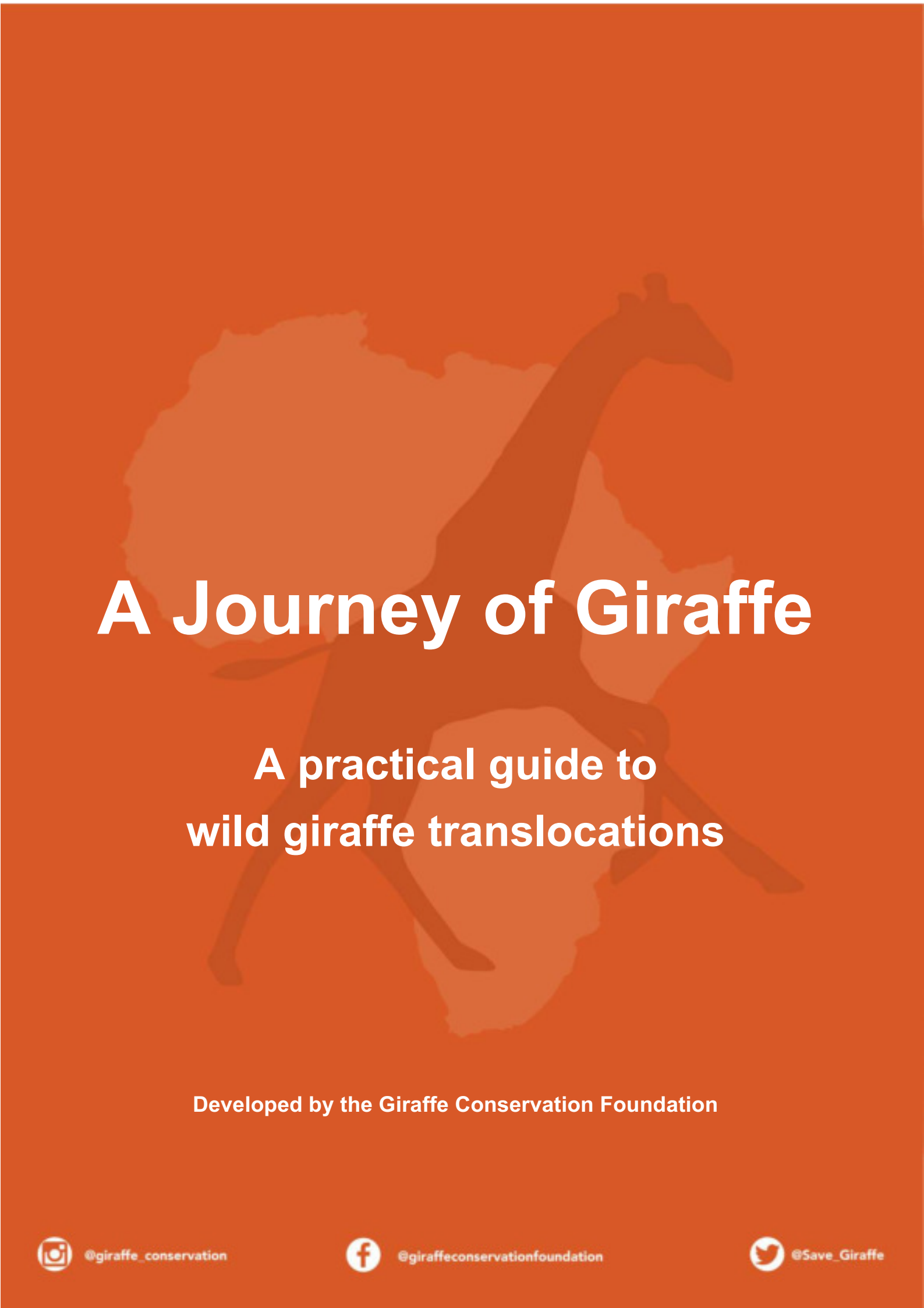

A Journey of Giraffe

A practical guide to wild giraffe translocations

Developed by the Giraffe Conservation Foundation

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GCF

GIRAFFE CONSERVATION FOUNDATION

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INTRODUCTION

Document purpose

This manual is designed to give practical guidelines to wildlife and game capture teams, veterinarians and conservation managers for the translocation of giraffe in the wild. With an increasing number of giraffe translocations occurring throughout Africa, this manual provides base level requirements to undertake a translocation following an appropriate assessment of its purpose. The International Union for the Conservation of Nature (IUCN) Guidelines for Reintroductions and Other Conservation Translocations (IUCN/SSC 2013) clearly outline the processes involved when assessing and planning a translocation – from defining the primary objective of the effort, all the way through to post-translocation monitoring. These guidelines should be read in conjunction with this giraffe translocation manual.

We envisage this manual to be a 'working document' which should regularly be reviewed and new information added to ensure that it is accurate, up-to-date and thus of most value to those working in the field to translocate wild giraffe.

What is a translocation?

Translocations with deliberate conservation intention are generally categorised as conservation translocations and are in turn classified according to the intended benefit of the process (Seddon 2010; Table 1). The IUCN guide on translocations provides the following definitions for translocations (2013):

"Translocation is the human mediated movement of living organisms from one area, with release in another. This may be intentional or accidental and the founder populations may be from captive or wild sources. Translocations may address a variety of motives which include: reducing the population size, welfare, political, commercial or recreational and conservation objectives.

Conservation translocation is the intentional movement and release of a living organism where the primary objective is conservation benefit. This will usually comprise improving the conservation status of the focal species locally or globally, and/or restoring natural ecosystem functions or processes. Conservation translocations can include releases either within (population restoration) or outside (conservation introduction) the species' indigenous range.

Population restoration involves:

- Reintroduction: The intentional movement and release of an organism to an area inside its indigenous range from which it has disappeared.
- Reinforcement: The intentional movement and release of an organism into an existing population of conspecifics.

Conservation introductions involve:

- Assisted colonisation: The intentional movement and release of an organism outside its indigenous range to avoid extinction of populations of the focal species.
- Ecological replacement: The intentional movement and release of an organism outside its indigenous range to perform a specific ecological function. This is used to re-establish an ecological function lost through extinction, and will often involve the most suitable existing subspecies, or a close relative of the extinct species within the same genus."

Table 1: Classification of conservation translocations. *IUCN/SSC 2013.*

PRIMARY FOCUS	TERM	DEFINITION	SYNONYMS	SCOPE
Single species	Reintroduction	Intentional movement of an organism into part of its native range from which it has disappeared or became extirpated in historic times	Repatriation	Population restoration (release into known range)
	Reinforcement	Movement of individuals to increase the size and/or diversity of an existing population	Supplementation, augmentation, restocking, enhancement (plants only)	Improvement of existing population "health" through increased genetic diversity
Ecosystem	Ecological replacement	Introduction of the most suitable extant organism to fill the ecological niche left vacant by the extinction of species	Sub specific substitution, taxon substitution, ecological substitutes/ proxies/surrogates	Benign/Conservation introduction (release outside known range)
	Assisted colonisation	Translocation of species beyond their natural range to avoid current or future threats on a population	Assisted migration, managed relocation	Create a new population in an area deemed to be safer/ more feasible long-term than the current range
	Community construction	Introduction of suites of species to fill ecological niches and create new species assemblages	Futuristic restoration, designer/novel/invented ecosystems	

OVERVIEW OF GIRAFFE BIOLOGY

Taxonomy

Giraffe (*Giraffa* spp.), belong to the family Giraffidae in the order Artiodactyla (even-toed ungulates). The okapi (*Okapi johnstoni*) is the only other extant genera of this family.

In 2016, the IUCN completed the first detailed assessment of the conservation status of giraffe, revealing that their numbers are in peril. This was further emphasised when the majority of the IUCN recognised subspecies where assessed in 2018 – some as *Critically Endangered*. While this update further confirms the real threat to one of Africa's most charismatic megafauna, it also highlights a rather confusing aspect of giraffe conservation: how many species/subspecies of giraffe are there? The IUCN currently recognises one species (*Giraffa camelopardalis*) and nine subspecies of giraffe (Muller *et al*. 2016) historically based on outdated assessments of their morphological features and geographic ranges. The subspecies are thus divided: Angolan giraffe *(G. c. angolensis),* Kordofan giraffe *(G. c. antiquorum),* Masai giraffe (*G. c. tippleskirchi*), Nubian giraffe *(G. c. camelopardalis),* reticulated giraffe *(G. c. reticulata),* Rothschild's giraffe *(G. c. rothschildi),* South African giraffe (*G. c. giraffa),* Thornicroft's (*G. c. thornicrofti*) and West African giraffe *(G. c. peralta).*

However, over the past decade the Giraffe Conservation Foundation (GCF) together with their partner Senckenberg Biodiversity and Climate Research Centre (BiK-F) have performed the first-ever comprehensive DNA sampling and analysis (genomic, nuclear and mitochondrial) from all major natural populations of giraffe throughout their range in Africa. As a result, an update to the traditional taxonomy now exists. This study revealed that there are four distinct species of giraffe and likely five subspecies (Fennessy *et al.* 2016; Winter *et al.* 2018). The four species are Masai giraffe (*G. tippelskirchi*), northern giraffe (*G. camelopardalis*), reticulated giraffe (*G. reticulata*) and southern giraffe (*G. giraffa*). Nubian giraffe (*G. c. camelopardalis*), Kordofan giraffe (*G. c. antiquorum*), West African giraffe (*G. c. peralta*) are the three subspecies of the northern giraffe, while Angolan giraffe (*G. g. angolensis*) and South African giraffe (*G. g. giraffa*) fall under the southern giraffe. Rothschild's giraffe is genetically identical to the Nubian giraffe, and thus subsumed into it. Similarly, preliminary data suggests that the Thornicroft's giraffe is genetically similar to the Masai giraffe, however, additional research is necessary to determine if they are genetically identical or should be considered a subspecies of Masai giraffe (Winter *et al.* 2018). Based on this research, GCF in all publications refers to the updated giraffe taxonomy of four species, while a taxonomy review by the IUCN is ongoing.

Table 2: Four species with five subspecies classification of giraffe based on recent genetic analysis. *Fennessy et al. 2016; Winter et al. 2018*.

Species	Subspecies
Giraffa camelopardalis	*G. c. antiquorum*
	G. c. camelopardalis
	G. c. peralta
Giraffa giraffa	*G. g. angolensis*
	G. g. giraffa
Giraffa reticulata	
Giraffa tippelskirchi	

Figure 1: Pelage patterns of the four species of giraffe. From left to right: Masai giraffe, northern giraffe, reticulated giraffe, and southern giraffe. *Images courtesy of GCF.*

Morphology

Spectacularly tall, the giraffe has an extremely elongated neck and long legs. The neck has a short, upstanding mane that runs down to the high shoulders (withers) from which the back slopes steeply to the hindquarters and tail. Adult males can stand on average 5.3 m (17 ft 4 in) tall and weigh on average 1,200 kg (2,600 lb) while adult females average 4.3 m (14 ft 2 in) and weigh an average of 830 kg (1,800 lb) (GCF 2020). The giraffe's neck is made up of the same number of cervical vertebrae as all mammals (7), but they are much larger and linked by ball and socket joints for improved flexibility (Kingdon 1997). The giraffe's hide (pelage) is individually patterned with spots or patches and is believed to assist in camouflage by breaking up their obvious silhouette and allowing them to blend into a woodland environment (Shorrocks 2016). The pattern may also function in heat absorption and dissipation (Mitchell & Skinner 2004; Kaspari 2008). Giraffe have thick tight skin which helps to maintain circulation especially in the legs by acting as a "pressure suit" (Hargens *et al.* 1987).

Giraffe have two to five horn-like structures on their skull made of skin-covered bone, known as ossicones. These are usually thin and tufted in females and thick and bald on top in adult males - as they are used as a weapon during fights with other males (Simmons & Scheepers 1996). Ossicones are connected to the parietal bones in the skull and macroscopically minimally vascularised. It was thought that ossicones possibly played a role in thermo-regulation (Ganey *et al.* 1990), however due to the high density of the bone in ossicones it is unsure how much they could assist with thermo-regulation (S. Ferguson pers. obs.). Males can develop calcium deposits on their heads in addition to their ossicones as they age which can help to deliver heavier blows during fights (Simmons & Scheepers 1996; Spinage 1968). They have ~45 cm long, prehensile tongue; usually blue/black in colour, specially adapted for stripping leaves and flowers off thorny vegetation and for keeping their nostrils clean (Burnie & Wilson 2001). Their upper lips are prehensile to assist with stripping leaves and flowers. Giraffe have large, protuberant eyes, which combined with their great height and ability to distinguish colours, provide them with excellent vision (Mitchell *et al.* 2013). Giraffe have the largest eye and retinal surface of all ungulates (Mitchell *et al.* 2013);

they can detect movement at a distance of two kilometres (Dagg & Foster 1976) and distinguish colours (Backhaus 1959). They are also believed to have a well-developed sense of smell (Pereira 2013) and good hearing (Kasozi & Montgomery 2018).

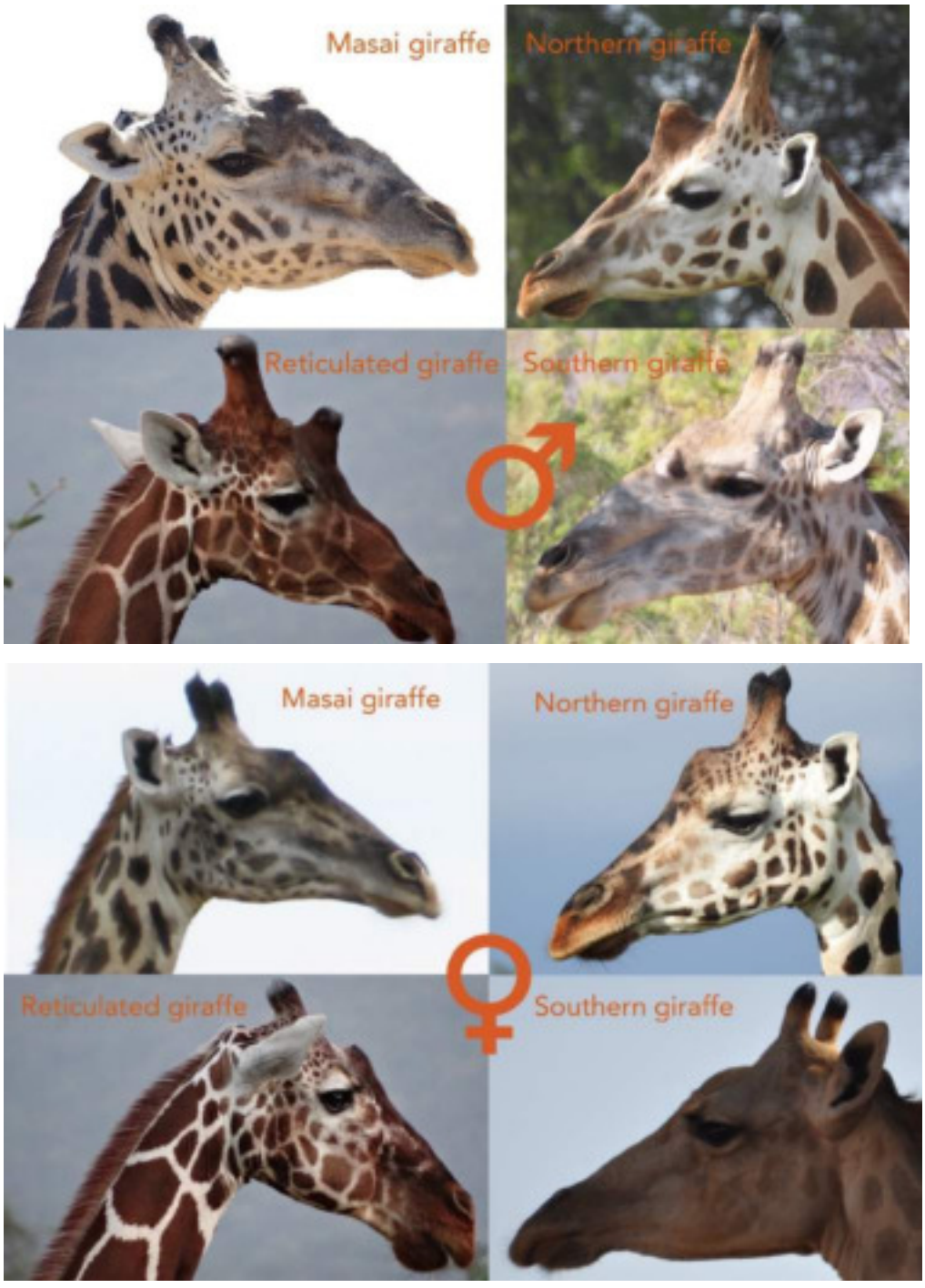

Figure 2a & 2b: Male and female cranium morphology in Masai, northern, southern and reticulated giraffe. Note the presence of more prominent median ossicones in the northern and reticulated giraffe compared to the smaller median ossicones present in Masai and southern giraffe. *Images courtesy of GCF.*

Habitat and forage

Giraffe primarily inhabit open savannah and woodland habitats (Mueller *et al.* 2016). Home range sizes vary depending on the availability of food and water. They are also influenced by seasonal rainfall and temperature, as well as the density of giraffe, predators and other herbivores (Dagg 2014). Recorded home ranges vary between 8.6 km^2 in the heavily vegetated Lake Manyara National Park in Tanzania (Van der Jeugd & Prins 2000) to 1,950 km^2 in arid northwest Namibia (Fennessy 2004). A female giraffe translocated to northeast Namibia was recorded to cover 11,692 km^2, however the study's authors caution that this individual may not have been displaying typical home range movement behaviour before settling (Flanagan *et al.* 2016). The average home range is ~100 km^2 with high variation between individuals and sexes (see Fennessy 2004, Appendix 12 for a review). Female giraffe tend to be somewhat philopatric (remain in the area of their birth), thus maintain smaller home ranges than males who roam between groups of females (Carter 2013; Bock *et al.* 2014). Recorded differences in habitat preferences between the sexes appear to be driven by females with young selecting open habitats for safety (Ginnett & Demment 1999; Young & Isbell 1991).

Giraffe in some populations can be completely water independent (Fennessy 2004) but others may visit water sources relatively regularly (Leuthold & Leuthold 1978; Brand 2007). They tend to avoid particularly high risk areas where predators, especially lion, may occur in higher densities as well as areas with domestic livestock and high prevalence of human activity (Gandiwa *et al.* 2013; Valeix *et al.* 2009), preferring open scrub and open woodlands (Thaker *et al.* 2011).

Giraffe are generalist browsers, with several *Acacia* species (*Vacheillia* and *Senegalia*) being the most preferred browse throughout their range when available. Other preferred genera include: *Balanites*, *Boscia*, *Combretum*, *Commiphora*, *Detarium*, *Grewia, Terminalia* and *Ziziphus* species among others (Ciofolo & Pendu 2002; Fennessy 2004; Muller *et al.* 2016). Their diet includes leaves, flowers and bark from these species. The giraffe's daily rate of food consumption is like that of other ruminants – around 2% of their body weight (Dagg 2014). However, they are the only extant ruminant known to ruminate while walking, suggesting that they are near the maximal body size that can be sustained by their wild food source (Clauss *et al.* 2003). Giraffe browse on a wide variety of trees year-round but when all the trees are in full foliage they are much more selective.

Browsing up to eighteen hours a day, male giraffe tends to reach for the higher leaves and branches whereas females often browse with their necks slightly rounded on the lower part of the tree (Ginnett & Demment 1999; Pellew 1984), this reduces resource competition between the sexes. Giraffe can survive in arid environments due to the lack of feeding competition for higher branches with other species, except elephant. Rumination is often increased in the heat of the day and/or at night (Fennessy 2004). Grazing and pica behaviour (the eating of substances not considered food) are rare but have both been observed in nutrient-poor environments (M. Castles pers. obs.). Pica behaviour may include eating soil (geophagia) or chewing bones (osteophagia).

Behaviour

The giraffe is non-territorial and sociable, forming loose herds with no known permanent group membership or leaderships (fission-fusion social dynamics). Herds can consist of any form of males and females, juveniles to adults; ranging from one to more than hundred individuals, depending on the habitat. Individuals or groups within a herd may be spread throughout a habitat depending on the availability of suitable browse (Shorrocks 2016). Recent research has demonstrated that despite group composition changing regularly, groups of giraffe are often non-random, instead made of females that are preferentially choosing to associate regularly with one another (Carter *et al.* 2013). Studies have also

shown that females may maintain preferred relationships with other females for at least six years despite spending minimal time together (Carter *et al.* 2013). These long-term relationships are sometimes maintained between kin (mother and offspring or siblings) but this is not always the case (Carter *et al.* 2013). In general, females with young tend to stay with other giraffe, regardless of whether they are related. Older females are often followed by younger individuals when travelling (Castles 2016) and bachelor herds occur which are believed to be the result of young males following older males. Dominant dark coloured males are regularly alone as they roam large distances between groups of females to check their oestrus status and attempt to mate, however not all dark coloured males are the most dominant. Subordinate, lighter coloured males may spend more time in groups with females and other males (Castles 2016).

Communication

With an extremely well developed visual system, visual cues are believed to play a substantial role in giraffe communication (Kasozi & Montgomery 2018). Giraffe may vocalise when threatened or in a stressful situation (Baotic *et al.* 2015; Kasozi & Montgomery 2018) but otherwise produce minimal vocalisations in the wild that can be detected by human ear. They are, however, believed to communicate via low frequency infrasound over long distances, in a similar manner to African elephants (Bashaw 2003; Von Muggenthaler 2013). Giraffe can perform olfactory discrimination between food sources (Pereira 2013) but there is minimal knowledge of their use of smell or olfactory cues in communication prior to the flehmen response by males when testing pheromones in female urine (Pratt & Anderson 1985; Kasozi & Montgomery 2018).

Reproduction

Female giraffe normally start to breed around the age of four to five years, and have a gestation period of approximately 15 months (Shorrocks 2016). Males are also considered to be sexually mature at around four to five years however, they continue to grow, albeit at a slower rate, until the age of seven or eight and may be competitively excluded from breeding until fully grown in a natural population. Giraffe do not hold territories or defend harems but males will form consortships and mate-guard females when they are in peak oestrus (Pratt & Anderson 1985). During a consortship a male may attempt to mount and mate with the female many times but is often thwarted by the female walking away (Pratt & Anderson 1985). Some recent studies suggest that cyclical changes in male androgen levels associated with changes in sexual behaviour, may be evidence that giraffe have a flexible rutting period, similar to that of the African elephant (Seeber *et al.* 2012; Wolf *et al.* 2018), although further research is required.

When giving birth, records of females moving to a calving ground, have been increasingly reported (Shorrocks 2016; J. Fennessy pers. obs.). New-born giraffe may be on their feet within 20 minutes and feeding on their mother's milk within an hour. Calves are up to 2m (6 ft) tall at birth and double their height in the first year (Patten 1940). For the first few weeks after birth, females may remain on their own and hide their calves in dense vegetation to protect them from predation, hence the calving ground. Calves are generally weaned around one year and can become fully independent by 15 months of age.

Temperament

In terms of capture, giraffe are relatively approachable and tractable. In some populations, it is possible to approach them close enough to dart on foot but more generally from a vehicle (~30-40m). However, due to their huge size and unique physiology, giraffe capture is extremely challenging. If alarmed, a giraffe can go quickly from a walk to a fast gallop of up to 56 km/hour and can sustain this for many kilometres (Dagg 2014). This presents difficulties in terms of darting as increased excitement can result in

hyperthermia, myopathy and other related complications if not managed. Even once darted, depending on the drug combination used, the animals can be dangerous to handle. They can strike with their front feet and kick with their back legs with tremendous force. They also awaken rapidly when reversed. Rope body restraints are sometimes necessary during wild capture procedures, as are blindfolds, head restraints and earplugs. The ropes are not only to protect the handlers but also the giraffe itself, as they can be prone to ataxia and the long neck can cause them to go over backwards which can fracture the skull or neck vertebrae. A fully-grown male's head may weigh up to 45 kg (Mitchell & Skinner 2004) and could easily injure the capture team if is not appropriately restrained. Care must always be taken to stay out of kicking or stomping distance. Giraffe are intelligent and once 'acclimatised', are reasonably tractable in both transport and boma situations.

Ageing

Height and colour are often fair indications of age in the field though neither are particularly effective for aging older individuals. Male giraffe and to some extent females, may darken in colour with age although this is dependent on environmental factors and may be linked to the giraffe's physical condition (Brand 2007). Within a population the darkest individuals are generally the oldest but not all old individuals will become dark (Castles 2018). An old male can grow up to 6m (19 ft 6 in) in height (GCF 2020) and height increases towards an asymptote at around eight years (Dagg & Foster 1976); therefore, as age increases, height is less likely to be a reliable predictor of age.

The head can also be an indicator of age for males. The ossicones of females, both sub-adults and adults are thinner and have tufts of hair on them. Ossicones of males start out similar to that of females, but continue to grow and thicken throughout the males' life and the tufts of hair are worn away from fighting (Dagg & Foster 1976). This results in thick bony knobs that are bald on top in older males. Males' skulls also become increasingly thick and ossified as they age, for increased fighting weaponry (Simmons & Scheepers 1996). Depending on the species, smaller (Masai and southern giraffe) or larger (northern and reticulated) median ossicones develop in the front of the skull (also present but smaller in females) as well as at the base of the skull, in addition to over the eyes and on the nose (Spinage 1968).

Dentition

Giraffe dentition is similar to that of other ruminant species. They only have teeth (incisors and canines) along the front of the lower (mandibular) jaw, with the front of the upper jaw (maxilla) consisting of a hard palate. They then have premolars and molars on both the top and bottom jaw towards the back of the mouth, making a total of 32 teeth which can measure 43 cm (17 in) long (Hall-Martin 1976).

Conservation

Conservation status

Giraffe currently occur in 21 countries, forming a wide arc throughout sub-Saharan Africa from Niger to Central and East Africa, down to southern Africa (Figure 3). Latest estimates by GCF indicate that giraffe numbers have plummeted across Africa by ~30% from >155,000 to ~111,000 individuals in the past three decades (GCF 2020). At the same time, limited conservation efforts and research have been undertaken on giraffe across Africa, however efforts in both of these areas have been increasing in the past decade.

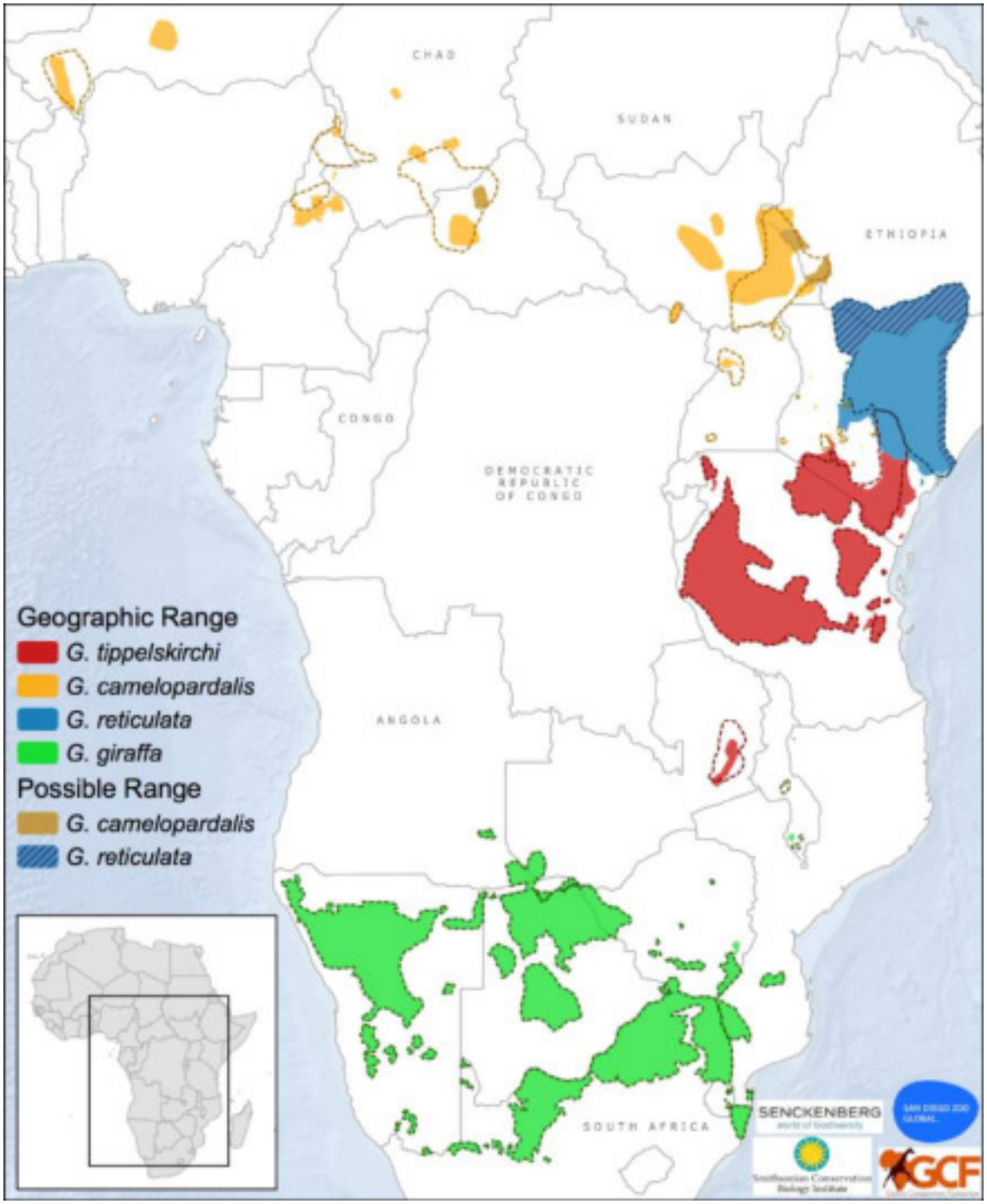

Figure 3: Distribution of extant giraffe species and subspecies populations across Africa. *O'Connor et al. 2019.*

Giraffe, as a single species, were up-listed to 'Vulnerable' to extinction from 'Least Concern' on the IUCN Red List of Threatened Species in December 2016 (Muller *et al.* 2016). This new conservation status assessment of giraffe as a species was submitted by the IUCN SSC Giraffe & Okapi Specialist Group with the support of GCF and other partners. During 2018-19, eight of the nine IUCN recognised subspecies were assessed with two classified as 'Critically Endangered' (Kordofan, Nubian), two as 'Endangered' (Masai, reticulated), two as 'Vulnerable' (Thornicroft's, West African), one as 'Near Threatened' (Rothschild's) and one as 'Least Concern' (Angolan). The South African giraffe assessment has not been completed.

In October 2017 giraffe were added to Appendix II of the Convention on the Conservation of Migratory Species of Wild Animals (CMS) and in August 2019 were listed on CITES Appendix II (Maritime Executive 2019; UNEP/CMS Secretariat 2018).

To develop a solid baseline for giraffe numbers and range in the wild, GCF has, and continues to, compile historical and current data on giraffe numbers, distribution and threats from across their range into giraffe conservation Country Profiles per range State. This work has been undertaken collaboratively with African governments, NGOs, Universities and independent researchers.

Conservation threats

According to the IUCN SSC Giraffe Red List Assessment (Muller *et al.* 2016), giraffe numbers and distribution are affected by fragmentation, degradation and loss of habitats, disease, illegal hunting (poaching), the growth and expansion of the human population, wars, and civil unrest. These threats may arise either directly or indirectly. For instance, human's need for agricultural land can be in direct competition with giraffe ranging areas (Figure 4). This increases the interaction between humans (and/or livestock) and giraffe often results in conflict. Such conflicts arise when, for example: giraffe destroy crops, humans encroach on giraffe habitats, there is bi-direction transfer of diseases or other similar scenarios (Muller *et al.* 2016). Fragmentation of habitats leads to isolation of giraffe populations which in turn limit gene flow and ultimately decreases the genetic diversity of isolated populations. This may be caused by increased levels of inbreeding and has restrictive implications on the species evolutionary potential (Muller *et al.* 2016).

Figure 4: A West African giraffe crossing the railway line outside the capital Niamey, south-eastern Niger. *Image courtesy of GCF.*

PRE-CAPTURE CONSIDERATIONS

Wild giraffe are notoriously difficult to capture and transport. Their unique anatomy and physiology makes chemical and physical capture a challenge, particularly as their weight is difficult to assess in field conditions for accurate drug dose determination and their underling health status is unknown prior to immobilisation. When combined with the fact that an adult male can stand up to 6 m tall, weigh more than 1,500 kg and can strike and kick with deadly accuracy, this type of capture should not be attempted by inexperienced personnel – although note normally younger and smaller animals are translocated.

It is imperative when undertaking a capture operation with giraffe that the team is appropriately skilled and has had practice working together, simulating capturing, placing ropes and restraints prior to the actual event. One experienced team leader should be in charge with the authority to control operations and if necessary, cancel the capture, should something go wrong. Under some circumstances, giraffe are prone to a high level of morbidity and mortality during capture operations and on occasion, it is necessary for the team leader to assess the conditions and if not favourable, release the animal(s).

The equipment necessary to translocate giraffe is not extensive but must be of good quality. Vehicles that will help to capture and transport giraffe should be in reliable working condition and 'chariots' (field recovery crates) should be equipped with good, non-slip flooring and padded as appropriate. Giraffe have an advantage over some species in that if the vehicle and chariot is big enough, it is possible to transport more than one animal at a time in the same compartment thus saving on transport costs and time. Great care must be taken especially on off- or rough roads since giraffe are not particularly stable in moving vehicles. For this reason, it is not advisable to administer any tranquiliser or sedative (even short acting) to giraffe prior to transporting as this will further decrease their stability. If giraffe become recumbent (lying down), it is sometimes difficult to get them back on their feet and if moving several animals at once, they can potentially injure one another if on the ground. Giraffe can also clear extremely high walls and fences, which is an important consideration for both the vehicle and chariot. Before the capture, it is important to consider the gender and age of animals being transported together as two males may fight and possibly injure themselves or others in the truck. Caution must be taken when taking any larger males with other animals in the chariot and/or truck.

Planning a capture or translocation exercise

Good planning is essential for giraffe capture and translocation. There are several factors to consider prior to undertaking any capture or translocation exercise including but not limited to discussing the justification of performing a translocation, overall risk assessment, habitat assessment, population viability assessments, pre- and post- population monitoring and appropriate dissemination of reports. To help ensure safety and success, it is recommended to include a detailed planning session with all stakeholders prior to any translocation using the IUCN Guidelines for Reintroductions and Other Conservation Translocations (IUCN/SSC 2013). During the translocation it is also helpful to include a planning session before setting out for each capture and a debrief/discussion immediately after each giraffe is unloaded into the boma.

Area receiving giraffe

The area that will be receiving giraffe must be evaluated and determined to have sufficient and suitable habitat for a sustainable population, no specific threats, and appropriate education and awareness created with local communities/landowners. This habitat assessment should be ideally undertaken using the IUCN Guidelines for Reintroductions and Other Conservation Translocations as a basis (IUCN/SSC 2013). As stated previously, giraffe are predominantly browsers with a preference for specific tree species.

In areas that experience seasonal changes in browse, availability of adequate forage should be taken into consideration when planning the time of the translocation. Moving giraffe from one habitat to a completely different one can take a considerable amount of time and planning and one needs to be assured the animals can adjust to the new environment. Importantly, if one (sub)species of giraffe exists in an area already, it is critical that only the same (sub)species is introduced to prevent potential hybridisation.

Giraffe have a relatively small rumen and are prone to acidosis, which can cause problems if the change in browse is too extreme (Enemark *et al.* 2002). Sufficient and well-distributed water sources are important enabling giraffe the opportunity to drink if they are interested. If there is fencing, it should be tall game proof fencing for giraffe (minimum 2.4m) as they can jump/go through even high fences and there may be a danger of getting caught up in them, injuring themselves and/or breaking the fence. Having fences clearly marked may also be an option.

Fortunately, giraffe are not territorial so introducing new individuals into an area should not cause territoriality problems. Dominant males will quickly establish a hierarchy with other males. They are however, susceptible to disease and can carry a high parasite burden so appropriate veterinary assessment and any interventions should be taken prior to release. In some areas, giraffe develop skin lesions from fungal infections, papilloma virus ("warts"), filarial worms and more (van Dyk *et al.* 2011; Karstad & Kaminjolo 1978; Muneza *et al.* 2016; Vanmechelen *et al.* 2017). It is unclear how some of these skin infections are transmitted between giraffe, or whether there are risks to other wildlife or livestock. Before translocating giraffe with skin disease lesions or any other apparent infectious disease, an assessment should determine if lesions already exist in the animals to be moved or at the reintroduction site, and the risk for potential spread of disease should be taken into consideration. Importantly, all animals should be examined by an experienced wildlife veterinarian and any preventative intervention should be undertaken as needed for all animals being translocated as some diseases may be latent.

Donor population

Giraffe are relatively long-lived, and our limited information estimates that they can live up to 25 years or more – ongoing long-term research will help to better understand longevity in the wild but average might be between 15-20 years (Dagg 2014; J. Fennessy pers. comm.). As previously stated, females are on average sexually mature around four to five years of age and males similar, although in a natural environment they will rarely breed at this age as dominant males will exclude younger individuals. Prior to the start of any translocation, an assessment of the donor population should be undertaken to help determine how many individuals can be removed and still have a sustainable population. Conservation translocations should not be viewed as one-time events to establish new population(s) in one large movement. Rather they should be considered as long-term investments wherein small groups of individuals are moved over a few years to (re)establish or supplement the recipient populations.

Ideally, only younger animals (approximately 2 to 4 years of age) should be translocated as it is logistically easier – depending on distance and purpose, as well as them having a longer breeding life. However, it should be taken into consideration that females are more inclined to breed with older, sexually mature males, and as such reproduction in a newly established population with young animals may take longer to establish. For management purposes, it is good to know that giraffe have a gestation period of approximately 456 days (~15 months) and an inter-calving period of up to a year, although less in ideal situations (Suraud 2011). Females with calves or heavily pregnant animals should not be moved due to the complications of both the chemical and physical capture methods so careful assessment should be made in the field, based on appearance of the female's belly, udders and vulva. After induction, it is

possible to make a closer assessment of the pregnancy or lactation status, and if heavily pregnant or lactating then they should be released.

Where appropriate, translocated dominant males should be strong, healthy specimens with no apparent disease, minimum parasites or injuries. Several young "backup" males should also be translocated if the dominant male is over ten years of age. Importantly, adult males should preferably not be housed together with other males in a boma, as they will quickly assert their dominance and could cause unwanted injuries and create unnecessary stress for other giraffe. Additionally, they should not be translocated together or with younger individuals because if problems arise they can assert authority aggressively resulting in potential issues.

Other considerations

If the donor population has been/is being monitored or studied prior to the translocation, more detailed selection of individuals may be possible which could improve the overall success of the translocation. Targeted selection of genetically dissimilar individuals will maximise the genetic diversity possible for the new population. Additionally, as relationships among females have been proven to be non-random (Carter *et al.* 2013), selection of individuals that associate regularly or are known to be socially compatible, may decrease the stress on individuals during translocation, aid in release-site fidelity and establishment of a new social system. However, this degree of understanding is often difficult to ascertain considering the limited giraffe scientific studies undertaken in collaboration with translocations (Flanagan *et al.* 2016). As research on giraffe populations across Africa increases these improvements may become more achievable.

Translocation period

Giraffe are often best moved in the early dry or winter seasons, depending on the area from which they are coming and going to. The advantages of this are that:

- Field conditions are dry, making movement of the chariot and vehicles easier, which then assists quicker capture, loading and recovery of animals.
- Working condition are more comfortable for the personnel.
- Ambient temperatures are cooler for the giraffe with less chance of hyperthermia and associated problems during the capture and transport process.

However, there are also several disadvantages, especially towards the end of the dry season:

- Body condition of the giraffe may be less than optimal, particularly if the browse is limited or the year has been excessively dry.
- Field conditions in the recipient area may also be poor adding extra strain on giraffe moving in and adjusting to new surroundings, possibly adapting to new browse and finding water sources.
- Giraffe are poor thermoregulators as they carry little body fat and are thus more susceptible to cold, particularly if they are not in prime condition.
- Shortage of quantity and quality of good browse in the dry season can be challenging for feeding giraffe in a boma.
- Lack of surface water can cause added stress. Even though giraffe can go indefinitely without water, water following translocation can be valuable and reduce stress and dehydration.

The above problems are inherent for any capture operation and it is advisable to move animals early in the dry season, where feasible. Due to the semi-arid nature of where giraffe inhabit, translocations may be able to be carried out in other seasons. Special attention should be paid to weather forecasts; capture should be carried out early in the morning or in the later afternoon providing enough daylight time is left

for the operation. If there is sufficient cloud cover, capture can take place throughout the day but the team leader should decide on an upper ‘cut off’ temperature. When ambient temperatures rise, induction and recovery should be carried out as fast as possible to reduce the chance of hyperthermia.

If bomas are used in the rainy season, the drainage must be sufficient to reduce mud and if roofed, should be high enough to prevent injury. If giraffe are kept in the boma for more than a few days, raking and adding clean sand can help prevent slipping.

If bomas are used in the dry season, dust can be controlled by spraying water on the ground regularly. This helps prevent dust damaging the eyes or lungs of the giraffe. Dust levels can also be controlled by laying clean sand on the ground within the boma.

CAPTURE

Chemical immobilisation

Despite frequent movement of giraffe in some parts of Africa, the chemical immobilisation of giraffe, particularly of free-ranging animals, remains extremely challenging. Their unique anatomy and physiology not only make it difficult to assess drug dosage amounts but can also create difficulties during critical periods of induction and recovery. As stated, capture should only be undertaken by an experienced team.

Key points to note on giraffe physiology relating to capture:

- Relative weight estimations are difficult to assess so drug dosages can be inaccurate, even in boma situations.
- Weight and length of extremities combined with a rapid recovery rate on drug reversal may make handling of giraffe dangerous to both the capture team and the animal itself, particularly during induction and recovery.
- Their long neck may present problems during recumbency as mal-positioning can result in airway obstruction, cramping of neck muscles and/or neck injuries, which can lead to fatalities.
- A unique cardio-vascular system relating to maintaining circulation to the brain combined with a large respiratory “dead space” means that the giraffe heart has to work harder and is more susceptible to damage from oxygen debt during periods of hypoxemia.
- Their long legs make them prone to stumbling and falling, which can lead to potential injury. Recumbent giraffe require good footing and lots of space to rock forward with their neck and get their feet underneath them during recovery.
- Giraffe have elongated skulls with narrow interdental spaces making endotracheal intubation difficult and largely impractical in field conditions.
- The posterior position of the larynx impedes drainage of pharyngeal fluids and is a potential cause of fatal aspiration pneumonia due to passive regurgitation.
- Giraffe are prone to hyperthermia if overexcited during capture and conversely, hypothermia during anaesthesia, if ambient temperatures are too cold.

Equipment

Darts and projectors

Giraffe have a thick, tough hide. For capture in the field, a robust and reliable dart system such as DanInject, Pneudart or Cap-Chur is preferable. However, this also depends on the experience of the veterinarian (the assumed operator). Importantly, do not change to new or unfamiliar equipment just for this operation as it is better to adapt familiar system to the situation.

Equipment must be thoroughly checked prior to capture – and before heading into the field. Importantly, it is recommended that veterinarians always practice shooting to ensure that the power settings are correct and dart gun is in good working order. The user should be proficient at assessing distances and practice shots should be carried out at the varying distances that are expected in the field, using a similar target material such as conveyor belts or old tyres, as an example. A flat trajectory without excessive impact is required.

In the field, a push rod should be carried to push out a dart from the barrel if stuck or unused. Dart needles should be minimum of 50mm to penetrate the giraffe thick skin. The darts should be robust and in good condition. A spare gun or parts may also be valuable in cases of potential malfunctioning, if anticipated or

has not been used for some time. If the rifle is equipped with a floating red dot scope system, extra batteries should also be to hand at all times.

Additional equipment

- Giraffe chariot (field recovery crate – see Transportation section below).
- Crowbar, spades, picks, chainsaws, saws, pangas (machetes) and axes to clear the capture area once the giraffe is recumbent, help with digging chariot wheels into the ground, etc.
- Pliers, hammers, nails, wire etc. to help with any running repairs to equipment.
- Ropes: all ropes should be ~25 mm soft braided nylon ropes, or similar.
    - Capture ropes: minimum of two 10-15 m ropes.
    - Loading ropes: 20-25 m long, with a noose around one end.
    - Funnel ropes: minimum of two 10 m ropes to form a loading funnel.
    - Additional ropes always valuable in case some break or can be used for other purposes e.g. to turn a giraffe, guide a giraffe into the chariot, etc.
- Minimum of 40 L of water to cool the giraffe when recumbent.
- Experienced team of ~6 people to restrain and/or move the giraffe is preferable.
- Blindfold/head harness (including spares) to minimise stress for the giraffe once captured.
- Ear plugs e.g. cotton wool or similar, to block the ears of the giraffe and minimise stress. Importantly, when used they should be easily removable before entering the boma.
- Stethoscope to measure for heart and lung movements (heartbeat and respirations).
- Rectal thermometer to measure the giraffe body temperature whilst it is recumbent.
- Medical kit for preventative care and treatment of injuries including long acting antibiotics, intramammary ointment for dart wound treatment, anti-inflammatories (such as flunixin meglumine), potentially antiparasitics (such as ivermectin; see below for further discussion on their use in the field), , vitamin E, antibiotic eye ointment, fly repellent, various sizes of syringes and needles, and anything (blood tubes, tissue tubes, etc.) needed for sample collection.
- Cool box or car fridge with ice packs for storage of drugs and/or samples.
- Human medical kit to treat any injuries of the team including adequate amounts naltrexone for accidental human exposure to potent opioids.
- Rifle and ammunition to protect against other wildlife and in the worst-case scenario of a giraffe sustaining a bad injury as a result of the capture attempt and needing to be euthanised.
- Necropsy kit – knives, steel, axe, rib cutters, sampling bottles with 10% buffered formalin*.
- Oxygen with regulator and administration tube, if necessary*.
- Pulse oximeter to monitor oxygen saturation levels of the giraffe whilst it is recumbent*.
- I-stat blood gas analyser and CG8 cartridges (or similar) for blood gas monitoring*.
- Saw, hoof clippers and rasp to trim giraffe hoofs if issues are observed whilst the giraffe is recumbent*.
- Sling to help moving giraffe if required*.
- If no electricity, then maybe a generator/power source is required to run any equipment to fix vehicles, store any drugs, medicines and samples, etc., as necessary*.

*Note that this equipment that is not absolutely necessary.

Darting

Darting on foot

Although giraffe are relatively easy to approach in a vehicle, darting on foot is not recommended unless the giraffe are extremely habituated e.g. West African giraffe in Niger. Their height and excellent eyesight make it difficult to approach them unseen and most wild giraffe are not used to being approached in this way. The first dart placement is invariably the best and if this chance is missed, a second dart may be difficult as the giraffe often moves away. Trying to re-dart the same giraffe may increase their likelihood of excitement and consequent dangers of hyperthermia, myopathy and injury, particularly if only a partial dose is administered.

Darting from a helicopter

Giraffe are prone to extreme excitement during helicopter darting with the associated risks. If helicopter darting is planned because giraffe are in remote areas or vegetation impedes easy access, then a larger dose of opioids is recommended to ensure swift induction. Additionally, the helicopter should be used to drive the darted individual towards a strategically placed ground team or area so that they can capture the giraffe as quickly as possible. It is important that the helicopter not lose sight of the darted giraffe although use of a transponder dart maybe helpful. The use of a helicopter can be advantageous to drive the darted giraffe away from hazards such as gullies and water bodies, and a very experienced game capture pilot is critical for the whole exercise. If the first dart fails, the use of a helicopter can easily help administer another dose. Any additional dosage requirements may need to potentially increase as the giraffe's excitement level increases, and all should be assessed appropriately. Importantly, once darted the helicopters should be kept a good distance away, while keeping the giraffe in sight, to avoid unnecessary chasing and stress to the giraffe and only come down to drop the team on the ground for capturing or securing the individual. Importantly, if a ground team is being used, both the qualified veterinarian(s) in the helicopter and in the ground team should have reversal drugs available for those who reach the animal first to inject.

Darting from a vehicle

Darting from a vehicle is the most commonly used darting method as giraffe are more used to being approached in vehicles, and up to a certain distance are accustomed to them. As with an experienced helicopter pilot, clear communication between the veterinarian, capture team and vehicle driver must be had throughout the process, both leading up to and including the darting and any subsequent chase and capture. It is normally possible to approach close enough to dart without the animal taking off – often 50 m, sometimes closer, but occasionally it might be necessary to slowly follow, take a different angle or even to drive the giraffe to a better place for darting.

Dart placement

A good dart placement is very important. The shoulder and upper part of the hind leg, rump and the brisket/pectoral muscles of the chest are best to dart to enable good penetration and drug absorption. The shot should preferably be perpendicular to ensure good drug deposition into a large muscle belly. Importantly, one should avoid darting in the neck, thorax and abdomen of the giraffe.

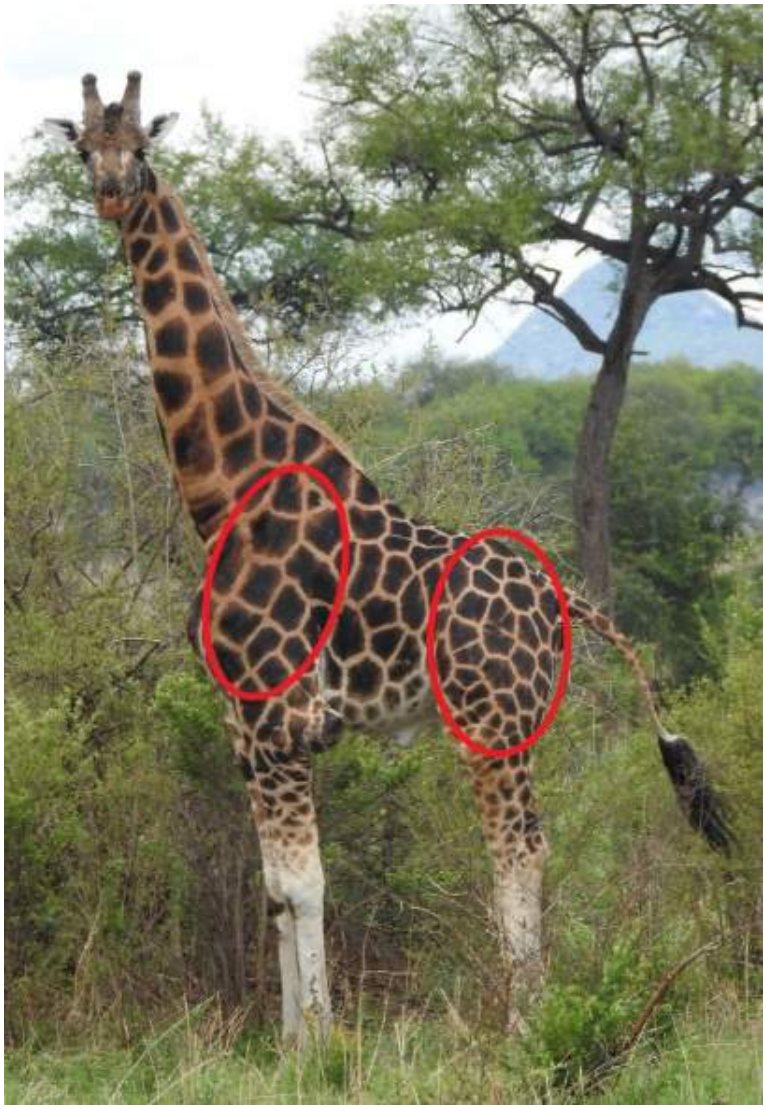

Figure 5: Dart placement. The shoulder and upper part of the hind leg, rump and the brisket/pectoral muscles of the chest are best. *Image courtesy of GCF.*

Ambient temperature

Giraffe are relatively sensitive to ambient temperature changes. Depending on the individual, a darted giraffe may run hard, particularly if darted from a helicopter or a first dart was not fully deployed, and depending on the weather, may suffer from hyperthermia as a result. As such, giraffe should not be darted in the heat of the day. Early morning or afternoon are the best times and ambient temperatures around 25°C. A cut off temperature for both the operation and animal should be decided beforehand and an animal whose body temperature exceeds 41°C must be cooled with water and/or released. Care must be taken if darting in the afternoon that there is sufficient daylight left to capture and transport the giraffe. Conversely, while immobilised, giraffe have been known to become hypothermic especially in cooler weather, although in a translocation setting with a rapid turnover, this scenario is unlikely.

Female and calf

When darting a female giraffe with a calf from a helicopter, it is good procedure to have an additional fixed wing plane circling the site as a spotter to ensure an eye is kept on both giraffe – radio communication between air and ground is important. The mother should be darted first with the calf immediately after. If the timing and the dart placement is good, they should go down together. If they should split up, the spotter plane can stay with one animal and the helicopter the other, with good communications between each. If in open country, the darting will likely be easier and can be done without a spotter plane. If the adult goes down first and mother and calf are split in thickly vegetated terrain without a spotter plane, the position of the mother can be marked with a GPS, smoke bomb or toilet paper dropped from the helicopter and the calf followed.

Choice and dose of immobilising drugs in the field

Due to the difficulties of immobilising giraffe, current capture methods for wild caught giraffe use high doses of opioids alone, with no sedatives or tranquilisers. This enables rapid induction and no lingering effects of drugs once the giraffe is released or during transport.

It is best to prepare any dart(s) in advance and to add the drug once the specific animal is spotted, adjusting the dosage accordingly. The opioid antidote should also be pre-drawn in a syringe and ready for rapid intravenous administration to the giraffe once recumbent, or in case of accidental human exposure as it is lethal to humans. If more than one field team, then each veterinarian should have an opioid antidote to give depending on who gets to the animal quicker. The recommended drugs and dosages for giraffe are summarized in below in table 3.

Table 3: Giraffe dosage recommendations from *Chemical and Physical Restraint of Wild Animals: A Training and Field Manual for African Species Second edition. 2014. Ed. Michael D. Kock and Richard Burroughs.*

Age/Sex	Primary Drug	Narcotinic Reversal	Tranquilizer/sedative/other
Adult Bull	Etorphine 12-16 mg OR Thiafentanil 14-20 mg	Diprenirphine 28-40 mg Naltrexone 120-160 mg Naltrexone 140-200 mg	Up to 5,000 IU hyaluronidase
Adult Cow	Etorphine 10-12 mg OR Thiafentanil 12-14 mg	Diprenorphine 28 mg Naltrexone 120-140 mg	Up to 3,000 IU hyaluronidase
Sub-adults	Etorphine 7-9 mg OR Thiafentanil 8-12 mg	Diprenorphine 22 mg Naltrexone 80-120 mg	1,500 IU hyaluronidase
Juveniles	Etorphine 4-7 mg OR Thiafentanil 4-7 mg	Diprenorphine 22 mg Naltrexone 60-90 mg	1,500 IU hyaluronidase

*Note: Many veterinarians mix etorphine and thiafentanil in a 50:50 ratio, other make a mixture of 30:80 etorphine:thiafentanil; based off personal preference. A mixture of 60:40 is also used in the field with rapid induction times noted and good overall immobilisation ratings.

Most recently, veterinarians have either increased dosages of etorphine for wild giraffe using up to 20 mg for adult males and 17 mg for adult females or used the combination of etorphine:thiafentanil – this will allow for quicker knockdowns. Recent immobilisations in the field in Tanzania employed the used of etorphine:thiafentanil in a 40:60 ratio (total opioid mg dose of 12-14 mg for an adult female) and noted induction times averaging 3 minutes or less (J. Alves pers. comm.). This same combination ratio was used

for adult female giraffe during an exercise in the Democratic Republic of the Congo, where the terrain is very difficult for giraffe capture, with good success.

IMPORTANT: All participants should be made aware of the potential dangers of exposure to the drugs used and the required first aid procedures should exposure occur. This is particularly important for the potent opioids (etorphine and thiafentanil) which are lethal to humans at veterinary strengths. The veterinarian in attendance should be the only person handling the dart and in charge of treating the dart wound to prevent accidental human exposure of the team.

Animals in poor condition

Variation in the reaction to immobilising drugs may exist among animals. Considering the four distinct giraffe species, let alone sex, there will undoubtedly be some variations in their reactions to the drugs. Individuals can also react differently, and it is important for the field team to observe these reactions and respond accordingly.

Rapid induction is particularly important for giraffe to lessen the trauma associated with capture and to enable the field team to recover the animal quickly as there are several potential negative reactions to immobilisation that need to be addressed quickly to ensure the animal survives. These include:

- Passive regurgitation leading to fatal aspiration pneumonia.
- Respiratory depression (hypoventilation) with resulting hypoxemia (low blood oxygen) and hypercapnia (high blood carbon dioxide).
- Tachycardia (rapid heartbeat), hypertension (high blood pressure), bradycardia (slow heartbeat), hypotension (low blood pressure) and other significant cardiovascular complications.
- Self-induced trauma during induction and/or following reversal.
- Hyperthermia (elevated body temperature) and/or capture myopathy secondary to a prolonged and problematic induction or incomplete reversal of immobilization drugs.

Induction

If the dosage is sufficient for the size of the animal and the dart is placed well, induction should occur within 3-6 minutes. Induction times vary with different animals e.g. a large male or pregnant female will normally take longer than a young animal. Giraffe are prone to excitement, particularly if darted from a helicopter, and this will also lengthen induction times. If induction time is less than 3 minutes, it is essential for the ground crew to get to the animal as quickly as possible as there is a chance that it has been overdosed, or drug absorbed quickly because of the dart placement. If induction does not occur after 7-10 minutes, it is likely that the full drug was not administered, and the animal should be darted again.

Giraffe become narcotised (affected with the drug) rapidly but it is usual practice to rope the animal to minimise injury and further stress as it goes down. This is done by the ground team running in front of the giraffe with a long rope at chest level, then moving around the back of the animal to pull it down. Once down, muscle relaxation is poor and the animal must be restrained to prevent injury to itself or the team. The field team should restrain the giraffe first by holding down the head and upper neck, then additional team members can assist with restraining the neck and along the back at the shoulder to avoid kicking legs. Care should be taken to avoid placing pressure on the ventral region of the neck where the trachea runs which would inhibit appropriate respiration. Importantly, the reversal drug, diprenorphine or naltrexone (see Antidote section), should be given immediately once the animal is down and head/neck restrained to prevent hypoxemia. Reversal is ideally given intravenously for rapid recovery but may also be given intramuscularly if unable to access the vein for drug administration. The quicker the reversal, the better for giraffe recovery.

IMPORTANT: It is better to overdose and rapidly reverse than to under-dose and increase the risk of complications. The reversal drug should be given as quickly as possible once the animal is down.

Figure 6a & 6b: Ground team roping and restraining a giraffe during a capture. *Images 6a courtesy of GCF; image 6b courtesy of Sean Viljoen/GCF.*

Blindfold and earplugs should be applied as quickly as possible to minimise stress for the giraffe once down. Additional tools such as ropes, as appropriate, can then be used. This technique, whilst effective, may only be appropriate for capture of wild giraffe for translocation, removing snares or for fitting GPS satellite units. It may be difficult to complete other procedures once the giraffe has received reversal drugs as they can rapidly become responsive to any stimuli, kicking with their legs, which can be dangerous to the field team. It is essential that the field team is well trained and experienced to safely secure, restrain and load (or release) the giraffe.

Handling immobilised giraffe

Standardised procedures

- In the field giraffe are usually held in lateral recumbency and immediately reversed once restrained (ideally within 30 seconds of being restrained). Regurgitation and aspiration in this position is less of a problem once the animal has been reversed (i.e. is awake).
- Importantly, the head/neck of the giraffe should be kept facing uphill if on a slope, so the giraffe may need to be manipulated.
- If the giraffe must be immobilised for a longer period of time, the neck should be supported, sometimes with a board or ladder, with the head above the rumen and the nose pointed down, to facilitate drainage of any fluids such as saliva or regurgitated material. A partial opioid reversal is often used during longer procedures.
- Always work from the back side of the giraffe to avoid kicking legs.
- If available, oxygen can be supplied by nasal insufflation.
- Sufficient space and good footing are essential for the recumbent giraffe to regain their feet during recovery. Remove any rocks/tree branches or vegetation around the front of the giraffe (or under if possible) to prevent trauma during recovery. If unable to do so, move the giraffe using ropes away from the obstructions.
- Safely remove dart (by first checking to make sure the dart has discharged or depressurised prior to its removal) and treat dart wound with an antibiotic ointment. When possible, mark dart site with coloured antibiotic wound spray. Notify any team members handling the giraffe of the dart location so they can avoid touching this area as the immobilisation drugs are lethal to humans. This ideally should be done by the veterinarian in attendance to minimise the potential for accidental human exposure to the opioid drugs.

Monitoring

The fact that giraffe are fully (or partially) reversed with the antagonist limits what can be done to them in the field. Once down, restrained and reversed, it will take time for the heart rate, blood pressure and respirations to normalise. Any procedures should be carried out as quickly as possible and vital functions (respiration, temperature, heart rate and capillary refill) continuously monitored whilst the giraffe is recumbent. The first ten minutes are critical. Respiration, temperature and heart rate should be the primary focus, in that order. It should be kept in mind that the level of exertion and excitement of the animal during capture and induction will affect these readings. The age and condition of the animals will also have an impact e.g. old, heavily pregnant, very young.

If available, a blood sample should also be assessed in the first few minutes after the reversal has been given, to measure serum lactic acid levels (using I-stat machine and CG4 cartridges or similar). Preliminary research suggests that lactic acid levels of 12 mmol/L or higher in giraffe could indicate that the individual is at risk for fatal capture myopathy (Dadone *et al.* unpublished data). If high levels are measured, the veterinary team should consider whether to proceed with the transport/procedure or release the animal

to minimize further stress. To help minimize the risk of fatal capture myopathy, medical treatments could include vitamin E and flunixin meglumine injections.

Extra members of the team can help with monitoring vital signs although care should be taken not to have too many people around the recumbent giraffe, blocking airflow to the animal. If more than one dart was used, check if all the dart contents were injected as this will affect how much antidote should be used. If unsure, administer full dose of antidote for the amount of drugs in all darts. If available, a pulse oximetry can help monitor blood oxygenation and pulse. The sensor clip should be attached to the giraffe's ear or vulva. The ear must be scraped on both sides to provide more accurate readings. The sensor should be covered to keep it out of the sun. A rectal probe against the nasal mucosae also works well. Even with the best plans, procedural complications can occur and the team leader should have sufficient knowledge and experience to call off a capture if the animal is under too much stress. As an example, the giraffe should not be recumbent for more than 30 minutes.

Eyes, ears and ropes

For transporting, once recumbent the giraffe's ears should be plugged with cotton wool (or equivalent), a head halter with blindfold should be put in place and the necessary ropes for leading the animal attached. If the giraffe is only having a snare removed, being fitted with a GPS satellite unit or another procedure not requiring transport, then all the above applies except for the head halter and ropes.

Figure 7: Examples of giraffe in a head halter with blindfold and guiding ropes. *Images courtesy of Sean Viljoen/GCF.*

Respiration/oxygen

Most animals will suffer from some degree of oxygen debt after capture due largely to the respiratory depression associated with anaesthetic drugs (opioids), and it may be necessary to give oxygen to a recumbent animal, if available. Giraffe need very high blood pressure to provide adequate circulation and oxygen delivery to the brain thus the heart operates under extreme pressure and has a high oxygen demand (Paton *et al.* 2009). They also have a large physiological "dead space" because of their long tracheas and this compromises gas exchange in animals that have depressed respiration.

Respiration is the first and most important function to be monitored. There must be a free flow of air in and out of the nostrils, which can be checked by holding a hand in front of the giraffe's nostrils.

Breathing should be slow, deep (to ensure air reaches the lungs) and regular. Monitor for at least 30 seconds as breathing can change during recumbency.

The respiration rate of a resting giraffe will be between 8-10 breaths per minute. After capture and induction this can increase to more than 12 breaths/minute (Vogelnest & Ralph 1997; Geiser *et al.* 1992). Historically, a dose of butorphanol can help with respiratory depression and a regime using thiafentanil and butorphanol has been used for capture of wild giraffe for this reason. However, with the complete reversal of opioid drugs with naltrexone, butorphanol use has become obsolete in managing respiration. Some veterinarians have also used doxapram to manage respiratory depression, but this is not common practice.

Venous blood is a good indicator of blood oxygen levels. Dark red or black colouration indicate poor levels of oxygen saturation. The colour of mucous membranes is also a good indicator, and should be a healthy pink. Giraffe that have gotten overexcited and are hyperthermic should be given oxygen (if available) and have water poured over their thorax and rubbed into their fur.

If oxygen is necessary, giraffe can be intubated with an endotracheal tube. Giraffe can be intubated "blindly" without visualising the airway. To do this, an experienced team member can carefully feel for the glottis with the endotracheal tube and insert into the airway or a team member with a relatively narrow hand can manually palpate the glottis (if the giraffe is large enough to accommodate this) and then feed the endotracheal tube into the airway (but this requires the giraffe to be deeply anesthetised). They are best intubated using the 'bush technique': visualising the glottis with a laryngoscope, passing a tracheal exchange catheter through the glottis, threading the exchange catheter through the Murphy's eye of the endotracheal tube, and passing the tube through the glottis using the exchange catheter as a guide. They can also be intubated by passing a fibre optic endoscope through the endotracheal tube visually passing the endoscope into the trachea and then using the endoscope as a stylet to place the tube. Oxygen can then be supplied by insufflation or jet ventilation and respiratory support given with a one or two demand valve system or field ventilator. Concurrent monitoring of respiratory rate and depth, and blood oxygenation remain essential.

If the giraffe stops breathing more reversal (ideally naltrexone or diprenorphine) can be administered and artificial stimulation given on the chest.

Body temperature

Monitoring body temperature is an important indicator of the level of exertion that the giraffe underwent during induction. Every 1°C increase in temperature will increase oxygen consumption and possibly the need for supplementary oxygen. Giraffe are prone to both hyper- and hypothermia under immobilisation. Temperatures will vary according to ambient conditions but they should not be allowed to become too

hot and if the excitement during induction was high, they should be cooled down using water rubbed onto the skin.

Giraffe have a normal body temp of 38.5°± 0.5°C. They have several unique thermoregulatory features including the extremely long neck, which allows for good heat exchange (Mitchell & Skinner 2004). Their ossicones have limited macroscopic vascularisation in and around the ossicone and it is unsure how much they assist with thermo-regulation (S. Ferguson pers. obs.). The brain is kept cool by evaporation through the nasal passages. They are equipped with sweat glands, particularly under the dark patches but sweating does not seem to be their primary method of cooling down. Monitoring of the temperature throughout induction and recumbency is vital. If body temperature exceeds 41°C, the team leader should consider calling off the operations and release the giraffe. During induction, there might be a slight increase in rectal temperature (0.3-0.5°C) as the heat moves from the muscles into the general circulation.

Heart rate and blood pressure

Heart rate is best obtained using a stethoscope, by feeling the caudal artery under the base of the tail, on the inside of the ear (auricular artery), along the lower jaw (mandibular artery) or by putting a flat hand against the chest. It can often be seen by looking at the chest wall over the heart. The heart rate in an unstressed animal is usually about 60 beats/minute but can be as high as 150 beats/minute if the giraffe had a difficult capture and induction.

The giraffe has the highest blood pressure of any mammal due to its unique physiology and the need to maintain cerebral oxygenation (Paton *et al.* 2009). Blood pressure can be measured using a blood pressure monitor with the cuff attached to the metatarsus (back lower leg) or to the tail. The range in unstressed giraffe will be between 140/90 to 180/120 systolic/diastolic. Capillary refill time (CRT), which measures peripheral perfusion, can be measured by pushing hard against the giraffe's gum for about two seconds then releasing and counting how long it takes the gums to go from pale to pink again. CRT should not exceed more than two seconds.

Dart wound

The dart and dart wound should be handled by the veterinarian only. This is to minimise the potential of team members being exposed to the dangerous immobilisation drugs. Darts are best removed by twisting in one direction and pulling at the same time. The wound must be cleaned and treated. As an example, 5 ml of a 100 mg/ml solution of oxytetracycline can be used directly into the wound. Alternatively, intramammary antibiotic preparations can be infused directly into the dart wound. A long acting broad-spectrum antibiotic should also be given. It is not recommended to use a lanolin-based cream.

Drawing blood

The most commonly used vascular site is the jugular vein, which is most easily accessible closer to the head although palpitation may be necessary to reveal it. Auricular and facial veins are also easily accessible. If blood gas monitoring units (such as an I-stat) are available and the field team has prior experience with arterial blood sample collection, monitoring arterial blood samples can also be considered to collect more detailed information on anaesthetic parameters.

Medical Record Keeping

To help track giraffe procedures and continue to improve giraffe field technique safety, medical records should be kept for each giraffe anaesthesia. Records should include the name of the overseeing veterinarian, the doses and times for all medications given (especially immobilisation drugs and their reversals), the sex of the giraffe, any relevant health findings (i.e. site of old injury or skin disease, whether lactating) and an estimated age of the individual. Additionally, it is valuable to record time of dart, time

giraffe became recumbent, whether casting ropes were used, time of anaesthetic reversal, total time recumbent, time in transport to the boma, and other key events or complications. Physiological parameters such as rectal temperature (every 5-10 minutes while down), heart rate, and bloodwork results should also be documented. The results should then be compiled into a summary report.

Additional tasks

For female giraffe, check for signs of late stage pregnancy or a dependent calf, as this will make the giraffe a poor candidate for translocation. Signs of a dependent calf can include mammary development with milk production, vulvar swelling or discharge, or a perineal tear. Once the blindfold, ear plugs, ropes and/or halter are in place, the purpose would be to load as quickly and safely as possible.

Reversal

As emphasised, giraffe are usually fully reversed immediately after capture and manually restrained during preparation for loading, which can be anything up to 30 minutes of recumbency time. Reversal for etorphine or thiafentanil induced giraffe is diprenorphine (2 mg/mg of opioid used) or better naltrexone (at least 10-30 mg/mg of opioid used). Giraffe should not be sedated for transport.

It has been shown that intravascular injection for reversal is better for the giraffe, particularly as it is reversed immediately on recumbency. The key points to observe during recovery are that the footing around the animal is good, dangerous obstacles are removed or covered (as far as possible) and good distance is between the handlers and the rising giraffe. If needed, the animal can be pulled into sternal recumbency using the ropes but importantly should be allowed to rise in its own time. Too much pushing and pulling is not recommended. Importantly, and as much as possible, the head should be held in place to prevent the giraffe injuring its head or neck by falling back as it tries to stand.

Other drugs and doses for immobilisation

Additional drugs for treatments that may be of use during immobilisation include long acting antibiotics, anti-inflammatories and potentially antiparasitics and vitamin supplementation (Table 4). All doses are based on recommended cattle doses and are off-label. The supervising veterinarian should confirm doses based on what is written on the bottle you are using, prior to administering to a giraffe. Caution should be taken when considering the use of antiparasitics as there can be detrimental secondary effects on dung-dwelling insects (Jacobs & Sholtz 2015; Verdú *et al.* 2018).

*NOTE: don't inject more than 10 ml of medication per site to help minimize injection site abscess. If injecting more than 10 ml of a medication, use multiple sites.

Table 4: Supplemental drugs and dosages that may be useful during immobilisations.

Drug	Function	Dose	Route	Comments	Don't Use With
Ceftiofur CFA	Long-acting antibiotic	6.6 mg/kg	S.C./I.M.	In cattle, up to 7 days	
Noromycin 300 (oxytetracycline)	Long-acting antibiotic	6.6-11 mg/kg	S.C./I.M.	In cattle single dose treatment for wound infections	
Flunixin Meglumine	Non-steroidal anti-inflammatory	1.0-2.0 mg/kg	S.C./I.M.	In cattle, lasts about 1 day	Dexamethasone; Dexamethasone

Drug	Function	Dose	Route	Comments	Don't Use With
					SP; or any other steroid
Ivermectin	Dewormer/parasite treatment	0.2 mg/kg	S.C.	In cattle, can last 14-28 days, depending on parasite	Use eprinomectin instead, if available
Eprinomectin	Long-acting dewormer/parasite treatment	1 mg/kg	S.C.	In cattle, can last 100-150 days	If available, use instead of ivermectin
Vitamin E (tocopherol)	Antioxidant; may help prevent capture myopathy	7-10 I.U./kg	S.C.		

Nonchemical/Mass Capture

An alternative capture method that should be considered, especially if planning to move a large number/entire herd(s) of giraffe, is mass capture. This method utilises herding animals by a helicopter through a large funnel into a holding boma or directly onto a transport truck (Laubscher *et al.* 2015; Kock & Burroghs 2014). The technique described here was first developed in South Africa in 1968 by Jan Oelofse to reduce capture related injuries and mortalities and is now the most widely used method for mass capture in Southern Africa (Laubscher *et al.* 2015). Animals that are easily stressed can be captured and transported with minimal trauma using this method, though one disadvantage of this method is the inability to isolate specific individuals from a herd (Kock & Burroghs 2014).

Plastic sheeting is used to construct a large funnel divided into curtained segments leading either to a ramp into the transportation truck or into a capture boma (Figure 8). The mouth of the funnel should be at least 100-120m wide to allow adequate access to the funnel entrance and well camouflaged (Laubscher *et al.* 2015). Giraffe perceive the plastic sheeting as a solid barrier during capture and are encouraged further into funnel by closure of strategically placed curtains pulled closed by personnel after the animals run past thus also preventing the animals from turning around (Kock & Burroghs 2014). Care should be taken to ensure all components of the funnel fulfil the height requirements for giraffe – especially ensure any wires strung for curtain closure are at least a meter higher than the tallest giraffe (for example at least 6m in height if any large bulls present) to reduce the chance of injury during capture. It is useful to have an audio cue (such as a siren) triggered when animals enter the funnel, so staff are alerted and can be ready to close the curtains as animals run past.

Position of the funnel is important to overall success of the capture. Ideally, the funnel should be positioned upwind from where the giraffe will be herded and the walls should have adequate camouflaging to reduce chances of giraffe spooking at the entrance and refusing to enter the funnel (Laubscher *et al.* 2015). A competent and skilled helicopter pilot is essential for the success of mass captures as is a competent and experienced ground team (Kock & Burroghs 2014). Once captured, the maintenance and transport of giraffe is the same as chemically immobilised individuals.

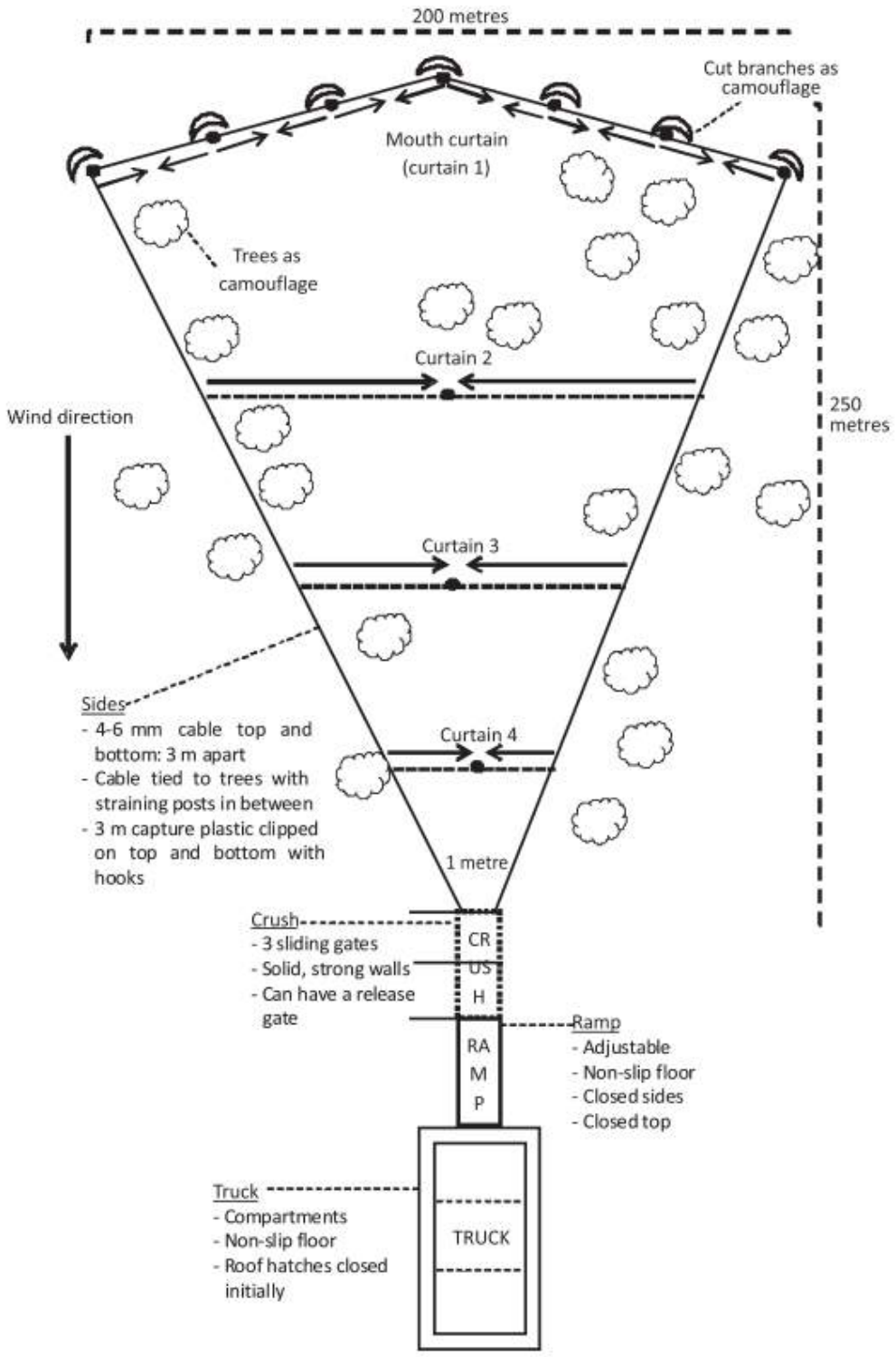

Figure 8: A schematic of a boma funnel used for mass capture. *Laubscher et al. 2015.*

TRANSLOCATION

Translocation through bomas

Many giraffe have been translocated using bomas whereby giraffe are mass captured into large bomas or transported by chariot and dropped off in the boma after capture and before the next stage of the translocation. Various options are highlighted below which may be valuable to consider. In general, giraffe should never be individually housed in bomas for extended periods, as they are sociable animals and likely become stressed and at greater risk of capture myopathy, injury, or even death. The exception may be for large, dominant giraffe males, which will quickly assert their dominance with other males thus may not be good candidates for translocation unless done so individually. However, these males should preferably be in a boma next to the others to minimise their stress.

Boma to boma

After capture, the giraffe have either been mass captured in or are transferred to a boma close to the capture site where they are kept for a period of time before being transported to the release site where they are held for a further period of time before being released ("soft release"). This enables animals to be monitored individually for illness, overall body condition and to acclimatise allowing a less stressful move. In addition, the giraffe are exposed to and hopefully can become used to the local browse and conditions of the capture area. If problems arise, the giraffe can be released easily.

Field to boma

After capture, the giraffe are moved directly to a boma at the recipient site ("soft release"), where they are held for a period of time before being released. Whilst this is probably appropriate where distance and environmental conditions are not too far removed from their home environment, the disadvantages to this are:

- Transport directly after capture may be more stressful for the animal(s).
- If conditions or environment are very different to what the giraffe are used to there may be added stress factors e.g. unfamiliar browse, water availability.
- If the animals are released prematurely for any reason, it will be in a totally unfamiliar environment.

Boma to field

The giraffe are transferred to a boma close to the capture area. They are held there for a period with the advantages listed above before being transported to the recipient site and released directly ("hard release"). This works well in some environments but may not be a good option in others as ideally the giraffe should be allowed time to acclimatise in the new environment whilst under observation, particularly if the conditions are very different from the capture site. The animals are also likely to be stressed after the transport and can be dehydrated so release in proximity of a water source may be important for them to be able to locate drinking water. However, if the distances travelled is not long, the giraffe travelled well and/or the browse available similar, the stress maybe reduced and possibly advantageous for the giraffe in a group.

Field to Field

This option can be advantageous if the environmental conditions and distance between sites are not too great. The giraffe are either mass or individually captured and immediately transported to the recipient site and released directly ("hard release") into the field.

Other considerations

- Giraffe should be kept as stress free as possible.
- Experienced capture team that are capable of catching, transporting and releasing giraffe with minimum stress and problems.
- Distances between capture and recipient sites are preferably not more than a few hundred kilometres away – however, acknowledging that if longer translocations are required then other a highly skilled team is important or other options are assessed.
- Field conditions are good enough to allow quick inductions and recoveries, particularly if several animals are to be moved at the same time.
- If the available boma situations are less than ideal, field to field can often be better than placing the giraffe into a situation where they may be more stressed and lose significant body condition.
- If moving during the winter season, wind chill can be an issue during transport and the vehicle or transport crate should provide adequate protection.

TRANSPORTATION

Problems with transportation

Transporting giraffe can be challenging, primarily because of their physiology, height and shape. Giraffe are best transported from the field in a chariot (field recovery crate – see below) still blindfolded. Once they arrive at the boma or transport truck, they are transferred and any remaining ropes, along with blindfold and earplugs are removed. The giraffe are fully reversed before loading (preferably immediately after capture) and should not be given sedatives or neuroleptics whilst being transported due to the danger of disorientation, unsteadiness on their feet and collapsing. The truck must either be open topped or of sufficient height so that the giraffe are able to stand with their necks fully extended, or slightly bent if a small move.

Some of the problems associated with transport are:

- Injury or fracture of the head and/or damage to the ossicones caused by bumping.
- Neck and spinal cord injury if the giraffe falls or becomes entangled during transport.
- Fracture or injury to the neck or legs through losing balance and falling.
- Injury and leg entanglement when transporting several giraffe together.
- Heat stress, particularly if hot and vehicle breaks down.
- Respiratory problems if transported in an open vehicle caused by wind and dust.
- Hypothermia if the weather is inclement and wind chill factors are high.
- Vehicle accidents.

Preparation

As with any transport of live animals, sufficient preparation is vital. There is a high level of responsibility incurred when travelling with live, wild animals, particularly as giraffe are not sedated. The driver must be skilled and experienced. Transitions between gears must be as smooth as possible and sharp braking/sudden swerving avoided, as giraffe will be unsteady on their feet. Frequent checks must be made on the animals to ensure that they are not suffering undue stress or have fallen. The veterinarian must always accompany the vehicle, along with extra handlers in case emergency action is required.

Chariot (field recovery crate)

The chariot is a critical piece of equipment and used to move a captured giraffe from the field, relatively short distances, to the boma or transport vehicle. The crate should be approximately 2.3 m long, 2.3 m high and 1.1 m wide (Morkel 1993), with a clearance of ~500 mm (if the floor is higher, the crate is more unstable for the giraffe during transport). The crate should preferably be built of wood and/or metal. The floor of the crate should have good, a non-slip surface. Bolted, woven, rubber matting (e.g. 10 mm rubber conveyor belting) is ideal for this, otherwise a thick layer of sand or equivalent can work. There should be high sides and no gaps or prominent fittings where a giraffe could stick its head, neck or leg through and injure itself. External observation panels are usually at higher levels as there is a danger of giraffe putting their feet through lower slats. Many chariots are designed for a single animal, or mother and calf, but duel chariots also work well if operated by an experienced capture team.

The chariot should preferably be mounted on a dual axle system with independent suspension. The tow-hitch should be a hold and pin type (not ball type). The rear door should extend the total height of the crate. On the outside of this door is a folded loading ramp the width of the crate, with hinging on the floor

of the crate. The front of the crate should preferably have a padded 150-200 mm round restraining bar, about 500 mm from the front, to both restrain the giraffe while leaving space for the legs and preventing the giraffe from pushing against the front of the crate. Along the outside of the front of the crate, about 500 mm from the top, should be a 300 mm wide catwalk to facilitate removing the blindfold from the giraffe prior to unloading the animal.

Figure 9a: Examples of giraffe chariot configurations used across Africa. *Images courtesy GCF, except bottom left courtesy of Michael Brown/GCF.*

Requirements

- Chariot for field transport and transport truck
    - Serviced and in good condition.
    - Spare tyres, wheel spanners, jack, hacksaw, bolt cutters, spades, picks and toolbox.
    - Water, fuel, oil, brake fluid, hydraulic fluid checked and extra carried.

Figure 9b: Example of a giraffe transport truck configurations used across Africa. *Courtesy of Sean Viljoen/GCF.*

- Driver and driver assistant
    - Trained in driving live animals.
    - Aware of the need to control sharp movements.
    - Not to drive too fast.
    - Stops should not be made where there is a lot of noise.
    - Driver should be aware of what the giraffe are doing.
    - Carry additional money, food and drinks to limit stops.
    - Carry cell phone, credit and contact numbers for relevant people.
    - Carry map or GPS with coordinates.
- Back-up vehicle(s)

- Torches (flashlights)
- Communication – phones and/or walkie talkies between truck and support vehicles
- Spare straps, ropes, blindfolds and head halter.
- Veterinarian(s), equipment and drugs, especially prodder and pole syringe should be on the truck.
- Route well planned and escort provided where possible, and support vehicles traveling with. The route must avoid low-lying power lines and overpasses. Low-hanging or obstructive branches must be trimmed in advance (or on route if needed).
- Contact maintained with the recipients of the giraffe throughout translocation.

Techniques

The transport of giraffe for the sake of this document is related exclusively to road transport between wildlife areas (Parks, Reserves, Conservancies, etc.) in Africa. There are other techniques that relate to sea and air transport for wild or zoo-based animals, but these are not covered here.

As stated previously, giraffe should not be transported anesthetised or sedated, and must be completely reversed from the opioid drugs. Giraffe are usually transported standing up but if an animal sits down, and is not in any danger of being stepped on by other giraffe, it can be left in sternal recumbency for a period if its physiological status is monitored and it seems comfortable and stress free.

The chariot should be towed by a sufficiently strong vehicle such as a Land Cruiser or tractor. When loading, the chariot should be backed up close to the recumbent giraffe allowing sufficient space for it to get to its feet. Once the giraffe is standing, and restrained by ropes around its neck, chest and legs, the capture team must then walk the giraffe into the trailer using the ropes and if needed, pulling the animal in – similar to the method used when loading a recalcitrant horse. Great care must be taken to avoid giraffe kicks and the process should be as quiet and stress free as possible.

Once the giraffe is in the chariot, it should be transported slowly and carefully to the boma or transport truck, preferably with ropes removed. If there is not a dual opening on the chariot, it should be backed up to the boma or truck's door and the animal carefully backed out, taking care to avoid handler injuries from the head should the giraffe lash out. Before the giraffe enters the boma or truck, which should also have similar flooring to the chariot, the earplugs and blindfold – preferably in that order, should be removed so the giraffe is completely unencumbered for the duration of the journey or time in boma. Any blindfolds or other restraints could exacerbate the giraffe's instability on its feet. The boma or truck must be free from any protuberances that could injure the giraffe. The boma and truck should be as quiet as possible, with additional noise minimised. In a truck, there should also be good drainage for urine, as this will make the floor slippery e.g. place several inches of sand along the floor of the truck. There should be sufficient ventilation, particularly if ambient temperatures are high but wind chill should be minimised. If possible, rubberisation of the walls of a truck is advantageous as it will help prevent falling injuries and rubbing off of the skin. It also helps with sound proofing and warmth.

The truck must be either open topped for short distances or sufficiently high for the giraffe to stand with its neck fully extended. Once loaded in a truck, the giraffe should be driven directly to the recipient site and unnecessary stops should be avoided to help minimise stress to the animals. Slow and steady, as with all animal transport, should be the rule.

HOLDING GIRAFFE

Holding facilities

Site Selection

There are several factors to consider when positioning a boma. One of the principal considerations to help decision making is whether the boma is to be used once or a few times to release the giraffe (or other animals) into their new habitat. The boma should be situated:

- centrally to the old and new translocation areas;
- away from fences;
- close to a water source(s) but not near rivers that could flood;
- away from hazards like cliffs;
- in good habitat with plentiful browse for the giraffe; and
- away from human disturbance.

For bomas that will be used frequently there are some additional considerations. The boma should be situated:

- close to roads;
- with easy access by supervisory staff and labour; and
- being near good supply of water and electricity can be an advantage.

All bomas require the following factors taken into consideration:

- Surface: Substrate should not get too dusty or slippery, for example sand or gravel. Good drainage is also important.
- Wind: Pay attention to the prevailing wind. The boma should be upwind from human habitation and downwind from water sources for release purposes. The wind should also not blow directly into shelters.
- Cold: Captive giraffe are very sensitive to the effects of cold so the boma should not be situated in a low lying or damp area with too much wind.
- Heat: Shade should be provided for the animals, in the form of a covered shelter – natural or man-made. Whilst too much wind is a negative factor, there should be a free flow of air through the boma to ensure that the giraffe do not get too hot, particularly in summer. If there is a tree in the boma for shade, branches should be removed up to the height of the tallest giraffe, to minimise risk of injury to the animals.
- Sun: The angle of the sun can be a factor, particularly when further away from the equator.
- Fire: A firebreak should be made around the boma and firefighting equipment should be present at the bomas in case of emergency.
- Staff: All bomas should have at least one, preferably two staff members present at the boma at all times. In addition, there should be adequate staffing during the day to care for the animals while housed in the boma (feeding, watering, cleaning, maintenance, etc.).

Boma design and construction

Before going to the expense of constructing a boma, some factors should be taken into consideration:

- Is the boma temporary or permanent?
- Will the boma just be used for giraffe or will other animals be using it too? This will have an impact on the size and robustness of the construction.

- Is the boma for a once-off release or will it be used many times over the years?
- Would a mobile boma be a better option?

Size

Giraffe require as a minimum between 12-15 m^2 per animal, 18 m^2 minimum if holding for any period longer than a few days. The walls of the boma should be at least 3.5 m high, or 4.1 m for adult giraffe. If necessary, the walls of ordinary game bomas can be extended to 4.1 m by spanning cable at that height and using a hessian or plastic curtain to close the top. However, having a view out has also been observed to help calm giraffe and if not a safety concern may want to be considered.

Materials

Various materials can be used in the design of bomas for giraffe including wood, steel, mesh and/or brick. However, wood is probably the material of choice as it is stout and more animal friendly than metal which can be either too hot or too cold and does not "give" if the giraffe runs into it or leans against it. Wood should, however, be treated against termites and other insects if it is to last. Creosote is toxic so alternatives such as Tanalith should be used. Giraffe tend to lean against fences to reach browsing trees outside so the walls if near so must be sturdy enough to withstand this. If a combination of wood and steel is used, it is a good idea to cover the metal with padding such as conveyor belting. The inside of the boma is best covered in a mesh and/or pole/wire structure to prevent them from pushing or seeing through. This will help to minimise stress.

An option for giraffe that are being released immediately can be mobile bomas made of steel and conveyor belting, which can be quickly assembled and dismantled.

Design of Boma and Shelter

Giraffe bomas should have facilities for separating animals if necessary, e.g. if an injury occurs or for introduction of new animals.

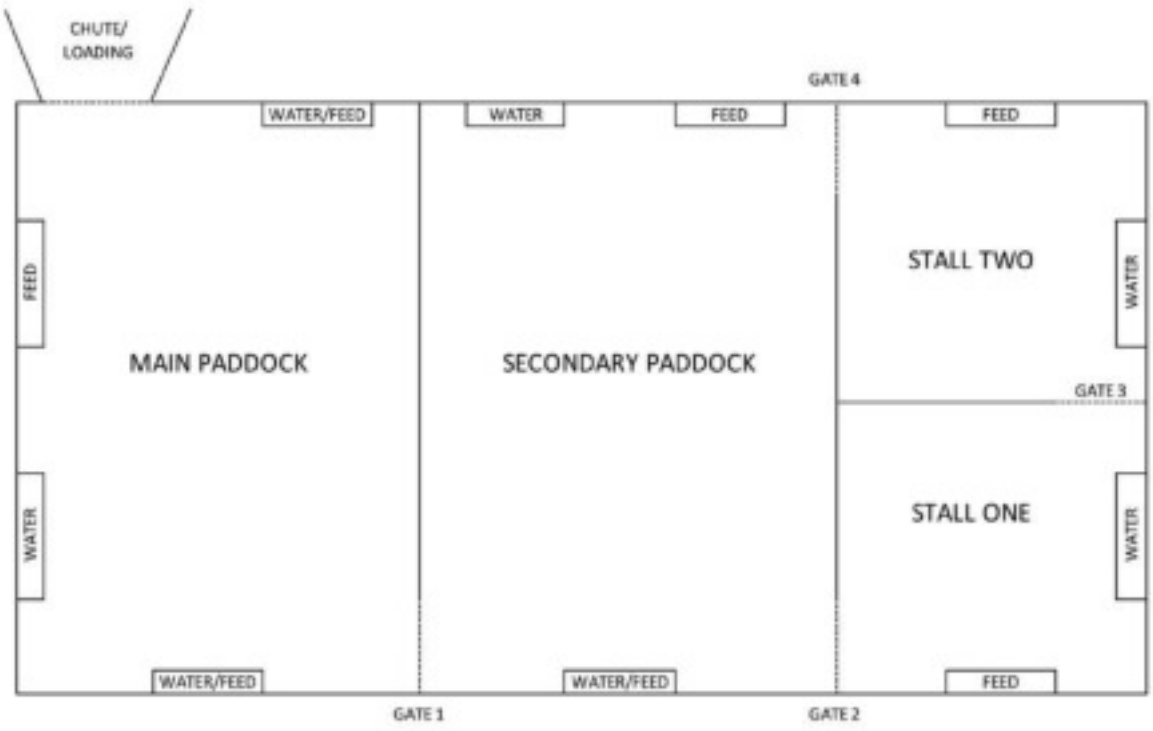

Figure 10: Schematic sketch of boma layout.

The area should not be too steeply sloped, although some sloping is valuable for drainage. The substrate should be firm, well drained and not too dusty.

Shade and shelter from the elements are critical to the well-being of giraffe in bomas. A shelter must be provided, especially if holding animals for extended periods. Trees may or may not provide sufficient shade as they can lose their leaves and the giraffe will eat them so it is important to assess this appropriately. Additionally, if trees are in or around the boma, they should not be a toxic species and all branches should be above head height of the tallest giraffe. Shade netting is also not considered a good option as it may flap in the wind and sag down into the boma. Therefore, if for long-term holding or numerous captures, a properly constructed giraffe boma should be provided. Some considerations for this are:

- Giraffe bomas can be open plan or a series of stalls, depending on the group structure. Sometimes it is necessary to separate animals, for example, one male from another male.
- The size of the boma will depend on the number of animals being held, bearing in mind the minimum space per animal. There should be room for all individuals to lie down, and enough area for food, water, etc.
- Giraffe walkways should be wide enough for them to turn around in.
- Bedding material inside the boma can be provided in the form of sawdust or straw if needed, particularly if the giraffe are to be held for a longer period of time. Giraffe will less likely lie down on hard substrates.
- Access into and out of the boma from the chariot/truck must be high enough so that the giraffe can move in and out without having to duck their heads. This means that any shelter/roof structure must be at least 6 m in height if accommodating large males. If built, the roof should be solid with the drainage angle taking water away from the boma using gutters if necessary. There should also not be any single support poles in the boma.
- Ventilation is important as materials such as corrugated iron can get very hot in the sun.
- Attention should also be paid to the location of the openings bearing in mind the direction of the prevailing wind and the position of the sun at different times of year.

Walls

The walls of the boma must be a minimum of 3.5 m high. They should ideally be made of sturdy poles because of the tendency of giraffe to lean over them to try and reach food outside. There are a number of considerations for wild caught giraffe regarding the boma walls, and the following are good examples but see below figures as examples:

- A solid wall made up of tightly fitting poles at the back of the boma with gap walls (10-12 cm between upright poles) at the front of the boma. These gap walls help with accustoming giraffe to human presence and if the newly caught giraffe are very stressed, the gaps can be temporarily wired shut. Vertical support poles and corner posts should be cemented in if possible.
- Horizontal poles used to support the walls should be placed about 30 cm from the top and bottom of the wall. They should be long enough to go between the vertical support poles. If they are not long enough and two poles have to be used, the overlap should be at least 1 m.
- Vertical wooden poles should be either bolted, held by bent round bar or wired to the horizontal support poles. Bolting is the best but care must be taken to countersink bolts/nuts to prevent protruding metal objects.
- Cable bomas have the vertical poles wired to a strong cable stretched between corner posts. The cable has a lot of “give” if leant on by the giraffe but can be used with no real problems.

- A walkway or viewing platform at head height can be valuable for observation and feeding purposes (hanging browse, filling feed racks etc.), especially if animals held for longer periods. If necessary, giraffe can also be darted from the walkway.
- The internal walls should be smooth and there should be no protruding objects, which the giraffe could damage itself on. The giraffe should also not be able to access any electrical fittings.

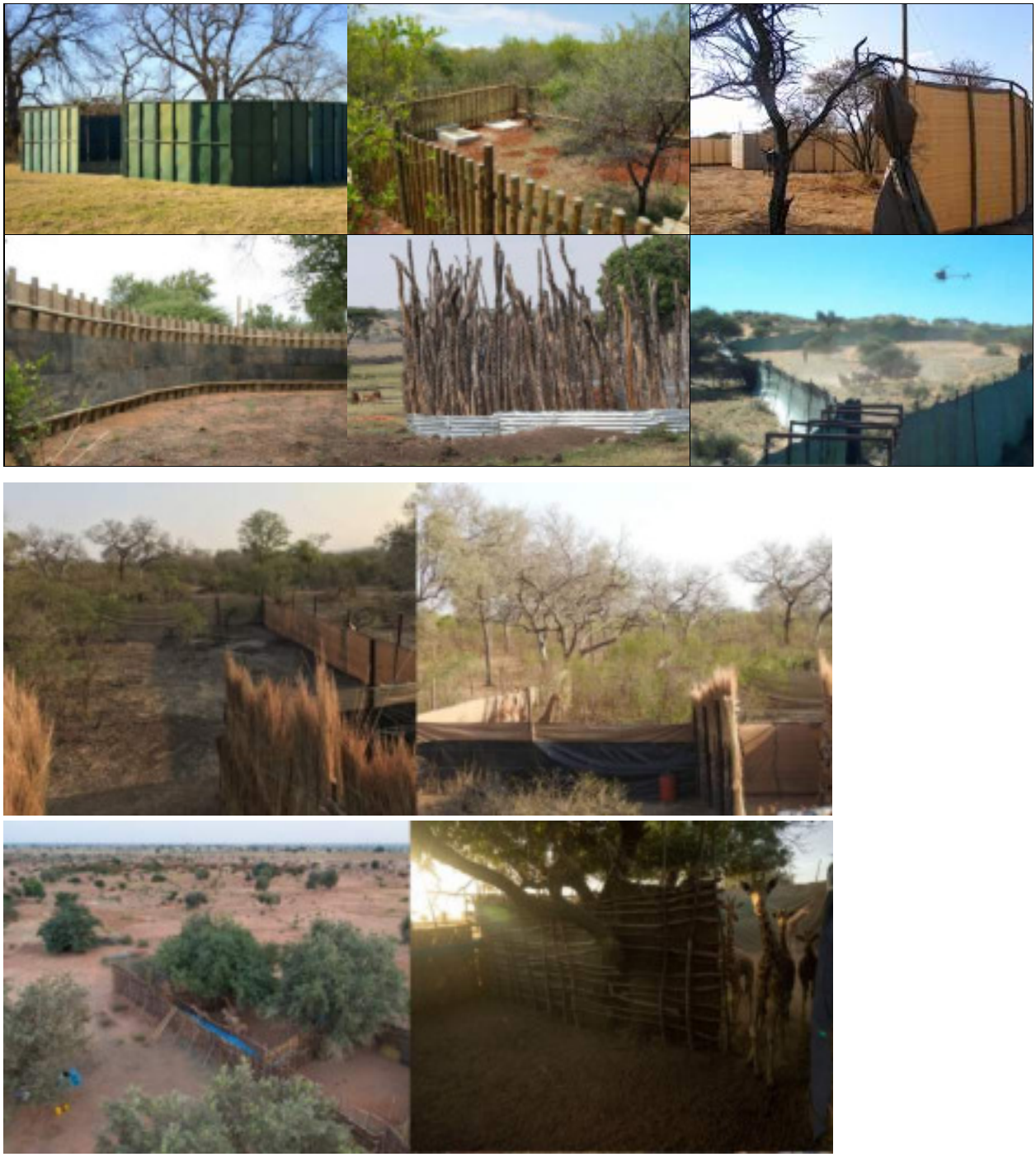

Figure 11a & 11b: Giraffe in various boma constructions. *See Image Reference for 11a. Images courtesy of GCF (11b top), Sean Viljoen/GCF (11b bottom).*

Figure 11c: Giraffe in various boma constructions. *Image courtesy of Michael Brown/GCF (11c).*

Doors/barricade

Doors or barricade are essential for boma management. The most important thing to remember for a door/barricade used for giraffe is the height and width. The height must be sufficient so a giraffe cannot stumble over and as such at least 6 m to accommodate large males if needed. They should also be 1.5 m wide to avoid giraffe becoming stressed through narrow gaps and to allow ease of entry for handlers and equipment. Giraffe can also become stressed about doors/barricades because of the association with noise, movement and human presence, so simple and easy can work well.

Sliding doors/barricades are considered the best option but might be challenging in some areas and can be made of either steel plate or wood that may or may not be padded. If a 'proper' door the sliding mechanism should have bearings for smooth movement and should be suspended on an overhead steel beam with support at the bottom provided by a beam or a pipe gutter. However, this is rare in the field. The door/barricade should be on the outside of the boma and should slot securely into the boma of the closing side. Fastenings and handles should be on the outside of the boma and should be secure. It is also advantageous to have a doorstop and a means of holding the door open if necessary. Swing doors should only be used on the outside of the boma and should only open outwards.

In the field, pole doors are often the easiest to manage and most cost effective. If poles are used, it is important that all staff are well trained in fitting them and supported appropriately, and they can then be covered with a mesh or similar to limit viewing out. Good communication is required in the team to ensure the safety and welfare of the animals and team.

Water trough

The water trough for a giraffe boma can be placed on the ground to simulate natural drinking practices or secured higher but in reach of all giraffe. It should be approximately 25-30 cm deep by 50 cm wide by 90 cm long (e.g. 60 cm inside the boma, 30 cm outside) or if wall-mounted at ~2-3 m (or low enough for the shortest giraffe) and secured appropriately.

The water trough should not be too big, as the water gets dirty and stale or, too small as it will be insufficient for their needs. Giraffe can drink up to 10 L of water at once so monitoring of water levels is necessary. In more permanent bomas, a float valve can be fitted to ensure that there is always adequate water. However, it is also very important that stale and dirty water can be emptied easily (either by a

bucket or using a suction pipe). A hole or a French drain should be near the trough to prevent the area around the trough getting wet and slippery during cleaning. Water troughs should be cleaned regularly and left to dry to inhibit algae growth. It can then be refilled but should be checked regularly to ensure that the water is clean and sufficient.

Importantly, the edges of the trough should be rounded and only 15 cm above the ground (if on the ground) to minimise potential welfare issues.

Figure 12a: Preferred browse species of giraffe in different (left to right *Vachellia abyssinica; Senegalia caffra; Boscia albitrunca, Faidherbia albida*). *See Image References.*

Feeding area

Giraffe feeding troughs, racks and browse should be hung at about 2-3 m off the ground, similar to the wall-mounted water trough – depending on the size of the giraffe in the boma. Any dropped food should be collected off the ground to avoid the giraffe over ingesting sand or dirt. Dedicated feeding areas should be used so giraffe know where to feed each time, and before actual translocation fed in the boma to sensitise them to the truck.

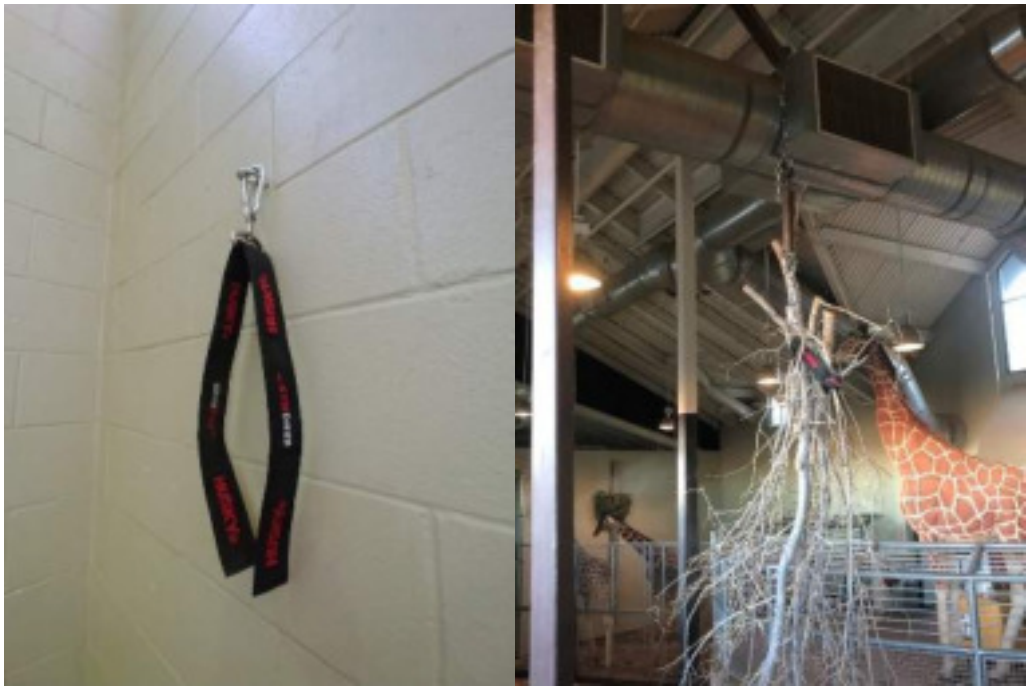

Figure 12b: A thick and durable Velcro strap can be useful for hanging browse in bomas. This is a useful but not necessary tool. *Images courtesy of Jason Bredahl, Cheyenne Mountain Zoo*.

When possible, fresh browse can be fed to giraffe in the boma by tying branches to the fencing. Branches are less likely to fall if they are tied at the fork in a branch. It is best to use a rope such as parachute cord that won't fall apart (and be an ingestion risk for the giraffe), and is easy to untie, as the branches will need to be replaced at least 3-4 times daily while the giraffe are in the boma. If available, Velcro straps suspended from a carabiner clip can be used (see Figure above).

Crush or chute

If giraffe are to be held for any length of time in a boma, it maybe advisable to build a crush or chute to restrain the animals without drugs for any routine procedures. The chute should be positioned in a place in the boma where the giraffe walk though regularly, so that they become accustomed to the confined space. Several designs exist from a standard 'cattle crush' to a hydraulic squeeze chute. The chute should be designed so that the sides are removable to allow easy access and if necessary, removal of the animal. The most common design of a crush is with a steel piping body and removable poles sliding into the frame. Sometimes webbed belly strapping and additional holes for further restraining bars are also incorporated but importantly all must be appropriate for the area.

Offloading ramp

The offloading ramp can be built-up or dug into the ground. A built-up offloading ramp should extend an estimated 7 m from an end boma – depending on the size of your vehicle and chariot. The ramp should gradually increase to a height of 1.6 m and preferably the last 2 m should be flat – this all depends on the truck being used and should be measured appropriately. If walls are to be built along the side of the ramp, they should be solid and the same height as the boma walls. The ramp width should be 1.5 m, the same as the doors.

Other considerations

- Obstacles: High, concrete water troughs, poles and other potential accident causing hazards should be kept out of bomas.
- Hideaways: Like most animals, giraffe prefer an area of seclusion. This should be partially closed, dark and quiet. This is particularly true of newly caught, wild giraffe. It allows them time to adjust before they are confident in the more open areas of the boma.
- Ease of management: A balance should be found between the needs of a nervous giraffe and the needs of those managing them.
- Other giraffe: If there is sufficient space, a group of unrelated giraffe should coexist together. Young males together in a pen may be prone to excessive necking and other behaviours if they are bored. It is a good idea to be able to separate these animals, as they may develop injuries from fighting, although contact should still be allowed. Having large males in the boma can cause greater issues and should be monitored. If issues arise males should be separated.

Introducing giraffe into a boma

Introducing giraffe into a boma should be as stress free as possible. Therefore, it is often a good idea to have a means of separating the animals already in the boma when new individuals are brought in. For example, females with calves should ideally be separated initially, particularly if there are males establishing hierarchy as the smaller animals could get injured.

Preparing the boma

- Check that the boma is free from sharp or protruding objects like nails or wire.
- Make sure that the doors/barricades that are supposed to be closed are closed and latched. Someone responsible should oversee the doors that are needed to be open (and closed). It is good practice to have two people complete these checks.
- The water trough should initially be empty as it potentially provides a slipping hazard if there is a lot of excitement on release. It can be filled once things have calmed down.
- Some natural browse should already be in the boma for the giraffe. Lucerne and cubes should not be given initially if available otherwise a variety of fresh browse.

Offloading

The truck should be backed up to the offloading ramp so that the opening door of the truck is directly in line with the offloading ramp. Barriers should be put in place if there any gaps between the door and the ramp. Before the doors are opened and the giraffe allowed to walk into the boma in their own time, each giraffe should first have its earplugs removed and then its blindfold. During this time, all those not directly involved should be away from the boma with only a few select individuals helping as and where required. All participants should remain as quiet as possible to minimise further excitement by the giraffe. Some gentle encouragement can be given if they show no signs of moving by prodding them gently towards the opening. Canvas can be placed over the gap between the walls of the boma and the truck door and slats of wood on the gap in the floor so the giraffe do not have a sensation of space. The giraffe should be calm and noise should be kept to a minimum. If offloading at night, ensure the handlers have sufficient light.

Captive care

Captivity is a huge adjustment for wild giraffe and handlers should be patient and accept that some individuals are easier to settle than others. Handlers should be selected based on their affinity with animals. Loud, abrasive personalities can cause anxiety in nervous animals. It is also important that consistency amongst the handlers is maintained and for routines established quickly.

Giraffe are generally considered tractable and intelligent. They adapt quickly to captive conditions, however, specialised monitoring is considered highly beneficial. Below we present some important care and management considerations.

Boma management

There should be two experienced people at the boma 24 hours a day to handle any potential emergencies. Some responsible individuals should sleep close the boma to listen out for any problems at night. A veterinarian should also stay near the boma after capture for any immediate response. The handlers sleeping close to the boma should be equipped with communication (cell phone/radio/sat phone), torches, rifle, prodder, ropes and tools for fixing the boma fence. Depending on the location, other animals like hyena, lion or elephant may come to the boma out of curiosity and the responsible people should be equipped to deal with any situation as it arises.

Handlers

Stress can be a contributing factor to capture myopathy. Care should be taken to minimise any giraffe stress while they are in the boma. The number of people visiting the giraffe should ideally be limited to their handlers/browse providers during the day, and to the transport team during loading and off-loading. Giraffe that are being translocated back into the wild should not be attempted to be “tamed”. Therefore, caretakers should be quite and calm while delivering food and water. Tents, fires and human activity should not be allowed near the boma, or where giraffe can be in visual site of them. If people are watching

the giraffe for safety reasons, they should station themselves within visual distance, but far enough away that it does not cause pacing or limit feeding behaviour of the giraffe.

Boma cleanings are not necessary if giraffe are only being held for a short period (i.e. less than 1 week), and depending on the set-up and condition of the boma. If cleaning is causing pacing, running or necking behaviours to occur, a decision should be made as to whether the cleaning is worth the stress. In between loads of translocated giraffe, the boma should be cleaned before new animals are brought in.

It is crucial to have an understanding of normal behaviour as any change, even expressing decreased or no behaviour at all, could indicate high levels of stress (Normando *et al.* 2018). Symptoms of stress behaviours in giraffe include flared nostrils, wide eyes, ears far forward or pinned back, pacing, kicking, necking, bucking, lack of appetite or drinking (Tarou *et al.* 2000).

Routine

If giraffe are in a boma for an extended period, it is important to establish a routine of feeding, cleaning, resting, etc. as quickly as possible – and to stick to the routine once established. An example of a routine is as follows, but should vary depending on the area:

- 7 am: Start to clean boma and refill water troughs, remove old browse and pellets on the floor beneath the feeding racks. Other staff members should start collecting fresh browse.
- 10 am: Boma is clean and fresh browse given.
- 12 pm: Check water troughs.
- 3 pm: Staff start collecting fresh browse for the evening feed.
- 4-6 pm: Old browse from the morning feed is removed, fresh browse is given and lucerne pellets (or other) given, as appropriate.
- 8-10 pm: Old browse from the afternoon feed is removed, fresh browse and lucerne pellets (or other) given, as appropriate.

Giraffe often ruminate and rest in the heat of the day so it is important to give them peace and quiet at this time. Cleaning in the initial few days after capture can cause unnecessary stress to the giraffe so it is a good idea to observe the reactions of the giraffe first before trying to do so. It is not worth provoking a stress related accident to clean the pen. Quiet confidence in the boma is essential and those cleaning should be aware of their surroundings and what the giraffe are doing.

Feeding

Nutrition of the giraffe under captive conditions is important. Particularly if they are to be kept for a longer period. It is vital that condition is maintained prior to release thus attention must be paid to supplying the right food in sufficient amounts.

Giraffe will eat approximately 2% of its body weight in browse daily. This equates to about 20 kg in an adult male so an average would be about 15 kg per animal – although potentially less in a boma. Giraffe are highly selective feeders and a variety of different browse should be put into the boma, preferences and quantities eaten should be noted. The browse must be hung at head height with leaves facing outwards and tied firmly with appropriate material (wire and plastic string should preferably not be used as the giraffe can ingest them). It should be cut as soon as possible prior to feeding to prevent wilting. Important to note, giraffe may only take small quantities of leaves from each preferred species before moving onto the next branch.

Giraffe in the wild, particularly males, feed more often higher up in trees where the leaves may be more tender and better quality. Care must be taken to select these for captive feeding as the lower leaves may contain greater tannins, making them less palatable and potentially dangerous if a large amount is eaten.

Preferred tree species, depending on the area, include *Acacia* (*Vachellia* and *Senegalia*), *Faidherbia*, *Terminalia* and *Combretum* species, as they are high in protein and calcium, important for the giraffe given the relatively small amount of bulk it eats compared to its size.

Browse can be kept for a short period if it is sprayed with water and kept in the shade or kept with the cut portion of the branch in water in a large barrel. However, fresh browsed is preferred by giraffe. Feeding in the initial days of activity may likely be lower than expected as the giraffe adjust to captive conditions.

Supplementary feeding

If extended time in the boma is required (longer than a week), giraffe should be put onto supplementary feeding as soon as possible in the form of good quality lucerne (~18% protein), bean hay, cubes, melons, etc. (described below). They require a high level of protein to maintain their condition and are unable to select their preferred browse in captive conditions, hence the need for supplementary food. All supplementary feed should be free from mould and foreign objects. It should be placed in the feeding racks at head height. If the giraffe are reluctant to take it at first, it can be mixed with chopped browse and sprayed with molasses or sugar water to make it more palatable.

Horse or browse cubes can also be fed. Horse cubes are not as good as the other options as the protein content is different. As much as 5 kg of browse cubes can be given to individual adult giraffe per day but should be introduced gradually. Cubes are normally placed on top of any lucerne provided or may be separate. They should not be fed on the floor because of ingesting additional sand and dirt.

A mineral block can also be supplied depending on the boma and amount of time the animals are inside.

Evaluating body condition

Giraffe are predominantly browsers that do not adapt easily to changes in diet. Therefore, it is essential to accurately evaluate the animal's condition prior to capture and monitor effectively while in the boma, especially as an animal that appears "healthy" can rapidly lose condition and die if the situation is not ideal in terms of environment and husbandry.

When monitoring body condition, special attention should be paid to the neck, particularly the base, which should be rounded and fleshy, as should the flanks and pelvic area (see Table below). Sunken flanks or prominent hip bones suggest that the animal is losing condition. Attention should also be paid to the colour, texture and general appearance of the pelage of the coat as an indication of general health. Finally, the condition of the hooves, particularly in animals that are in the boma for a relatively long period will reflect the general health of the individuals. While in the boma, fresh browse (from appropriate tree species) should be provided at least 2-3 times daily and attached to the sides of the boma at chest or neck height. Ideally, each giraffe should have access to a minimum of 100 kg of fresh browse each day (much of this weight will be branches and twigs which are not edible to the giraffe). For long-term management, this amount needs to be markedly increased. Giraffe should also be monitored to ensure they are defecating and urinating daily.

Table 4: Giraffe body condition scores and descriptions for monitoring giraffe in the bomas. *Anonymous, 2005*.

Score	1	2	3	4	5
Image					
Neck & Shoulders	Emaciated; Bone structure easily visible; no fat	Neck is thin; decreased girth	Neck is thin; Shoulders are flat	Neck is thick; Fat deposits are evident; Shoulders are slightly rounded	Fat is evident along neck; Bulging fat; Neck is thick; Neck blends into shoulder; Shoulders are rounded
Withers	Emaciated; Bone structure easily visible; no fat	Thin; bone structure is evident	Withers has fat deposits; Decreasing visibility of bone structure	Fat deposits are evident	Fat deposits make withers appear flatter/ less discernible
Lion & Back	Emaciated; Spinous processes (pointy back of vertebra) are easily identifiable	Spinous processes are not individually identifiable but spine is still prominent; transverse (side) process faintly discernible	Back is sloped to withers	Fat deposits are present; Back appears flatter	Wide back; Patchy fat; Back is flat
Tail head & Hips	Hooks and pins very prominent	Hooks are round but still evident; pins may be slightly discernible	Fat is present around tail head; Hips are flat	Hips are rounded	Hips/thighs are very round
Ribs	Emaciated; Rib spacing appears wide and depressed	Ribs are visible but fat is also discernible by touch	Ribs are not visible but are discernible by touch	Ribs are not visible; Fat deposits may be evident	Fat deposits may be present, easily evident

Fighting

Male giraffe will likely fight if in the same boma. Dominant males will establish a dominance hierarchy quickly and will tolerate other males after this. However, young males are more likely to engage in necking and often other deviant behaviour including mounting other males. Necking continuously can result in injury and if it shows no sign of abating, the males should be separated.

Enrichment

Giraffe in captive environments can suffer from repetitive boredom issues, weaving, rocking, compulsively licking and so forth. As giraffe spend over 50% of their time in the wild browsing, food is a significant boredom alleviator. A variety of browse should be hung at different intervals around the walls of the boma. The chewing process also appears to be important in the giraffe's mental health. If giraffe are to be held for long periods feeding treats to giraffe can be useful as incentives for training, moving them to another place or even taking oral medicines.

It is also useful to accustom the giraffe to background noise such as a radio playing or someone sitting outside the boma reading aloud if the giraffe are to be kept in captivity for a long period. The latter has the advantage of also accustoming the giraffe to human smells and noise. This will help lessen the fear of sudden background noises.

Monitoring

It is extremely difficult to maintain giraffe in top condition in boma situations and it is important to try and keep the animals in the best condition possible, prior to translocation or release. Records and photos of individuals should be kept, both for individual identification purposes and to monitor body condition

changes. Records help note changes in behaviour, feeding patterns, etc. Individual giraffe have their own idiosyncrasies thus records should include their likes and dislikes, and management adjusted accordingly.

The best time to carry out routine checks of the giraffe in bomas is during the morning to ensure consistency in assessments.

- Assess the overall condition and general appearance of the giraffe. Is the coat lying flat and looking healthy? With practice, much can be told by the general appearance of the animal. Giraffe suffer from cold and ambient temperatures, and this will influence how it looks.
- Faeces should be checked for volume, consistency, colour, smell, worms, etc.
- Check the urine. It should be clear and yellow, and they should urinate at least two times daily. Some browse species may colour the urine an orange colour (e.g. *Vachellia karroo*, *Dichrostachys cinerea*). If the urine is darker and port wine coloured with a lot of froth, it may indicate a haemolytic crisis (breakdown of the red blood cells), and the giraffe should be attended to immediately. There are numerous potential causes but in wild caught giraffe, it is likely to be theileriosis (caused by the Theileria parasite). Sometimes after transport, the urine will be blood tinged. This is myoglobin/haemoglobin caused by bruising during capture and is usually not serious.
- Check there are no discharges either on the animal or on the ground (blood, pus, mucus).
- Check for injuries and wounds.
- Check for lower incisor teeth, opportunistically.
- Check regularly to see which species of browse the animals eat.

Health Concerns

- Parasites (external and internal): Giraffe are host to a variety of parasites. They do not groom themselves but rely on scratching or obligate parasite such as the oxpecker to remove ticks and other parasites. The most prevalent giraffe ticks observed are of the genera *Hyalomma*, *Amblyomma* and *Rhipicephalus*. They can also carry a heavy internal parasite load. If kept in a boma for long periods of time, faecal evaluation can be performed at a group or individual level. If indicated after faecal examination, injectable treatment should be used such as Ivermectin or, if exceptionally bad, a dorsal anti-tick treatment can be used.
- Skin Disease: One of the most obvious indicators of a sick giraffe is its coat. If the hair is 'staring' and dull, there is a good chance that the animal is not well. Some giraffe suffer from skin diseases, papilloma virus or a filarial nematode (*Stephanofilaria* spp.) and potentially exacerbated by fungal infections caused by damp moist conditions. These skin diseases cause lesions and wounds on the body, depending on what is the cause. Treatment may include antiparasitic medications (i.e. ivermectin), wound oil and antifungal spray, with a good fly spray for open wounds. Wounds can sometimes also become infected with clostridium bacteria; in these cases, a long-acting antibiotic and tetanus vaccine (or anti-toxin, if available) should be administered.
- Diseases: Giraffe do not have specific diseases but can get the same diseases suffered by domestic livestock including clostridial diseases, leptospirosis, brucellosis, anthrax, pasteurellosis, Johne's disease and tuberculosis. These can be tested for, through blood analysis and treated accordingly, time permitting.
- Eyes: These are another good indicator of sickness. Dull, lackluster eyes show that the animal is not well. Sometimes dust, thorns or corneal abrasion can injure the eye during capture. This can be flushed with saline solution and if necessary, antibiotic cream (specifically for eyes) put in the eye. The eyes should be checked during capture for thorns or blindness. Blind animals may not adjust well to captivity or translocation, and best released.

- Abortion: Pregnant giraffe may abort due to stress of capture or brucellosis. Try to make sure that the placenta and membranes are out and that there is no malodorous discharge afterwards. It may be necessary to anaesthetise the female and insert antibiotic pessaries. Brucellosis can be tested for.
- Fractures: Fractures in boma environments are rare but can be caused by fighting or falling (either through slipping or from panic). They can be anywhere from the head to the legs but the prognosis is not good and generally the animal may need to be euthanised.
- Diarrhoea: This can be caused by stress, parasite, diet or a clostridia infection. Supplementary food such as lucerne, bean hay and cubes should be introduced slowly so the giraffe have time to adjust to it.
- Pneumonia: Giraffe are susceptible to pneumonia, particularly if it is cold, dusty, windy or wet. They can also develop aspiration pneumonia because of passive regurgitation during capture. The giraffe should be kept warm and dry, with the addition of an infrared lamp in the shelter if necessary. Long-acting antibiotics given at capture can help with this.
- Babesia/Theileria (parasites): The stress of capture can precipitate the clinical symptoms of babesiosis in the animals in the boma. The giraffe will be lethargic and have dark red, frothy urine. The haemocrit (PCV) will be low and the mucus membranes pale or yellow. Many piroplasms (small or large) will be found in the red blood cells. The giraffe should be treated with diminazine (Berenil) or imidocarb (Forray 65) by pole syringe or dart, then kept in a warm and stress-free environment with good palliative care. Stress, anesthetisation or exertion will almost certainly kill the animal due to the lack of red blood cells.
- Snare wounds: Snares can sometimes become deeply embedded in the flesh; on occasion the soft tissue or even bone can grow over the snare. The best technique is to cut the snare at the front and then pull it out from the other side, depending on the site. Once removed, the wound should be flushed with diluted iodine solution and water then treated with antibiotic spray or wound powder and a long acting antibiotic administered. Fly spray should also be applied.
- Trypanosomosis (protozoan): Giraffe can develop clinical signs of the disease in boma conditions. This is especially true of ‘naive’ animals being taken from a disease-free area to one with the vector. Stress seems to be an important factor in precipitating the disease. Diminazine (Berenil) can be used for treatment and isometamidium as a prophylactic. If possible, limit exposure of giraffe to the tsetse flies in the initial days, increasing exposure as the animals settle and adjust. Tsetse fly traps and targets can be used to reduce and monitor exposure. Blood samples can also be taken to see if the animals are infected and what the parasitemia is.
- Anthrax: This is an annual vaccination for captive animals. Antibiotics and the anthrax vaccination cannot be given at the same time so it is probably more useful to give just antibiotics although a blood screen is useful to know if they are carriers or not.
- Abscesses: Giraffe can develop abscesses in the boma, often because of broken needles, untreated dart wounds and general debilitation. Best to leave the abscess till ripe, increased in size and localised. If necessary, at a certain point over the abscess the skin is thinner and tends to be shiny and softer. Lance a cross into it with a scalpel over the lowest point and drain all the pus and foreign objects out of it, flushing with warm water and dilute iodine. When clean, flush it with a weak peroxide solution. Fill the wound with an antibiotic e.g. oxytetracycline or long acting penicillin or put it in a pessary. The wound should be left open to drain so fly repellent may be useful. The animal should be injected with long-acting antibiotic even if given previously.

Pregnant females

Heavily pregnant females should not be caught but as they have such a long gestation (~456 days), most females may be at some stage of pregnancy. If captured, heavily pregnant females should be released immediately. If this is not possible and the female shows signs of calving (swollen vulva, sometimes with discharge, udders filled with milk, agitation) she must be separated from the other giraffe and put into a secluded, quiet area. Calving is usually performed standing up. There should be no problems with calf acceptance but occasionally problems occur with inexperienced mothers and poor latch on to the udder, for example. If the calf is not able to stay with its mother for whatever reason, it should be hand reared where possible.

Length of time in the boma

For longer translocations from one site to another, greater than a few hundred kilometres, a period 3-4 weeks is recommended to boma giraffe, depending on the conditions. A longer boma period is better than a shorter period, as long as they are maintaining good body condition and not showing signs of excessive stress in the boma. Before the giraffe are moved, they should be:

- used to being in the boma and the routine regime;
- relaxed and comfortable with the presence of humans and noise;
- in good health and body condition; and,
- eating well on natural forage and supplementary food (e.g. lucerne, bean hay and cubes).

For international export, the giraffe should be in the boma at the capture site for 2-3 months, as a much greater level of habituation is needed.

If a soft release at the new area, the giraffe could be held for 10-14 days, or if similar environment much less a period. Prior to release, they should be:

- over the stress of transportation;
- relaxed and in excellent condition; and
- used to the browse and local conditions.

Loading from the boma

Giraffe that have acclimatised well to the boma and people, can be conditioned to walk up the loading ramp and into the transport vehicle using food. When loading is required, the giraffe will walk up the ramp, bars can then be slotted in behind them to stop them from turning back down the ramp away from the truck. Strapping behind their hindquarters will also encourage them to keep moving forward and the prod (not electric) can also be used although not with too much force, and only as necessary. For those not completely acclimatised, gentle persuasion using tarpaulin or boma material behind the giraffe to guide into the truck is the most practical. Importantly, once the truck poles are in place the doors behind are closed as soon as possible.

RELEASE AND POST-RELEASE MONITORING

A critical part of moving giraffe is the actual release of the animals in their new environment and the monitoring of them once they are there. This monitoring may take several months but generally, if conditions are good, they should settle down easily.

Pre-Release

Prior to release – in the field when captured or in the boma, each individual giraffe should be photographed and distinct features and characteristics noted. GPS satellite or other tracking units should be fitted to a select few individuals when captured for future monitoring where feasible. The telemetry equipment should be tested to ensure both transmitters and receivers are working and the range and correct frequency noted. Individual identification files for the giraffe with all the above information should be developed – this will also assist for monitoring the giraffe when in the boma(s) and when released.

The release area should be checked to ensure that the fences, if any, are in good condition, there are no wires or snares or other hazards like old wells around to cause issues.

As and where appropriate, extra water should be provided or be accessible, particularly along fence lines and checked regularly after release to see if they are being used. These can be clean, half drums dug into the ground, low troughs or even plastic lined holes, or preferably, natural water present.

Training people to monitor giraffe

Post-release monitoring of giraffe is essential and should be incorporated into the translocation planning process. Ideally, plans should be put in place to closely monitor the giraffe for the first 3-6 months post-release as well as for yearly population and habitat assessments. The monitoring teams at the translocation site should be trained and appropriately equipped to be able to undertake efforts after the giraffe are released into their new environment e.g. vehicles, communication, binoculars, GPS, camera, etc. The team should be able to recognise and track individual animals (ID photos and sheets established) and should keep records of body condition and behaviour that might indicate adaptation or maladaptation. Digital photographs can be a useful aid for monitoring and recording changes in physical condition over time. Staff can be trained on location or off-site. Initially, and dependent on the area and people, a trainer/researcher who is experienced in tracking giraffe may be brought in to assist. Those monitoring should be able to:

- track the giraffe;
- record data, including identifying individual characteristics – this observation allows for early warning of sickness or injury;
- read a map and use a GPS;
- take photographs; and,
- use a telemetry receiver.

Where possible, awareness amongst the local community should be undertaken prior to and during the translocation to provide awareness and education about the giraffe introduction. Importantly, local people should be asked to notify local authorities when/where giraffe are seen if they venture outside the Park/Reserve boundaries.

Release

Release from a boma

All giraffe should be released from the boma at the same time, and as one group. Giraffe are diurnal so it is best to release them early in the morning in order for them to have the whole day to adjust to their surroundings before nightfall. They should be kept to their usual routine the night before and fed normal rations.

The release should be as quiet and stress free as possible. The outside door should be opened with nothing blocking the exit. A slight funnel can be made with branches to channel the animals out of the gate but

not essential. The giraffe should be left alone to leave the boma at their own pace. If they do not leave as nightfall is approaching, close the gate and try the following morning. The giraffe should preferably not be pushed into leaving the boma. Once they leave, they often return so food and water should be left in the boma for a day or two, particularly if there is a particular giraffe of concern (i.e. thin body condition).

Release from a vehicle

If the giraffe are to be released on a site away from the boma or a "hard release", the release site should be identified before moving any giraffe. The release site should be relatively flat with a clearing or path for the giraffe to run to as they unload. The site needs to be elevated relative to the road such that the truck ramp can lay flat on the ground during unloading. The team may need to dig at the site to modify the terrain for safe unloading. The team should bring supplies including shovels, ropes, tarps, and medical kits for site selection and for when giraffe are released.

Post release

Giraffe should be monitored but not stressed during their first few days out of the boma. Fence lines should be checked to make sure that they have not got out or got caught up in the fence. Water supplies should be monitored to see which ones are being used. If an animal is losing condition after a few days, supplementary food (e.g. lucerne, bean hay and cubes) can be put out.

Tracking

This is an essential skill for monitoring giraffe. Where possible, trackers should be able to recognise the tracks of individual animals and be able to follow them over any terrain. A tape measure is useful to measure the size of the tracks and to record the details as they may be useful distinguishing.

Telemetry

Giraffe can be fitted with GPS satellite units or GSM/VHF/UHF radio units to aid in post-translocation monitoring. Trackers must be trained in how to use this equipment and it is important to test the frequencies of the transmitters and receivers prior to putting them on. If using a collar or similar, the units should generally only be placed on adult animals as growing animals may outgrow the collars and develop wounds from the strap or otherwise a drop-off mechanism attached which can be timed and/or manually released. Depending on how they are mounted, care must be taken that the units are not too tight and strangling the giraffe and conversely not too loose where the giraffe can either lose it or hang itself, if it gets hooked up on a branch. Note that different giraffe species have different head morphology and head harnesses are not recommended but rather ossicone units to ensure no impact on the giraffe.

Figure 13: Reticulated giraffe with 'ossi-unit'. *Image courtesy of Ken Bohn/SDZG.*

Problems observed after release

- Giraffe falling into hazards such as dongas or holes.
- Giraffe getting over fences or caught up in fences.
- Giraffe being killed or eaten by predators e.g. lion.
- Giraffe suffering from low ambient conditions and losing condition or even dying as a result of cold, wind and driving rain.
- Male giraffe may fight other resident males for hierarchy and suffer injuries as a result.

EUTHANASIA

Sometimes giraffe have to be euthanised, usually relating to a non-recoverable injury such as a fractured leg, broken neck or similar. It is possible to inject the animal with 2 g of succinylcholine (Scoline) diluted with water which will kill the animal quickly and leave a non-toxic carcass or to inject it with an overdose of etorphine or other potent opioid drug with or without barbiturate anaesthetic such as pentobarbitone. The latter is more humane but the carcass must be disposed of carefully as it will be toxic (burnt or buried). Alternatively, it can be humane to euthanise a critically injured giraffe using a heavy calibre rifle and experienced marksman.

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