-scrubland dominated by *Acacia tortilis* trees, other *Acacia ehrenbergiana* as well as *Maerua crassifolia* trees (Fisher & Membery 1998). Perennial grasses, such as *Panicum turgidum*, *Lasiurus scindicus* and *Octochloa ompressa*, which are important Arabian Gazelle forage species (Blank 2000; Shah et al. 2013), are abundant on sandy areas and some of elevated areas and depressions. Net primary production in Mahazat as-Sayd is low and rainfall is unpredictable and patchily distributed (Treydte et al. 2001). Mean temperature

ranges from 17°C in winter to 34°C in summer, but maximum temperatures in summer often exceed 45°C (Islam et al. 2012). Mahazat as-Sayd is completely fenced (2244km²) and was gazetted in 1988 as a reintroduction site for Arabian Oryx (*Oryx leucoryx*), Houbara Bustard (*Chlamydotis macqueenii*) and the Arabian Sand Gazelle (*Gazella subgutturosa marica*) and Arabian Gazelle (Vessey-Fitzgerald 1952; Child & Grainger 1990; Islam et al. 2012). Predators were originally eradicated from several protected areas, but one Arabian Wolf (*Canis lupus*) was located in Mahazat in 2008 (Musleh Ammar (Head ranger) pers. comm. 2012). The Arabian Gazelles were originally extirpated primarily by excessive hunting before declaration of PA (Islam et al. 2010a,b).

After the identification the area as wildlife reserve with fencing and proper protection from livestock grazing, within five years the recovery of the vegetation increased the chances of re-introduction of Arabian Gazelles in the area as compared to areas outside the reserve, which was overgrazed and disturbed. The local community was taken in to confidence during the process and Saudi Wildlife Authority got full support both from civil society and the government for the re-introduction of native wildlife.

METHODS

Arabian Gazelles were captured just before dark by using boma-trapping and put in individual crates constructed of plywood and measuring 100x36x90 cm. Crates could be opened from both ends and had 30-40 ventilation holes of 1cm diameter. Animals were transported the 670km to Mahazat at night by truck. Upon arrival at the reserve the gazelles were placed in a quarantine enclosures identical in size (500x500 m) and features to those at the KKWRC. Food and water were provided in enclosure. Arabian Gazelles were obtained from King Khalid Wildlife Research Center (KKWRC). All the translocated gazelles were born in captivity at KKWRC.

Between 2011 and 2014, three groups of animals were released from the pre-release enclosure into wild when the vegetation condition was favorable. All animals were released by opening gates of pre-release enclosure and allowing them to leave of their own, while water and alfalfa was provided outside of the enclosure for three weeks. All animals that were radio-tagged were monitored on a daily basis by ground telemetry and at least once a fortnight by aerial telemetry using Maule aircraft and date, time, location, activity, habitat



Image 1. Arabian Mountain Gazelle male in the night



Image 2. Arabian Mountain Gazelles with collars males and a female



Image 3. Arabian Mountain Gazelle male with collars



Image 4. Arabian Mountain Gazelle released by HH Prince Bander (President of SWA)

and group compositions were recorded.

First Release: The first group of 17 (4 males, 13 females) Arabian Gazelles was transferred from KKWRC to Mahazat on 14 March 2011 by road. Age of gazelles ranged between three months old calf to 10 years old. Radio-collars were secured to each individual with tag numbers. One female died on 19 March 2011 in the release pen. On 08 April 2011 four Arabian Gazelles (1 male, 3 females) were released directly from boxes by His Highness Prince Bandar bin Saud bin Mohammed Al Saud (President of SWA), including two (1 male, 1 female) from NWRC and other two females from KKWRC. The remaining 14 gazelles (4 males, 10 females) were kept in the pre-release enclosure and released by opening the gate (Images 1–4).

Second Release: The second group of 23 (8 males, 15 females) gazelles was transferred from KKWRC to Mahazat on 12 February 2012. Age structure of this group was mostly 2–4 years old and ranged between 1–5 years old animals. One female gazelle was recorded

dead in the pre-release enclosure on 21 February 2012. This group of 22 Arabian Gazelles was released by opening the enclosure gate on 06 March 2012.

Third release: Another nine animals (2 males; 7 females) were released in Mahazat in June 2014.

All animals were tested for tuberculosis, vaccinated against rabies, foot and mouth disease, rinderpest, and pasteurellosis, marked with either eartags, marker collars, or radio transmitters, and placed in quarantine pens for a few months and soft released by opening the gate of the enclosure.

RESULTS

Post-release monitoring: In summer of 2011 and 2014, when the vegetation mostly dried off, a total of eight Arabian Gazelles were recorded dead, mostly just after the release from the first release between

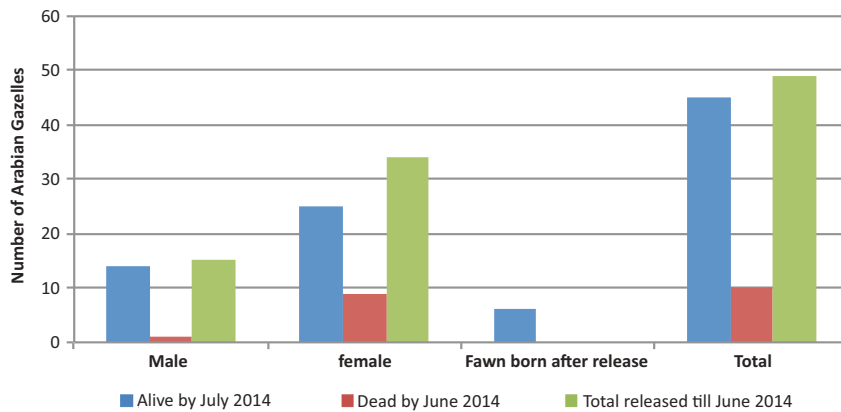


Figure 1. Status of re-introduced Arabian Gazelles in Mahazat PA with fawn born in the wild

May and November 2011 and five gazelles (1 male, 4 females) went missing due to radio-collar failure and the radio collar fell off one female. These animals were not recorded again until now. Only one female was found dead on 13 March 2012 among the second released group. Mortalities were controlled by further improving the release method by releasing animals in winter months, not as late as in 2011. Another factor assisting the successful release was that the reserve received good rainfall contributing to the growth of greenery.

Post-release dispersal of Arabian Gazelles has been recorded from the intensive monitoring programmes. After release, the productivity was high. After one year of release, the gazelles started breeding and five radio-tagged females gave birth to calves (Fig. 1).

Breeding records of the gazelles: The first wild born Arabian Gazelles calf was recorded in Mahazat on 28 August 2012 near the fence. This calf was almost one month old when recorded with the group. Six other females delivered one each by end of September 2012. The offspring show more adaptability to the wild than their captive-bred parents. All young animals born before the end of 2012 were alive at the end of 2013. The present population of Arabian Gazelle in Mahazat reserve is 40–50 (Fig. 1).

Studies related to habitat use, feeding ecology, range and space use, and group composition are being carried out in Mahazat.

Habitat preference by Arabian Gazelles

A recent spot image with 2.5m resolution in color was acquired from the remote sensing section of the King Abdulaziz City for Science and Technology in Saudi Arabia for the Mahazat as-Sayd Protected Area to study the landcover and classified in four major classes. The dominant landcover class is sandy followed by rocky

Table 1. Landcover classification of satellite image and habitat use by gazelles

	Landcover class	Area in sqkm	Percent Area	Percent Area used by Arabian Gazelle (landcover)
1	Sandy areas	1014	45	08
2	Rocky barren	478	21	43
3	Grasslands	432	19	34
4	Scrub forest	320	14	17
Total		2244	100	100

and grassland as depicted in Table 1 and Fig. 2. Arabian Gazelles use mainly scrub and grassland areas in the rocky barren and most avoiding sandy areas in the reserves (Fig. 2).

Food and water: The released gazelles and their offspring were mixed feeders, eating grasses, forbs, and shrubs. Growing leaves of *Acacia tortilis* were eaten. Occasionally gazelles were observed to stand on their hind legs, resting the forelegs on bush, to reach leaves growing above their normal levels.

After release, gazelles were occasionally seen drinking water from the waterhole that was created especially for them. Once animals moved away from the release sites, the territorial male was rarely seen outside his territory; however, regular checks were made for the gazelle footprints near the release site and some of the animals used to visit in the late evening and early morning in search of food and water.

One of the males moved almost 20km from the release sites. The release site is near to the hilly part of the reserve (10km away) and most of the animals are confined to these areas. Females who were about to deliver young went to a secluded place and after delivering the calf, female and the calf moved around

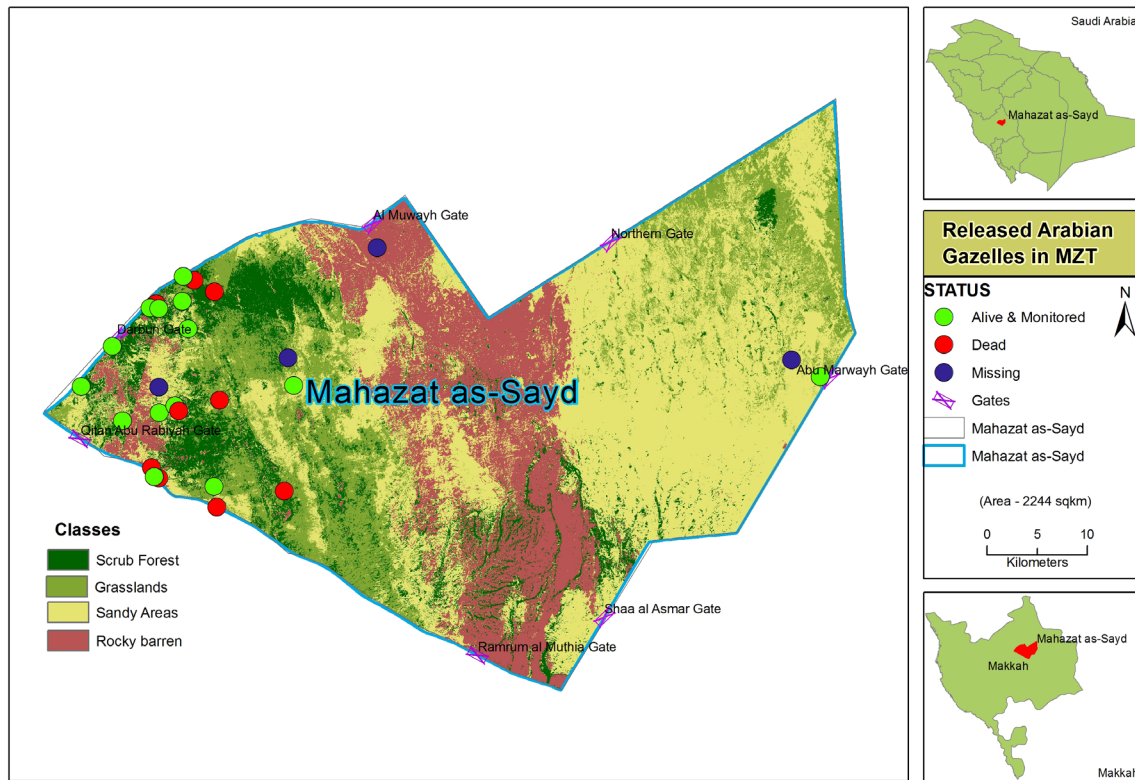


Figure 2. Land-use pattern and distribution of Arabian Gazelles in Mahazat PA.

50m away, likely to avoid small carnivores being attracted to the smell of the placenta.

DISCUSSION

The reintroduction of the Arabian Gazelles in Mahazat as-Sayd has faced some difficulties including (a) maintaining long-term regular monitoring due to lack of full time researchers; (b) lack of skills for mass capture techniques for Arabian Gazelles in case of need to fix or re-fix the radio collars, especially of new born individuals.

Major lessons learned from other reintroductions in Saudi Arabia include (a) when wide-ranging species are confined to restricted areas, even if such areas are large, it is essential that an effective population management plan is in place before any re-introduction is carried out, and that the plan is properly implemented. If this is not done, large-scale mortalities will occur (Islam et al. 2010a,b); (b) prior to any transplantation, range conditions in the release area have to be improved and the area protected from livestock exploitation. Once pasture conditions show adequate signs of improvement and the site is adequately protected, re-introduction of

the animals can be contemplated; (c) the time of release should coincide with suitable vegetation conditions; (d) keeping the animals in pre-release enclosures within the re-introduction site to get them acclimatized to the natural environment and provide minimal amount of food and water; (e) regulate tourism in re-introduction areas as this can lead to increased habitat degradation; and (f) a public-awareness program should be put in place to inform citizens of the biological and historic significance of the Sand Gazelle in the society.

A healthy (disease-free, injury-free) breeding Arabian Gazelle population has been established in Mahazat as-Sayd Protected Area for more than two years, and is considered to be a success. Productivity by released Arabian Gazelles high; society and the government support the re-introduction and Mahazat has been suggested as a destination for national and international tourists.

Management plan

The ungulate populations in the Mahazat As-Sayd Protected Area are valuable resources that could be put to good conservation (or other use) with careful planning. An active management plan for the ungulate populations in Mahazat As-Sayd Protected Area was

developed in the end of 2008 by experts including ecologists, biologists, botanists, vets, sociologists and policy and decision makers to minimize periodic large-scale mortalities in the reserve (Islam et al. 2010b).

In the plan artificial provision of water and alfalfa is provided at five different locations to animals in Mahazat since May 2008 to minimize mortality.

Under this project, auxiliary rangers are given training to monitor the population and protect it from suspected hunters. Such surveillance would be greatly facilitated by the rugged nature of most gazelles in the area.

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