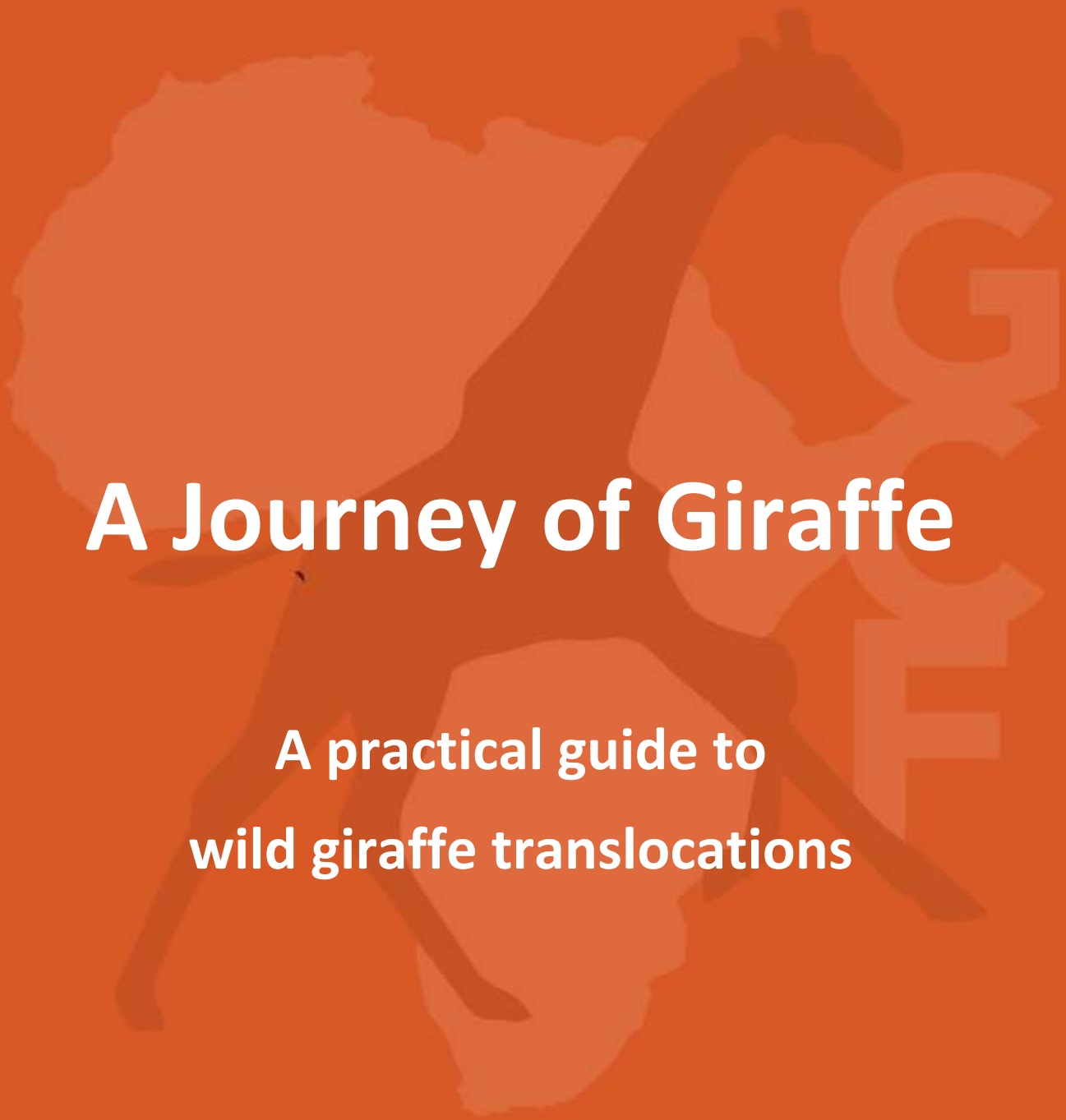

A Journey of Giraffe

A practical guide to wild giraffe translocations

Developed by the Giraffe Conservation Foundation

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Table of Contents

1. 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 a broad introduction and guidelines on why and how to undertake a translocation following an appropriate assessment. 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 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' (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	

2. 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 and being up-listed to *Vulnerable* on the IUCN Red List (Mueller et al. 2018a). This assessment was further emphasised when eight of the IUCN recognised subspecies were assessed in 2018/19 – 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, which is historically based on outdated assessments of their morphological features and geographic ranges. The subspecies are Angolan *(G. c. angolensis),* Kordofan *(G. c. antiquorum),* Masai (*G. c. tippelskirchi*), Nubian *(G. c. camelopardalis),* reticulated *(G. c. reticulata),* Rothschild's *(G. c. rothschildi),* South African (*G. c. giraffa),* Luangwa (or Thornicroft's, *G. c. thornicrofti*), and West African giraffe *(G. c. peralta).*

However, the Giraffe Conservation Foundation (GCF), together with its partner Senckenberg Biodiversity and Climate Research Centre (BiK-F), performed the first-ever comprehensive DNA sampling and analysis (genomic, nuclear, and mitochondrial) of all major natural populations of giraffe throughout their range in Africa. These studies have resulted in an updated understanding of the traditional taxonomy. The data show that there are four distinct species of giraffe, and potentially seven subspecies (Coimbra et al. 2021; Winter et al. 2018; Fennessy et al. 2016). The four distinct species are Masai (*G. tippelskirchi*), Northern (*G. camelopardalis*), reticulated (*G. reticulata*) and Southern giraffe (*G. giraffa*). The Angolan (*G. g. angolensis*) and South African giraffe (*G. g. giraffa*) are the two subspecies of the Southern giraffe. Nubian (*G. c. camelopardalis*), Kordofan (*G. c. antiquorum*) and West African giraffe (*G. c. peralta*) are the three subspecies of the Northern giraffe. Rothschild's giraffe is genetically identical to the Nubian giraffe. As the nominate species, Nubian giraffe takes precedence and Rothschild's giraffe is thus subsumed into it. The Luangwa (*G. t. thornicrofti*) giraffe is genetically similar to the Masai giraffe (*G. t. tippelskirchi*) and considered a separate subspecies. In all GCF's conservation work and publications, based on this research, we use the updated giraffe taxonomy of the four species.

All four giraffe species and their subspecies live in geographically distinct areas throughout Africa. While some of these species have been reported to hybridise in zoos, there is very little evidence that this occurs readily in the wild.

Table 2: Four species with seven subspecies classification of giraffe based on recent genetic analysis. *Coimbra et al. 2021; Winter et al. 2018; Fennessy et al. 2016.*

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	*G. t. thornicrofti*
	G. t. 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 top of the shoulders (withers) from which the back slopes steeply to the hindquarters and tail. Adult males can stand 4.9-5.2 m tall and weigh 970-1,500 kg while adult females measure 4.3-4.6 m and weigh 700-1,000 kg (GCF 2022; Kock & Burroughs 2021; Mitchell 2021). The giraffe's neck is made up of seven cervical vertebrae (same as most mammals), 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 2021; Hilsberg-Merz 2008; Mitchell & Skinner 2004). Giraffe have thick, tight skin which helps to maintain circulation especially in the legs by acting as a "pressure suit" (Mitchell 2021; 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. It has been hypothesised that ossicones could possibly play a role in thermo-regulation (Ganey et al. 1990), however due to the high density of the bone in ossicones, and their overall very small surface area, the likelihood of ossicones' ability to play any role in thermoregulation is insignificant (Mitchell 2021; S. Ferguson pers. obs.). Males usually develop boney deposits on their skulls in addition to their ossicones as they age as a result of bone growth stimulated by heavy blows sustained during fights (Simmons & Scheepers 1996; Spinage 1968).

Giraffe 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 also 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 enabling them to detect movement up to two kilometres away (Mitchell et al. 2013; Dagg & Foster 1976; Backhaus 1959). They are also believed to have a well-developed sense of smell (Pereira 2013) and good hearing (Kasozi & Montgomery 2018).

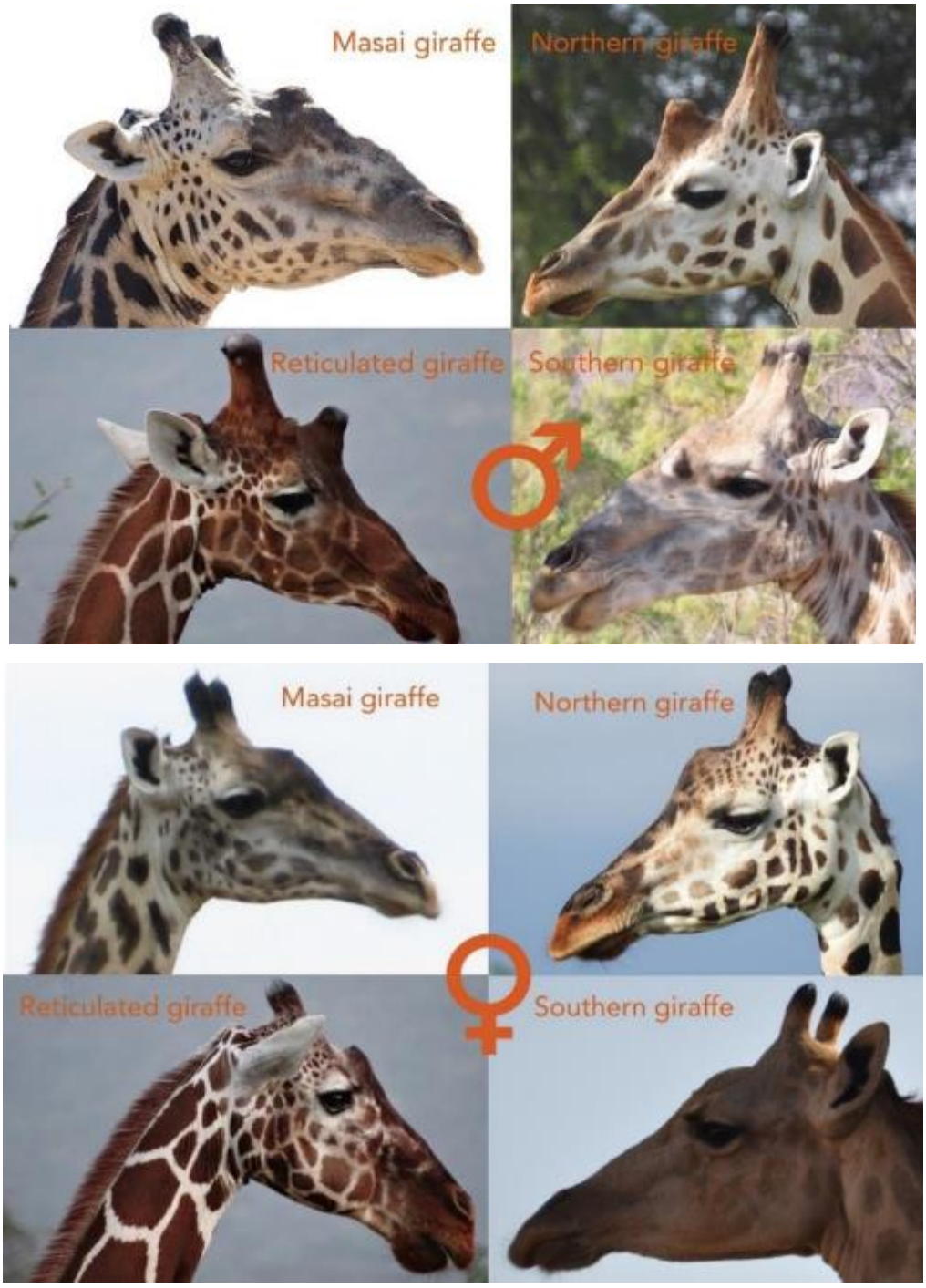

Figure 2a & 2b: Male and female cranium morphology in Masai, northern, southern, and reticulated giraffe. Note the presence of more prominent median ossicones in the northern and reticulated giraffe compared to the smaller median ossicones present in Masai and southern giraffe. *Images courtesy of GCF.*

Habitat and forage

Giraffe primarily inhabit open savannah and woodland habitats (Mueller et al. 2018a). 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 ~350 km^2 with high variation between individuals, sexes, and species (Brown et al. 2022). Female giraffe tend to be somewhat philopatric (remain in their birth area), thus maintain smaller home ranges than males who roam between groups of females (Bock et al. 2014; Carter 2013). 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). In seasonally dynamic environments, some giraffe populations are known to exhibit partial migration and variation in habitat selection (Brown & Bolger 2021; Pellew 1984).

Giraffe in some populations can be completely water independent (Fennessy 2004) but others may visit water sources relatively regularly (Brand 2007; Leuthold & Leuthold 1978). 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 *Vachellia*, *Senegalia, Terminalia and Combretum* species being the most preferred browse throughout their range when available (Mandinyenya et al. 2018). Other preferred genera include: *Balanites*, *Boscia*, *Commiphora*, *Detarium*, *Grewia,* and *Ziziphus* species among others (Muller et al. 2018a; Fennessy 2004; Ciofolo & Pendu 2002). 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). Rumination is often increased in the heat of the day and/or at night (Fennessy 2004). Giraffe browse on a wide variety of trees year-round but when all tree species are in full foliage, they are observed to be much more selective (Pellew 1984).

Browsing up to eighteen hours a day, male giraffe tend 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), thus reducing resource competition between the sexes. Giraffe can survive in arid environments due to the ability to become water independent and the lack of feeding competition for higher branches with other browser species, except the African savanna elephant. Grazing and pica behaviour (the eating of substances not considered food) are rare but have both been observed in nutrient-poor environments (M. Castles & J. & S. Fennessy pers. obs.). Pica behaviour may include eating soil (geophagia) or chewing bones (osteophagia).

Behaviour

Giraffe are 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 one 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). 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). 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 (Kasozi & Montgomery 2018; Baotic et al. 2015) 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 (Von Muggenthaler 2013; Bashaw 2003). 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 beyond the flehmen response by males when testing pheromones in female urine (Kasozi & Montgomery 2018; Pratt & Anderson 1985).

Reproduction

Female giraffe generally reach sexual maturity around the age of four to five years and have a gestation period of approximately 15 months (can range 14-16 months; Mitchell 2021; 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 cyclical changes in male androgen levels associated with changes in sexual behaviour may be evidence that giraffe have a flexible rutting period, like musth observed in African savanna elephant bulls (Wolf et al. 2018; Seeber et al. 2012), 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 2 m 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 habituated populations, it is possible to approach them close enough to dart on foot, but usually one darts from a vehicle (~30-40 m). Due to their unique anatomy and physiology, giraffe capture is extremely challenging and should only

be attempted with an experienced and well-trained team. 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 immobilisation as increased excitement can result in a prolonged induction time, hyperthermia, capture related myopathies and other complications if not properly managed. Even once darted, the animals can be dangerous to handle. They can strike with their front feet and kick with their back legs with tremendous force, and care needs to be taken to avoid the giraffe as it falls into lateral recumbency. Using the recommended/most common immobilisation protocols, they also require immediate reversal of the immobilisation drug, requiring manual restraint for procedures. Ropes used for body restraints are sometimes necessary during wild capture procedures, as are blindfolds, head harnesses and earplugs. The ropes are not only to protect the handlers during the procedure but also the giraffe itself during the induction phase of immobilisation by facilitating the giraffe to fall forwards or to the side into lateral recumbency. The immobilisation drug(s) cause giraffe to become ataxic and can cause them to go over backwards which can result in severe fractures the skull or neck vertebrae and death. 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 should 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 6 m in height (GCF 2022) 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. Ossicones of males start out like that of females (thinner with tufted hair) 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, knobbly ossicones that are bald on top in older males. Males' skulls also increasingly become more knobbly as the skull continues to ossify as they age due to fighting (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 other ossicones or bony protuberances at the base of the skull, in addition to over the eyes and on the nose (Spinage 1968).

When immobilised, one can also evaluate the teeth of a giraffe and roughly approximate age, similar to what is done with domestic cattle and horses (Hall-Martin 1976). Age is more accurately determined from tooth eruption in younger animals, but only until the age of six (after all teeth have erupted; Mitchell 2021). However, it needs to be noted that tooth wear can differ dependent on the environment and is more is subjective and therefore can impact age estimates in adult animals (Mitchell 2021).

Dentition

Giraffe dentition is similar to other ruminant species. They only have teeth (incisors and canines) along the rostral aspect (front) of the mandibular (lower) jaw, with the front of the maxillary (upper) jaw consisting of a hard palate (dental pad). They then have premolars and molars on both the top and bottom jaw, making a total of 32 teeth (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). The most recent estimates by GCF indicate that giraffe numbers have plummeted across Africa by ~30% from >155,000 to ~117,000 individuals in the past three and a half decades (Brown et al. 2021).

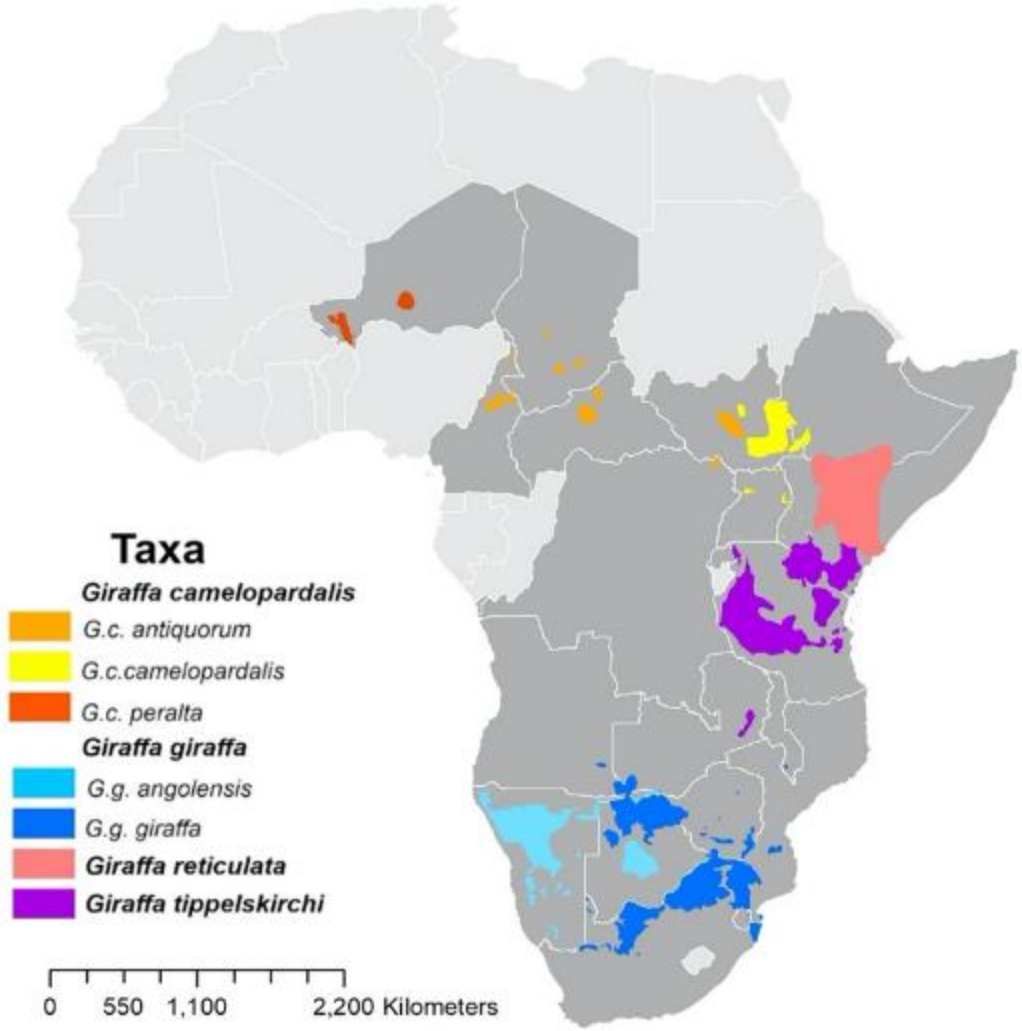

Figure 3: Distribution of extant giraffe species and subspecies populations across Africa. *Brown et al. 2021.*

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. 2018). 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 yet to be 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 (CITES 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

In the past few decades, giraffe numbers and distribution have been affected by fragmentation, degradation and loss of habitats, disease, illegal hunting (poaching), the growth and expansion of the human population, wars, and civil unrest (Brown et al. 2021; Muller et al. 2018a). These threats 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 (Brown et al. 2021; Muller et al. 2018a). 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 (Brown et al. 2021; Muller et al. 2018a).

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

3. 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 underlying health status is unknown prior to immobilisation. Furthermore, due to the nature of wildlife capture, there is little to no control during the induction period (time from darting until the animal is in lateral recumbency), which in addition to the recovery period are considered the most dangerous portions of immobilisation and anaesthesia procedures. When combined with the fact that an adult male can stand up to 6 m tall, weigh more than 1,000 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/immobilisation operation with giraffe that the team is appropriately skilled/trained and has had practice working together, simulating capturing, placing ropes and restraints prior to the actual event. An experienced team leader should be in charge in collaboration with a wildlife veterinarian, 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 injury and mortality during capture operations, and on occasion, it is necessary for the team leader and/or veterinarian to assess the conditions and if no longer favourable, release an animal(s) and/or call off the operation.

The equipment necessary to translocate giraffe is critical and should be of good quality. Vehicles that will help to capture and transport giraffe should be in reliable working condition and 'chariots' (field recovery crates), as well as transport crates, should be equipped with good, non-slip flooring and well-padded as appropriate. Giraffe have an advantage over some species in that if the vehicle and transport crate is big enough, it is possible to move more than one animal at a time in the same compartment thus saving on transport costs and time. Great care should 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 may further decrease their stability. If giraffe become recumbent (lying down), it can be 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 should 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 should 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 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 and minimise loss of biodiversity.

Giraffe have a relatively small rumen and are prone to acidosis, which can cause potentially significant health 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 2.4 m) 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/made visible is also recommended.

Fortunately, giraffe are not territorial so introducing new individuals into an area should not cause territorial 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 (Vanmechelen et al. 2017; Muneza et al. 2016; van Dyk et al. 2011; Karstad & Kaminjolo 1978). 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 any skin lesions or any other apparent, potentially infectious disease, a risk assessment should be performed evaluating the potential for spread/introduction of disease. Importantly, all animals should be examined/approved by an experienced wildlife veterinarian to attempt to move only healthy individuals, and any preventative intervention should be undertaken as needed for all animals – especially as some diseases may be latent or become apparent during the move.

Donor population

Giraffe are relatively long-lived, and our limited information estimates that they can live >25 years with the average age estimated at 15-20 years – however ongoing long-term research will help to better understand longevity in the wild (Dagg 2014; GCF pers. comm.). As previously stated, females are on average sexually mature around four to five years of age and males reach maturity at a similar age, 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 the current population size, recent demographic trends, and the number of individuals that can be sustainably removed. It is important to note 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 through multiple translocations performed over a few years to (re)establish or supplement the recipient populations and be monitored closely as to its success.

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. Managers should be aware that giraffe have a gestation period of approximately 456 days (~15 months) and an inter-calving period averaging 21 ±2 months, although less in ideal situations (Lee et al. 2017; Strauss et al. 2015). Females with calves or heavily pregnant animals should not be moved due to the complications of both the chemical and physical capture methods. As such, careful assessment is necessary in the field, based on appearance of the female's belly, udder, and vulva. After immobilisation, it is possible to make a closer physical assessment of the pregnancy or lactation status, and if heavily pregnant or lactating, they should be released.

While unadvisable, it is sometimes desirable/necessary to translocate an older, more dominate adult male. Where appropriate, translocated dominant males should be strong, healthy specimens with no apparent disease, minimal parasite loads and no signs of 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/stress for other giraffe. Ideally, they should be translocated alone and not with other adults or younger individuals because if problems arise, they can sometimes be aggressive during the move.

Other considerations

If the donor population has been 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 (Hart et al. 2022; 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. Within a population, this degree of understanding is often difficult to ascertain considering the limited giraffe scientific studies undertaken in collaboration with translocations (Hart et al. 2022; Flanagan et al. 2016). As research on giraffe social dynamics across Africa increases, these improvements may become more achievable.

Translocation period

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

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

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 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 are not water dependent, water following translocation can be valuable to reduce stress and dehydration.

Due to the semi-arid nature of the environments where giraffe often inhabit, translocations may also be able to be carried out in other seasons. Special attention should be paid to weather forecasts. Captures should be carried out early in the morning or in the later afternoon, providing enough daylight time is left for the operation to reduce the chances of heat related stress/hyperthermia. If there is sufficient cloud cover, capture can take place throughout the day, but the team leader should decide on a maximum temperature where capture operations would be halted once reached. 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, drainage should be sufficient to prevent/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 the substrate and adding clean sand is advisable to help prevent slipping and maintain appropriate sanitation.

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.

4. CAPTURE

Chemical immobilisation

Despite decades of experience with varying capture methods of giraffe across Africa, their chemical immobilisation 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 malpositioning can result in airway obstruction, cramping of neck muscles, nerve and/or neck injuries, which can lead to severe injuries and 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 must 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.

- 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 have elongated skulls with narrow interdental spaces making endotracheal intubation difficult and largely impractical in field conditions.
- 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 darting system such as DANiNJECT, Pneu-Dart or Cap-Chur is preferable. However, this also depends on the experience of the veterinarian. Importantly, one should not change to unfamiliar equipment for an operation where possible as it is better to adapt a familiar system to the situation.

All equipment should be thoroughly checked prior to heading into the field. Importantly, it is recommended that veterinarian(s) always practice shooting to ensure that the power settings are correct, sight is not off and the 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 (20-50 m) that are expected in the field, using a similar target material to giraffe hide such as conveyor belt or old tyre, as an example. Ideally a flat trajectory without excessive impact is desired as an appropriate darting technique.

Dart needles should be minimum of 50 mm (preferably 60 mm) to penetrate giraffe skin. The darts should be robust and in good condition. Spare parts (or even a spare gun) are valuable to address any potential malfunctioning or account for issues if the gun has not been used for some time/properly maintained. If the rifle is equipped with a floating red dot scope system, spare batteries should be always to hand. Additionally, a push rod should be carried to push out a dart from the barrel if stuck or unused.

Additional equipment

- Giraffe chariot (field recovery crate – see 'Transportation' section below).
- Crowbar, spades, picks, chainsaws, saws, pangas (machetes) and axes to clear the 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 field equipment.
- Ropes should be ~25 mm in diameter, 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 for handles.
    - Funnel ropes: minimum of two 10 m ropes to form a loading funnel.
    - Additional ropes are 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 4-6 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, socks, or similar, to block the ears of the giraffe and minimise stress. Importantly, when used they should be easily removable before entering the boma/release.
- Stethoscope to measure heartbeat and listen to the lungs.
- Rectal thermometer to measure body temperature whilst is the giraffe is recumbent.
- Medical kit for preventative care and treatment of injuries including injectable long acting, broad spectrum antibiotics, intramammary ointment for dart wound treatment, anti-inflammatories

(such as flunixin meglumine), eye ointment, fly repellent, and various sizes of syringes, 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 for protection from dangerous wildlife and in the worst-case scenario of a giraffe sustaining a bad injury because of the capture attempt, humane euthanasia.

Other equipment that is not necessary but may be useful if available:

- Large bore tube/hose and handheld pump (such as the kind used in equine medicine) or funnel to administer large volumes of fluids rectally.
- Oxygen with regulator and administration tube.
- Pulse oximeter to monitor oxygen saturation levels of the giraffe whilst it is recumbent (however in giraffe pulse oximeters are not reliable).
- Portable blood gas analyser and cartridges for physiologic monitoring.
- Sling to help moving giraffe if required.
- Necropsy kit – knives, steel, axe, rib cutters, sampling bottles with 10% buffered formalin.
- If no electricity at camp, then maybe a generator/power source is required to run any equipment to fix vehicles, store any drugs, medicines, and samples, etc., as necessary.

Darting

Darting on foot

Darting on foot is not recommended unless the giraffe are extremely habituated to human presence 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 (or impossible) as the giraffe often moves away. Furthermore, if the giraffe needs to be re-darted it may increase the likelihood of excitement and consequent dangers of hyperthermia, myopathy, and injury, particularly if only a partial dose is administered.

Darting from a vehicle

Darting from a vehicle is the most common used darting method as giraffe are generally used to being approached by vehicles, and one can maneuverer into appropriate darting range. Clear communication between the veterinarian, vehicle driver and capture team should be had throughout the process, both leading up to and including the darting and any subsequent chase and capture. The veterinarian should be the lead commander of the operation and all personnel follow the veterinarian's direction. It is normally possible to approach close enough to dart without the animal taking off – often ~40 m, sometimes closer, but patience is key as occasionally it might be necessary to slowly follow, take a different angle or even to drive the giraffe to a better place for darting.

Darting from a helicopter

Giraffe are prone to extreme excitement/running during helicopter darting, potentially exacerbating the risks mentioned prior. If helicopter darting is planned because giraffe are in remote areas or vegetation impedes vehicle access, then a larger dose of opioids is recommended to ensure swift induction. A very experienced game capture pilot is critical for the exercise. 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 and safely 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 bodies of water. If the first dart fails, generally it is easy to administer another dart with a helicopter. Any additional dosage requirements may need to increase as the giraffe's excitement/adrenaline level increases, and all should be assessed appropriately. Importantly, once darted the helicopter should be kept a good distance away, while keeping the giraffe in sight, to avoid unnecessary chasing and stress to the giraffe. The helicopter should only come down to drop the team on the ground for capturing or securing the individual. 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 immediately.

Dart placement

Good dart placement is essential for successful immobilisation. One should aim to place the dart into a large muscle such as the shoulder on the forelimb, quadriceps of the hind limb, or the rump/gluteal region, as they best enable good penetration and drug absorption (Figure 5). Ideally the dart should be placed perpendicular into the muscle and not at an angle to ensure good drug deposition into a large muscle belly. Importantly, one should try to avoid darting in the neck, thorax, and abdomen of the giraffe.

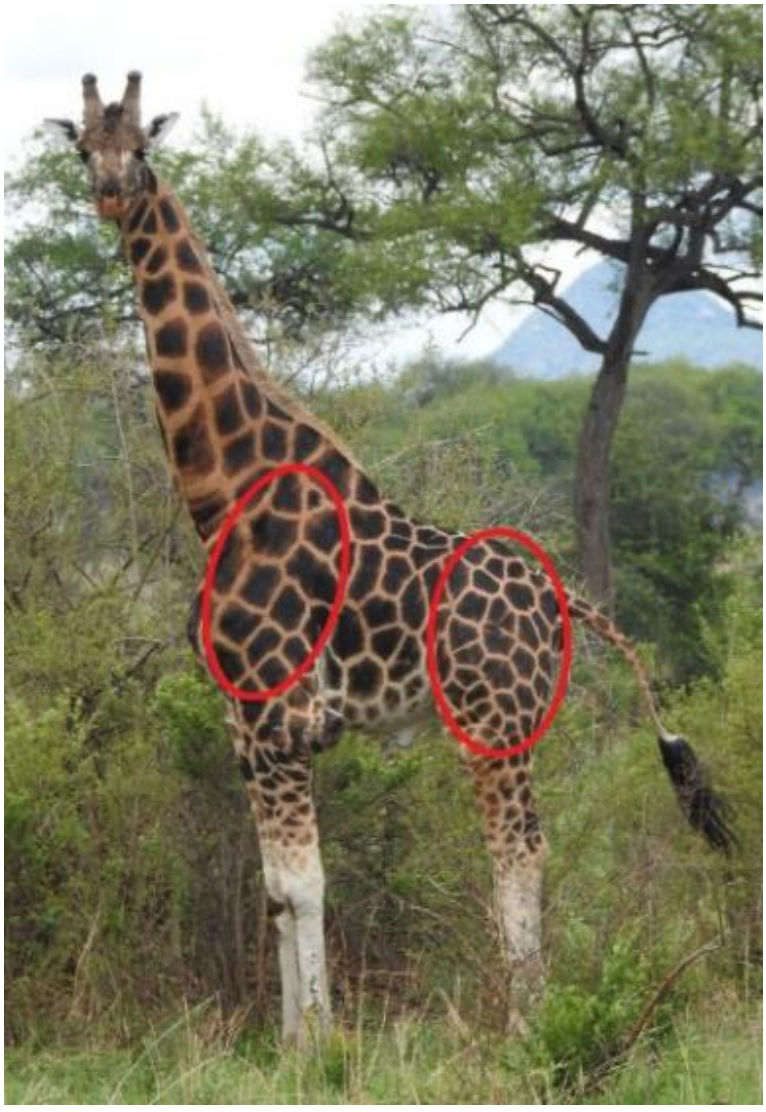

Figure 5: Dart placement. The shoulder on the forelimb, quadriceps of the hind limb, or the rump/gluteal region are the best muscle groups to target. *Image courtesy of GCF.*

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 dose 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 with ambient temperatures around 20-27°C. A cut off temperature for both the operation and animal should be decided beforehand and any animal whose body temperature exceeds 41°C should be cooled with water and/or released. Care should be taken if darting in the afternoon that there is sufficient daylight left to capture and transport the giraffe before nightfall. Conversely, immobilised giraffe have been known to become hypothermic in cooler weather, although in a translocation setting with a rapid turnover, this scenario is unlikely.

Females and calves

Unless necessary, female giraffe with young calves should not be darted or moved for translocation. It is better to wait until the calf is weaned from the mother (about 1-1.5 ys), facilitating the calf and mother to be darted/immobilised as two separate entities (i.e. not requiring simultaneous darting). When unavoidable, it is recommended to dart a female giraffe with a calf from a helicopter and have an additional fixed wing plane circling the site as a spotter to ensure an eye is kept on both giraffe and have two teams on the ground ready to go (one for the mother and one for the calf) – good radio communication between air and ground is essential. 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 and the respective ground teams to guide them to each giraffe.

Choice and dose of immobilising drugs in the field

The current recommended capture methods for wild giraffe use high doses of potent opioids alone, with no sedatives or tranquilisers. This enables rapid induction, is quickly reversable, and ensures no lingering effects of drugs once the giraffe is released or during transport.

It is best to prepare any dart(s)/needles in advance and to add the drug once the specific animal is spotted, allowing the veterinarian to adjust the dosage accordingly. The reversal drug should also be pre-drawn in a syringe and ready for immediate intravenous administration to the giraffe once recumbent, or in case of accidental human exposure (as both potent opioids are lethal to humans). If more than one field team is being used, then each veterinarian (or paraprofessional) needs to have a reversal to administer depending on who gets to the animal quicker. **For this high dose opioid protocol it is crucial that the reversal drug be administered intravenously in less than 30 seconds of the giraffe becoming recumbent and restrained.** The nature of the opioids and the doses necessary to achieve quick and safe immobilisation of giraffe induce a hypoxemic state and the longer the opioid(s) is/are active the higher the risk of complications and/or death of the giraffe. Recommended drugs and dosages for wild giraffe are summarised below (Table 3).

Giraffe immobilisation protocols have been a ‘work in progress’ for wildlife veterinarians over the past three decades. Historically immobilisation protocols used very low doses of potent opioids (averaging 5 - 6 mg total for an adult male giraffe), however these resulted in extensive induction times, increased physical stress for the giraffe, and were overall less safe for both the giraffe and capture team (P. Morkel pers. comm.). Wildlife veterinarians have moved towards using higher doses of potent opioids (up to 24 mg in an adult bull or 17 mg in an adult female) and/or combining the use of two potent opioids to allow for quicker inductions, making immobilisation safer for both the giraffe and capture team.

As a note, thiafentanil has been suggested to provide quicker induction times than etorphine, however giraffe seem to be more sensitive to thiafentanil than etorphine. Giraffe darted with only thiafentanil have more often been observed to undergo moderate to severe apnoea in lateral recumbency even with quick IV reversal using naltrexone and have required stimulation (jumping on the chest and/or IV injection of doxapram) to stabilise breathing (GCF pers. comm.). This side effect appeared to be less common or absent with giraffe darted using a combination of etorphine:thiafentanil or etorphine only and immediate reversal with naltrexone.

More recent immobilisations in the field have employed the used of etorphine:thiafentanil in either a 50:50 of 40:60 ratio (with total opioid mg dose remaining the same) and noted induction times averaging ~3 minutes (J. Alves pers. comm., GCF pers. comm.). This combination appears to work well in creating quick(er) induction times associated with the use of thiafentanil without the risk of induced apnoea as noted above (GCF pers. comm.). However, it is important to note that each and every immobilisation should be tailored to the giraffe, terrain, and capture team and be adapted as appropriate by the leading veterinarian(s).

Recently some wildlife veterinarians have been experimenting with a 'low-dose opioid' protocol than entails the use of a potent opioid in combination with the alpha-2 agonist medetomidine. This 'low-dose' protocol results in significantly longer induction periods of 20 minutes or more (Kock, M.D. & Burroughs, R. 2021), and while it has worked well for many antelope species it is not recommended for wild giraffe capture and not discussed further in this document (GCF pers. comm.).

IMPORTANT: All participants should be made aware of the potential dangers of exposure to potent opioid drugs used and know the required first aid procedures should accidental human exposure occur. The potent opioids (etorphine and thiafentanil) for giraffe capture are lethal in extremely small amounts to humans. The veterinarian(s) in attendance should be the only person handling the drugs, dart and in charge of treating the dart wound to prevent accidental human exposure of the team.

Table 3: Giraffe immobilisation dosage recommendations from GCF adapted from *Chemical and Physical Restraint of Wild Animals: A Training and Field Manual for African Species Third Edition. 2021. Ed. Kock, M.D & Burroughs, R.*

IMMOBILISATION DRUGS*					
DRUG	**FUNCTION**	**ADULT MALE**	**ADULT FEMALE**	**SUBADULT**	**JUVENILE**
Etorphine (M99)	Opioid agonist - immobiliser	14-24 mg	12-17 mg	7-14 mg	4-10 mg
Thiafentanil (A3080)	Opioid agonist - immobiliser	14-20 mg	12-16 mg	7-12 mg	4-7 mg
Etorphine: Thiafentanil Combo	Etorphine and thiafentanil may also be combined in either 50:50, 40:60, or 20:80 ratios, with the total dose reaching the same mg as recommended for each sex e.g. for an adult male one could combine 8 mg etorphine with 10 mg thiafentanil for the total immobilising dose of 18 mg.				
Naltrexone**	Opioid agonist - reversal	140-600 mg	120-510 mg	70-360 mg	40-210 mg
Diprenorphine***	Partial opioid antagonist - reversal	28-40 mg	24-34 mg	14-24 mg	8-14 mg
Hyaluronidase	Enzyme to increase tissue absorption	5,000 IU	5,000 IU	1,500 IU	1,500 IU

*NB: Doses in the table above are given as total doses.

**Naltrexone doses range from 10x to 30x the mg of opioid used; given IV.
***Diprenorphine doses are calculated 2x the mg of opioid used. Keep in mind diprenorphine is a partial antagonist and if given at higher doses can see narcotinic effects; given IV.

Animals in poor condition

Variation in the reaction to immobilising drugs will exist among individual giraffe. Therefore, it is important for the veterinarian and field team to observe these reactions and respond accordingly.

Rapid induction is particularly important for giraffe to lessen the trauma/stress associated with capture. It is therefore important for the field team to recover the animal quickly to avoid any potential negative reactions to immobilisation. Reactions include:

- Passive regurgitation leading to fatal aspiration pneumonia.
- Respiratory depression (hypoventilation/apnoea) 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 immobilisation 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 younger animal, and drugs used. 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 the drug absorbed quickly because of the dart placement (e.g. accidental IV injection). If induction does not occur after 10 minutes, it is likely that the full drug dose was not administered or the dart did not discharge, and the animal should be darted again.

Giraffe should become narcotised (affected with the drug) rapidly (drug effect noted within 2-3 minutes after darting) and it is usual practice to use a capture team to rope the animal instead of waiting for the giraffe to fall on its own. Roping allows for decreased induction time as well as providing an opportunity to minimise injury to the giraffe as it falls (e.g. prevent it from falling backwards or in an undesirable area) (Figure 6a). This is done by the ground team running in front of the giraffe with a long rope at chest level, then moving towards the back of the animal to slow it down. The team should continue to jog with the giraffe until it comes to a halt (largely due to the drug effect combined with the added pressure of the rope, but not due to the strength of the team), cross the rope at the back, and cause the giraffe to trip and fall forward or to the side. It is important to note that without an adequate dose of opioid, the capture team will not be able to effectively rope the giraffe, so good drug dosing is essential for success and safety of the animal and people.

Once down, the giraffe should be immediately reversed with the appropriate drug(s), and manually restrained to prevent injury to itself or the field 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 lower neck – placing pressure along the back at the shoulder is not necessary and may risk being kicked by the hind legs (Figure 6a, b). Care should be taken to avoid placing pressure on the ventral region of the neck where the trachea runs which would inhibit appropriate respiration.

IMPORTANT: It is better to overdose and rapidly reverse a giraffe than to under-dose and increase the risk of complications. The reversal drug should be given IV within 30 seconds once the animal is down.

A blindfold and earplugs should be fitted as quickly as possible to minimise stress for the giraffe once down, and just after the giraffe is fully reversed (Figure 7). Additional tools such as ropes, as appropriate, can then be used for any additional restraint and handling. This immobilisation technique is effective for capture of wild giraffe for translocation, removing snares and treating wounds as for fitting GPS satellite units and sample collection. If a more surgical procedure is necessary, it may be difficult with this protocol as once the giraffe has received reversal drug(s), they rapidly become responsive to any stimuli, kicking with their legs, which can be dangerous to the field team. If surgical procedures are necessary to perform, the above immobilisation protocol may need to be altered or additional drugs (such as regional blocks with local anaesthetic like lidocaine, NSAIDs for pain relief, or even full anaesthesia) used for safer handling. However, surgical procedures are not normally associated with translocations and so are not discussed in further detail in this document. We recommend directly contacting veterinarians with experience in anaesthesia/surgery of giraffe for further guidance.

IMPORTANT: It is critical that the field team is well trained and experienced to safely secure, restrain and load (or release) the giraffe.

Figure 6a: Ground team roping and restraining a giraffe during a capture. *Images courtesy of GCF.*

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

Reversal

Giraffe should be reversed within 30 seconds of becoming recumbent and manually restrained during preparation for loading, which can be anything up to 30 minutes of recumbency time. Full reversal for etorphine and/or thiafentanil is naltrexone (at least 10-30 mg/mg of opioid used) or partially reversed with diprenorphine (2 mg/mg of opioid used). It has been shown that intravascular injection for reversal the best for the giraffe, particularly as it is reversed immediately on recumbency. Giraffe should not be sedated or tranquilised for transport.

Handling immobilised giraffe

Standardised procedures

- In the field, giraffe are held in lateral recumbency and immediately reversed once restrained (ideally within 30 seconds of becoming laterally recumbent). 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. Additionally, such a position can help if the giraffe needs to be manipulated into a better/more appropriate position with ropes.
- Always work from the back side of the giraffe to avoid kicking legs.
- 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.
- Only the veterinarian should safely remove and handle the 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, the dart site should be marked 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.

- If available, oxygen can be supplied by nasal insufflation.
- If the giraffe needs to be fully anaesthetised (NB. an entirely different drug protocol is needed for full/prolonged anaesthesia and not discussed in this document) or immobilised for a longer period than 30 minutes, the neck should be supported, with a board or padded ladder, with the head above the rumen and the nose pointed down, to facilitate drainage of any fluids such as saliva or regurgitated material.

Monitoring

The fact that giraffe are fully (or partially) reversed with the reversal drug can sometimes limit 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 time) 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, or very young.

If available, a blood sample should also be assessed in the first few minutes after the reversal has been given, to measure blood gases for an idea of the physiologic state. This can help guide the veterinarian and team on how the immobilising dose worked and make any necessary changes to improve future immobilisations as well as guide immediate animal care decisions.

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. 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 total 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 should 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.

Respiration/oxygen

Most animals will suffer from some degree of oxygen debt after capture due largely to the respiratory depression associated with immobilisation 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 trachea and this compromises gas exchange in animals that have depressed respiration.

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

Breathing should be slow, deep (to ensure air reaches the lungs) and regular. Monitor respiration frequently (every 2-5 minutes) for at least 30 seconds as breathing can change quickly 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 temporarily stimulate respiration, 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 can also a good indicator in most species and should be a healthy pink, however giraffe gums are often pigmented a purple/grey colour making it difficult to assess. Giraffe that have gotten overexcited and are hyperthermic should be given oxygen (if available) and have water poured over their thorax and rubbed into the fur to allow contact with the skin/superficial blood vessels.

If oxygen is necessary (and available) it can be administered through a tube placed into the nose (nasal insufflation). It is uncommon to carry the necessary equipment in a field setting for intubating a giraffe, however if to hand a giraffe can be “blindly” intubated with an endotracheal tube. To do this, an experienced team member can insert the endotracheal tube and carefully advance the tube while rotating it and keeping the giraffe’s head extended. To assist, a team member with a relatively narrow hand can manually palpate the glottis (if the giraffe is large enough to accommodate this) and feed the endotracheal tube into the airway (but this requires the giraffe to be deeply anesthetised). Alternatively, they can be 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. 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) should be administered and CPR compressions started. This can be done with either a team member jumping on the chest (just behind the elbow) or 2-3 team members pumping the chest in coordination.

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 into the fur and 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). The brain is kept cool by evaporation through the nasal passages as well as counter current blood cooling through a series of vessels (the rete mirabile) located at the base of the brain. They are equipped with sweat glands, particularly under the dark patches of skin, but sweating does not seem to be their primary method of cooling down. Monitoring of the temperature throughout recumbency is vital. If body temperature exceeds 41°C, the team leader should consider calling off the operations and release the

giraffe. During recumbency just after 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 just behind the elbow. It can also 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 heart rate should decrease every 5 minutes after capture. If the heart rate remains elevated (>100 beats per minute) then an assessment needs to be made to continue with the procedure or to release the animal.

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 – however these may give faulty readings and therefore it is not common practice to monitor blood pressure. The range in unstressed giraffe should be between 140/90 to 180/120 systolic/diastolic. It is better and easier to monitor capillary refill time (CRT), which measures peripheral perfusion, can be monitored 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 should only be handled and the dart wound treated by the veterinarian. This is to minimise the potential for 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 should be cleaned (e.g. pouring water and spraying with a topical antibiotic) and treated with either an injectable antibiotic or antibiotic infusion. As an example, 5 ml of a 100 mg/ml solution of oxytetracycline can be injected directly into or adjacent to the wound. Alternatively, intramammary antibiotic preparations for lactating cows can be infused directly into the dart wound. It is not recommended to use a lanolin-based cream as this may result in abscess formation and/or delayed healing.

Drawing blood

The most used vascular site is the jugular vein, which is most easily accessible just below the lower jaw in the top 1/3 of the neck, although palpitation may be necessary to reveal it. Auricular and facial veins are also easily accessible. If blood gas monitoring units 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 physiologic 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 immobilisation. 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 signs of disease, whether lactating), and an estimated age of the individual. Additionally, one should record time of dart, time giraffe became recumbent, time of reversal, total time recumbent, and other key events or complications. Physiological parameters such as rectal temperature (every 5-10 minutes while down), heart rate, and bloodwork results (if obtained) should also be noted. The results should then be compiled into a summary report for the operation, and data entered into any relevant database(s).

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.

Preparation for transport

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 (Figure 7). If the giraffe is only having a snare removed, being fitted with a GPS satellite unit or another procedure not requiring any kind of transport, then one only needs to place a blindfold and ear plugs.

The key points to observe prior to allowing the giraffe to stand 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 stand in its own time. Excessive pushing and pulling is not recommended and care should be taken to minimise the number of attempts the giraffe needs to stand to avoid causing overexertion and potential muscle damage. 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.

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

Emergency and supplemental drugs and doses for immobilisation

Additional drugs for treatments that may be of use during immobilisation include emergency drugs, long-acting antibiotics and anti-inflammatories (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 any anti-parasitics as there can be detrimental secondary effects on dung-dwelling insects and/or environmental residues (Jacobs & Sholtz 2015; Verdú et al. 2018).

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

EMERGENCY DRUGS				
DRUG	**FUNCTION**	**DOSE**	**ROUTE**	**COMMENTS**
Naltrexone	Full opioid antagonist - reversal	10–30 x mg opioid administered	IV preferred; IM if IV access compromised	Little to no adverse side effects recorded
Epinephrine	Emergency treatment for shock, severe allergic reactions, cardiac arrest	1 mg/45 kg body weight	Half IV, Half IM	May not be available/practical for large doses
Atropine	Emergency treatment for bradycardia	0.03–0.06 mg/kg	Half IV, Half IM	May not be available/practical for large doses
Fluids – water	Volume resuscitation; dehydration; shock treatment	10–20 mL/kg	Rectal	Most practical for field administration for giraffe. Can administer adequate amounts and uses clean non-sterile water.
Doxapram	Central nervous system respiratory stimulant	0.5 mg/kg	IV	Temporarily increases respiratory rate for 3 min post injection. Advise if going to administer, give just before release of giraffe.

SUPPLEMENTARY DRUGS				
DRUG	**FUNCTION**	**DOSE**	**ROUTE**	**COMMENT**
Flunixin meglumine	Non-Steroidal Anti-Inflammatory	1-2 mg/kg	IM, SC, IV	Do not use in combination with dexamethasone/other steroid injection
Oxytetracycline LA	Broad spectrum antibiotic	19 mg/kg	IM, SC	A single dose at 19 mg/kg in cattle known to be active for 72 hours. Ideally use concentrated oxytetracycline (e.g. 300 mg/mL) to reduce injection amount. Split injections, when possible, over multiple sites.
Ceftiofur	Broad spectrum antibiotic	6-9 mg/kg	IM, SC	A cephalosporin-based antibiotic that in cattle is known to last for up to 7 days with a single dose.
Penicillin G procaine (300,000 IU/mL solution)	Antibiotic	1 mL/45 kg	IM	Antibiotic mainly active against Gram-positive bacteria. Usually recommended 24h injections for 2-3 days so may not be appropriate for field use.
Dexamethasone SP	Steroid	0.06 mg/kg	IM, SC	Do not use in conjunction with a NSAID (like flunixin). Do not use for heavily pregnant or suspected pregnant animals as may cause abortion.

Nonchemical/Mass Capture

An alternative capture method that should be considered, especially if planning to move a large number of giraffe, is mass capture. This method herds animals using a helicopter through a large funnel into a holding boma or directly onto a transport truck (Kock & Burroughs 2021; Laubscher et al. 2015). The technique 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 sometimes the inability to isolate specific individuals from a herd (Kock & Burroughs 2021).

Plastic sheeting, or a similar material, 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 100-120 m wide to allow adequate access to the funnel entrance and be well camouflaged (Laubscher et al. 2015). Giraffe perceive the plastic sheeting as a solid barrier during capture and are encouraged further into the 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 & Burroughs 2021). 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 one metre higher than the tallest giraffe (for example at least 6.5 m in height if any large bulls are 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.

Positioning of the funnel is important to the 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 highly skilled wildlife helicopter pilot is essential for the success of mass captures, as is a competent and experienced ground team (Kock & Burroughs 2021). Once captured, the maintenance and transport of giraffe is the same as chemically immobilised individuals.

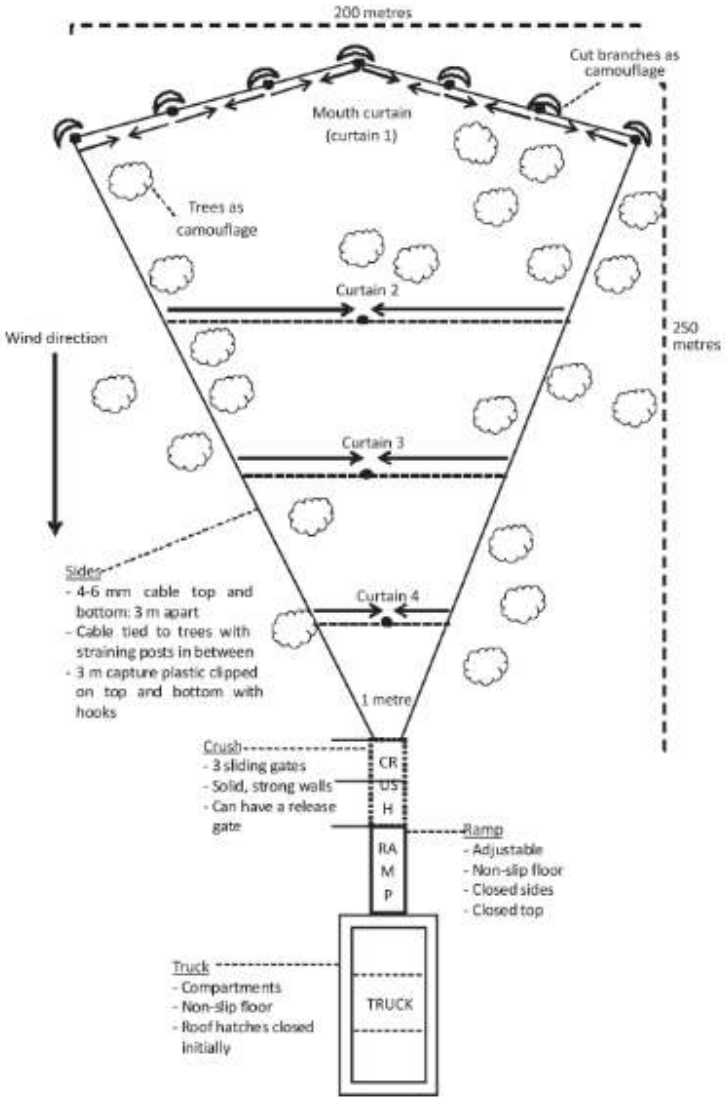

Figure 8: A schematic of a boma funnel used for mass capture. *Laubscher et al. 2015.*

5. TRANSLOCATION

Translocation with bomas

Many giraffe have been translocated using bomas (pens) whereby giraffe are mass captured into a boma or transported by chariot and dropped off in the boma after capture to rest/adjust 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; this can lead to a greater risk of myopathies, 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/in sight of the other giraffe to minimise their stress.

Boma to boma

After capture, the giraffe are transferred to a boma close to the capture site where they are kept for a period before being transported to the release site where they are held in another boma for a further period before being released ("soft release"). This enables animals to be monitored individually for illness, overall body condition and time to acclimatise to their new environment, 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 treated or 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 in a boma 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 can be:

- 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 upon arrival ("hard release"). This works well in some environments but does not allow the giraffe time to acclimatise in the new environment whilst under observation, particularly if the conditions are very different from the capture site. The animals may also be stressed after the transport and can be dehydrated. Therefore, being released in proximity of a water source may be valuable for them 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 to be released directly into the field.

Field to Field

This option can be advantageous if the environmental conditions and distances between capture and release 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.
- An experienced capture team that can catch, transport and release giraffe with minimum stress and problems.
- An experienced boma team to care for giraffe while in temporary holding (provide fresh browse, hay and water, cleaning, etc).
- 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 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.

6. 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 should be fully reversed 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 should 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 should be skilled and experienced. Transitions between gears should be as smooth as possible and sharp braking/sudden swerving avoided, as giraffe will be unsteady on their feet. Frequent checks should be made on the animals to ensure that they have not fallen and are not suffering undue stress. An experienced veterinarian should 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 dual 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 approximately 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.*

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. *Images courtesy of GCF/Sean Viljoen.*

- 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 described here.

As stated previously, giraffe should not be transported anesthetised, tranquilised, or sedated, and must be completely reversed from the immobilisation 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 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, 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 – like 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 and legs 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 or sharp edges 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. Rubber matts may be added to the sides of the truck to help prevent injury during transport.

The truck should be either open topped 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. However, if the drive is long, then regular stops can be made to feed and water the giraffe to help reduce stress. Slow and steady, as with all animal transport, should be the rule.

7. 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 as a once-off or repeatedly to release 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 always present at the boma. 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, several factors should be taken into consideration:

- Is the boma temporary or permanent?
- Will the boma be used only 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 year(s)?
- 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, a factor that 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 the walls, so walls 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 gaps. 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.

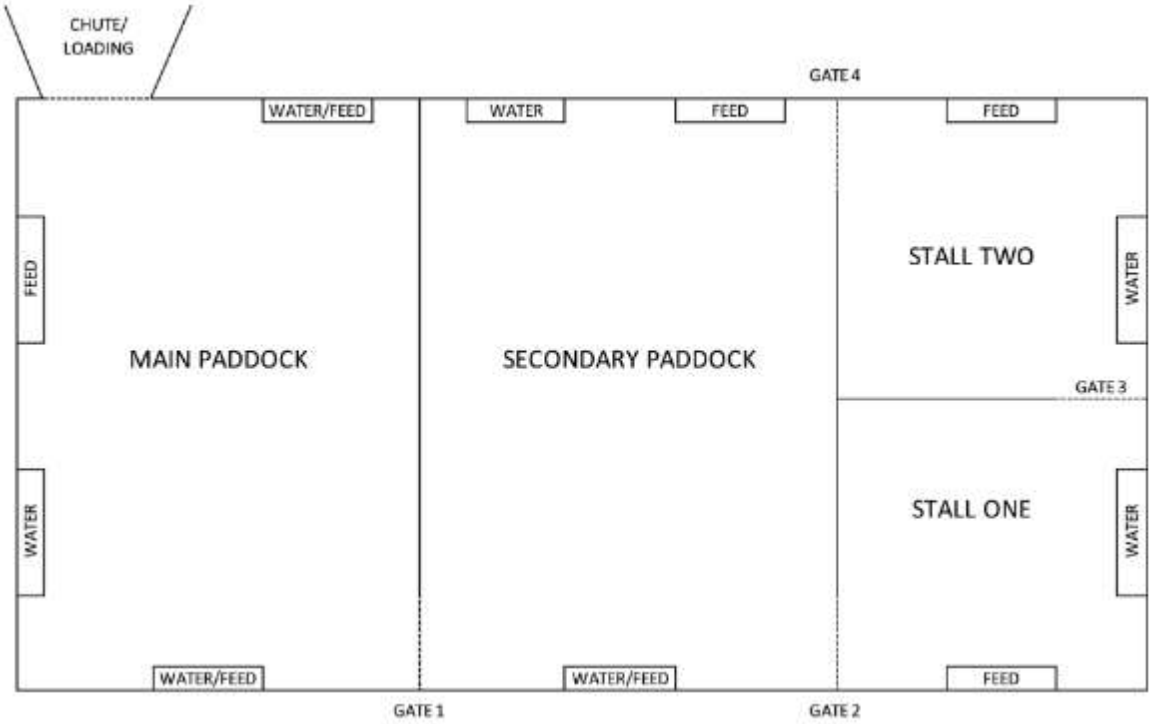

Figure 10: Schematic sketch of boma layout for larger operation. If smaller operation and no large bulls, the two stalls are not necessary.

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:

- Open plan or a series of paddocks and stalls, depending on the group structure. Sometimes it is necessary to separate animals, for example, one male from another male.
- 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. 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, 4.1 m if holding adults. 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 several 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 must 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 are 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: Giraffe in various boma constructions. *See Image Reference for 11a.*

Figure 11b: Giraffe in various boma constructions. *Images courtesy of GCF (top), Sean Viljoen/GCF (bottom).*

Figure 11c: Giraffe in various boma constructions. *Image courtesy of GCF.*

Doors/barricade

Doors or barricades 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 limit the giraffe 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 ensure it is within 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 a height of ~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. For 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.

Feeding area

Giraffe feeding troughs, racks and browse should be hung at about 2-3 m off the ground, like 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.

When possible, fresh browse should 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 or secured to fence posts. 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.

Crush or chute

If giraffe are to be held for any length of time in a boma, it may be advantageous 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 the end of the 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 approximately 1.5 m, and importantly the same (or slightly wider) than the doors. The goal of the offloading ramp is to have the animals be able to walk directly off the transport crate/chariot without having to step up or down. The ramp (as with the boma, chariot, and transport crate) needs to have non-slip footing so there is no risk of giraffe slipping or falling during the offloading process.

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, bolts, or wire.
- Make sure that the doors/barricades that are supposed to be closed are closed and latched. Someone responsible should be designated to 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, or removed for new introductions, 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) and a natural variety of fresh browse is the preferred feed for giraffe while in the boma.

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 monitor the giraffe and handle any potential emergencies. A veterinarian should also stay near the boma after capture for any immediate response. The handlers monitoring the boma should be equipped with communication (cell phone/radio/satellite 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-related myopathy. Care should be taken to minimise any giraffe stress while they are in the boma. The number of people visiting the giraffe should 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 (e.g. 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 being placed on the giraffe. In ideal circumstances, giraffe should be able to be shifted to a separate section of the boma while cleaning is going on to limit human/giraffe interaction and for safety of all involved. In between loads of translocated giraffe, the boma should be thoroughly cleaned before new animals are brought in.

It is crucial to understand normal giraffe 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, or 'freezing' meaning they stand in one place and do not respond to any stimuli or to any other giraffe for long periods of time (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 would 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 during 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 giraffe be in good condition 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 should 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.

Any grain or pellet feedstuff should be avoided as these tend to contain a high carbohydrate level and can induce ruminal acidosis when fed at high amounts.

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 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. Taking photos at capture, entry into the boma and subsequently after will provide a valuable suite of images to assess ongoing.

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. 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. 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.

Fighting

Male giraffe will likely spar/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 potentially result in injury, cause issues with other giraffe in the boma, and if it shows no sign of abating, the males should be separated.

Enrichment

Giraffe in captive environments can suffer from repetitive boredom issues such as 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 fresh 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.

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.

Routine checks of the giraffe in bomas should be done at the same time every day (e.g. in the morning at 08h00) and by the same people 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 an animal.
- 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* spp. parasite). Sometimes after transport, the urine will be blood tinged. This is myoglobin/haemoglobin caused by bruising or muscle damage during capture and is usually not serious but if persistent with other clinical signs can indicate a capture related myopathy.
- Check there are no discharges either on the animal or on the ground (blood, pus, mucus).
- Check for injuries and wounds.
- 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 commensal parasites such as the oxpecker to remove ticks and other ectoparasites. 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 topical tick treatment can be used.

- 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 which can be caused by a 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 cleansing, and/or a topical antifungal spray, with a good fly spray for around open wounds. Wounds can sometimes also become infected with clostridial bacteria; in these cases, a long-acting antibiotic and tetanus vaccine (or anti-toxin, if available) should be administered.
- Diseases: There are not many specific diseases that are of great concern in wild giraffe, but they are susceptible to many diseases that affect 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. Again, only visually healthy-looking individuals should be candidates for translocation operations.
- Eyes: These are another good indicator of sickness. Dull, lacklustre 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. Truly blind animals should not be translocated and a discussion on animal welfare should be had regarding release back into the wild.
- Abortion: Pregnant giraffe may abort due to stress of capture or brucellosis. Every effort should be made to not translocate knowing pregnant females. If a pregnant female is captured and aborts, 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 the animal may need to be euthanised.
- Diarrhoea: This can be caused by stress, parasite, diet, or an 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 diminazene (Berenil) or imidocarb (Forray 65) by pole syringe or dart, then kept in a warm and stress-free environment with good palliative care. Stress, anaesthetisation, or exertion will almost certainly kill the animal due to the anaemia (lack of red blood cells).
- 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. Diminazene (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 parasitaemia is.

- Anthrax: This is an annual vaccination for captive animals. It may or may not be valuable to vaccinate translocated animals.
- Abscesses: Giraffe can develop abscesses in the boma, often because of broken needles, untreated dart wounds and general debilitation. It is best to monitor the abscess till ripe, increased in size and localised. If necessary, the abscess may need to be lanced. To do this, cut a cross over the abscess the where the skin is thinner and tends to be shiny and softer and lowest point to allow drainage of all the pus and any foreign objects. Follow with flushing the abscess with warm water and dilute iodine. 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 during capture.

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 should 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 keep giraffe in the boma, depending on the conditions. A longer boma period is better than a shorter period, if 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.
- 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, as well as to allow for appropriate quarantine testing.

For shorter distances or if a soft release at the new area, the giraffe could be held for 7-10 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.
- 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 a prodder 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 after the translocation. Post-translocation monitoring needs to be incorporated into every translocation event. Giraffe should be monitored for at least 3-6 months after their release to monitor their movements and especially ensure no mortalities occur related to the capture or stress from translocation (capture myopathy) which can occur days to several weeks post capture/translocation (Breed et al. 2019). Generally, when appropriate steps and preparations are taken for translocations, giraffe settle into their new environment quickly when conditions are good.

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 or low-hanging power lines 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.
- 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 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. However, this is not always feasible and may vary to local needs.

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.

Telemetry

Giraffe can be fitted with GPS satellite units or GSM/VHF/UHF/LoRa/SigFox radio units to aid in post-translocation monitoring. Those monitoring 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 the units on. Ongoing developments have shown that using collars or head harnesses is no longer appropriate. Different giraffe species have different head morphology and as such alternative technology and research shows that GPS satellite tail mounted (above the tassel) or light-weight ear tags are now the GPS units of choice for giraffe.

Figure 12: Ceres GPS ear tag fitted to the ventral (inside) of a southern giraffe ear. *Image courtesy of GCF.*

Figure 13: A southern giraffe fitted with a Savannah Tracking GPS tail unit. *Image courtesy of GCF*.

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 because of cold, wind and driving rain.
- Male giraffe may fight other resident males for hierarchy and suffer injuries as a result.

8. EUTHANASIA

Sometimes giraffe need 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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