Restoration of Goitered Gazelles to the Iori Plateau – Vashlovani Landscape, Georgia

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Executive Summary

The goitered gazelle once inhabited the whole of the semi-arid zone of Georgia as part of a contiguous population across the South Caucasus and beyond. As medium sized grazer occurring in large numbers, the species undoubtedly played a critical role in shaping the landscape, vegetation communities and therefore biodiversity of the region. Given the continued availability of quality habitat and no material change in land use in recent history, its extirpation from Georgia is likely to be due to previously unsustainable levels of hunting

Following recent review and site assessments, the biological basis and institutional support for a reintroduction goitered gazelle *Gazella subgutturosa* to Georgia are extremely favourable. A large, uninterrupted area of over 2,000km^2 defined as the Iori-Plateau-Vashlovani Landscape is available for dispersing gazelles over the long-term, offering the attractive possibility of using the species as a flagship for the conservation of biodiversity across the entire semi-arid zone of Georgia. This is contiguous with an area of equivalent size and land use in Azerbaijan presenting the even greater opportunity to re-establish goitered gazelles across the South Caucasus through international cooperation.

Current land use through the seasonal pattern of livestock grazing is entirely compatible with gazelle reintroduction: pastures are grazed during the autumn and winter, but with little or no impact during the late spring and summer. As a result, vegetation condition is generally good with both grass and *Artemisia*-dominated steppes showing varied structure and good species diversity.

The presence of wild predators, particularly wolves may limit the gazelle population growth and expansion in the early years, but is critical for natural selection and population control in the long term. However, risk assessment and measures to mitigate potential threats from infectious disease, illegal hunting and predation by sheepdogs are critical to success.

Vashlovani National Park (VNP) is the most suitable choice for an initial reintroduction site because of its protected status, the presence of rangers, the existing infrastructure, and ecological diversity. The site is connected through Gumuru valley to the adjoining Samukhi (Eldari) steppes and thence to the Iori Plateau, thus facilitating dispersal to the wider landscape.

Based on taxonomic considerations, morphological, physiological and behavioural adaptation, and that a donor population must be large enough to withstand removal of animals without negative impact, Shirvan National Park in Azerbaijan is the favoured source of goitered gazelles. A wild to wild translocation of 100 gazelles over five years is recommended in preference to the more expensive and logistically challenging option of *in situ* captive breeding.

Large tracts of pasture within VNP are under-utilised resulting in rank swards and the loss of finer grasses and herbs favoured by gazelles. Monitoring of vegetation and active pasture management will be needed to optimise the habitat for gazelles, and avoid the risk of uncontrolled wild fires.

The requirement for pasture management presents an opportunity to engage the pastoralist community in the reintroduction process, with possibility of offering additional grazing access as an incentive. The concept of enlisting local land users as gazelle custodians should be explored while the population is being re-established, with long term economic value and benefit-sharing in mind. Population viability modelling suggests that sustainable harvesting of gazelles for hunting or translocation to other sites should be possible, but the population should remain fully protected until re-established. Under favourable conditions, this could be as little as 10 years.

Long term monitoring and adaptive management is recommended to support reintroduction. This includes surveillance of the gazelles, particularly during the early release phase when the then small population remains vulnerable, and monitoring of the wider environment and human impacts. Institutional cooperation and a programme of local capacity building and will be needed to underpin these activities.

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Appendices:

1.0 The Goitered Gazelle *Gazella subgutturosa*

1.1 Species Biology

Goitered gazelles are medium-sized gazelles; adult males weigh 20-43 kg and females 18-33 kg (Heptner *et al*. 1961). The common name refers to an enlargement of the larynx that is present in both sexes but is more prominent in males and swells during the rut. Males have annulated, lyrate horns up to 340 mm long that curve outwards, upwards and backwards from a narrow base before turning in at the tips. Females in typical forms are hornless. The coat is medium to light brown, white underneath and with a faint flank stripe. The face is pale with few markings. The tail is 120-200 mm in length with a prominent black tip and is held upright in flight or when alarmed. The winter pelage is longer (Heptner *et al*. 1961; Kingswood and Blank 1996).

Goitered gazelles inhabit semiarid and desert areas, level or undulating terrain, foothills and valleys. They avoid very rocky areas and dense woody vegetation. They feed on grasses, forbs small shrubs and halophytes and they may eat crops; in Azerbaijan they have been noted eating seaweed. They feed mainly in the early morning and late afternoon-early evening, but can become partly nocturnal where they are heavily hunted. In hot weather they may seek shade under vegetation or rock ledges.
In winter they may graze throughout the day. They are sensitive to winter cold and wind and seek shelter in valleys, broken ground or vegetation. They have difficulty in moving in deep snow due to their relatively high foot loading (Kingswood and Blank 1996).Goitered gazelles are susceptible to severe winters and heavy snow, which occur on average every 10-15 years in the South Caucasus, much less frequently than in Central Asia (Heptner *et al*. 1961, Vereshchagin 1959). Climatic conditions within gazelle range in Mongolia and Central Asia are generally more severe than in the Caucasus region.

Goitered gazelles usually occur in small groups, but congregate during the rut. Females reach sexual maturity at 1.5 years and males at 1.5-2.5 years. Males are polygamous and may breed with 2-12 females. They occupy breeding territories of 50-120 ha which they mark with dung piles, urine, or secretions from the preorbital glands and defend them against other males. The rut takes place in autumn, generally October to December, and young are born in April-early June, depending on latitude (timings are later in more northerly populations). In the South Caucasus the rut takes place in November-early December (Heptner *et al*. 1961). Gestation lasts 148-160 days. Females seek shelter in foothills or vegetation to give birth. One or two young are born and the twinning rate may reach 75% (Pereladova *et al*. 1998). Reported densities in Central Asia and the Caucasus are 0.02-4.21/km^2. Longevity in the wild averages 6 years (less for males) but females can live for 8-12 years.

Goitered gazelles are susceptible to bacterial infections (e.g. ulcerative enteritis) and viruses, including foot and mouth disease, bluetongue, catarrhal fever and epizootic haemorrhagic disease. Several species of ticks, other ectoparasites and endoparasites have been recorded (Kingswood and Blank 1996).

1.2 Taxonomy & Distribution

The goitered gazelle *Gazella subgutturosa* spp. occurred across the Middle East and Asia to Mongolia, China and Pakistan (Strauss, 2005; Mallon, 2008). Four subspecies of *Gazella subgutturosa* have been listed using morphological characteristics: Mongolian goitered gazelle *G. s. hilleriana* (Mongolia); Arabian Sand Gazelle, *G. s. marica* (Arabian peninsula); *G. s. yarkandensis* (China); and the Persian goitered gazelle *G. s. subgutturosa* (plains of Asia and the Middle East) (Hayatgheib *et al*., 2011; Mallon, 2008).

The range of the Arabian sand gazelle *G. s. marica* covers Iraq, Jordan, Syria and southern Turkey. This sub-species has a pale body with a white face. Males have lyrate horns and females have long slender horns (Wacher *et al*., 2010). The Persian goitered gazelle's *G. s. subgutturosa* geographic range covers Northern Iraq, Western Iran, Turkmenistan, Uzbekistan, Azerbaijan, Georgia, Turkey, Tadzhikistan (Sorokin *et al.* 2011; Gür 2008; Murtskhvaladze *et al.* 2012), but the sub-species is now locally extinct in Georgia (Mallon, 2008). The morphology of the goitered gazelle *G. s. subgutturosa* differs from that of *G. s. marica* by having larger body weight, and by adult females lacking horns. The adult males also develop a prominent swelling or 'goiter' on the larynx during the rutting season (Wacher *et al*., 2010). Hybrid zones are thought to exist where the range of *G. s. marica* overlaps with *G. s. subgutturosa* e.g. the Euphrates-Tigris basin, Zagros Mountains of Iran, Turkey and Iraq. Hybrids have traditionally been identified by intermediate morphology, for example females have poorly developed horns (Murtskhvaladze *et al.* 2012; Wacher *et al.* 2010).

Historically, the sub-species have been distinguished using only morphological characteristics, but recent studies have identified genetic differences between *G. s. marica* and *G. s. subgutturosa*. The two sub-species are more distantly related than previously thought with *G. s. marica* having greater genetic kinship with *Gazella leptoceros* (slender-horned gazelle) and *Gazella cuvieri* (Cuvier's gazelle), both from North Africa, than *G. s. subgutturosa* Wacher *et al*. (2010), *a*lthough this is based only on the analysis of mitochondrial DNA. Furthermore hybrids may not always exhibit intermediate morphology (Murtskhvaladze *et al*., 2012). Gazelles from Ceylanpinar in Eastern Turkey (close to the anticipated hybrid zone) were assigned to *G. s. subgutturosa* based on morphological characteristics. Analysis of mitochondrial DNA revealed maternal haplotypes of *G. s. marica*, indicating hybridisation. Consequently, morphology alone is not sufficient to identify hybridisation between *G. s. marica* and *G. s. subgutturosa*.

Goitered gazelle (*G.s.subgutturosa*) exhibit remarkable within sub-species morphological variation which is distinct from *G. s. marica* (Hayatgheib *et al.* 2011; Zachos *et al.* 2010). Additionally, recent studies have quantified some of the genetic relationships between different goitered gazelle populations and have concluded that they exhibit genetic differentiation, and in some cases hybridisation with *G. s. marica* (Sorokin *et al.* 2011; Murtskhvaladze *et al.* 2012).

1.3 Goitered Gazelle in the South Caucasus

The earliest fossil remains in the region date from the Holocene and goitered gazelles probably reached the area from Iran via the Mugan steppes. The South Caucasus gazelle population was cut off from Iran during the historical period by agricultural development (Heptner *et al*. 1961, Vereshchagin 1959).

Former distribution in the South Caucasus covered the Karabakh-Milsk Steppe, Mugan Steppe and Kura-Araks lowlands, extending north-west to the Shiraki and Eldari steppes of Georgia. In the north-east they occurred on the Apsheron peninsula and up to about 41^0 N. In the 19th century they probably also occurred in Armenia, in the Araz (Araks) Valley between Nakhchivan and Erevan (Heptner *et al*. 1961).

Range and numbers declined rapidly in the 20th century, especially from the 1930s onwards, as a result of intensive hunting and wide-scale cultivation of the steppes. An estimated 50,000-60,000 were present at the start of the 20th century but by the end of the 1940s only 5000 remained, all in Azerbaijan. By 1961 they had dwindled to only 130 in an area near the mouth of the Kura River on the Caspian coast. Byandovan Sanctuary (zakaznik) was established in 1961 to conserve this relict population (Heptner *et al*. 1961) followed by the adjacent Shirvan State Reserve in 1969. As a result, the population increased steadily to c. 4,500 by 2003 and an estimated 6000 in 2012. This represents >95% of the South Caucasus population. Small groups are still found elsewhere in Azerbaijan - (Williams *et al*. 2006) including sites in the NW of the country not far from the Georgian border (Korchay Sanctuary, Palandeken mountains).

Eight gazelles from Shirvan were released into Ak-Gyol NP, central Azerbaijan, in 2009 and have since reproduced. In 2011 there were further translocations from Shirvan to Gobustan in the NE and the Ajinour steppe in NW Azerbaijan, not far from the Georgian border.

1.4 Goitered Gazelle in Georgia

Goitered gazelles are known to have occurred in Georgia since the early Holocene when the climate became more arid (Vekua and Lordkipanidze 2008). Their former distribution covered the steppes of the semiarid zone in the south-east and in the 1870s it extended up the Kura/Mtkvari valley as far as Avchal, about 10 km west of Tbilisi (Radde 1899). The species disappeared from Georgia by the 1930s due to uncontrolled hunting, encouraged in part by government policy designed to maximise livestock production. A few individual gazelles were reported on winter grazing grounds in the 1980s (Baratashvili 1986) and had presumably wandered from small relict populations in Azerbaijan.

An unsuccessful reintroduction attempt took place in 1988 when 10 gazelles were brought to Vashlovani from the Bukhara Breeding Centre in Uzbekistan but all died within two years due to disease and wolf predation. Flaws in the fence design enabled wolves to gain access to the pre-release enclosure which was sited in an area of *Pistacia* woodland, a unsuitable habitat for gazelles, and one that optimised predation possibilities for wolves while hindering vigilance and escape on the part of gazelles.

In 2006, the World Bank's Georgia Protected Area Development Project provided funding for another reintroduction. Preliminary agreement was reached with the Azerbaijan authorities to bring gazelles from Shirvan State Reserve but that operation could not be finalised in time before the funding deadline ran out.

In 2008 The Ministry of Environment Protection and Natural Resources of Georgia and the Agency of Protected Areas made an agreement with the Ministry of Environment and Forestry of the Republic of Turkey, to assist Georgia in its efforts to reintroduce *Gazella subgutturosa* (APA 2010).

A breeding enclosure was constructed in Vashlovani with the financial support of USAID/DOI. The Georgian Carnivore Conservation Project (EU/FFI/NACRES) also donated equipment, including photovoltaic systems to supply an electric fence around the enclosure. Eleven gazelles, nine females and two males, were brought from Ceylanpinar breeding centre in SE Turkey in 2010 and released into the breeding enclosure. Although young have been born, the gazelles have decreased in number and by April 2012 only six remained, one adult male, one subadult male and four females. Young animals that were born in 2011 died after a few months due to unknown causes. One young animal found dead had a heavy infestation of ticks which may have been a contributory factor; other factors include the unusually severe winter 2011-2012, suboptimal habitat (rank grass) in the breeding enclosure and consequent lack of natural forage, and low genetic variability of the founder animals: the Ceylanpinar population had only four founders, 1 male and 3 females in 1968, though these had increased to 1,530 by 2010; Durmuş, 2010).

The rationale for using Turkish gazelles was that they represented the ‘next nearest source when the nearest is unavailable’ in accordance with IUCN reintroduction guidelines. The Turkish gazelles have always been considered to belong to the same subspecies as those in the South Caucasus, *G. subgutturosa subgutturosa,* and they are morphologically similar. Since then, the Arabian sand gazelle *G. s. marica* has been raised to species rank and its distribution described as including Turkey (Wacher *et al*. 2010). Genetic analysis of samples from animals currently in VPA carried out at Lisbon University has confirmed that they are genetically closer to *G. [s] marica* (Carlos Fernandes *in litt.* 2012).

2.0 Framework for Reintroduction in Georgia

2.1 Strategic Background

2.1.1 Caucasus Ecoregional Conservation Plan

The Caucasus Ecoregional Conservation Plan identifies goitered gazelle as one of 25 focal species (Williams *et al*. 2006). The plan's long-term Target 10 (to be achieved by 2025) states: 'The goitered gazelle is restored to Protected Areas in its former range and the population is doubled'. Medium-term target 10.3 (by 2015) is: 'A program of goitered gazelle reintroduction is under way' and three Immediate Actions are listed: 10.3.1 'Create breeding centres in Shirvan and Vashlovani National Parks'. 10.3.2. 'Determine potential sites for release of gazelles and ensure their protection'. 10.3.3. 'Work with local communities to ensure support for the release program'. In addition, the whole semi-arid zone of Georgia and Azerbaijan was identified as a priority conservation area (Iori-Mingechevir) in the Ecoregional Plan.

2.1.2 National Biodiversity Strategy and Action Plan (NBSAP)

Georgia is a signatory to the Convention on Biological Diversity. Georgia's NBSAP was adopted by the Cabinet of Ministers of Georgia on 2 February 2005 (Resolution 27, 19.2.05). Strategic Goal B5 of the NBSAP is to 'Develop a national recovery programme for goitered gazelles and initiate its implementation' during 2005-2010. The Indicator is: 'National goitered gazelle recovery programme approved by the government and implementation started'. The NBSAP is currently being revised by the Biodiversity Services department of the Ministry of Environmental Protection.

2.2 Legislation and Protected Areas

2.2.1 *Legal*

Goitered gazelle is listed in the Georgian Red Data Book and is protected by law. However, national laws concerning hunting and threatened species were radically revised recently and new quotas issued. These changes are being challenged so the current legal situation in regard to hunting is not fully resolved.

Rangers are responsible for protecting wildlife within Vashlovani PA. Enforcement outside was the responsibility of the Environmental Inspectorate but this dissolved and its role transferred to the Ministry of the Interior in early 2012, so the situation regarding gazelles dispersing outside the reserve is unclear and action is needed to cover this eventuality.

The national Border Police are stationed at several points in the area, including the bottom of Pantishara gorge and several points further west. The Border Police are technically responsible for enforcing all national laws, though to date may have regarded wildlife as a low priority and even turned a blind to some hunters. This force seems well trained and organised and it represents a significant potential enforcement resource. Attempts should be made to engage the Border Police formally in the restoration plan and gazelle protection preferably through negotiations at the highest command level.

2.2.2 Protected Area Network

Vashlovani (34,753 ha) is the most important protected area in the Georgian semiarid zone. It consists of two sectors, a strict nature reserve (IUCN category I; 10,143 ha) and a national park (category II; 24,610 ha). VPA protects a representative sample of all the habitats of the semiarid zone - semidesert, steppe, scrub, two types of arid light woodland (dominated by pistachio and juniper, respectively), foothill deciduous forest and floodplain forest. It also harbours a wide range of large carnivores and breeding raptors. The management plan is currently under revision.

Chachuna Managed Reserve (5200 ha); Iori Managed Reserve (1336 ha) and Korugi Managed Reserve (2068 ha) are all IUCN Category IV protected areas created to protect stretches of riverine forest in the Iori Valley. It has been proposed to combine the management of VPAs and Chachuna MR in one unit. A further large reserve has been proposed that covers the area around Davit Gareji but this is unlikely to be ratified in the near future.

Most of the semiarid zone lies within the Iori Region IBA (Important Bird Area GE011; BirdLife International 2012). The IBA is important for breeding and wintering birds of prey (25 species recorded) and the steppe bird assemblage.

2.3 Institutional

2.3.1 Statutory Agencies

The principal government agencies concerned with the gazelle restoration are the Agency for Protected Areas and the Biodiversity Services department of the Ministry of Environmental Protection. A government reorganisation took place in 2012 which has made the administrative situation more complex. Some functions of the MEP were transferred to the Ministry of Energy and Natural Resources and the Environmental Inspectorate was dissolved and its functions transferred to the Ministry of the Interior. Importing gazelles will require authorisation from the Customs service and veterinary/animal health authorities. Other government bodies with a potential role are the Ministry of the Interior (involvement of Border Police in gazelle protection) and Ministry of Economy and Sustainable Development (National Tourism Agency, Department of Sustainable Development) and Ministry of Agriculture (work with herding communities).

2.3.2 Non-Statutory Agencies and Additional Stakeholders

The NGOs and other organisations that have been involved in efforts to restore goitered gazelles to Georgia so far include NACRES, WWF-Caucasus, Ilia University, Tbilisi Zoo, GIZ (formerly GTZ) and FFI. Other potential stakeholders include: Caucasus Nature Fund, UNDP, IUCN Caucasus Cooperation Center, and EU, as well as local NGOs. The Georgian Church could play a future role in securing the protection of gazelles around Davit Gareji at the appropriate time.

3.0 Site Description & Justification

3.1 The Iori Plateau – Vashlovani Landscape

A field trip was made in April 2012 to carry out a rapid assessment of potential reintroduction sites, including Vashlovani PA, Samukhi, Chachuna Managed Reserve, Davit Gareji, and the Iori Plateau. Driving to, from and between these sites provided the opportunity to assess connectivity and to gain an overview of the wider area (Figure 1, Appendix A).

Vashlovani is the largest protected area within the former distribution of goitered gazelles in Georgia and has been designated as the initial release site since it is the only one with legal protection, staff and infrastructure. However, an extensive area of suitable gazelle habitat was identified, covering approximately 2000 km^2, extending along the whole of the south-western sector of the semiarid zone, between the crest of the plateau, which is marked in part by a low escarpment, and the Azeri border and runs from Vashlovani to the northwestern edge of the Iori Plateau (Figure 1). The area consists of *Artemisia* steppes and grassland and contains no natural or man-made barriers. Consequently an extensive area of contiguous habitat is available for colonisation by dispersing gazelles and future releases at other sites, such as Davit Gareji, are a viable option. These are important considerations in ensuring the long-term resilience of a reintroduced population, since there are limits on the number of gazelles that Vashlovani can support, and a single site remains vulnerable to stochastic events.

It is recommended to plan the goitered gazelle restoration programme in the context of this 'Vashlovani-Iori Plateau landscape'. The summit and north-eastern side of the Iori Plateau contain further suitable gazelle habitat, although these areas are more developed and include some agricultural fields, and there is a similar extent of habitat on the adjacent Jeyranchel steppe in Azerbaijan.

Serious consideration should be given to using the gazelle as a flagship for the conservation of the semi-arid zone as a whole, which contains significant biodiversity value: dry steppe and semidesert; relict dry woodlands; riverine forests in the Alazani and Iori River valleys, and a diverse suite of large carnivores. Most of the semiarid zone lies within the Iori Region IBA (Important Bird Area GE011; BirdLife International 2012). The IBA is important for breeding and wintering birds of prey (25 species recorded) and the steppe bird assemblage.

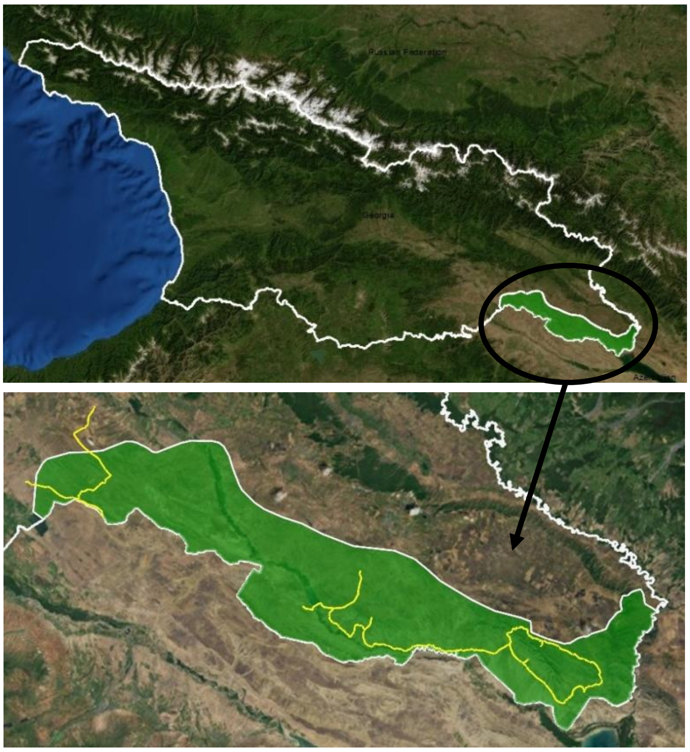

Figure 1: The area of contiguous habitat suitable for reintroduction of goitered gazelles within the semi-arid zone of Georgia (above), and the tracks followed for the fieldtrip in April 2012 (below).

3.2 Complementary Land Use

VNR has the status of Strict Nature Reserve (IUCN category 1) and no human land use is permitted. VNP and the adjoining steppes of Samukhi and westwards along the Iori Plateau contain some cattle farms that are occupied year-round. In winter the area is grazed by large numbers of sheep and goats from Tusheti. Shepherds arrive in October and return to the mountains in late April-early May, depending on the conditions. The number of families and livestock using these winter pastures has increased since 1990-1991 when their former pastures on the northern side of the Caucasus range became inaccessible after the break-up of the Soviet Union.

The Georgian Carnivore Conservation Project (GCCP) has mapped 55 farms in VNP and 39 more within a 2 km buffer around the park, making 84 in total, of which 23 were inactive (Popiashvili, 2011). The western section of the Iori Plateau is grazed in winter by ethnic Azeri shepherds from the Javakheti region who follow a similar seasonal grazing schedule. Cattle do not compete directly with gazelles, which are more selective feeders and their continued presence in and around Vashlovani is essential in helping to maintain pasture condition. Sheep and goats also provide an important grazing function in winter but their numbers are much higher and will compete with gazelles.

Rangeland condition was found to be generally good, with no signs of damage from overgrazing, and some sites undergrazed. The key factor is that sheep and goats which make up most of the livestock numbers are present for only around half the year, from late autumn to early spring and the rangeland is lightly grazed by cattle during the whole growing season, thus allowing plants to flower and set seed and maintain species-diverse communities compatible with gazelle reintroduction. However, undergrazing within Vashlovani National Park has led to rank, species poor swards that would benefit from management intervention.

A few small areas are cut for hay and some crops are grown on the NW side of the plateau in open fields. Areas closer to the road along the Alazani valley and on the fringe are more developed. A few hunting farms have been established, mainly for shooting wild boars, hares and birds. The future of the hunting farms remains uncertain until the situation regarding the new hunting laws has been clarified.

4.0 Reintroduction Strategy

4.1 Sources of goitered gazelle

Although populations have declined and contracted Goitered gazelles still exist across most of their historic range (Mallon, 2008) and there are reasonable numbers in captivity, including approximately 335 *G. s. subgutturosa* in zoological institutions in Europe, the USA and the Middle East (ISIS, 2012).

Animals selected for reintroduction should ideally be of the same subspecies or race as those extirpated so they are morphologically and physiologically matched with the environment, unless adequate numbers are not available (IUCN, 1998). If there is a choice, it is better to trans-locate animals from wild populations rather than release captive bred stock (IUCN, 1998). This is because individuals are more likely to be physically and behaviourally adapted to local conditions than their captive bred counterparts which may exhibit some adaptation to captivity (Frankham 2008; Frankham *et al*. 2010), be immunologically naive and take longer to adjust to the new environment. Indeed in practise, wild trans-locations tend to be more successful compared to reintroductions of captive bred animals (Lindenmayer, 2000).

In addition to taxonomic considerations and adaptation of founder stock, the donor population must be robust enough to withstand removal of animals without negative impact (Kleiman *et al.* 1994). Sufficient numbers of animals must also be available to minimise risk of inbreeding and maximise probability of maintaining genetic diversity following reintroduction.

Excluding captive bred animals from zoological institutions, there are four potential donor sites that could provide *G. s. subgutturosa* for Georgia (table 1). Of these, Shirvan national park In Azerbaijan is the best match, meeting all of the criteria above. It is also geographically the closest of the potential donor sites, which is helpful for minimising translocation time and offering animals from a population that was once contiguous with Georgia. Indeed, the Shirvan gazelles are genetically distinct from the populations at the closely related Dzheyran Ecocenter in Uzbekistan and Ogurchinskii Island in Turkmenistan (Sorokin *et al.* 2011).

The second best match is Ogurchinskii Island in Turkmenistan by virtue of its relatively large population, while Ceylanpinar in Turkey is the least favoured option because of evidence of historic hybridisation with *G. s. marica* (Murtskhvaladze *et al.* 2012).

Rank	Location	Country	Number	Notes	Source
1	Shirvan National Park	Azerbaijan	5-6000	Genetically distinct from the Dzeyran and Badkhyz populations. Represents more than 90% of the regional population	1 & 2
2	Ogurchinskii Island, Badkhyz	Turkmenistan	~1500	Genetically similar to the Dzeyran (Uzbekistan) population but distinct from the Shirvanskaya (Azerbaijan) population	1
3	Dzeyran Ecocenter in Bukharskaya Oblast	Uzbekistan	~550	Genetically similar to the Badkhyz (Turkmenistan) population but distinct from the Shirvanskaya (Azerbaijan) population	1
4	Ceylanpinar captive breeding centre	Turkey (southern)	?	Genetic introgression from *G. s. marica*	1 & 3

1: (Sorokin *et al.* 2011) 2: (Mallon 2006) 3: (Zachos *et al.* 2010)

Table 1. Potential source populations of *Gazella subgutturosa subgutturosa.* The populations are ordered by preference as donor sites.

4.2 Population Viability

There are a number of important factors that influence reintroduction success including: (1) the genetic diversity of founders; (2) the number of animals released and the period over which they are released; (3) the timing of the release; (4) quality of the release site; 5) post-release monitoring leading to adaptive management; 6) the use of post-release supportive measures; and (7) the removal of the initial cause of decline (Fischer & Lindenmayer 2000; Mésochina *et al*. 2003).

4.2.1 Genetic diversity & demographic profile of the founder group

Genetic diversity is an important influencing factor on reintroduction success (e.g. Mésochina *et al.* 2003), so this should be reflected in the founders whilst maintaining sub-species integrity. To achieve this, gazelles should be individually captured from across the range of the source population to maximise the possibility of obtaining unrelated individuals (Ballou & Foose 1996; Frankham *et al.* 2010), and an equal (50:50) sex ratio among founders should help to maximise long term retention of genetic diversity in the re-established population (Frankham *et al.* 2010). Tissue samples (biopsies or blood) should be collected at the time of translocation so that molecular studies can be carried out to assess diversity of the founders and whether genetic augmentation needs to be considered at a later date.

The founder group should comprise young adults or juveniles approaching reproductive maturity to allow mating during the following winter's rut, and offspring to be born one year after translocation. Once breeding has been established the population should enter a reasonably rapid growth phase as long as the environment is favourable and threats are controlled, with the possibility of females producing twins in the right conditions (Cunningham 2008; Qiao *et al.* 2011; Pereladova *et al.* 1998).

4.2.2 The number of animals in the founder group

Reintroduction projects have a higher chance of success if large numbers of animals are released (Fischer and Lindenmayer, 2000). For example, the reintroduction of *Gazella subgutturosa marica* to Mahazat as-Sayd Protected Area in Saudi Arabia saw 164 individuals released over four years, and the reintroduction of *Gazella gazella* to Central Arabia involved the release of 84 animals over five years (Haque & Smith 1996; Dunham 2001; Cunningham *et al.* 2008).

The recommended target of translocating 100 gazelles to Georgia, staggered over five years (Section 4.2.5) provides a hedge against the possibility of mortality during the early release phase as seen elsewhere (Haque & Smith 1996; Dunham 2001; Cunningham *et al.* 2008), and compensates for the fact that not all released animals will necessarily breed.

4.2.3 Timing of release

The timing of the release must be planned to optimise the opportunity for translocated animals to explore and adapt to their new environment, supported by availability of quality grazing at the least challenging time of the year. Taking into account seasonal social structure of goitered gazelles and habitat condition, translocation and release should take place after the rut, but prior to parturition between March and May. This will provide the animals with access to grazing during the spring a summer growing seasons, which will be particularly important if females arrive pregnant, and provide ample opportunity to become familiar with spatial distribution of resources (food, water, shelter) in time for the winter.

4.2.4 Population viability modelling

Population viability models were constructed using Vortex 9.99b for a range of reintroduction scenarios by varying (1) the total number of released animals to a maximum of 100 individuals; (2) the number of animals released each year; and (3) the number of years over which releases take place, based on a low density (3 / km^2) carrying capacity (k) of 753 gazelles in Vashlovani National Park. Natural history traits used in the models were based on published data for goitered gazelles or their close relatives if species-specific information was not available (see Appendices B & C).

All strategies resulted in k being reached. Unsurprisingly, population growth rate increased as numbers of founders increased. However, a strategy based on consecutive annual releases of 20 animals (10♂:10♀) performed better than releasing 100 animals at one time, with no further augmentation. Genetic diversity retained after 100 years increased with the number of founders, although there was little difference in genetic diversity between single v consecutive year release strategies.

With a more stable growth rate, greater retention of genetic diversity (both founder alleles and gene diversity) and a more stable population fluctuating around k, the strategy of releasing 20 animals of equal sex ratio per year for five years is the favoured strategy.

Further modelling was carried out to understand the impacts of harvesting gazelles for hunting or for translocation to other sites. A variety of regimes were simulated from the harvesting of 20 to 60 individuals per annum from year six to 100, and then repeated for harvesting from year 10 to 100. Assuming parameters used in the model reflect reality, sustainable off-take could be possible in as little as 10 years as the population nears capacity, but harvesting before then increases the probability of extinction even when very few animals are taken. It is therefore recommended that reintroduced gazelles are protected until the population has become established (see monitoring section) and not harvested during the growth phase. This results in a more stable population with higher stochastic growth rate, greater predicted retention of genetic diversity (gene diversity and number of alleles), lower overall probability of extinction, and a longer time to extinction for those simulated populations that went extinct.

4.2.5 *Carrying Capacity & Intervention*

Modelling carrying capacity and population growth are useful ways of understanding the likely number of herbivores that can be maintained in a particular area and predicting when management intervention may be needed. However, predicting outcomes in dynamic ecosystems is imprecise as it requires long term datasets of environmental variables, information on likely occurrence of catastrophes such as long term drought and assumptions about birth and death rates, and the influence of population genetics and demographics. This is particularly apparent in arid regions where conditions can be extremely variable because of erratic rainfall. For the purpose of this exercise, carrying capacity for goitered gazelles in VNP was based on known densities of this and closely related species elsewhere.

New populations normally grow rapidly when resources are abundant, grow more slowly as they reach ecological carrying capacity and stabilise around that level (Begon *et al*, 1990). However, if resources become limited, birth rates may drop because reproduction is compromised in animals investing additional time foraging and females are less likely to have successful pregnancies. Mortality rate may also increase due to starvation, lack of milk for calves, increased susceptibility to predators and disease. This density dependent population performance is likely to occur sooner in limited areas, but can also be detected amongst species in unrestricted and even migratory conditions.

Intervention through supplementary feeding (section 6.2) or veterinary care (section 6.1.3) may be needed to support the small and therefore vulnerable founder population of goitered gazelles immediately after reintroduction. However, maintaining animals at falsely high levels should be avoided as the population may crash when support is withdrawn, and the numbers of animals could have adverse impacts on vegetation and other local biodiversity. Instead, in the long term the established gazelle population should be allowed to fluctuate naturally in harmony with the environment.

5.0 Animal Acquisition & Management

5.1 Veterinary health screening and initial assessments

Veterinary screening of trans-located gazelles needs to consider the health risks to the imported animals themselves, and whether they could potentially be carriers of pathogens that could infect wildlife and domestic livestock in and around Vashlovani.

Georgia's statutory veterinary authority, representing the importing country, may impose quarantine or other restrictions and ask for results of specific tests before animals arrive to ensure they are free of infectious disease. This poses a practical challenge for wild to wild translocations because individuals are randomly selected without prior opportunity to undertake veterinary screening. To overcome this, infectious disease and parasite profiling of animals in Shirvan National Park, and Vashlovani National Park should be undertaken. This should include screening of domestic livestock at both sites and a random sample of gazelles in Shirvan. The results of this work will inform a risk assessment and veterinary intervention plan as part of the reintroduction process, which may include specific testing and treatment of animals prior to release.

Measurements and sampling of each translocated gazelle is recommended to support veterinary health screening and provide additional study data (Appendix D).

5.2 Translocation

In situ captive breeding is an option for building numbers of animals prior to release if only a small number of founders are available. However, it is logistically and technically challenging, and expensive because of the need for infrastructure, and ongoing animal husbandry, veterinary care and human resources. The favoured option is wild to wild translocation of gazelles from Shirvan National Park in Azerbaijan (section 4.1)

Translocation of wild animals is established practise for conservation and game ranch management. It is not without risk and should be carried out by an experienced team with the aim of minimising stress from fear and anxiety, sudden and excessive muscular activity, and bodily injuries that arise from the capture-care operation, including exposure to unnatural surroundings such as transport crates, associated noise and smells, unfamiliar food and holding pens.

There are a number of techniques that can be used to capture wild gazelles, including chemical capture by administrating immobilisation drugs by dart, use of suspended or drop nets, and manual night capture with spotlights. Goitered gazelles have been successfully translocated within Azerbaijan, so local expertise and experience is available.

The translocation operation should follow a clear plan to target the correct number of gazelles of the required sex and age (section 4.2.1), avoiding obviously weak animals, and females with dependent young or in the late stages of pregnancy. Capture operations should not happen during hot weather or during the breeding season, so an early to mid-spring translocation is advisable (see also section 4.2.4).

To reduce stress, the most efficient method of capture should be adopted and the use of tranquilisers considered under expert veterinary supervision. Gazelles should be transported in specially designed crates following internationally recognised guidelines (IATA), and moved to Vashlovani *via* the shortest and quickest route possible. If transport by air is impractical or unaffordable, road transport from Shirvan to the Lagodekhi border crossing then directly to Vashlovani would be the preferred route. Export and import permits, evidence that animal health requirements have been met, and any other official documentation should be prepared in advance, and special arrangement made at the relevant border post to ensure no delays are encountered. Speed is essential to reduce risk of mortality. Experience has already been gained with the transfer of gazelles from Turkey in 2010.

5.3 Animal Management on Arrival

On arrival in Vashlovani, the gazelles should be examined briefly to ensure there are no injuries, ear-tagged and fitted with collars as appropriate (Section 5.3), but otherwise allowed to leave the crates calmly and in their own time. Animals may be released directly into the park which is the approach successfully adopted for translocations within Azerbaijan, or held for a short period beforehand. Holding wild caught animals in captivity creates stress and must be planned carefully. However, it provides an opportunity to observe individuals to ensure they are free of injury or illness, offer water and supplementary food to help overcome stresses of translocation, and facilitate social coherence of small groups of animals that are likely to remain together after release. The timeframe for holding animals may be dictated by quarantine requirements (usually one month), but should otherwise be kept as short as possible with the judgement based on the health and behaviour of the gazelles. It is not possible to be entirely prescriptive about the process and it is recommended that an experienced, knowledgeable and confident animal manager be present to lead this part of the operation in consultation with a wildlife vet.

Specially designed holding facilities (Appendix E) will be needed to provide flexible options for animal management, but can be based around the existing enclosure in Vashlovani NP. Pasture management is needed to reduce the current cover of moribund grasses and create large patches of shorter sward to encourage fresh growth of the fine grasses and herbs that comprise the gazelle's diet. If there is access to sufficient natural pasture, there is no need to provide any supplementary forage for animals being held for a short period in the 5ha pre-release enclosure. However, animals held in the smaller reception pens will need a diet of good quality hay and access to a mineral supplement (salt lick). A concentrated feed pellet (formulated for small grazing ruminants) may be given in addition to *ad lib* hay to animals in poor condition to help their recovery, but is otherwise unnecessary, while high energy forages (e.g. barley) should be avoided because of the risk of inducing rumen acidosis. Fresh water should be available at all times.

5.4 Animal identification

Captured gazelles will need to be assigned unique identification to support subsequent post-release monitoring, tissue sampling and any required veterinary health screening and intervention. A dual system of ear-tagging to aid observations in the field and implanting of subcutaneous transponders to be read when in contact with the animal is recommended. Both forms of marking should only be carried out by an experienced practitioner to avoid unnecessary harm or infection.

Ear-tagging is commonly used for ungulates as they are inexpensive, quick and easy to apply, and simple to read. Plastic ear tags are readily available in a variety of sizes, shapes and colours, and can have numbers printed on them. Consequently, they can be used to readily distinguish individuals, their age and sex according to the marking protocol.

Subcutaneous transponders are similarly quick and easy to apply, permanent and inconspicuous, and provide an alternative system if ear tags are lost. However, they can only be read in close proximity to the animals, so are effective during the capture and translocation process, or for identifying a sick, injured or dead animal.

Release year	Colour	♂	♀	Individual
1	White	Right	Left	Numbers 1 - 20
2	Yellow	Right	Left	Numbers 1 – 20
3	Light blue	Right	Left	Numbers 1 – 20
4	Light pink	Right	Left	Numbers 1 – 20
5	Light green	Right	Left	Numbers 1 - 20

Table 2: Tagging protocol for translocated animals

6.0 Monitoring & Management

The purpose of monitoring is to assess whether reintroduction aims and objectives are being achieved, understand factors affecting gazelle population performance, and to help inform and evaluate the effectiveness of management intervention. The process requires the establishment of baseline information prior to reintroduction, and ongoing post-release monitoring of gazelles and their environment. Factors affecting gazelle population performance are those influencing recruitment and mortality: availability of food and water, and competition for these resources; predation; infectious disease; and weather. Human activities may have direct impacts (e.g. hunting) or indirect impacts whereby disturbance causes behavioural shifts, making gazelles more susceptible to factors such as predation, or confers competitive disadvantage.

6.1 Monitoring gazelles

The approach to monitoring gazelles will change over time in relation to the status of the population, with appropriate methods needed at each stage of the reintroduction process.

During the early release phase, it is important to gather as much information as possible about the status of individually known animals as each founder represents a significant proportion of the total number, genetic diversity and demography of the population. Indeed, at this stage the very small population will be extremely vulnerable to environmental pressures and human influence, so the founders must be afforded a high degree of protection and closely monitored. The latter is critical for understanding how founders adapt to their new environment and for deciding if management intervention is required. For example, the stocking plan could be adjusted if mortality rates are higher than expected; supplementary food may be provided during a particularly harsh winter; or veterinary support provided in the event of disease outbreak. These more intensive studies are also important for understanding gazelle life history traits that can help refine population models. The constant presence of monitoring personnel watching known animals is also likely to be a deterrent to poachers.

During the rapid growth phase, the emphasis shifts from the monitoring of individuals to understanding the overall status of the population, with particular attention to dispersal patterns, distribution, and estimating the number of gazelles. By the time the population is fully established, it may occupy the entire semi-arid landscape. Ongoing monitoring will be needed to assess population trends, particularly if sustainable harvesting quotas are needed as a community benefit or for sport hunting.

6.1.1 Monitoring the founder population

Despite previous experience, it is always difficult to predict the precise behaviour of released animals. Ideally, they will remain visible and can be observed relatively easily. However, depending on their reaction to human disturbance they may become flighty, making detailed observations difficult, or may even become cryptic by hiding during the day and being more active at night. In addition, human activity or environmental factors may cause the gazelles to disperse so widely that they become almost impossible to find whilst still at very low numbers. Monitoring methods need to take these possibilities into account and the techniques employed may need to be adjusted accordingly.

6.1.2 Gazelle monitoring with GPS collars and through direct observation

Use of GPS technology and radio telemetry will allow individuals to be found more readily and provide a wealth of data on the animals' diurnal activities, movement patterns, habitat use, and distribution in relation to human activity and grassland management. Social behaviour of goitered gazelles is known to change according to season, with mixed groups occurring during the rut, but single sex groups are the norm during the summer months. As a result, fitting both male and female gazelles with GPS collars will be necessary, using a minimum of 10 animals (5♂5♀) in the first cohort to ensure reasonable sample sizes. Additional animals may be collared in subsequent years to replace those that have died or gone missing, or as the original collars themselves come to the end of their lifespan.

Although collars will store data for periodic download, monitoring personnel should conduct daily gazelle searches to collect direct observation data using a standard recording sheet. This should include date; time; location (either by marking approximate location on a map, or by GPS waypoints corrected from the observers position by noting direction and distance from the gazelles); number of gazelles seen, plus their identities (by reading the ear tag), sex, age class, general behaviour (e.g. feeding, resting, moving), and body condition of each animal; and, the prevailing weather conditions at that location.

Once the gazelles settle into their surroundings, patterns in their time budgets and behaviour should become more predictable, so monitoring effort should become more efficient and the quality of data should improve.

6.1.3 Veterinary monitoring & intervention Post-mortem examinations
Understanding the causes of gazelle morbidity and mortality is particularly important during the early release phase. Given the density of predators and scavengers, it is unlikely that a carcass or sufficient remains of a dead gazelle will be found to ascertain cause of death. However, if whole or largely intact animals are found opportunistically, they should be identified if possible using the ear tag or subcutaneous transponder and collected for post-mortem examination. GPS collars emit a signal if an animal has been inactive for a long period. This should be investigated immediately to ascertain if this is a technical problem or if the animal is dead or injured.

Injured or sick animals should be examined by a qualified veterinarian and founder animals should be treated and re-released. Body condition scores of observed gazelles should be recorded routinely by monitoring personnel (see above), while faecal parasite screening should be undertaken seasonally.

6.1.4 Rapid population growth
Monitoring of known and individually marked founders should continue as long as needed, so possibly for several years based on the life span of a typical gazelle. However, assuming the founders have been adequately protected and have not been affected by stochastic events such as prolonged extreme weather or disease, the gazelle population should start to grow exponentially. During this phase, the total number of animals born equals and then overtakes the number of animals released, so the emphasis of monitoring changes from population counts and following the progress of individuals to generating population estimates.

The most practicable method is likely to be vehicle line transects. Ideally, transects should be driven in a straight line and aligned to cross environmental variables, but the terrain in and around VNP means that much of this work will need to be done along existing tracks. However, the principles of the method remain the same with the number of gazelles recorded over a given distance covered at a set speed under standard conditions (e.g. time of day), providing an index of relative abundance. Transect data can be converted into density through distance sampling, and then into a population estimate. Quarterly (i.e. seasonal) monitoring of the core reintroduction area should be carried out, with additional surveys of the peripheral areas undertaken to determine patterns of dispersal. This should include recording of direct sightings of gazelles and indirect evidence of their presence such as latrines and anecdotal reports.

6.1.5 The established population
By this time, it should be clear whether the population is confined to VNP because of disturbance elsewhere, or if (as is more likely) gazelles have dispersed over the wider environment. If the latter is the case, aerial strip transects will be the most practical way of surveying such a large area. The principles are the same as above, except counting all gazelles within a defined strip (usually 100 – 500m) on the observers' side of the aircraft while flying for a set distance at constant speed and height. Large groups of gazelles should be photographed to help verify the count afterwards. The frequency of surveys depends on likely rate of population change, but this should be carried out annually to begin with.

6.2 Environmental monitoring
The distribution and abundance of all species is influenced by environmental variables. Large scale stochastic events such as wild fires, drought or harsh winters will be a challenge for the gazelle population, while they should thrive under mild conditions. At smaller spatiotemporal scales, localised weather conditions or micro-climates may explain gazelle behaviour and distribution. Regardless of naturally occurring events or human intervention, environmental data is critical for multivariate analyses that help to interpret population performance, and for predicting future trends. Routine data collection should include: (1) An annual written record of the prevailing state of the ecosystem supplemented with maps showing the extent of particular impacts (e.g. fire, habitat or pasture management) and fixed point photography recording changes in habitat seasonally and over time; (2) fixed point automatic weather stations recording rainfall, wind speed & direction, temperature, and relative humidity set up at the VNP Ranger Station and another site on the Eldari Plain; and (3) hand held devices and observational data recorded locally while monitoring gazelles (section 6.1.2).

Founder animals are especially valuable because of the cost of acquiring and releasing them and the small population is particularly vulnerable during the release phase of the project. As a consequence, supplementary feed and water should be available during severe winters or droughts. However, once the population is growing rapidly and nearer to becoming established, this sort of intervention should cease so that numbers of gazelles fluctuate with the changing capacity of the environment.

6.3 Vegetation Monitoring & Pasture Management

Availability and access to quality grazing is a critical factor for reintroduction of gazelles. Livestock grazing is entirely compatible with gazelle reintroduction across the Iori Plateau – Vashlovani Landscape, with pastures left lightly grazed or untouched during the late spring and summer leaving vegetation in generally good condition. However, large tracts of pasture are under-utilised within VNP resulting in rank swards and the loss of finer grasses and herbs favoured by gazelles. Monitoring of vegetation and active pasture management will be needed to optimise the habitat for gazelles, and avoid the risk of uncontrolled wild fires.

A specific rangeland assessment is recommended to produce more detailed pasture management prescriptions. However, options include summer grazing by cattle to help remove dominant grasses, controlled burning during the late autumn to remove rank, deciduous grasses and accumulated litter, and cutting areas for hay production or animal bedding. Additional grazing within VNP, or hay production could form part of a benefit sharing strategy for the pastoralist community to support gazelle reintroduction (section 7.1).

An accurate map of vegetation communities in and around VNP would be helpful for interpreting gazelle activities, while periodic assessments of biomass would inform stocking density and grazing management.

6.4 Livestock

The presence of domestic livestock could create competition for grazing resources, disturbance and be a vector for infectious disease transmission. On the other hand, livestock can also help to maintain pasture in good condition by removing excess biomass and facilitate grazing by gazelles. Hence, the need to understand the health, stocking density and behaviour of livestock, with particular attention paid to closely related bovine animals.

Fortunately, competition with livestock should only be an issue during winter, and the Gazelles will have exclusive access to grazing inside the strict nature reserve section of Vashlovani. Moreover, gazelles are very mobile and able to move to areas not occupied by sheep and goats. Competition during winter in Samukhi and other sites where stocking density is higher may be more challenging. Hence, fine-scale mapping of occupied farms, the number of livestock, and their pastures to identify spatial gaps in sheep and goat grazing patterns that could be favoured by gazelles is recommended.

Monitoring of livestock and pasture management should continue post-release, including ongoing veterinary surveillance during the initial five years of the project (see also section 5.3).

6.5 Predators

Natural predators represent both a threat and a benefit to reintroduced gazelles. High levels of predation during the early release phase may be unsustainable, while natural selection and some degree of population control to help avoid density dependent population growth should prove valuable in the long term.

The wolf *Canis lupus* is the major predator of goitered gazelle across its range and is the main potential predator in Vashlovani where it appears to be relatively common. Eurasian lynx *Lynx lynx* and brown bear *Ursus arctos* are more restricted to wooded habitats but may pose a small threat. Common leopard *Panthera pardus* is extremely rare and doubtfully still present so can be discounted as a significant threat. Golden jackal *Canis aureus* may take young animals and red fox *Vulpes vulpes* the new-born young. Large raptors such as golden eagle *Aquila chrysaetos* and imperial eagle *A. heliaca* may also take very young gazelles. Gazelles seeking shelter and females giving birth in hilly terrain and the edges of denser cover may be more vulnerable as they are exposed to a wider range of potential predators. Sheep and goats represent a large alternative prey base in winter, but in summer the only other large prey species is the wild boar *Sus scrofa*.

It is possible that wolf predation could become a limiting factor on population growth in the early stages of the release. However, wolves are common in Shirvan Reserve and gazelles originating from there will not be predator-naïve. During the initial stages of the release operation, introducing a small number of 'sacrificial' sheep or goats at the same time as the gazelles could be an option to divert wolf predation to a more easily accessible prey. It would be useful to obtain information on the survival of gazelles released recently in Azerbaijan.

Shepherds' dogs represent a further threat, especially to young animals when still at the hiding stage. Measures to minimise this risk e.g. by keeping dogs tied up or under close control will likely be more straightforward inside VPA within the framework of PA regulations, but require more careful negotiation outside, such as Samukhi. The impact of domestic dogs on the gazelle population will also need to be understood. Hence, numbers of sheepdogs associated with each farm should be recorded and monitored, along with periodic analyses of faecal samples to determine the composition of their diet.

Baseline data on the status of carnivores in Vashlovani has already been gathered through camera trapping and radio-collaring studies and is a sound basis for further monitoring, particularly of wolves, in relation to changing numbers of gazelles. Further work should be carried out to evaluate the diets of carnivores through scat analyses before and after the release of gazelles to relative contributions of different prey species and if this changes over time.

7.0 Public Engagement

7.1 Community Participation & Benefits

The support of local communities is an important factor in the success of conservation projects. Securing the support of the herding families who depend on the rangelands in and around Vashlovani will be crucial, especially as livestock grazing is essential to maintain rangeland condition and pasture management for gazelles may require negotiated modifications to stocking densities and spatial grazing patterns.

At the most basic level, there is a need to minimise the risk of illegal hunting and predation or disturbance by sheep dogs. Opportunities for more direct involvement include participatory monitoring, supplementary wardening and practical work. Enlisting the more committed community representatives as 'gazelle custodians' would integrate them fully into the restoration programme. Such roles may be especially appropriate to those families resident year-round who may have a greater sense of attachment to the area, but need to be shared among the more numerous wintering families too. Different approaches may be needed within Vashlovani where protected area regulations apply, and outside its boundaries. Payment for some services as appropriate would provide an incentive. In the future, ecotourism may bring further opportunities and benefits. Vaccination of domestic flocks closest to the gazelle release site to reduce risk of disease transmission is a further option and incentive, but this would need repeating annually, with clear time and cost implications. At one time, eviction of livestock from the area around the reintroduction site was proposed. The decision to retain grazing in the interests of grassland management could be used as an indirect incentive.

Good contacts have been established with local shepherds through GCCP and these form a sound basis for constructive engagement. As a first step, local shepherds need to be informed about the project aims and timetable. An on-site meeting would be a good way of initiating dialogue. Developing the relationship between the reintroduction programme and local families and gaining their participation will be a time-consuming and ongoing process that may be best delivered by appointing a project officer with appropriate experience and skills.

7.2 Communications, Education & Public Awareness

Securing official and public support for the restoration programme is essential to its long-term success, especially if the gazelle reintroduction is intended to serve as a model for other species. Good communications and awareness-raising are therefore vital. A simple communications strategy should be developed to identify the different target audiences and the most effective ways to reach them, as well as allocating responsibility for its implementation. The principal audiences are the government, the public, young people and local communities (dealt with above). The strategy should explain the rationale and aims of the programme and encompass the press, radio, TV and the internet including social media such as Facebook. The aesthetic and cultural appeal of gazelles makes them an attractive subject and facilitates their acceptance by the media. Setting up a goitered gazelle website that also covers the biodiversity of the whole semi-arid zone will provide a central point of reference. This should be supplemented by regular progress updates through press releases, photos and video clips. With its large numbers of visitors, Tblisi Zoo could become a focal point for the project in the capital, particularly if a small group of goitered gazelles could be kept there with imaginative forms of interpretation and public engagement. These captive gazelles would represent the 'public face' of the restoration programme and have a valuable role in raising awareness. Finally, having the programme endorsed at the highest possible government level will increase its profile and ensure official commitment.

8.0 Developing & Maintaining Capacity & Capability

Monitoring of released gazelles will need to track movements, habitat use, predation and breeding and be carried out through direct observations and radio/satellite collaring. NACRES staff have acquired considerable experience in radio collaring and monitoring techniques and these skills are directly transferable to gazelles. Reserve rangers and local herders will also be involved in monitoring but will need basic training in identifying, sexing and aging the animals. Rangers can combine monitoring with anti-poaching duties so should be provided with adequate means of transport (see below). Studying the release of gazelles into Vashlovani and their adaptation to the environment is a critical part of the monitoring process (Section 6.1), ideally managed through a collaboration between an academic institution such as Ilia State University and science-led conservation organisations such as NACRES and FFI.

Reserve staff will be expected to take the lead on anti-poaching activities, hopefully supported by the local community through a participative programme (Section 7.1). The latter will need adequate means of communication to report suspicious activity. Gazelles are mobile animals and it is impossible to predict their movements on release: they may cluster in a limited area or some or all of them may move a considerable distance. Protecting them until fully established may be quite intensive and will require sufficient personnel with the capacity to cover the reserve by vehicle, motor cycle or on horseback. Protection of gazelles moving outside Vashlovani, e.g. by the Border Police, should receive early consideration, and the police post at Pantishara which controls one entry point should be informed of the release and the increased need for vigilance..

Veterinary checks are needed on gazelles pre-release, and animals that arrive injured, weak or sick will need a longer period of care in captive conditions. A field centre that includes a veterinary clinic has recently been constructed in Vashlovani and expertise in animal management is available from Tbilisi Zoo and the wider zoological community.

Rangeland assessment and management is the one area where capacity appears to be currently lacking within the main project partners and this gap should be addressed: a detailed assessment of rangeland condition and recommendations are provided by Gintzburger (2012). Responsibilities for each of these aspects of the reintroduction programme, plus the communications and awareness strategy will need to be clearly defined and a lead person allocated. Finally, a project coordinator should be designated to take overall responsibility for the reintroduction.

9.0 Evaluation

In basic terms, the programme can be adjudged a success once a self-sustaining goitered gazelle population has been established in Georgia, contributing to its wider restoration in the South Caucasus. The principal milestones are:

- Goitered Gazelle Restoration Programme approved by government
- First cohort of gazelles released (Year 1)
- First cohort reproduces successfully (Year 2 and thereafter)
- Second cohort of gazelles released (Year 2)
- Second cohort reproduces successfully (Year 3 and thereafter)
- Third cohort of gazelles released (Year 3)
- Third cohort reproduces successfully (Year 4 and thereafter)
- Numbers increase annually
- Gazelles utilise all suitable habitats in VPA
- Gazelles disperse and establish subpopulations outside VPA
- Releases take place at other sites
- Self-sustaining gazelle population established across the Vashlovani-Iori Plateau landscape

10.0 Conclusions & Recommendations

There is a strong institutional and biological basis for the gazelle restoration programme:

- It has the full support of government agencies and NGOs
- Implementing the programme would contribute significantly to national and regional biodiversity targets
- An area of c. 2000 km^2 of contiguous habitat is available, extending from Vashlovani PA to the NW end of the Iori Plateau with no natural or man-made barriers (the' Vashlovani-Iori Plateau Landscape')

Recommendations:

- Plan the restoration programme in the context of the Vashlovani-Iori Plateau Landscape to provide long-term perspective
- Use the goitered gazelle as a flagship for the conservation of the whole semiarid zone
- Source gazelles for the reintroduction from Shirvan State Reserve in Azerbaijan
- Conduct a wild-to-wild translocation with release as soon as possible after arrival, subject to quarantine regulations
- Release gazelles first into Vashlovani PA because of its existing protected status
- Consider later releases at other sites, especially Davit Gareji and Chachuna area
- Modify management of the gazelle enclosure to improve pasture quality
- Review management of grazing in VPA and amend as necessary
- Engage local communities fully in the restoration plan
- Develop a post-release monitoring plan
- Develop a comprehensive communications and awareness strategy
- Begin planning for protection of gazelles that disperse outside the reserve

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APPENDIX A: FIELD TRIP REPORT

Restoration of goitered gazelles to Georgia, Field trip report 17-25 April 2012

INTRODUCTION

The aim of the field visit was to make a rapid assessment of potential reintroduction sites for goitered gazelles within its former distribution in Georgia. Participants were: Gareth Goldthorpe (FFI), Bejan Lortkipanidze (NACRES), David Mallon (IUCN Antelope Specialist Group), Irakli Shavgulidze (NACRES), Tim Woodfine (Marwell Wildlife).

The results of the field trip and all aspects of the gazelle restoration project were discussed with Tamar Pataridze (Deputy Head, Agency for Protected Areas), Ioseb Kartsivadze Head, (Biodiversity Services), Nugzar Zazanashvii (WWF-Caucasus Project Office), Zurab Gurielidze (Ilia University and Director of Tbilisi Zoo), Merab Pirosmanashvili (Director, Vashlovani PA).

The principal sites visited on two separate visits were: (1) Vashlovani PA, Samukhi, Chachuna Managed Reserve and (2) Davit Garjei and the NW Iori Plateau. Driving to, from and between these sites provided the opportunity to assess connectivity between them and an overview of the wider landscape (Fig. 1).

RESULTS

Site reports

<u>Vashlovani PA</u>
This is the largest protected area within the former distribution of goitered gazelles in Georgia and has been selected as the initial release site since it is the only site with legal protection, staff, and infrastructure. VPA covers 34,753 ha and is zoned into two sectors: Strict NR (IUCN Category I; 10,143 ha) and National Park (IUCN Category II; 24,610 ha).

VPA protects a mosaic of habitats, including steppe and semidesert vegetation. The most extensive areas of grassland, Boegi Moedani, where the gazelle breeding enclosure has been constructed, and Gumuru Maidani below it are located on the eastern side of the reserve at the head of Gumuru valley. This valley provides a connection to the Samukhi steppes (see below).

Extensive tracts of grassland are dominated by *Botriochloa ischaemum* which exceeds 1 m in height in places. The sward is patchy and rank in places, reflecting different levels of grazing intensity and much of it is undergrazed. Other areas are dominated by *Stipa* spp. and are more herb-rich.

Above Boegi Moedani is light woodland which offers some further habitat and a strip of excellent grassland runs along the ridge immediately adjoining the reserve. This has a short, even sward with 75-80% vegetation cover and varied composition of grasses, including *Stipa,* and herbs.

<u>Gazelle enclosure</u>
The breeding enclosure covers approximately 5 ha and was constructed with the financial support of USAID/DOI. The fence has an overhang to prevent predators from climbing in and is dug into the ground to prevent them burrowing under it. An electric fence around the enclosure provides further security (supplied by photovoltaic systems donated by the Georgian Carnivore Conservation Project (EU/FFI/NACRES). A small shelter provides shade. There is a temporary ranger post adjacent and a permanent building for rangers and for veterinary use is under construction with funds from EU and GIZ.

Eleven gazelles were brought from Ceylanpinar breeding centre in SE Turkey in 2010. Although young have been born, the gazelle numbers have decreased and only six remained by April 2012 (one adult male, one subadult male and four females). Young animals that were born in 2011 died after a few months due to unknown causes. This lack of breeding success is surprising because gazelles have regularly demonstrated the capacity to increase in number rapidly when protected.

A major factor, if not the main cause, is probably suboptimal habitat and lack of good forage. Vegetation inside the enclosure is dominated by *Botriochloa ischaemum* which has grown long (over 1 m in places) and rank. At several points, fallen tussocks cover the ground with a heavy mat of dead grass litter, suppressing the emergence of new growth. Rangers have cut the grass by hand in the upper part of the enclosure, close to the gate and green growth of grass and herbs is visible in these areas, but the area cut is small due to the amount of effort involved. The long grass also facilitates the build-up of ticks which can have an adverse effect, especially on new-born animals which hide for several days before they start to move around. In fact, one young gazelle was recently found dead with a heavy infestation of ticks.

A second possible factor is cold weather: winter 2011-2012 was much more severe than usual with very low temperatures and prolonged snow lie. The enclosure site is also somewhat exposed (it was selected to take advantage of breezes to reduce exposure to summer heat and biting flies).

There has been some concern over the other low genetic variability of the Ceylanpinar animals: the population had only four founders, 1 male and 3 females in 1968, though these had increased to 1530 by 2010 (Durmuş 2010).

Changes to the management of the enclosure are urgently needed to reduce the extent of coarse grass, remove the accumulated litter and promote fresh growth of palatable grasses and herbs. There are three standard management options, cutting, grazing or burning.

Cutting: preferably the whole area, but at least to create extensive cleared patches. It is best done using a powered mower or mechanical strimmers. If this equipment is not available, hand-cutting should be carried out more extensively than to date, using additional local labour. The cut material needs to be removed and preferably burned.

Grazing: Introducing a large number of livestock for a short period to graze the sward heavily may work, but the coarse grass litter is unlikely to be very palatable.

Burning: Controlled burning in patches is a safe option if carried out with care and would remove the litter and dead material effectively. Ad hoc burning is used by shepherds across the region to produce a flush of new growth, though it is banned in the strict nature reserve.

<u>Samukhi (Eldari steppe)</u>

This is a wide strip of low steppe lying between VPA and the border with Azerbaijan. The vegetation is mainly dominated by *Artemisia.* Several winter farms are located here and it appears to be quite heavily grazed, but not overgrazed and fresh green growth of several species of grasses and herbs was visible. It offers an extensive area of suitable gazelle habitat and is connected by Gumuru valley to Boegi Moedani so is important as a potential dispersal site and one of the first places gazelles can be expected to move to.

<u>Iori Plateau</u>

Immediately west of Samukhi lies a small area of low hills that contain short, diverse grassland with a range of grasses and herbs that provides excellent gazelle habitat. Beyond, level steppe continues north-westwards, similar in character to Samukhi, with *Artemisia* and grass-dominated vegetation communities. Grazing intensity also increases: the sward is short, there are multiple sheep and goat tracks parallel to the road, and shrubs have been clearly bitten-off. This may reflect restricted access to water and regular movement of many flocks to reach the river.

<u>Chachuna Managed Reserve</u>

An IUCN Category IV reserve (5200 ha) that protects a strip of riverine forest along the Iori river. There is a permanent ranger base and an observation tower. The rangeland immediately surrounding is heavily grazed, but condition (sward height and species composition) improves as one ascends the slope away from the lower zone. The upper section of the escarpment is quite broken, with patches of dry woodland and scrub and is much richer. Chachuna has potential as a reintroduction site: there is full habitat connectivity to Vashlovani and also to the NW and extensive habitat exists across the top of the escarpment, but a disadvantage may be that the rangers do not have any authority outside the current boundaries of the reserve which does not include extensive steppe habitats, and those outside are heavily grazed. Two other managed reserves that protect riverine forest are located higher up the Iori Valley: Korugi (2068 ha) and Iori (1336 ha).

Chachuna Reservoir
Suitable habitat continues up the Iori valley from Chacuhna MR to Chachuna Reservoir. Extensive steppes and dry hills extend from the western side of the reservoir to the border with Azerbaijan and are in good condition. The site has some potential as a release site, but suffers from the disadvantage of its proximity to the border, and that gazelles could easily move over the ridge into Azeri territory. It has no official protected status but the presence of a Border Police post may provide a future basis for protection.

Davit Gareji
This site lies at the NW end of the semi-arid zone and around a set of ancient monasteries. The terrain is more hilly than elsewhere, but an extensive area of suitable gazelle habitat is present. No data on livestock numbers are available, but density appeared to be relatively low. The adjoining NW end of the Iori Plateau consists of undulating steppe with good quality grassland; several patches here had been cut for hay.

The road between Chachuna and Davit Gareji is in poor condition making direct access difficult and time-consuming so the site was approached directly from the north. However, there are no physical barriers to gazelle movement between here and Chachuna and the lack of easy access would in fact represent an advantage.

Davit Gareji has good potential as a future release site although it has no official reserve or legal status at the moment. However, the monks and church authorities maintain a no-hunting zone around the central monasteries and this raises the possibility of engaging the Georgian Church directly in a future stage of the restoration programme. The combination of reintroduced gazelles and the existing cultural and tourist interest is an attractive prospect.

Grazing
Vashlovani and the other sites are grazed year-round by cattle. In winter these are supplemented by large numbers of sheep and goats form Tusheti and Javakheti (western sites). Shepherds arrive in October and return to the mountains in late April-early May, depending on the conditions. The number of Tushetian families and livestock using the area has increased since 1990-1991 when their former winter pastures on the northern side of the Caucasus became inaccessible after the break-up of the Soviet Union. Cattle do not compete directly with gazelles, which are more selective feeders and their continued presence in and around Vashlovani is essential in helping to maintain pasture condition. Sheep and goats also provide an important grazing function in winter but their numbers are much higher and they do compete with gazelles. The seasonal grazing pattern is of key importance in maintaining rangeland quality, as during the whole growing season it is only lightly grazed by cattle, allowing plants to flower and set seed and maintaining species-diverse vegetation communities.

Conclusions
All sites visited lie in the SW section of the Iori Plateau/Shiraki steppes between the crest of the escarpment and the Azeri border. This forms a strip of contiguous grass and *Artemisia* dominated steppe habitats, containing no natural or man-made barriers and with full connectivity between sites, providing c. 2000 km^2 of suitable gazelle habitat (Fig. 2). Vashlovani PA is the obvious choice as for the initial reintroduction because of its existing protected status, but other potential sites were identified, especially Davit Gareji and the Chachuna area. Future releases in these sites would facilitate colonization of the whole area by gazelles. Planning the restoration programme in the context of this whole 'Vashlovani-Iori Plateau Landscape' would provide a useful long-term perspective.

The adjacent section of the Iori Plateau to the NW of the escarpment also contains tracts of suitable gazelle habitat although there are also some fields here and the fringes are more developed. The Jeyranchel steppes lie adjacent on the Azeri side of the border, offering a further extensive area of habitat.

There is very strong institutional support for the gazelle restoration programme among government agencies and NGOs and implementing this would contribute significantly to national and regional biodiversity targets.

PHOTOGRAPHS

Photo 1. *Botriochloa* steppes on Boegi Moedani

Photo 2. Short-grass steppes on Boegi Maidani

Photo 3. Grassland on the ridge near Vashlovani ranger Station

Photo 4. Samukhi steppes

Photo 5. Iori Plateau, NW of Samukhi

Photo 6. Chachuna

Photo 7. Steppes west of Chachuna Reservoir

Photo 8. Near Davit Gareji

Photo 9. NW Iori plateau

APPENDIX B: POPULATION MODELLING PARAMETERS

Table A1. Parameters for the release model

Parameter	Value
Model definitions	
Replications	500
Years	100-years
Extinction definition	Only one sex remains
Inbreeding	
Inbreeding depression (Lethal equivalents) *	6.16
% *LE* due to recessive alleles	50
Reproduction	
Breeding system	Polyganous
Maximum age of reproduction (and lifespan)	10-years
Minimum female breeding age	2-years
Minimum male breeding age	2-years
Maximum number of broods per year	1
Distribution of broods per year: 1 brood	100%
Maximum number of progeny per brood:	2
litter size of 1	25%
litter size of 2	75%
Sex ratio at birth (% males)	1:1
Density dependent reproduction	Yes
% of females breeding †	=(86-((86-46)*((N/K)^1)))*(N/(0+N))
Environmental variation in % of females breeding	5
% males in the breeding pool	33%
Mortality	
Female mortality	
Mean mortality 0 – 1 years	14
SD due to environmental variation 0 – 1 years	5
Mean mortality 1 – 2 years	10
SD due to environmental variation 1 – 2 years	5
Mean mortality >2 years	10
SD due to environmental variation >2 years	5
Male mortality	
Mean mortality 0 – 1 years	14
SD due to environmental variation 0 – 1 years	5
Mean mortality 1 – 2 years	10
SD due to environmental variation 1 – 2 years	5
Mean mortality >2 years	10
SD due to environmental variation >2 years	5
Environmental stochasticity	
Environmental variation of survival & reproduction	Concordant

Table A.1 continued

Parameter	Value
Catastrophes	
Type of catastrophes	
Catastrophe 1:	Severe winter
Global/local	Global
Frequency %	7%
Severity on reproduction	0
Severity on survival	8
Catastrophe 2:	Disease outbreak
Global/local	Global
Frequency %	10%
Severity reproduction	0
Severity survival	8
Carrying capacity (*K*)	
Carrying capacity	753
SD in K due to environmental variation	5
Future change in K	N/A
Initial population size	
Population size	10:10 (except for 10 founder scenario)
Age	5-years old
Population harvest & supplementation	
Harvest	Variable between scenarios
First year of harvest	6
Last year of harvest	100
Interval between harvests	1-year
Number of females to be harvested	Variable between scenarios
Age 1 year	0
Age 2 year	0
Adult	variable
Number of males to be harvested	Variable between scenarios
Age 1	0
Age 2	0
Age 3	0
Adult	variable
Optional criterion for harvest (density dependent)	
Population supplementation	Yes variable between scenarios
Breeding plan	
Breed to maintain population at *K*	No
Prevent matings with *F* greater than	No
Pair according to mean kinships	No
Using a dynamic MK list	No
Number of times to try and find a mate	10
Maximum number of females to one male	9

Note: the population was truncated (for each sex and for each age class) once the carrying capacity was reached, and density-dependent reproduction was included in the model. However, other populations e.g. *Gazella subgutturosa marica and Gazella subgutturosa subgutturosa* with limited dispersal options have crashed once the carrying capacity has been exceeded (Zafar-ul Islam 2010; Cunningham *et al.* 2008; Pereladova *et al.* 1998). This has not been incorporated into this model because of dispersal is likely to be an option, but adaptive management may be required to prevent the population from crashing when the population approaches the ecological carrying capacity

Table A2. The different scenarios included in the population viability analysis for goitered gazelle in Vashlovani National Park

Scenario name	Description
10 Founders	10 founders in year 1, no supplementation. 10 founders in total
20 Founders	20 founders in year 1, no supplementation. 20 founders in total
40 Founders	20 founders in year 1 and 20 in year two. 40 founders in total
60 Founders	20 founders in year 1 and 20 in each of years 2 and 3. 60 founders in total
80 Founders	20 founders in year 1 and 20 in each of years 2, 3 and 4. 80 founders in total
100 Founders	20 founders in year 1 and 20 in each of years two, three, four and five. 100 founders in total
1-year supplementation	100 founders in year 1
2-year supplementation	50 founders in year 1 and 50 in year two
3-year supplementation	30 founders in year 1 and 35 founders in each of year 2 and 3
4-year supplementation	25 founders in year 1 and 25 founders in each of years 2, 3 and 4
5-year supplementation	20 founders in year 1 and 20 founders in each of years 2, 3, 4 and 5
10 initial Founders	10 founders in year 1, no supplementation. 10 founders in total
20 initial Founders	20 founders in year 1, no supplementation. 20 founders in total
40 initial Founders	40 founders in year 1, no supplementation. 40 founders in total
60 initial Founders	60 founders in year 1, no supplementation. 60 founders in total
80 initial Founders	80 founders in year 1, no supplementation. 80 founders in total
100 initial Founders	100 founders in year 1, no supplementation. 100 founders in total
No harvest	100 founders over 5 years (20 per annum)
10:10 Year 6	100 founders over 5 years (20 per annum). 10:10 individuals harvested per annum from year 6 -100
20 females Year 6	100 founders over 5 years (20 per annum). 0:20 individuals harvested per annum from year 6 - 100
20 males Year 6	100 founders over 5 years (20 per annum). 20:0 individuals harvested per annum from year 6 - 100
15:15 Year 6	100 founders over 5 years (20 per annum). 15:15 individuals harvested per annum from year 6 - 100
30 females Year 6	100 founders over 5 years (20 per annum). 0:30 individuals harvested per annum from year 6 - 100
30 males Year 6	100 founders over 5 years (20 per annum). 30:0 individuals harvested per annum from year 6 - 100
20:20 Year 6	100 founders over 5 years (20 per annum). 20:20 individuals harvested per annum from year 6 - 100
40 females Year 6	100 founders over 5 years (20 per annum). 0:40 individuals harvested per annum from year 6 - 100
40 males Year 6	100 founders over 5 years (20 per annum). 40:0 individuals harvested per annum from year 6 - 100
25:25 Year 6	100 founders over 5 years (20 per annum). 25:25 individuals harvested per annum from year 6 - 100
50 females Year 6	100 founders over 5 years (20 per annum). 0:50 individuals harvested per annum from year 6 - 100
50 males Year 6	100 founders over 5 years (20 per annum). 50:0 individuals harvested per annum from year 6 - 100
30:30 Year 6	100 founders over 5 years (20 per annum). 30:30 individuals harvested per

	annum from year 6 - 100
60 females Year 6	100 founders over 5 years (20 per annum). 0:60 individuals harvested per annum from year 6 - 100
60 males Year 6	100 founders over 5 years (20 per annum). 60:0 individuals harvested per annum from year 6 - 100
10:10 Year 10	100 founders over 5 years (20 per annum). 10:10 individuals harvested per annum from year 10 -100
20 females Year 10	100 founders over 5 years (20 per annum). 0:20 individuals harvested per annum from year 10 - 100
20 males Year 10	100 founders over 5 years (20 per annum). 20:0 individuals harvested per annum from year 10 - 100
15:15 Year 10	100 founders over 5 years (20 per annum). 15:15 individuals harvested per annum from year 10 - 100
30 females Year 10	100 founders over 5 years (20 per annum). 0:30 individuals harvested per annum from year 10 - 100
30 males Year 10	100 founders over 5 years (20 per annum). 30:0 individuals harvested per annum from year 10 - 100
20:20 Year 10	100 founders over 5 years (20 per annum). 20:20 individuals harvested per annum from year 10 - 100
40 females Year 10	100 founders over 5 years (20 per annum). 0:40 individuals harvested per annum from year 10 - 100
40 males Year 10	100 founders over 5 years (20 per annum). 40:0 individuals harvested per annum from year 10 - 100
25:25 Year 10	100 founders over 5 years (20 per annum). 25:25 individuals harvested per annum from year 10 - 100
50 females Year 10	100 founders over 5 years (20 per annum). 0:50 individuals harvested per annum from year 10 - 100
50 males Year 10	100 founders over 5 years (20 per annum). 50:0 individuals harvested per annum from year 10 - 100
30:30 Year 10	100 founders over 5 years (20 per annum). 30:30 individuals harvested per annum from year 10 - 100
60 females Year 10	100 founders over 5 years (20 per annum). 0:60 individuals harvested per annum from year 10 - 100
60 males Year 10	100 founders over 5 years (20 per annum). 60:0 individuals harvested per annum from year 10 - 100

Inbreeding
A value of 6.16 lethal equivalents was incorporated into the model. This is the estimated number of lethal equivalents for Speke's gazelle *Gazella spekei* under captive conditions (Ralls, Ballou & Templeton 1988). Ralls et al (1988) also calculated the number of lethal equivalents for dorcas gazelle (the only other gazelle species included in the analysis) which was 3.7 lethal equivalents, but as inbreeding depression is thought to be more severe under more stressful wild conditions (Frankham 2010b; Frankham 2010a), the higher estimate for Speke's gazelle was used. The number of lethal equivalents included in a model are known to impact on the viability and sustainability of the population under simulation (Gilbert 2011), but it is not possible to accurately represent this in the model without data on the impact of inbreeding on juvenile mortality for goitered gazelle. Consequently the lethal equivalents value for another species was used.

The default value of 50% inbreeding depression caused by recessive lethals was used to allow some degree of purging of recessive lethals from the population.

Reproduction

Breeding system
Goitered gazelle are polyganous with territorial males maintaining harems of between one and nine females (Blank *et al.* 2012).

Minimum and maximum age of reproduction
Female goitered gazelle become fertile at 18-19 months, but can reach sexual maturity as early as 7 – 8 months if environmental conditions are good and their weight reaches 16kg. Males only reach sexual maturity at 18-19 months (Pereladova *et al.* 1998). An age of 2-years was entered for minimum age at first reproduction for both males and females in the model as this allows the 148 -163 day gestation period to be added onto the 18-month age of sexual maturity. Reproductive lifespan can be up to 10-years (Çobanoglu 2010), although males have shorter lifespans than females.

Broods per year
The social system of the goitered gazelle allows for only one brood per year in the wild despite the relatively short gestation period (Pereladova *et al.* 1998), but up to 75% of adult females produce twins with only young and old females producing a single calf (Cunningham *et al.* 2008; Qiao *et al.* 2011; Pereladova *et al.* 1998). These parameters were included in the model.

Sex ratio at birth
Pereladova *et al*. 1998 report that sex ratio at birth in the Bukhara Breeding Centre in Uzbekistan is approximately 50:50. Similarly, sex ratios for goitered gazelle in Kazakhstan are reported as being equal (Blank *et al.* 2012).

Density dependent reproduction
Pereladova *et al*. (1998) report clear density dependent reproduction in the Bukhara Breeding Centre in Uzbekistan despite the opportunity for dispersal. Annual growth rate decreased substantially when the population approached, and then exceeded, carrying capacity. This was at least partially due to reproduction. The figures provided by Pereladova *et al*. are included in the model as a density dependent function. Milner-Gulland and Lhagvasuren (1998) report a similar level of female fecundity for the Mongolian gazelle (of 87%), but do not report on any density dependent reproduction. The Allee effect was modelled at zero because this has not been quantified for the Mongolian gazelle and because the species preferentially forms very small groups and is polyganous (Kingswood & Blank 1996). A default value of 5% annual variance in reproduction due to environmental variation was included as data were not available to calculate a more precise value.

Percentage of males in the breeding pool
There are no data on the number of males that actually reproduce each year, although harem size is known on average to vary between two and ten. An estimated value of 33% was included in the model on the basis that most harems are probably small.

Mortality rates
There is little data on mortality rates of goitered gazelle in the wild. Çobanoglu (2010) included mortality data for a PVA on goitered gazelle in Turkey based on radio collar data. However, the sample size was very small and the mortality estimates are very high. Milner-Gulland and Lhagvasuren (1998) record age-dependent survival rates for the Mongolian gazelle *Procapra gutturosa* based on larger sample sizes. In Lieu of any other data, these data have been included in this model with the exception adult male mortality was increased to compensate for the shorter lifespans experience by male goitered gazelle.

Environmental stochasticity
Environmental concordance between survival and reproduction was included in the model because goitered gazelle inhabit the same area over the course of the year. Consequently, if environmental condition impact on survival, they are likely to impact on reproduction in a similar way.

Catastrophes
Two catastrophes were included in the model as the literature indicated that disease outbreaks and severe winters were threats to population sustainability of goitered gazelle in the wild .

Severe winters
Severe winter conditions have historically occurred once every 15-20 years equating to a probability of 0.07 (Mallon & Kingswood 2001). There were no data available for the impact of harsh winters on mortality or reproduction in goitered gazelle, but Milner-Gulland and Lhagvasuren (1998) report that severe winters increase mortality in Mongolian gazelle by up to 8%. In lieu of species-specific data, this has been incorporated into the model.

Disease outbreaks
Disease outbreaks were thought to have contributed to the failure of previous goitered gazelle reintroduction projects to Vashlovani National Park, and periodic disease outbreaks have impacted in wild populations of other gazelle species. Data for goitered gazelle were not available, so data from *Procapra gutturosa* were substituted (Milner-Gulland & Lhagvasuren 1998).

Dispersal
Dispersal was not included as only one population was modelled.

Carrying capacity
Reports on population density varies between 0.15 individuals per km² to 23.87 ind/ km² (although this last figure preceded a population crash) (Milner-Gulland & Lhagvasuren 1998; Cunningham *et al.* 2008; Xia *et al.* 2011; Zachos *et al.* 2010; Reading *et al.* 1999; Pereladova *et al.* 1998; Strauss 2005; GEF 2005; Blank *et al.* 2012; Çobanoglu 2010). There density figures were chosen to represent low (3.0/ km²), moderate (7.16/ km²), and high density (12.8/ km²). These figures were applied to release site size as follows in Table 2.

Table A3. Estimated carrying capacities based on low, moderate, and high population densities for each site

Site	Carrying capacity
Vashlovani NP 251 km²	
Low density (3/ km²)	753
Moderate density (7.16/ km²)	1797
High density (12.8/ km²)	3213
Vashlovani Nature Reserve 84.8 km²	
Low density (3/ km²)	255
Moderate density (7.16/ km²)	607
High density (12.8/ km²)	1,085
Total Vashlovani area 336 km²	
Low density (3/ km²)	1,008
Moderate density (7.16/ km²)	2,406
High density (12.8/ km²)	4,301
Core area in Georgia 2000 km²	
Low density (3/ km²)	6,000
Moderate density (7.16/ km²)	14,320
High density (12.8/ km²)	25,600
Whole semi-arid area 10,800 km²	
Low density (3/ km²)	32,400
Moderate density (7.16/ km²)	77,328
High density (12.8/ km²)	138,240

Harvesting
Harvesting was included in different scenarios.

Population supplementation
Population supplementation was included in different scenarios.

APPENDIX C: FOUNDER STRATEGY MODELLING

Founder strategy
Variances in release strategy (the number of animals translocated per annum, the total number of animals translocated, and the number of years over which translocations took place) were simulated using the model parameters in table appendix for the Vashlovani National Park (carrying capacity of *K* = 753).

Summary and recommendation
All of the founder strategies resulted in the population size reaching the carrying capacity for Vashlovani NP (Table B1, Figures B2 & B3). Population growth rate increased as founder number increased, and was higher for founder strategies that released 20 per annum over consecutive years (Figure B3).

The amount of genetic diversity (gene diversity and number of alleles) retained after 100-years increased as founder number increased. More genetic diversity was retained as the number of release-years decreased, with the highest levels of genetic diversity being for 100-founders released in year one (Figures B4 & B5). With the exception of a founding population of 10 (5:5) more than 91% of original founder gene diversity was retained in each scenario, and approximately 96% of gene diversity retained for each of the 100-founders scenarios (all 100 released in year 1 to 20 released per year over five years).

More genetic diversity is retained as founder number increases, there is minimal change in the retention of genetic diversity between all founders being released in one year and over five years, and the growth rate is higher with successive supplementations. We recommend that a regime of releasing 20 (10:10) founders per annum for five years is followed to establish the goitered gazelle population in Vashlovani NP. A population should be able to establish and retain high amounts of genetic diversity with fewer founders, but it is likely that some translocated animals will die and not all will reproduce. Translocating 100 individuals should ensure that enough survive and reproduce to establish a healthy viable population.

Table B1. Population statistics for the different founding regimes

Scenario	PE	N-extant	MedianTE	MeanTE
Annual supplementation				
10 Founders	0.002	745.22	0	16
20 Founders	0	749.07	0	0
40 Founders	0	749.59	0	0
60 Founders	0	750.86	0	0
80 Founders	0	748.48	0	0
100 Founders	0	750.15	0	0
100 founders over 1-5 years				
100 F Yr1	0	750.23	0	0
50&50 F Yr1&2	0	749.35	0	0
3 Yr Supp	0	749.6	0	0
4 Yr Supp	0	749.01	0	0
All founders released in year 1				
10 Founders	0.002	745.22	0	16
20 Founders	0	749.07	0	0
40 initial Founders	0	749.38	0	0
60 initial Founders	0	749.79	0	0
80 initial Founders	0	749.73	0	0
100 initial Founders	0	750.23	0	0

PE: probability of extinction; N-extant: the mean population size after 100-years of the extant populations; Median TE: median time to extinction; Mean TE: mean time to extinction

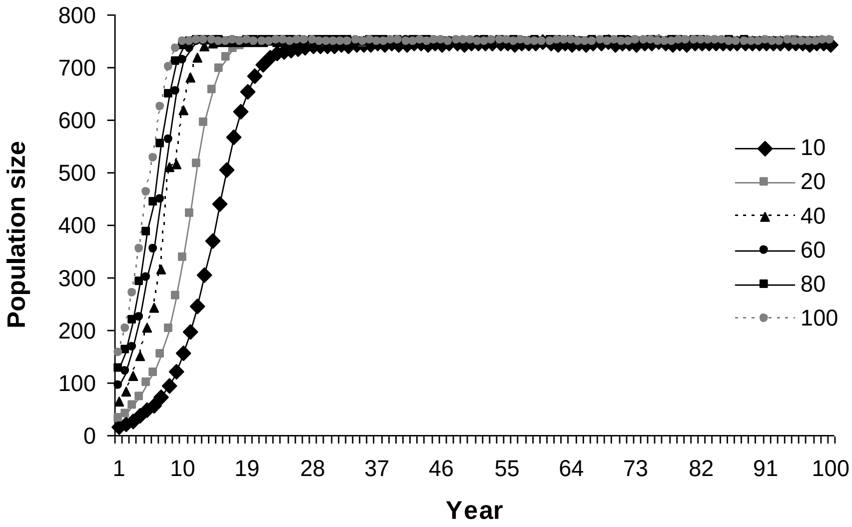


Figure B1. The simulated population size based on the initial number of founders. The release strategy assumes that all founders are released in year one with no further supplementation

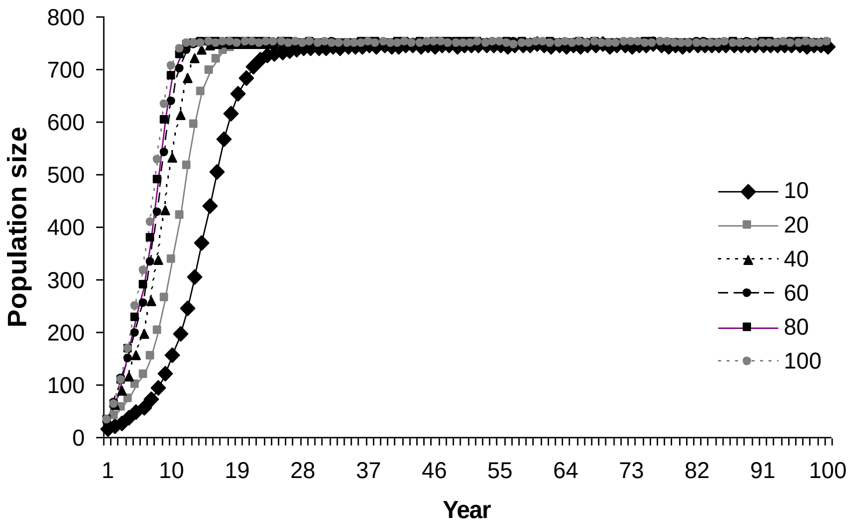


Figure B2. The simulated population size based on the number of founders. The release strategy assumes that the founders are released at a rate of 20 (10:10) individuals per year for one year (20 founders), two years (40 founders), three years (60 founders), four years (80 founders), and five years (100 founders)

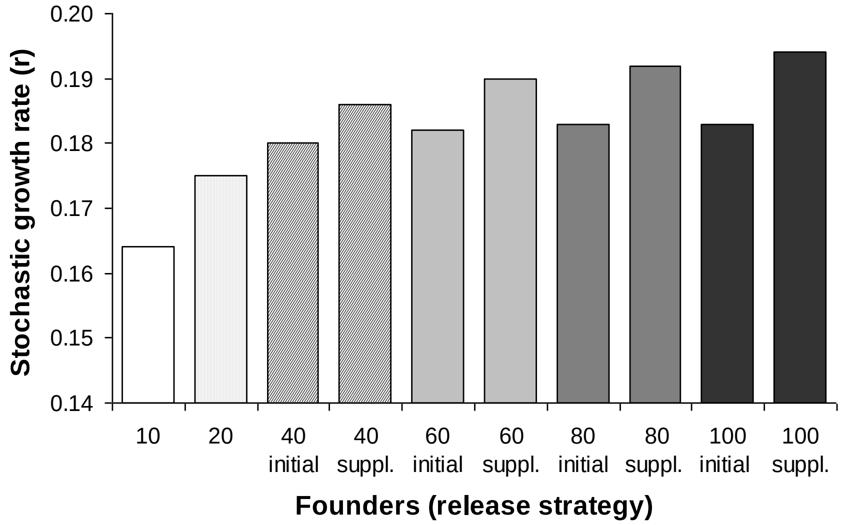


Figure B3. The simulated stochastic population growth rate over the 100-year period for the differing founder release strategy. 'Suppl.' Indicates that the founders were released over 2-5 years at a rate of 20 founders per year. 'Initial' indicates that all founders were released in year one. The overall growth rate is increased under an annual supplementation strategy

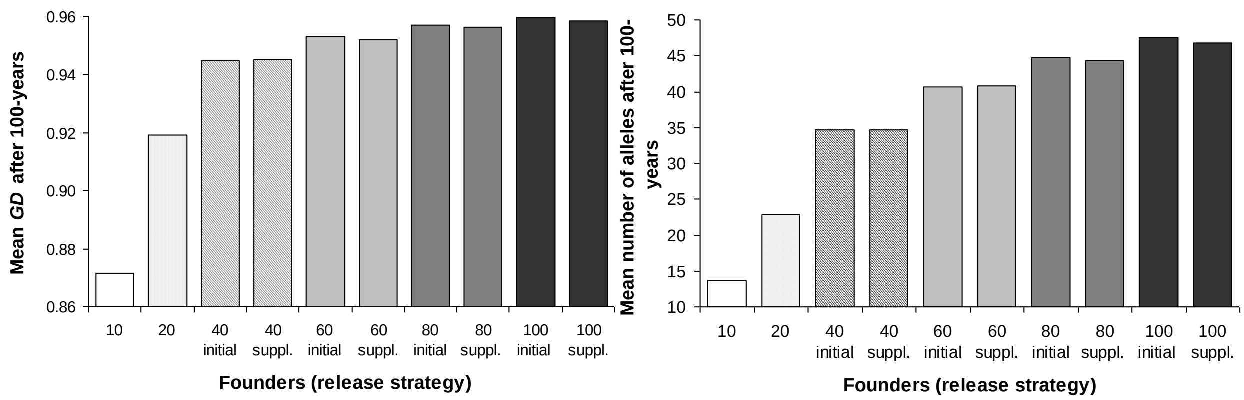


Figure B4. The mean gene diversity and mean number of alleles retained in the population after 100-years for the different founder release strategies. 'Suppl.' Indicates that the founders were released over 2-5 years at a rate of 20 founders per year. 'Initial' indicates that all founders were released in year one.

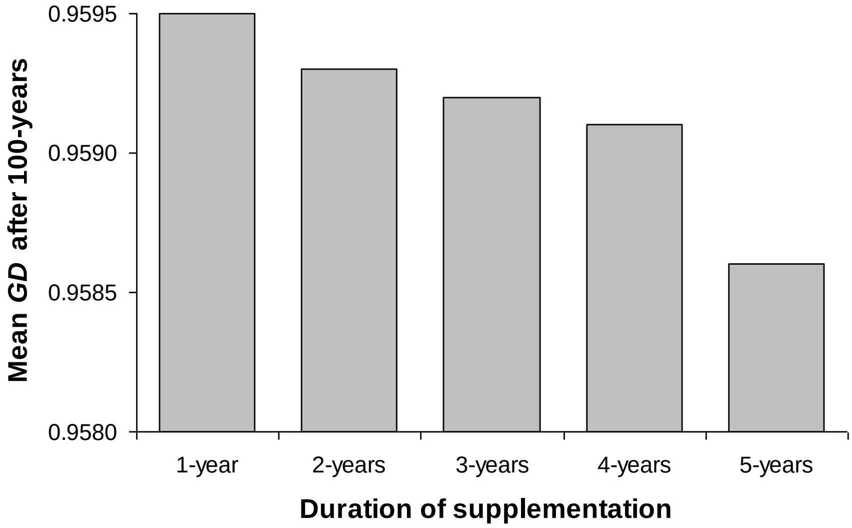


Figure B5. The mean amount of gene diversity retained after 100-years when 100 founders (50:50) are released over a period of 1-5 years.

Harvesting strategy

The harvesting scenarios started harvesting at year six or year 10 and assumed that 20 individuals (10:10) per year were released in years 1-5 resulting in 100 potential founders.

Summary and recommendations

The simulated goitered gazelle population was sensitive to harvesting (hunting or removal for translocation to other locations). A variety of regimes were simulated from the harvesting of 20 to 60 individuals per annum from year six to 100, and then repeated for harvesting from year 10 to 100. Waiting to harvest until year 10 (when the population was close to capacity) resulted in a more stable population with a higher stochastic growth rate, lower probability of extinction, greater predicted retention of genetic diversity (gene diversity and number of alleles), and longer time to extinction for those simulated populations that went extinct. In short, harvesting should be delayed until the reintroduced population is close to the environmental carrying capacity. If the actual goitered gazelle population grows as quickly as the simulated population then it could be in as little as 10-years.

Once the population has reached, or nearly reached (~50 individuals) capacity, a sustainable annual harvest could take place. The simulated populations could accommodate an annual harvest of 20:20 (40 in total) gazelles per annum without it impacting on population persistence or population size. If there is no hunting prior to the population reaching capacity then a sustainable harvest could be increased to 25:25. However, a note of caution is needed. This is based only on those parameters incorporated into the model and may not reflect the actual population dynamics of a real population. Whilst some harvesting can be allowed once the population has established it should be carefully monitored and hunting allowances adjusted if the population fails to grow or starts to decline. Whilst the scenarios incorporate harvesting from year six, or year 10, onwards, it would be prudent to prevent hunting until the population has reached capacity rather than a set date. If the real population does not behave in the same way as the simulation, the model will need to be adjusted, and this may impact on the harvesting regime. Data from post-release monitoring should allow the model to be validated or updated.

Table B2: population statistics after 100-years for the different harvesting regimes

Scenario	Year	stoc-r	PE	N-extant	N-all	AlleIN	MedianTE
No harvest		0.194	0	750.15	750.15	46.83	0
10:10	6	0.171	0	744.72	744.72	45.64	0
10:10	10	0.173	0	747.9	747.93	46.28	0
20 females	6	0.141	0.014	737.57	727.25	46.68	0
20 females	10	0.148	0	740.5	740.5	47.43	0
20 males	6	0.192	0	747.54	747.54	44.05	0
20 males	10	0.194	0	748.3	748.32	45.11	0
15:15	6	0.159	0	742.39	742.39	44.46	0
15:15	10	0.162	0	743.1	743.07	45.6	0
30 females	6	0.111	0.422	725	419.05	45.88	0
30 females	10	0.117	0.004	722.9	720	47.2	0
30 males	6	0.192	0	748.88	748.88	42.05	0
30 males	10	0.192	0	748.1	748.05	43.17	0
20:20	6	0.145	0.01	740.55	733.14	43.82	0
20:20	10	0.151	0	741.2	741.2	45.34	0
40 females	6	0.137	0.97	620.73	18.9	44.27	13
40 females	10	0.081	0.768	613.6	146.23	45.62	70
40 males	6	0.192	0.036	746.84	719.95	40.1	0
40 males	10	0.193	0	748	747.98	42.1	0
25:25	6	0.131	0.07	734.24	682.84	41.83	0
25:25	10	0.14	0	734.6	734.63	44.92	0
50 females	6	0.223	1	0	0	0	10
50 females	10	0.113	1	0	0	0	29
50 males	6	0.193	0.264	747.79	550.37	38.23	0
50 males	10	0.192	0	748	748	40.18	0
30:30	6	0.114	0.28	729.86	525.5	40.79	0
30:30	10	0.129	0	726.6	726.6	44.28	0
60 females	6	0.259	1	0	0	0	9
60 females	10	0.146	1	0	0	0	23
60 males	6	0.198	0.566	744.38	323.06	36.41	12
60 males	10	0.191	0.002	744.4	742.95	38.5	0

Stoch-r: stochastic growth rate; PE: probability of extinction; N-extant: the mean population size after 100-years of the extant populations; N-all: the mean population size after 100-years for all the populations; AlleIN: the mean number of alleles after 100-years; Median TE: median time to extinction

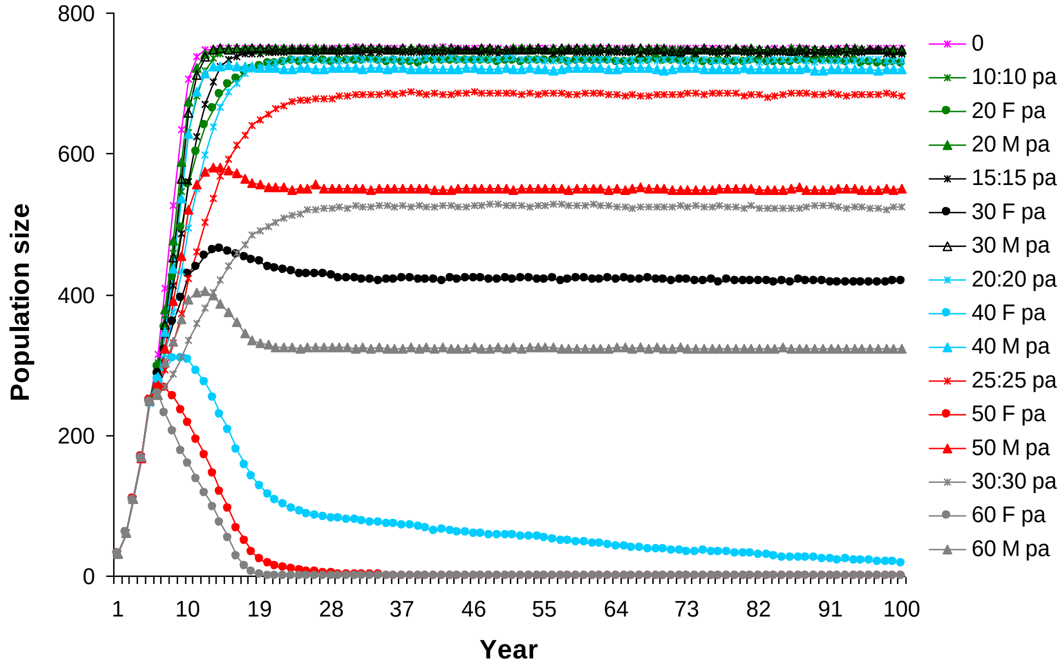


Figure B6. The simulated population size under the differing harvesting regimes from year 6 to 100 (inclusive). See table 2

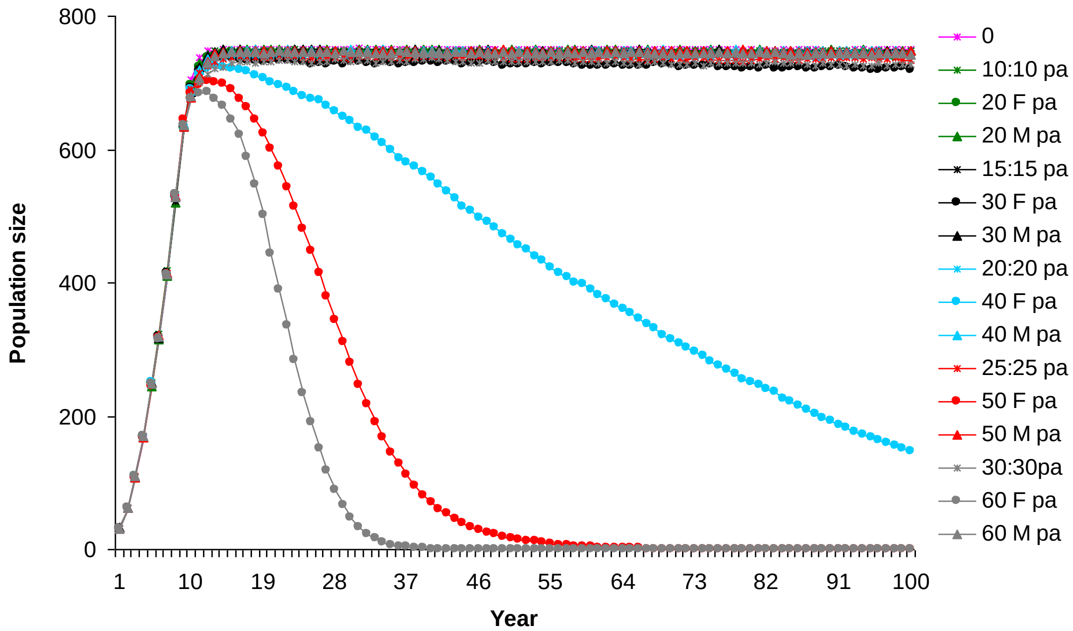


Figure B7. The simulated population size under the differing harvesting regimes from year 10 to 100 (inclusive). See table 2

Table B3. the Key for Figures B6 & B7

Key	Description
0	No harvesting of individuals
10:10	10 females and 10 males harvested per annum
20 F pa	20 females are harvested per annum
20 M pa	20 males are harvested per annum
15:15	15 females and 15 males harvested per annum
30 F pa	30 females are harvested per annum
30 M pa	30 males are harvested per annum
20:20	20 females and 20 males harvested per annum
40 F pa	40 females are harvested per annum
40 M pa	40 males are harvested per annum
25:25	25 females and 25 males harvested per annum
50 F pa	50 females are harvested per annum
50 M pa	50 males are harvested per annum
30:30	30 females and 30 males harvested per annum
60 F pa	60 females are harvested per annum
60 M pa	60 males are harvested per annum

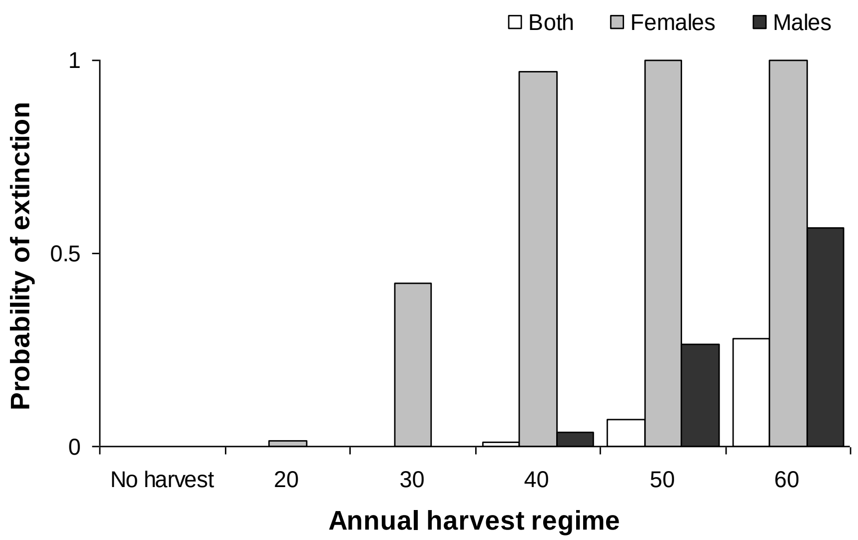


Figure B8. The probability of population extinction after 100-years for the differing harvesting regimes when an annual harvest takes place from year six

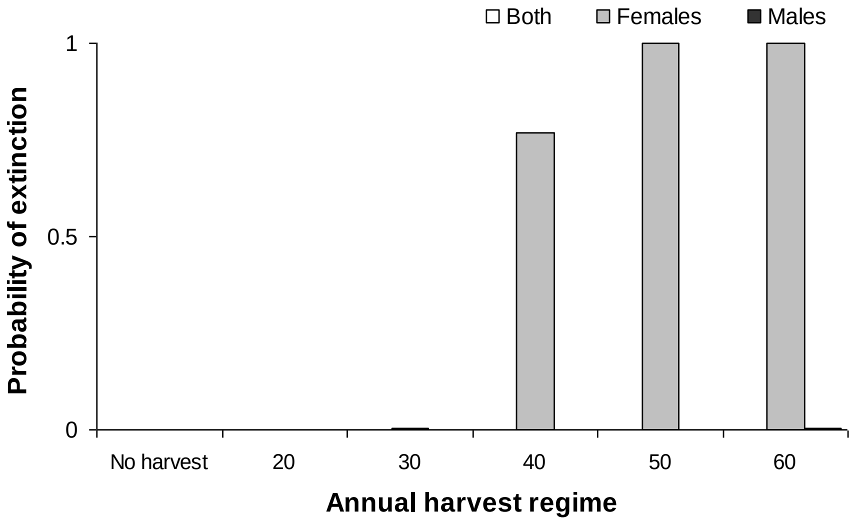


Figure B9. The probability of population extinction after 100-years for the differing harvesting regimes when an annual harvest takes place from year ten

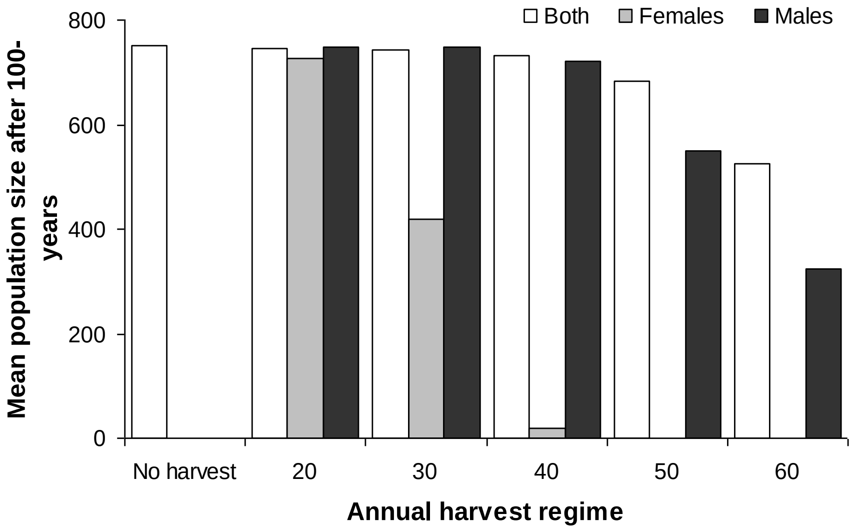


Figure B10. The simulated mean population size after 100-years for the different harvesting regimes when harvesting takes place from year six

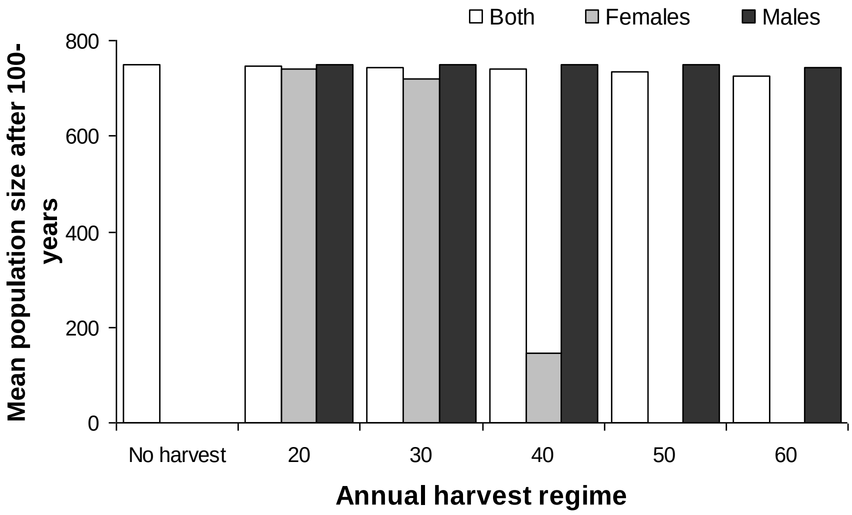


Figure B11. The simulated mean population size after 100-years for the different harvesting regimes when harvesting takes place from year ten

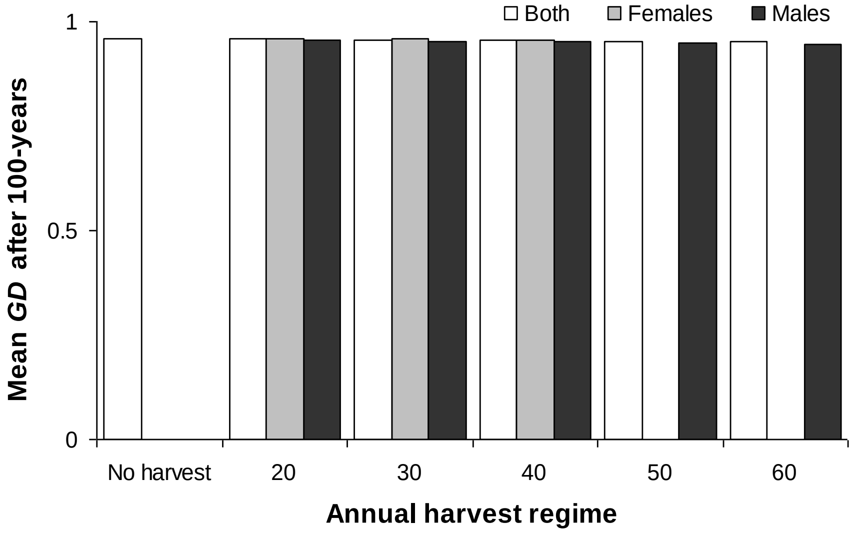


Figure B12. The simulated mean gene diversity after 100-years for the different harvesting regimes when harvesting takes place from year six

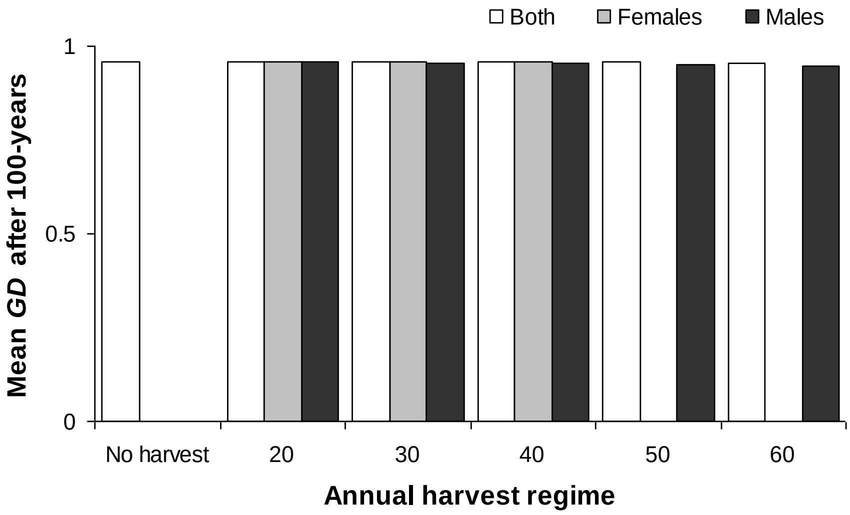


Figure B13. The simulated mean gene diversity after 100-years for the different harvesting regimes when harvesting takes place from year ten

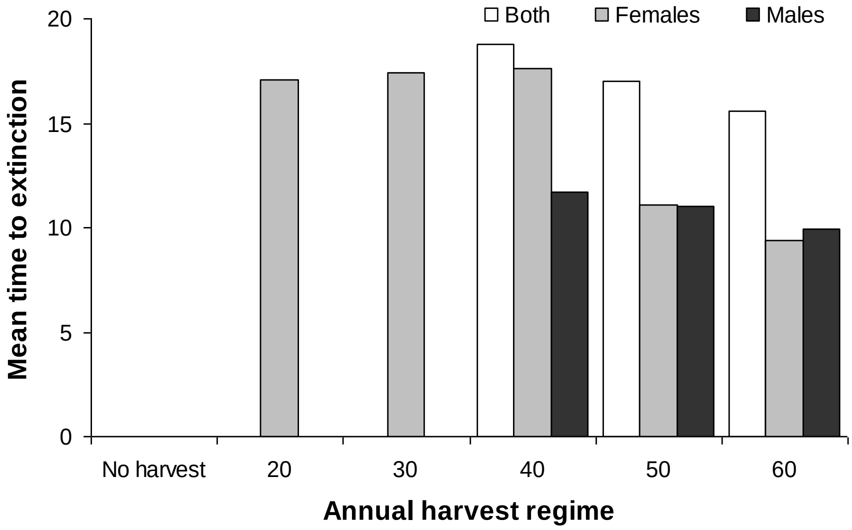


Figure B14. The simulated mean time to extinction (for those simulations that went extinct) for the different harvesting regimes when harvesting takes place from year six

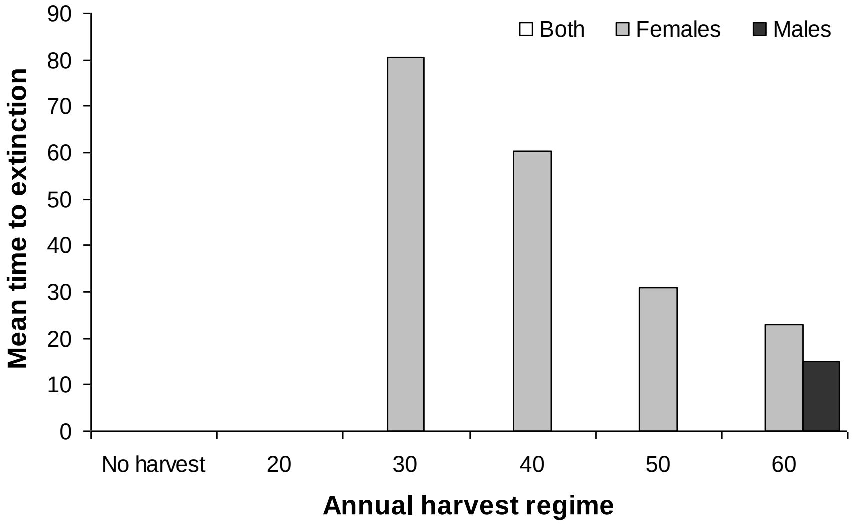


Figure B15. The simulated mean time to extinction (for those simulations that went extinct) for the different harvesting regimes when harvesting takes place from year ten

APPENDIX D: VETERINARY & RELATED DATA COLLECTION & SAMPLING PROTOCOLS

Name of recorder:……..

Capture Date:………

Site:……………….………

GPS Location (UTM):…….

Map Grid reference:……..

Social status at capture: In a group ☐ periphery of group ☐ Solitary ☐

Were any other gazelles captured from the same group? Yes ☐ No ☐

Age class: **Adult** ☐ **Juvenile** ☐ **Calf** ☐

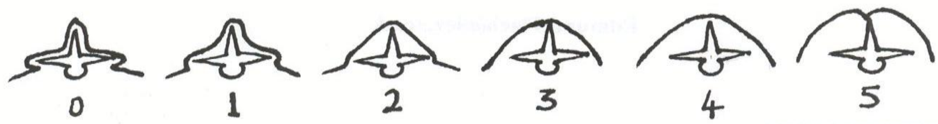
Sex: **Male** ☐ **Female** ☐

If female: **Pregnant** ☐ **Lactating** ☐ **With calf** ☐

Horn development: **Fully** ☐ **Partial** ☐ **None** ☐

Body condition

The body condition is assessed over the lumbar spine **whilst the animal is standing**. Please circle the body condition score (1-5) for the gazelle:



The number of ribs showing is assessed **whilst the animal is standing**. Please indicate whether full ribs, half ribs or no ribs (well covered) are showing.

Additional Notes (e.g. unique markings, injuries, health problems):

Blood or tissue sample collected for DNA analysis? **Yes** ☐ **No** ☐

Blood collected for health screening? **Yes** ☐ **No** ☐

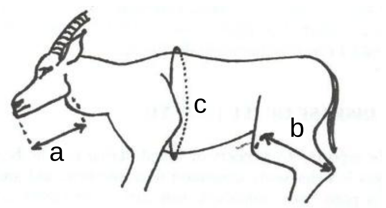
External parasites observed? **Yes** ☐ **No** ☐

If yes, the number and location of ticks:………………………………………………………………………………………

If yes, the number and location of lice:……………………………………………………………………………………….

Faecal sample taken? **Yes** ☐ **No** ☐

Morphology measurements (only if the animal is sedated)
Morphological measurements are used as a guide to growth and condition. Please measure the length of the horizontal ramus of the **left** mandible (a) and the length from the dorsal aspect of the flexed left stifle to the plantar aspect of the flexed hock (stiflehock) (b), and the thoracic circumference immediately caudal to the elbows (girth) (c).



Parameter	Measurement in cm
Left mandible (a)	
Left stifle-hock (b)	
Girth (c)	
Weight (kg)	

<u>Identification</u>

Unique identification number:………………………………………………………………………………………….

Ear tag colour: left:…………………………………………………right:…………………………………………………………….

Ear tag number: left:……………………………………………. right:…………………………………………………………

Microchip make and number:……………………………………………………………………………………………….

Microchip location:……….

Radio/GPS collar number:…….

Radio collar frequency:……….

Photographs taken (face and whole animal): **Yes** ☐ **No** ☐

Blood Collection & Tissue Sampling Protocol for DNA Analysis
Please label each tube clearly with the unique identification number, ear tag and microchip number, sex, and collection date. Tissue collection tubes containing ethanol should be labelled in pencil.

1. **Tissue samples (ear clip/skin biopsy/post mortem muscle):**
   Place a small piece of tissue (1 cm^3) in a screw cap tube containing 70-80% ethanol. Store in fridge.

2. **Blood samples:**
   Collect 2 - 4 ml whole blood into EDTA tubes. Store in fridge, do not freeze.

Parasite Sampling Protocol
Please label all samples with the unique identification number, sex of the animal, and collection date.

Ectoparasites
Carry out a visual inspection to detect living ectoparasites (ticks, lice, fleas) and dermal wounds (mites).

1. Inspect the whole animal as different parasite species can be found in different parts of the body. Pay particular attention to specific areas such as the nose, ears, and under the tail
2. If living parasites are found, pick them up and preserve them in 70% ethanol for further identification. Each collection tube should be labelled with the host unique identification number, location that the parasite was found, and the collection date.
3. If skin wounds are found, scrape each wound with a scalpel onto a glass slide and cover with a second glass slide sealing it with either clear tape or clingfilm. Send the sample to the laboratory for acari[1] identification. Label the slide with the unique identification number, sex, location of the wound, collection date. If there are several wounds, take a sample of each of them using a fresh slide and scalpel for each wound.

Gastrointestinal parasites (faeces)
Collect faeces from the rectal cavity and send the faeces to a laboratory to perform the following analyses. If possible analyses should be performed on fresh faeces:

1. Coprology to detect and count gastrointestinal parasites.
2. Staining to detect *Criptosporidium* oocysts and *Giardia* cysts.
3. Inmunological tests (e.g. ELISA) to detect *Giardia* and *Cryptosporidium* eggs in faeces.
4. Coprology by means of sedimentation to detect trematode eggs.
5. Detection of broncopulmonar larvae using the larval migration technique.

Blood parasites (blood and serum):
Extract ~15 ml of blood for detection of *Babesia spp*., *Theileria spp*., *Trypanosoma spp*. and *Schistosoma spp*., and place in a heparin-coated tube. Label the tube with studbook number and date. Send the samples to the laboratory for analysis.

[1]Acari: small mites less than 1mm in length. These are not identifiable by the naked eye and wounds should be scraped, and samples analysed in a laboratory to identify presence and species.

APPENDIX E: ANIMAL MANAGEMENT FACILITIES

Short-term reception facilities suitable for a short period of quarantine may be needed to manage the gazelles on arrival based on recommended specifications below. The facilities should include five (5mx10m) reception pens, two (2mx2m) intensive management pens as a contingency for animals requiring veterinary treatment, and a pre-release enclosure (approx. 5ha) making use of the existing infrastructure in Vashlovani NP. The facilities are designed to cope with the recommended translocation of 25 gazelles of approximately equal sex ratio and the social structure of this particular species.

During the spring, goitered gazelles should be tolerant of each other, but a flexible approach providing sufficient space and options to separate animals into smaller, single sex groups will be needed. This is achieved with a series of pens with interconnecting gates which should be outward opening and wide enough for a gazelle crate to slide into the opening. Where gates are paired for example between the reception pens, the race way and the 5ha enclosure, hinges should be opposing to allow the gates to form a secure corridor between enclosures. This will necessitate the raceway being the same width as the gates.

Food and water troughs should be placed in the corners of the holding pens to reduce the likelihood of injury to the gazelles as they move. It also helps to 'round-off' the corners. Flaps/small gates should be located by the food and water troughs so that food and water can be provided without entering the pens. Shelters should be located in each pen and orientated to ensure adequate protection against the prevailing wind.

Visual barriers need to be erected along all fence lines between the reception pens and pre-release enclosure. Gazelles may take flight once released from crates and clear visual barriers will reduce the likelihood of them running into a fence. Visual barriers between reception pens will also reduce the likelihood of aggressive interactions between gazelles whilst they wait to be released. Different materials can be used to provide visual barriers, but it should be non-harmful if the gazelle attempt to lick or chew it (so not plastic sheeting for example), and should be secured so it will not catch and billow in the wind and initiate a flight response in the gazelles e.g. canvas is a suitable material, but it needs to be very securely tied down. The materials used to secure it also need to be resistant to chewing by the gazelles e.g. plastic cable-ties would not be suitable, nor would string which gazelles can chew through (resulting in billowing in the canvas).

Fences should be chain-link so that they are strong, but flexible enough if gazelles run in to them, attached to posts positioned at 3m intervals placed externally to each pen to prevent injury. Three straining wires, one 50cm from the top, one in the centre, and the third close to the ground are used to support tension in the fence.

Enclosures need to be predator-resistant, so there should be an over-hang at the top and the fence posts and chain-link should penetrate the ground with a horizontal 'dig-guard' added.

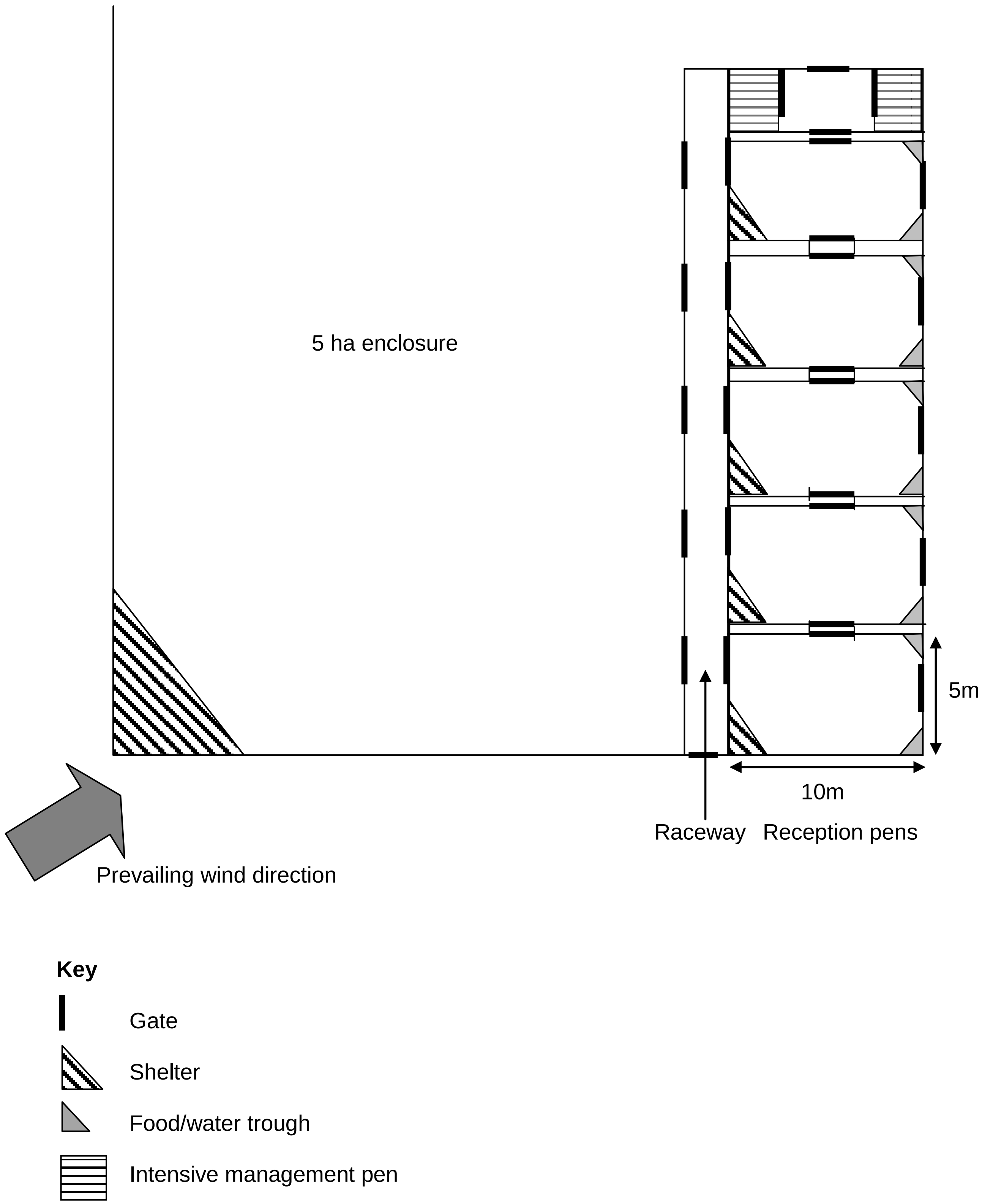


Figure 1: Plan for recommended reception pens, intensive management pens, and 5ha pre-release enclosure.

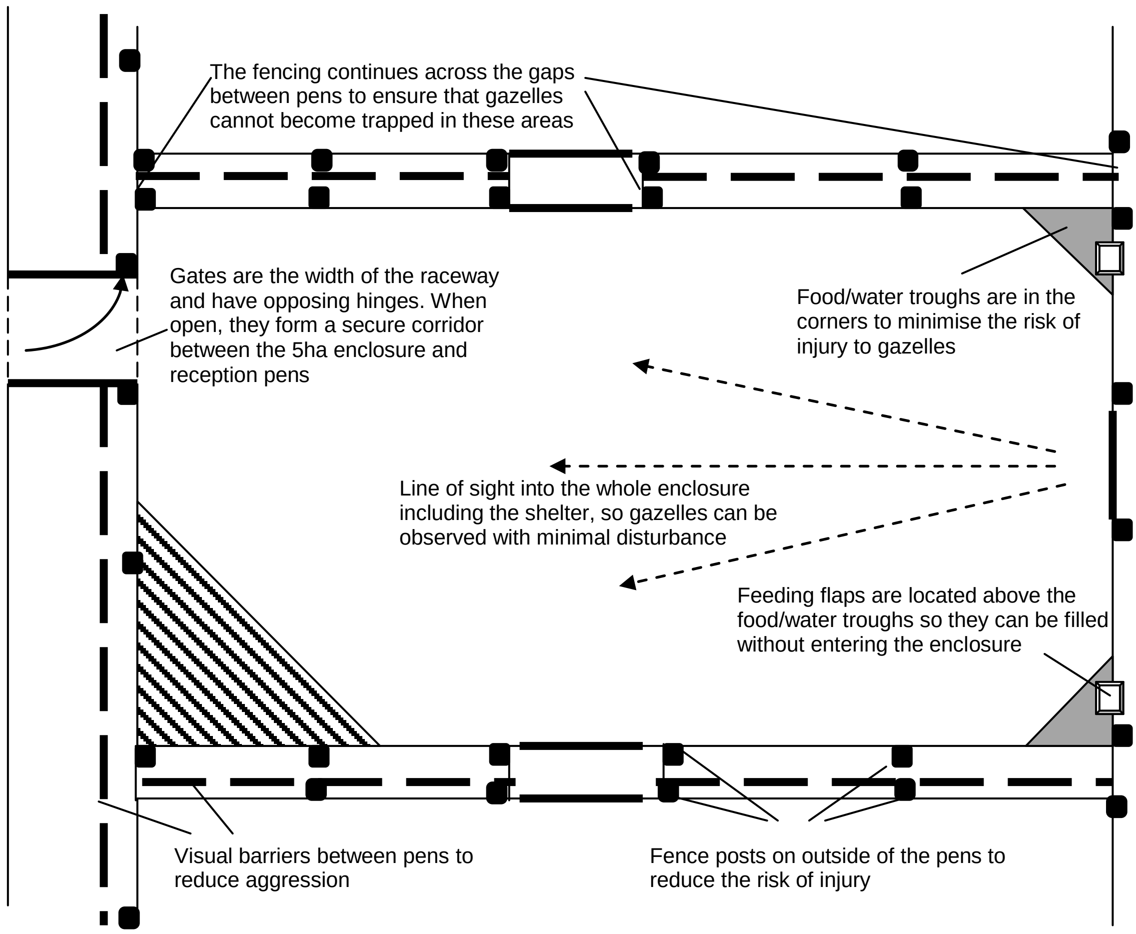


Figure 2: Detailed description of a reception pen.

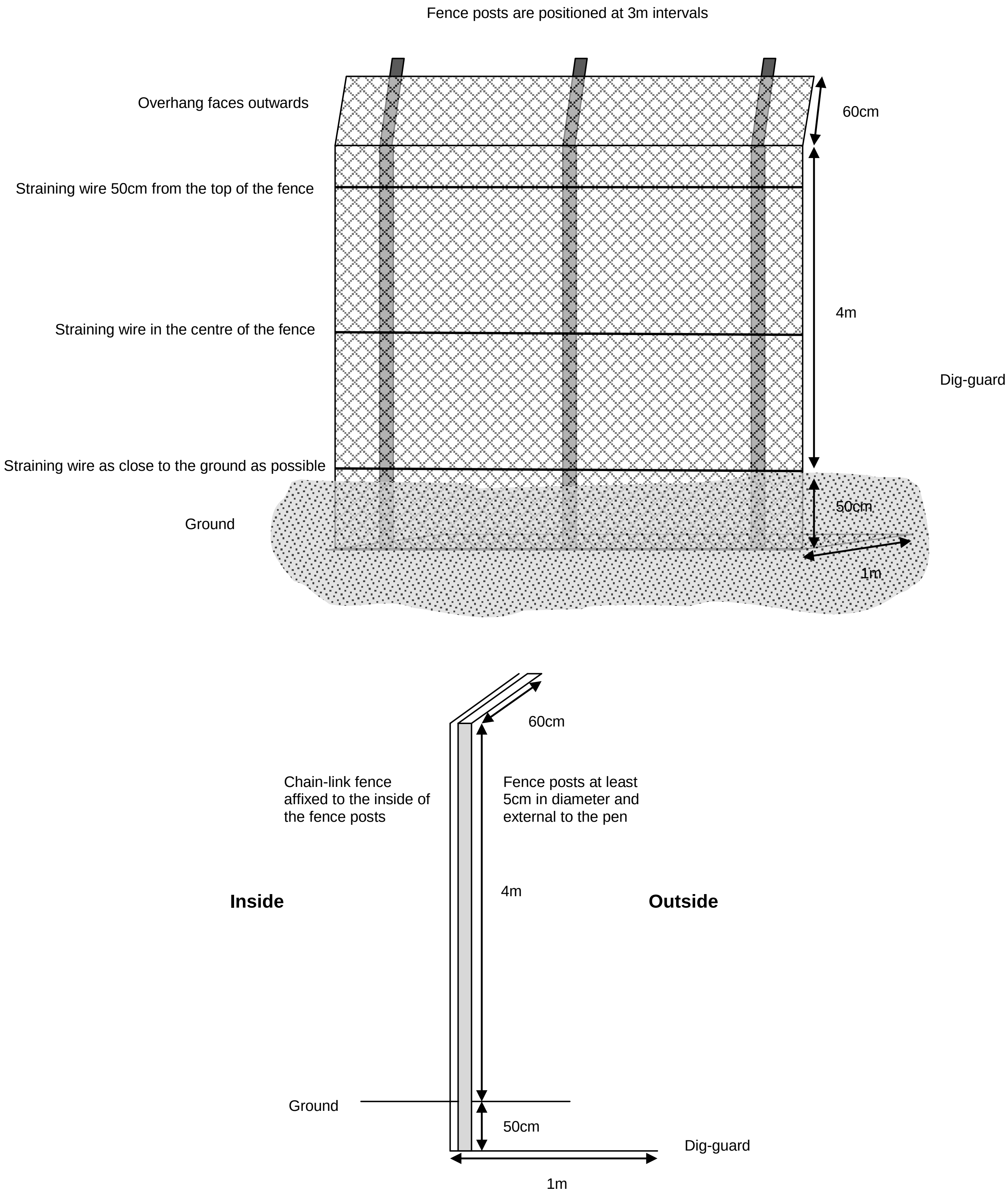


Figure 3: Diagram of recommended fencing (above) and cross section of the fence (below).

APPENDIX F: ACTION PLAN

Agree institutional roles, responsibilities & formal framework for cooperation
Appoint Project Coordinator
Engage Azeri authorities regarding acquisition of gazelles
Consult veterinary authorities regarding health screening & quarantine requirements
Engage pastoralist communities and agree participative plan, and funding requirements
Develop and implement CEPA strategy
Acquire project vehicle, and budget for fuel and maintenance
Acquire monitoring equipment (binocluars, rangefinders, hand-held weather station, GPS, camera, camera-traps)
Furnish & equip fieldwork base to accomodate project personnel
Map vegetation communities
Commence pasture management in VNP
Appoint and if necessary train monitoring personnel
Commence monitoring of livestock & pasture management
Continue monitoring populations of natural predators
Identify ans appoint veterinary and animal husbandry advisors
Undertake veterinary health screening of source population
Identify and appoint translocation operator
Agree technical and practical aspects of capture, transport and animal care
Apply for relevant gazelle export / import permits
Agree process for rapid customs clearance
Appoint and if necessary train animal management personnel
Build or acquire gazelle crates
Acquire veterinary drugs, equipment, and budget for testing and PMs
Prepare or modify existing animal management facilities
Construct additional gazelle reception pens
Maintain large patches of short sward in the 5ha pre-release enclosure
Acquire stock of hay, salt licks and small ruminant feed pellets, plus feed and water troughs
Acquire ear tags, transponders, GPS collars and ancillary equipment
Hire light aircraft