EAZA Best Practice Guidelines

De Brazza Monkey *(Cercopithecus neglectus)*

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EAZA Preamble

Right from the very beginning it has been the concern of EAZA and the EEPs to encourage and promote the highest possible standards for husbandry of zoo and aquarium animals. For this reason, quite early on, EAZA developed the “Minimum Standards for the Accommodation and Care of Animals in Zoos and Aquaria”. These standards lay down general principles of animal keeping, to which the members of EAZA feel themselves committed. Above and beyond this, some countries have defined regulatory minimum standards for the keeping of individual species regarding the size and furnishings of enclosures etc., which, according to the opinion of authors, should definitely be fulfilled before allowing such animals to be kept within the area of the jurisdiction of those countries. These minimum standards are intended to determine the borderline of acceptable animal welfare. It is not permitted to fall short of these standards. How difficult it is to determine the standards, however, can be seen in the fact that minimum standards vary from country to country.

Above and beyond this, specialists of the EEPs and TAGs have undertaken the considerable task of laying down guidelines for keeping individual animal species. Whilst some aspects of husbandry reported in the guidelines will define minimum standards, in general, these guidelines are not to be understood as minimum requirements; they represent best practice. As such the EAZA Best Practice Guidelines for keeping animals intend rather to describe the desirable design of enclosures and prerequisites for animal keeping that are, according to the present state of knowledge, considered as being optimal for each species. They intend above all to indicate how enclosures should be designed and what conditions should be fulfilled for the optimal care of individual species.

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Summary

These guidelines are composed of two sections. The first provides and overview of biology, ecology and behaviour in the wild summarising published information referenced at the end of the document. The second section provides information on management in captivity. This section was written using published information and from the findings of a questionnaire survey and the input of the species committee. Although the second section is written for the De Brazza much of the information is relevant for other guenon species.

Contents **Page**

SECTION 1: Biology and Conservation

1.1 Taxonomy

Kingdom Animalia

Phylum Chordata

Class Mammal

Order Primate

Family Cercopithecidae

Genus Cercopithecus

Species neglectus

Wild De Brazza monkey photographed in the Lesio-Louana Reserve Republic of the Congo (Tony King, Aspinall Foundation)

1.2 Morphology

The DeBrazzas monkey *(Cercopithecus neglectus)* is a sexually dimorphic species with males typically weighing up to 3kg more than females (males average 6-7kg, females average 3-4kg adult weight). Length ranges from 40-63cm.

Both have grey agouti (speckled appearance) bodies with black extremities and tail along with a white rump. A white stripe course down its lateral thigh. A bright orange dome sits above its eyebrows. It has distinctive white beard which begins under its nasal passages and continues down, spreading cross its entire mouth and down below its chin. Adult pelage begins to form at 6-8wks and is complete by 12wks of age and the mature males have a distinctive blue scrotum.

It has extensive cheek pouches which it uses to store food whilst foraging in the open and its tail is none prehensile.

1.3 Physiology

The normal body temperature is between 36-38^{o}C. Dental Formula is 2:1:2:3in both upper and lower jaws.

1.4 Longevity

The lifespan of the wild De Brazzas monkey has not been reported but other guenon species can live to 20-25yrs.

In captivity, in the European studbook the oldest animal was reported to be 32 years old.

1.5 Zoogeography

1.5.1 Distribution

This species ranges from north-eastern Angola, Cameroon, Equatorial Guinea (Rio Muni) and Gabon in the west of its range to Uganda, Kenya and south-western Ethiopia in the east.

Between 2002 and 2007 De Brazzas monkeys were observed either individually or within groups of up to 6, in the Reserves of the Bateke Plateau region of the Republic of Congo and although previously unknown in this area, it has been suggested that populations of De Brazzas may have been overlooked in previous surveys as they appear to only be detectable via audible means prior to 7am (King 2008). It is likely that they have always been resident there. The natural behaviour once startled is for the De Brazzas to freeze, it can remain frozen in one spot for hours and this may also be a reason that previous rapid surveys have missed their presence.

De Brazzas have also been located in Mbam, the Djerem, and the Lom in Cameroon (Maisels et al. 2007) and have also been recorded in the remote and isolated Mathews Range Forest Reserve of Samburu at an elevation of 2,200 m (the highest elevation at which the species has yet been recorded (Mwenja 2007).

1.5.2 Habitat

This species is associated with riverine forest habitats, generally being found within 1km of rivers and humid forests, swamp forest, semi-deciduous forest and Acacia dominated forest. They are mainly arboreal. De Brazza's Monkey is considerably more inconspicuous than most other guenons as they rarely use group calls and tend to live in small family groups (4-10 on average). They have been known to exist in groups of up to 35 members. [Leutenegger and Lubach, 1987; Geissmann, 2003; King, 2008]. The typical home range is about 5 hectares (Wahome et al., 1993; Wolfheim, 1983).

1.5.3 Conservation Status

The IUCN Red list classifies them as Least Concern. The species is considered generally common and widespread, albeit threatened locally in parts of its range. There is no current evidence to support that the species is declining at a rate that would warrant listing in a threatened category.

1.5.4 Threats

De Brazzas *(Cercopithacus neglectus)* monkeys are declining in localized areas across its range through deforestation of habitat for agricultural land and timber. It is hunted for meat, especially in the more western ranges, whilst in East Africa it is killed for both food and as an agricultural pest.

1.5.5 Conservation Actions

De Brazza monkeys are listened in CITES Appendix II.
There is little, if any specific field conservation actions or research being undertaken on this species. The most recent activity has been field surveys in Cameroon and Gabon (Maisels et al, 2007) and study of a newly discovered isolated population in Kenya (Mwenja, 2007).

1.6 Diet and Feeding Behaviour

De Brazza's are primarily frugivorous (75%) but also consume leaves, flowers, mushrooms, invertebrates and other small prey. In the wild, De Brazza's prefer to eat early morning and late evening. They will come down to the lower canopy and also the floor where they will, gather food with their hands moving around on all four feet.

1.7 Reproduction

Puberty and the onset of sexual maturity occur in males at around 6yrs of age and in females at around 5yrs of age. They seem to remain fertile well into their late 20's. The oestrus cycle is usually 30 days

Females give birth to their first infant at around the age of 4 (Diamond, 2011; Leutenegger & Lubach, 1987; Wahome, Rowell, & Tsingalia, 1993), this is also seen in captivity (Brennan, 1989). Gestation is 177-187 days with a 12mth interval between one pregnancy and another. Neonates are usually 260-410g in weight.

1.7.1 Infant Development

The female will nurse for one year. Young will have milk solely for the first 8wks of life and then they appear to begin to experiment with solid food in addition to maintaining the same level of suckling (Querouil & Blois-Heulin 1998). By 11wks the young De Brazzas have a distinct feeding pattern with the majority of feeding occurring in the morning. Between 3 and 6mths the young will gradually consume less milk and more solid food. With the entire weaning process completed by 12mths of age (Querouil & Blois-Heulin 1998). The exploration of solid food is accompanied by increased olfaction. Infants are more curious and explore their environment more intensively via olfaction compared to adults (Zschoke & Thomsen 2014). De brazza infants cling to the mother and nurse in the first week of life. After approximately a week the infant begins to take its first steps away from the mother. At the age of one month, the infant spends increasing time walking, climbing and interacting with other animals.

The role of the male in parenting has not been documented but it is thought that they protect the young from predators. In other guenon species the male may protect against infanticidal males but infanticide has not been reported in this species in the wild.

1.8 Behaviour

Time budget information for the De Brazzas is scarce but dominance and agonistic behaviours are rarely seen. Foraging and sitting are the most frequently observed behaviours, with play being part of the infant time budget but rarely the adult (Oswald & Lockard 1980).

1.8.1 Sexual Behaviour

Whilst males and females can encourage sexual activity, it is the female who solicits copulation. Using vocal calls including grunting during intake of air. Mating is preceded by a brief but important examination of the female genitals by the male. During copulation the female De Brazzas monkey will appear to pout by sticking out her bottom lip and keeping her lips closed. She may look back at the male.

1.8.2 Social Structure

Although they have been reported as socially monogamous species in Gabon (Leutenegger & Lubach 1987; Bouchet et al. 2012), in most habitats they form small multi-male multi-female groups with 6–10 individuals (Leutenegger and Lubach, 1987; King, 2008) and are accommodating to sympatric associations.

Infants, juveniles and sub adults will remain within the family group. When sexual maturity is achieved (at about 4yrs of age), the females remain philopatric, whilst males move out of the group until they are physically able to take over their own group of females (Zuberbühler 2004). The migration of males from natal groups ensures genetic diversity, with minimal opportunity for inbreeding (Strier, 2016).

1.8.3 Communication Behaviours

A comprehensive analysis of the vocal repertoire of 23 captive De Brazzas monkeys was conducted in 2012 (Bouchet et al. 2012), they concluded that male and female vocal ranges in addition to young and old vocal ranges are very similar to other guenon species. These include a ‘grunting’ contact call and a ‘cackling’ alarm call. Isolation calls are very distinct and are made by infants who become isolated from the family group. The male De Brazzas monkey makes loud, low booms and will shake tree branches when threatened. Young males in the group appear to imitate the resident male without eliciting any aggression or being seen as a threat.

De Brazza’s, like other guenons, use a range of visual display behaviours particularly related to avoiding physical conflict. They include:

Staring: This display by De Brazzas monkey is used as a threat display. The eyes are fixed on the stimulus and the eyebrows are raised and the scalp is retracted by moving the ears back.

Staring with open mouth: This is the stare accompanied by the mouth being open but the teeth are covered and is considered a threat.

Head-bobbing: This is accompanied by an open mouth and is a threat.

Fear grimace: The lips are retracted so that the teeth are shown; the teeth are clenched together. This display functions as an appeasement signal to reduce aggressive encounters.

Yawning: This is where the mouth is opened to reveal the canines, and is performed by the

adult male as a threat to another.

Head-shaking: This display indicates a sociable tendency, given during conflict situations.

Hiding – Youngsters have been seen to hide their bodies behind a branch so to be out of sight.

Section 2: Management in Zoos

2.1 Enclosures

A combination of indoor and outdoor accommodation is appropriate for this species, with at least two (and preferably more) indoor compartments available to facilitate separation as necessary (see Figure 1 and Figure 2 for examples of enclosures). Attention must be paid to the positioning of the enclosure as constant full sun should be avoided. The enclosure must be species appropriate and contain the necessary equipment and materials for the monkeys to have their psychological and physiological needs met.

2.1.1 Indoor Accommodation

It is advisable to have at least two indoor areas with several connections to the outdoor area, this ensures that all animals are able to move freely into and out of the housed area without conflict. At least one indoor area should facilitate separation of an animal, preferably off public view to allow introductions or medical treatments. Indoor enclosures should be interconnected using slides on pulleys so that keepers do not have to enter the enclosure to move animals. There must be multiple slides between each enclosure (including the outdoor enclosure) so a circuit can be created preventing an animal cornering or blocking escape. The individual areas should be separated by small (2cm x 2cm) mesh to allow visual and olfactory but not physical contact. Indoor enclosures should include visual barriers to allow animals to separate from co-specifics. Furnishings should allow the animals to use the maximum available space and be sufficient to avoid competition between animals.

Indoor accommodation needs to be a minimum of 4sq.m for the first adult individual and then 2sq.m for each individual animal planned to be housed. Dimensions of the accommodation are dependent upon group size, group composition and climate, in addition to future management plans. Larger indoor housing will be needed in colder climates where the animals are likely to choose to spend more times indoors. De Brazza monkeys should never be locked outside particularly in cold weather when there is a significant risk of frostbite to the tail. A double door system is needed for the keeper access to the indoor enclosure.

The indoor accommodation should offer some level of complexity for the monkeys. Indoor planting can buffer external noise and provide shelter. Tree branches and moveable objects can be used to enhance foraging and hand gathering. As these monkeys are arboreal, some height within the indoor accommodation is recommended to allow the monkeys to engage in the full space that they have. Climbing facilities like wooden pole structures, hammocks, platforms and fire hose hung between secured fittings are all suitable. Areas which give the impression of being ‘under the canopy’ might prove popular for the sleeping or resting De Brazzas monkeys.

2.1.2 Environmental Parameters

Mean minimum temperature indoors should be 16-20^{o}C and mean maximum temperature indoors should be 21-25^{o}C. Humidity of 65% is recommended for all guenon species. Heating can be provided using a radiator system of tube heaters mounted to the wall behind a wooden mesh guard or panel heaters. Temperature can be kept constant but can also be altered via a thermostat.

Indoor facilities should be well ventilated and have air flow which does not reduce air temperature.

2.1.3 Lighting

In addition to the natural light from well protected sky-lights and/or windows (think of the risks of broken glass falling into the enclosures). When climatic conditions allow for limited access to the outside area, insufficient exposure to UV light may lead to vitamin D3 deficiencies. This

can be overcome by feeding vitamin supplements, but since vitamin D3 is not transferred in the milk from mothers to nursing babies, they may still become deficient for this vitamin. Exposure to UV tube lights can help to solve the problem. It is best to use a low intensity type of tube light so that it can be switched on for several hours a day without becoming harmful. Remember that the spectrum of such lights quickly changes and that the tubes should be replaced at regular intervals as indicated by the manufacturer. Also the distance between light-tubes and the animals is essential. Whereas a distance that is too short can be harmful, a distance too long will not be effective. All lights have better to be placed outside the animal's space or protected, to avoid that broken lights fall on the enclosure floor.

2.1.4 Example Layouts

Example House Design for Guenons.

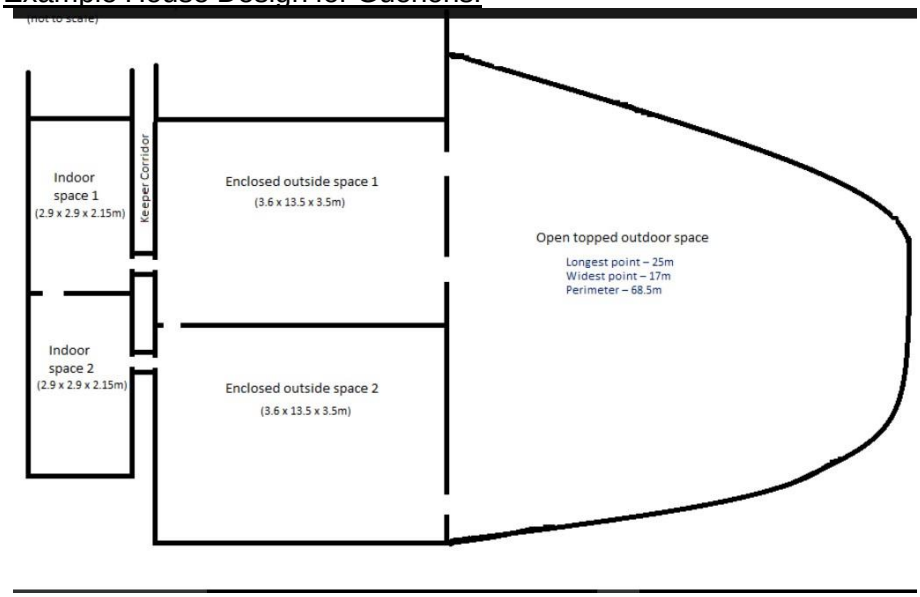


Figure 1. – Layout of De Brazza Enclosure

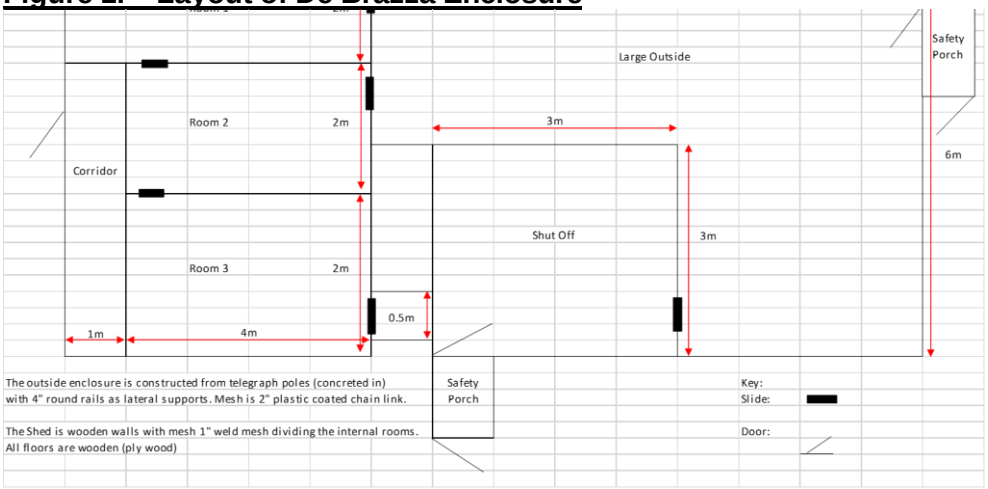
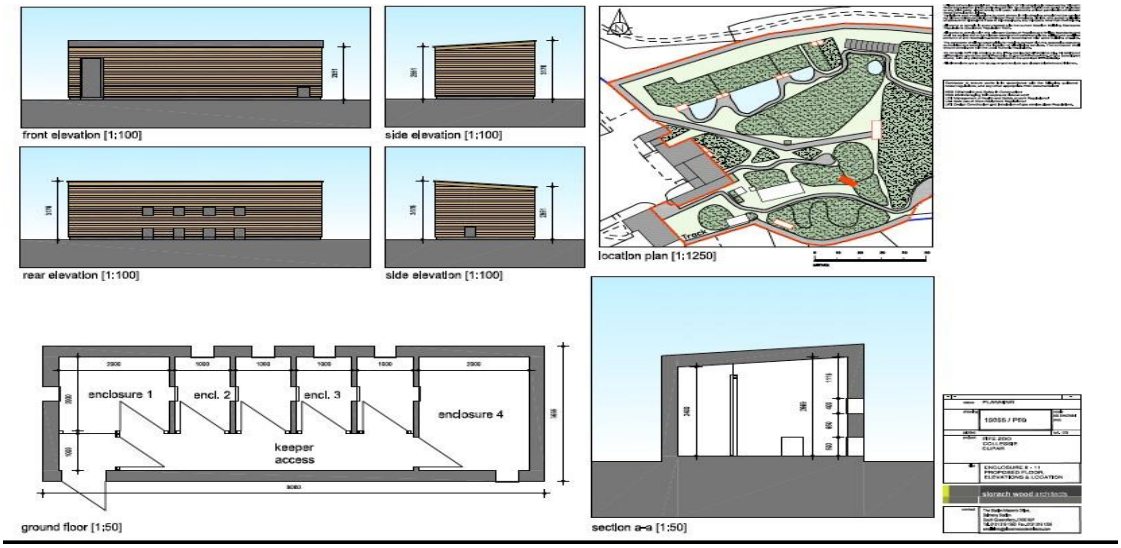


Figure 2.

This house has been designed to hold 2 species in the one house.



2.1.5 Outdoor accommodation

Outdoor accommodation must be a minimum of 30sq.m per individual (240sq.m for the recommended group size of 8 individuals) with a minimum useable vertical height of 5m.
Outdoor accommodation must be robust enough to prevent escape or damage, prevent wildlife from digging under and prevent visitors from making contact with the monkeys.

The materials used in construction must not be harmful to the monkeys and must be a balance between being attractive for the visitors without being threatening to the monkeys. A mixture of barrier types is recommended to create a naturalistic habitat which simultaneously allows good ventilation and viewing.

At its most basic an enclosure design could be a steel mesh fence with a wire ceiling, with at least a 1.5m curtilage from viewing public with a minimum height of 5m. The fence should be buried into the ground. Mesh size must be a maximum of 2.5cm x 2.5cm but smaller diameter is recommended

Safety glass can be used, although it is expensive and full walls of glass may create many reflections and noises which the De Brazzas may find threatening. This can be reduced by tilting the glass towards the animals slightly. Very close contact with the public provided by glass can be very stressful and provoke display behaviours. This can be reduced by planting vegetation to increase the contact distance. Safety glass must be a minimum thickness of 6mm and set into a steel or aluminium frame for security.

De Brazzas monkeys can swim and so a small water area not less than 100cm wide and not more than 50cm in depth within the outdoor enclosure provides enrichment. A shallow incline and ropes or net at the edges allow animals to climb out. Water moats alone, however, are not recommended, but in combination with electric fencing can be used. The jump distance of a De Brazza is suggested to be 4m.

Shelters/hiding places are recommended for shade, inclement weather and public view. At least two shelter areas should be provided for a group of 8 De Brazzas monkeys, with multiple access and exit routes accessible at all times. The dimensions of which are dependent upon the local climate, position of the enclosure, group composition and levels of vegetation within the enclosure. Again, furniture and climbing structures must be provided. These can be made

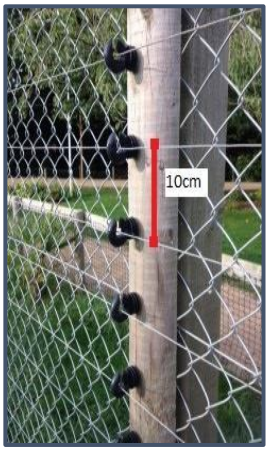
from natural materials such as dead trees, branches and rocks or wooden pole climbing structures, platforms, rope or fire hose strung between structures or made into hammocks. A number of visual barriers to allow for hiding behaviour from other guenons and the public are very important for the animals to feel secure.

A second double door system would be useful in the outdoor enclosure for ease of access for the keepers to clean and add enrichment items without disturbing the group. This could be a vehicular access to allow for landscaping and maintenance purposes.

2.1.6 Use of Electric Fencing

The use of electric fences to contain De Brazza monkeys is suitable. The fence must be tall enough to ensure that the animals are unable to jump over it and all structures within the enclosure must be positioned so as to ensure they do not provide a potential route over the fence.

Below are the details of the fence that is successfully used at Twycross Zoo.
Perimeter fence is two metres high with posts roughly every 3-4 metres. Heavy gauge wire mesh is installed on the internal edge of the posts with an additional wooden piece attached on top to which the electric isolators are fixed (see photos). The isolators are spaced every 10cms up the post and start about 20cm from the floor to avoid the grass etc hitting the lower strands and shorting the system (gravel has been laid beneath the fence to aid with this as well). There is an additional strand at the bottom that is elevated away from the post by about 15cm, this is to discourage the animals venturing to the floor and then trying to go under the electric strands. All the strands are live with the metal mesh fence behind acting as the earthing element in the design.



On the solid walls i.e. linking to the main enclosure and the two viewing areas multiple strands are secured to the walls to restrict climbing. These walls are also designed so they have minimal hand holds.

It is recommended that any electric fence that is being used to contain animals is fed from the main electrical power supply. A battery back-up is essential in case of a mains power failure, this can either be a separate unit or built in to energiser for the fence. The battery must be large enough to supply power for a suitable period of time e.g. 12 hours or more in case of a power failure overnight which may not be discovered until the following morning.

2.1.7 Substrates

All substrate for indoor enclosures must be easily removed and sanitised to prevent illness or disease. Concrete or epoxy floors sloped at 2-4% allowing cleansing and drainage.
Concrete flooring and brick, block, Trespa Board or tin lined walls are needed for ease of cleaning and for limiting bacterial or viral spore survival. Bark chip or straw is recommended for use on the floor in sufficient quantities to allow for comfort, and to assist with humidity and enrichment (if scatter feeding indoors). Deep litter bark chip or bio-floors are also suitable. Sawdust and wood chips can be excessively dusty and should be used with care. For outdoor enclosures natural substrates such as grass, leaf litter and bark should be used. For enrichment purposes having several types of substrate is advantageous.

Typical substrates and climbing materials for the monkeys are shown in charts 1 and 2 below.

Chart One:

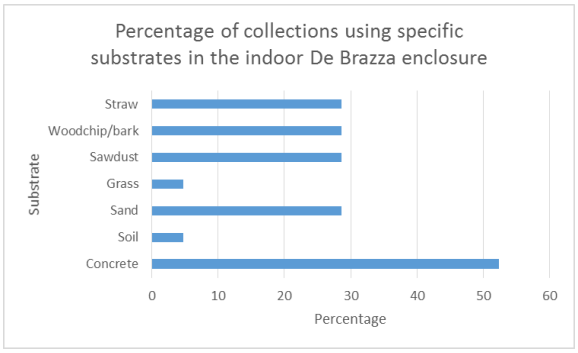
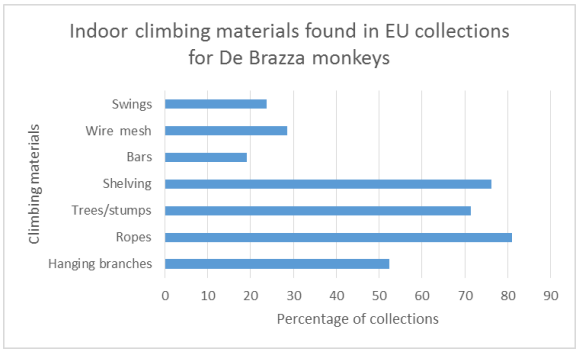


Chart Two:



Only natural or species appropriate substrates should be used. If in a mixed exhibit the substrate must be suitable for all species. Trees, branches, rope walks and logs can be used to create the variety of heights needed within the enclosure. Care must be taken to not place these near to the top of any boundary wall. Grass, shrubs, bark shavings, roots and reeds can be used to create dense vegetation.

Dense vegetation is recommended and where possible the enclosure should be naturally planted, ideally with a variety of plant types providing vegetation at numerous heights. Large trees will provide naturalistic climbing structures whilst low level shrubs and bushes will provide visual barriers allowing the animals to get away from both cage mates and the public. This vegetation will also provide shade and shelter as required. Care must be taken to ensure that any plant is not positioned in a way that may provide a potential escape route from the enclosure.

All plants that are used within the enclosure must be non-toxic as the animals may feed on the foliage, bark etc. Due to this fact it is recommended that the plants used may be best to be non-toxic but not particularly palatable either so the animals do not destroy the plants by eating them.

2.2 Feeding

A nutritionally balanced diet must be provided daily in a density appropriate for the species. If provided at all, fruit should be fed in very small amounts. Browse should be provided daily. Nuts and seeds should be used sparingly as a form of enrichment (due to their high fat content). Obesity is the most common nutritional disorder in this species.

A commercially produced primate pellet should constitute 40% of the dry matter of the diet. A combination of general primate pellet and leaf eater pellet is used by several zoos. These nutritional balanced products are fortified with much of the animals' vitamin and mineral

requirements. It is advised that pellet is fed in the morning as the first feed alongside green vegetables. Other, often more favoured foodstuffs, such as fruit, root vegetables, invertebrates and browse should be fed separately. In this way consumption of the pellet is more likely as the when the animal is most hungry. Guenons would spend much of the day foraging for food and therefore small frequent meals are more appropriate than a single large mixed feed. Bread, pasta and other white starches should not be fed as these have little nutritional benefit and are high in calories. Most collections use a vitamin and mineral supplement either sprinkled over the food or fed in tablet form.

The table below shows the appropriate nutritional requirements of pelleted food:

	Diet 1 – general primate pellet	Diet 2 – leaf eater pellet	Diet 3 – Primate browse pellet
Crude Protein	14.5%	23%	18%
Crude Oils and Fats	2.5%	5%	3%
Crude Fibre	22%	14%	16%
Crude Ash	9%	9%	8%

2.2.1 General Diet

This table demonstrates proportions of food types that should be in the diet. This is indicative only but highlights how fruits are

	Proportion of Total Diet
Pelleted Food	40%
Browse	As much as possible but ideally at least 20% make up with more greens if necessary.
Green Vegetables	20%
Root Vegetables	10%
Fruit	5%
Other Items	5%

Green Vegetables

Lettuce such as gem or cos (others have no nutritional value)	Spinach	Asparagus	Green beans – French beans, runner beans	Asian greens such as Pak Choy
Cabbage	Kale	Alfalfa sprouts	Peas and sugar snap peas	Chard
Broccoli	Brussels	Broad Beans, Edame beans, soy beans	Mange Tout	Herbs – parsley, coriander, etc

Root Vegetables

Carrot	Swede	Celeriac	Sweet corn	Pulses (soaked) – kidney beans, chick peas, etc
Parsnip	Sweet potato	Fennel	Butternut	Aubergine
Turnip	Cauliflower	Beetroot	Pumpkin	Mushrooms

Do not use onions.

Fruits – these have very little nutritional value

Apple	Plum	Mango	Currants	Pepper
Apricot	Cherry	Berries	Figs	Tomato

Nectarine/Peach	Melon/Watermelon	Celery	Cucumber	Pear
Banana	Pineapple	Grapes	Kiwi	Courgette/Soft squash

Citrus fruits should be avoided.

Other Items – should be used primarily for enrichment and scatter feeds

Seeds	Mealworms	Dried Fruits	Grains	Coconut (dried or fresh)
Nuts	Crickets	Eggs	Bran based breakfast cereals	Chicken meat

2.2.2 Browse

A variety of browse should be offered. Examples of suitable species are listed below.

Latin name	Common name	Latin name	Common name
Acer spp.	Maple	*Nandina domestica*	Nandina
Arundo donax	Spanish reed	*Olea europaea*	Olive
Betula pendula	European birch	*Pawlonia tomentosa*	Foxglove tree
Buxus spp	Box	*Penisetum purpureum*	Napier grass
Carya illinoinensis	Pecan	*Philadelphus coronarius*	Sweet mock orange
Casuarina cunninghamiana	Australian pine	*Phoenix dactylifera*	Date palm
Catalapa bignonioides	Catalpa	*Photinia spp*	Red fotinia
Celtis spp.	European hackberry	*Phyllostachis aurea*	Golden bamboo
Cercis siliquastrum	Judas tree	*Phyllostachis flexuosa*	Zig-zag bamboo
Chamaerops humilis	European fan palm	*Pinus palustris*	Longleaf pine
Citrus aurantium	Bitter orange	*Platanus x acerifolia*	London plane
Cornus florida	Flowering Dogwood	*Populus alba*	Silver poplar
Corylus avellana	Common hazel	*Pyracantha spp*	Firethorn
Crataegus spp	Hawthorn	*Quercus ilex*	Holm oak
Cyperus alternifolius	Umbrella plant	*Rubus idaeus*	Raspberry
Eleagnus umbellata	Japanese silverberry	*Sabal spp*	Palmetto
Eugenia spp	Eugenia	*Salix alba*	White willow
Fagus	Beech	*Sasa paniculata*	Japanese Bamboo
Ficus carica	Common fig	*Sugar cane*	Saccharum spp
Fraxinus excelsior	Common ash	*Thypha latifolia*	Bulrush
Hibiscus spp.	Hibiscus	*Tipuana tipu*	Rosewood
Ligustrum japonicum	Privet	*Ulmus spp.*	Elm
Ligustrum lucidum	Chinese privet	*Washingtonia filifera*	California fan palm
Miscanthus sinensis	Chinese silver grass	*Yucca elephantipes*	Spanish bayonet
Morus alba	White mulberry		
Musa spp	Banana		

2.2.3 Weaning Diet

At approximately 2 months infants are eating a small amount of solid food. Weaning does not occur until 6-8 months of age and youngsters of about 1 year are still observed to nurse on occasion.

The weaning diet from Twycross Zoo, includes a number of increases that are timed appropriately in accordance with the age of weaning and growth rate throughout the infant's development. The age of weaning is assumed to be 12 months.
The first increase is at birth and is 20% of an adult female diet (independent of the infant's sex). This is because in the early stages of development solids will not play a part in the infant's diet but the mother will require increased nutrition for the extra energy required for lactation. The second increase is 40% of adult female diet and the third increase is 60% adult female diet, these increases occurs at 4 and 8 months respectively. Then at 12 months (weaning age) the infant is provided with 80% of an adult diet (male or female depending on the sex of the baby). Increases thereafter go up by 10% every 4 months rather than 20% until the animal is being fed 100% of an adult diet. This is so that the calorie intake matches the growth curve of an infant whose growth is initially very rapid and then slows down after weaning.

2.2.4 Water

Fresh clean drinking water must be provided at all times ad libitum in the indoor and outdoor accommodation. The use of bowls allows intake to be measured but can be tipped over unless it presented in heavy broad bottomed containers. Automatic bowl waterers can be used but should be checked and cleaned daily. Automatic nipple drinkers can be used but care should be taken to ensure than animals know how to use these.

2.3 Social structure

2.3.1 Basic Social Structure

De Brazza groups should be composed of an adult breeding male, between one and five adult females (dependent on enclosure size) and their juvenile offspring. As experience of reproductive and parental experience is important for the social development of this species, sub-adults should not leave the group until they have reached puberty at 3-4 years old. Young males may start demonstrating sexual behaviour and causing conflict with their father at this age but males as old as 6 years old have remained in their natal group in some cases. Adult females have begun to show aggression to 5-7 year old adult daughters occasionally but this is uncommon.

In the wild sub-adult males would remain on the periphery of breeding groups or form small bachelor groups. This has been attempted with some success in European zoos. As of 2018, there are four bachelor groups composed of both related and unrelated males. Establishing bachelor groups larger than three animals has not been successful.

2.3.2 Changing Social Groups

Introducing new animals to existing groups is essential for programme management. All introductions should be managed gradually with increasing olfactory, auditory, visual and physical contact as described in the case studies. There have been successful reports of adults of both sexes being introduced to existing groups. The only introduction that would not

be attempted would be the introduction of an adult male to a female with a young offspring due to the potential risk of the youngster being dropped or injured during the increased activity.

There is a theoretical risk that an unrelated male would kill youngsters when joining a group but this has not be realized in European zoos however this has only been attempted once the youngster have been a minimum of 7 months old for the reason explained above.

2.3.2.1 Introducing lone male to lone female

Many collections have introduced a lone male to a lone female De Brazza and all introductions were successful, despite different techniques. The recommended technique is to allow visual and olfactory contact through wire mesh until the female displayed submissive behaviours and then remove the mesh.

2.3.2.2 Introducing a lone female into an established breeding group**.**

Some EU collections have successfully introduced a lone female into an established breeding group, the selected technique is leaving the new female with mesh access to the group, followed by many different individual introductions such as breeding adult male with new female and breeding female, then new female with just the breeding female, then the breeding females offspring with new female. Once positive postures and behaviours were noticed then supervised full contact with the whole group was allowed.

CASE STUDY*;* The new female was housed in the enclosure next door with double mesh between her and the established group. Once positive behaviours were observed, an attempt was made to introduce her to the group. Initial introduction was with the juvenile male, this went well. Then introduced the dominant male and again this yielded positive results. Final introduction was to add the established female and her young juvenile, all went well to start with but then the established female attacked the new female and caused some substantial wounds to her tail. New female was then isolated from group and housed next to them for a few weeks whilst the wounds heal.
Once healed the introduction process was repeated but with a considerable gap between introducing the dominant male and adding the established female. This allowed the male to bond with the new female and thus protect her when the established female was added, as it turns out there wasn't any aggression when the established female was added for the second time. The group has been stable since then.

2.3.2.3 Introducing a new lone male into a stable breeding group where the previous breeding male had been removed.

Some EU collections reported putting a new lone male into a group of females, who had previously been a stable group with a breeding male. The technique recommended for this is the same as the one above.

2.3.2.4 Introducing a lone male into a bachelor group.

There has been some limited success in establishing long term bachelor groups. There appears to be more success with related males which have lived together from birth. However there have been cases of successfully introducing unrelated sub-adult males. De-stabilization has been seen as the animals reach sexual maturity at 6-7 years of age. Bachelor groups can be set up using one entire male and all others castrated or all castrated males. Castration does not seem to interfere with dominance displays. Castration of animals not required for breeding has been successful in reducing aggression. Deslorelin acetate implants are not

recommended in this species as they appear to cause hyper-aggression and other behavioural changes and do not help the situation.

Introducing lone males into a bachelor group is performed in the same way as the other introductions- via protected mesh contact and individual introductions over time, until positive behaviours are reported between all the individuals within the group. All male bachelor groups are being managed successfully within EU collections.

2.3.3 Mixed Species Exhibits

A number of zoos house De Brazza's in mixed exhibits with gorilla, drill, mandrill, colobus monkeys, Diana monkeys, Rock hyrax, black backed Duiker, red river hogs, muntjac deer, blue Monkey and giraffe (OWM TAG Mixed Species Manual 2013). Advice should be sought from the EEP co-ordinator and the veterinary requirements as set out in the Appendices before these exhibits should be instigated.

In grouped exhibits, all species should have their own indoor enclosures, to allow separation of species and escape. It has been reported that the frequency of physical and social interactions between the DeBrazza and other primate species is high (median of 7/10 on a frequency scale). For example young De Brazzas have been seen engaging in play behaviour with colobus monkey and gorilla.

Being part of a mixed taxa exhibit does not result in poor reproductive function or stress (Diamond, 2011). When housing alongside other guenons, despite having similar behaviours and being in the same taxonomic family, there are specific visual patterns made by the different guenon species to their conspecifics, and this subtle yet specific communication prevents hybridization between guenons (Allen & Higham 2015).

CASE STUDY:

We recently successfully introduced Bertha, an old female De Brazza with an elderly spot nosed guenon. They were originally separate in adjacent rooms with 1 inch mesh dividing them. Both were calm with the spot nosed showing interest. The pair touched fingers and smelt each other over the course of the first day without aggression. On the second day a middle slide was opened allowing them access to each other whilst shut into the two rooms. Initially little interaction happened as they checked for food, but the spot nosed soon moved towards Bertha touching her and smelling her with no reaction from Bertha apart from sitting still. A few hours later mutual grooming had been observed and it was decided to leave the pair together overnight. Both were found in separate areas of the rooms, looking calm and showing no injuries. Outside access was given as the pair looked settled and Bertha chose to spend time outside with the spot nosed female maintaining contact with her at times. Both re-entered the shed area for feed times and the pair were left with full access overnight. They continue to appear to be happy with the attention and company from one another without incident.

CASE STUDY: Parque de la Naturaleza, Cabarcebo

When this process began, we had a group of 1.4 adult Gorillas (*Gorilla gorilla*), and 3 offspring (one female aged 4, a male aged 3 and a baby of 5 months).
The De Brazza (*Cercopithecus neglectus)* arrived from 3 different institutions:

- **2nd June:** Arrival from Bioparc Valencia a female (Madre) plus her male offspring (Cria 1). They stay in the De Brazza enclosure and they only have olfactory and auditory contact with the Gorillas.
  They are quiet except for hitting the doors answering the curiosity from the Gorillas. Gorillas are very curious and try to access the De Brazza dormitories but are quite relaxed and continue to play and behave normally.
- **5th July:** Two more De Brazza arrive from Barcelona Zoo, an adult non related male and a female (Carla, daughter from the female that arrived previously). At arrival they begin to make sounds of association and affiliative behavior through the bars. Both De Brazza groups can see each other but they cannot touch each other.
- **6th July:** The 2 De Brazza groups can touch through the bars, but cannot see nor touch the Gorillas. Positive reactions, sounds of association and grooming through the bars.
- **7th July:** The association of the 4 De Brazza begins in the De Brazza dormitories. There is a lot of aggressiveness, so they are separated for the night.
- **8th July:** We decide to let them access to a dormitory from the Gorillas to avoid territoriality.
  - Positive action, as fights begin to be testimonial and in general we observe affiliative behavior between the Barcelona male and the female from Valencia (Madre) and the offspring from Valencia (Cria1), although the other female from Barcelona (Carla) still fears her mother and runs from her. We separate them again at night.
- **9th July:** We begin to move the De Brazza "group" to the adaptation area, during one hour per day, to enable them to get used to the enclosure and to have visual contact with the Gorillas. From this day, they can have contact with the gorillas though the bars whenever they want.
  - The reactions from the gorillas are curiosity and fear in some individuals (Moja and Gwet). The 2 De Brazza females have positive reactions although the female from Valencia (Carla) charges a couple of times against the gorillas through the bars.
  - The affiliative behavior between the De Brazza improves (grooming, positive vocalizations, etc) whereas the agonistic behavior decreases (fear, flight, negative vocalizations), and there are no aggressions.
  - From this day, the De Brazza spend the night together as a group and have also free access to the adaptation area to avoid unnecessary tension and enable flight and scape in case of conflict.
  - This routine is followed until the arrival of the last female De Brazza.
- **20th July:** The last recommended De Brazza individual arrives from Cordoba, it is a female named Jeta. We put the 4 other De Brazza in one dormitory and we place Jeta in the other.
  - The aggressiveness between the 4 already associated De Brazza increases, so we give them free access to the adaptation area again to give them more options and reduce aggressiveness, which again is a very positive measure and decreases aggression.
  - We have to point out that the De Brazza make less association sounds towards Jeta and that Jeta does not respond to the normal sequence (Question/answer) that the De Brazza normally do, actually Jeta did not emit any affiliative sounds until she had contact with the Gorillas and has not until now, directed any affiliative sounds towards the De Brazza although she does towards the Gorillas.
- **23rd July:** The association between Jeta and the De Brazza begins. We do it in two steps:
  - First we introduce Jeta to the adult male from Barcelona and the female from Barcelona (Carla, her sister), because they seem quieter but they begin to be very nervous and the tension of being separated from the rest, makes them very aggressive so we separate them.
  - We give them access to another dormitory from the Gorillas (they had already access to the adaptation area which is normally used by the gorillas if there is no need for it) to give them even more space. We give access to all of them but one by one. Tension decreases and at the beginning there are no aggressions but Jeta does not respond to the vocalizations (question/answer) and seems very scared and aggressive, she runs from them which makes the rest of them get together and attack her. Slowly the fights decrease but Jeta continues isolated and runs from all the De Brazza that get near her.

- We set a routine to separate for the night and get together in the mornings for the following days. Aggressiveness decreases but there is always fights when we put them together after the night, and although there are positive behaviors from the 4 De Brazza towards Jeta, she is always fearful, aggressive and remains very distant from the group, and they attack her only occasionally and when there are at least 3. When she is alone with whichever De Brazza there are no aggressions.
- In an attempt to solve the morning fights, we leave Jeta access to the Barcelona male during the night, but the results are the same, no problem and they can share the space, but as soon as they are together and one of the females starts a conflict, the whole group participates and they hit her and we have to intervene and separate them to aloud her flight.
- We continue with the same routine but the relationship does not improve, there are occasional fights and Jeta does never respond to the socialization approaches from the De Brazza.

- **31st July:** We allow the De Brazza to spend an hour per day in the inside enclosure of the Gorillas while the Gorillas are in their dormitories.
  - Their reaction to this change is very positive and their behavior improves, even Jeta allows the female from Valencia (her mother) and her offspring do grooming to her and let them get near her. But the most surprising thing is that Jeta begins to make association sounds and she is fully subjected to the Gorillas, although she can only see and smell them. When the De Brazza go back to their area so the Gorillas could go to their enclosure, Jeta becomes fearful and isolated again.
  - We continue with the routine of letting the De Brazza use the Gorilla inside enclosure for 1 hour during a week, but the De Braza only show affiliate behavior towards Jeta during that hour that they spend at the Gorilla's inside enclosure, although fights are less frequent and less aggressive, but nevertheless they occur daily.
- **7th August:** We associate Gorillas with De Brazza. Step by step:
  - **First,** we let the De Brazza in the Gorilla inside enclosure as in the last days, and we introduce the gorillas one by one (Food was abundantly scattered to avoid conflicts):
    1. Nadia (old female) makes a display, she is fearful and she goes up to an aerial sitting place.
    2. Nicky and Gwet: Nicky ignores completely the De Brazza and concentrates on food!. Jeta sticks to Nicky, vocalizes greatly and tries to do grooming, but he puts her away, although he allows her to remain at a distance of half a meter. Gwet (female with baby) is very scared and runs away to the aerial sitting place to Nadia for protection.
    3. Chelewa and N'Guvu (Female and her 3 year old male offspring): N'Guvu is very scared; he cries and goes to his mother's back. Chelewa is not scared and quietly goes to inspect the De Brazza without aggression and some of them run out to their dormitories (except Jeta and the male from Barcelona).
    4. Last, female Moja and Duni, her 4 year old offspring): Duni is not scared and charges against the De Brazza, Moja at first is scared and goes to find Gwet and Nadia, but she then goes to inspect, she puts them away with a stick and charges against them, but nothing serious, no fights no bites.
  - The day goes by without problems, they all investigate each other and they test each other, but there are neither conflicts nor aggressions (Jeta clearly prefers to be in company of the Gorillas).
  - Some of the female Gorillas are visibly scared and in tension. The De Brazza go back to their dormitories for the night, except for Jeta that does not want to be separated from Nicky and whom form that day on, sleeps with the Gorillas.
- **8th August:** The first playing behavior is observed between N'Guvu and the De Brazza offspring. Moja and Gwet continue to be quite scared, actually when Nicky is in his dormitory (freely chooses to be) the De Brazza get together and attack some female Gorilla, so they get scared and run away, but when Nicky is there, there is always peace.
- **From the 14th August** the De Brazza and the Gorillas tolerate and respect each other, and they eat together for the most part of the day, although conflicts arise at specific times when the De Brazza get together to attack gorillas. The De Brazza continue to attack Jeta at least once per day (normally when the De Brazza go out), maybe it would be positive to let them sleep together to avoid the everyday get together routine, but it is dangerous because there could be non-controlled aggressions during the night.

CONCLUSION:

The association between the Gorillas and the De Brazza is going very smoothly, with some minimal aggressions, but without altering significantly the family balances in our group of gorillas. We still have not seen frequent affiliative interactions between the two species but they tolerate each other, and share space and food without conflicts, with rare exceptions. The integration between the 5 De Brazza on the contrary is being more complicated because Jeta continues to run away from the De Brazza. However, the so successful introduction from Jeta to the Gorillas makes things easier, and we hope that with more time the relationship between the two species can only improve.

2.4 Breeding

Breeding is not seasonal with births occurring throughout the year. It is common for females to cycle synchronously and therefore to have newborns from two matrilines at the same time.

2.4.1 Oestrus and Mating

Oestrus cycles are approximately 30 days. The four most common recorded signs of oestrus are reported as face pouting, submissive postures, grooming initiation by the females and menstrual bleeding. Menstrual bleedings will last 2-4 days and will vary between individuals.

Courtship behaviours are reported in all collections housing breeding animals. The most common courtship behaviours are: loud calling from the male with lots of mutual grooming and heightened aggression from the male towards keepers, the male keeping very close to the female and female presenting to him and frequent copulations which are initiated by the female.

2.4.2 Pregnancy and Birth

For those collections who have trained their De Brazza individuals, weight measurements are an accurate indicator of pregnancy. For most collections, however, diagnosis of pregnancy is made visual assessments. Increased feed consumption, increased size of abdomen, failure to show signs of oestrus and increase in mammary tissue are the most common reported signs of pregnancy.

Pregnant females become less active, seek isolation, have a reduced appetite and show frequent examinations of her genital area (sniffing and touching). It is not uncommon for the dominant female to not show any change of behaviour prior to giving birth.

2.4.3 Maternal Behaviour

Socialization with non-maternal individuals is important for learning, group cohesion, and help with future rearing (Forster & Cords, 2005; Thompson, Baker & Baker, 2010).

Primiparous females can demonstrate poor maternal skills, especially if they have not experienced other females rearing offspring. They will require close monitoring over the first few days. The loss of first offspring is not uncommon but they often go on to rear their second offspring successfully. If a primiparous mother is showing some sign of stress is should be considered if separating her with her newborn or with another animal is in order to give her more privacy. This process would last only a few days before reintroducing them again to the group.

Sometimes a female can snatch another one's offspring. In case of observing that this kidnapping is not momentary and the situation keeps prolonged, actions need to be taken in order to return the young to her mother and keep the nursing. It should be noted if this action is repeated and if there's a female that insists in this, she must be separated from the group for a while. However it's important to keep the young in their familiar group until they reach the sexual maturity so they can learn the typicals behaviors of the species and have an adequate social role, for example, observing and living with the breeding male.

If the infant is observed to be too weak, has been injured or abandoned and there is a risk of it dying **please contact the coordinator in order to discuss if hand-rearing this animal is advised or recommended**. Hand-rearing is always the last option and euthanasia may be indicated. In the case of an individual being hand-reared, an early introduction into a social group as early as possible and at least by the age of 2 or 3 months is required.

2.4.4 Infanticide

Infanticide is not common but has occurred in the past in zoological collections. Only one instance is reported of this behaviour in recent years.

CASE STUDY: The first neonate born to this pairing was killed by the male of the breeding pair, however, they have since bred and reared young together. It is not clear what caused this behaviour. The enclosure was not a mixed exhibit, there were low stereotypical behaviour scores for the group. The group was a stable family group (4.1.1 structure). The keepers had not employed any changes to the routines. The accommodation had not changed between the infanticide and the next successful birth and rearing. It is entirely possible that the neonate was unfit or incompatible with life.

The common behaviour changes seen upon a neonate arrival are aggression towards the keeper and protectiveness over the infant. Male behaviour does not appear to change and the breeding pair will still groom and rest together. In a group, the neonate arrival seems to stir up interest and excitement but no aggression has been reported from juveniles or none-family members towards the neonate.

2.5 Population Management

As of 1st July 2018 the European population consists of 56.70.9 animals held in 35 collections. There are four bachelor groups composed of two or three animals. The population was created from 40 founders with a 99% known pedigree.

The population is being managed to more replicate wild group structure with most groups consisting of a breeding male, 3 or 3 potentially breeding females and their offspring. Sub-adults are not being placed in other collections until they have reached at least 3 to 4 years old. Due to continued breeding success and lack of placements, a significant number of females have been contracepted with only unproven animals and the animals with the highest 6 mean kinship ranks being permitted to breed. Culling is not used as a management tool.

2.5.1 Contraception

A significant number of animals in the programme have received contraception. A small number of males have been castrated to potentially assist in the formation of bachelor groups. The use of contraceptive implants in adult males has been utilized with varying success. In some instances, hyper-aggression has been observed. Further data are required on male contraception. A set of contraceptive guidelines have been produced by the EAZA group on Zoo Animal Contraception (EGZAC).

2.6 Enrichment

In general, De Brazza monkeys tend to be quite able to use a wide range of enrichment types. Various devices made of a range of materials can be used from rope, fire hose, wood, willow, hessian, plastic and metal without issue. In terms of complexity, items are often kept quite basic to not frustrate the animal whilst achieving the desired effect be it broadly encouraging natural behaviours and preventing stereotypies, or more specific such as prolonging feeding times. Modest puzzle feeders such as mesh cubes work well but more intricate devices can prove difficult for them to complete. Monitoring new enrichment is recommended to observe effectiveness.

Different individuals may respond in different ways, some alarm call at new enrichment whilst others show more confidence and willing to interact. Care should also be taken when offering enrichment to consider the potential effects on group dynamics and individual interactions. Enrichment can be a tool to produce group hierarchical behaviours but could produce aggression if dominant animals act protectively toward the device. As such a suitable number of devices should be provided to the group, such as one for each individual or techniques such as anchoring the enrichment in place can be used to prevent hoarding.

Enrichment should not be left for the animals to have access for more than a few days maximum as novelty quickly deteriorated and it becomes part of the enclosure furniture. Often simple enrichment is quick and easy to make and has a short period of effectiveness. To help organise an enrichment program a rota is normally set up to ensure variety and consistency of devices offered, and will often include rest days when enrichment is not offered to prevent anticipatory behaviours.

Some enrichment examples can be seen below:

Examples of enrichment

2.7 Handling

2.7.1 Identification

Only **tattoos** and **microchip transponders** are recommended as individual identification methods.

2.7.2 Safety

During general management it is not necessary or desirable for keepers to enter the same space as De Brazza monkeys. Facilities should be designed so that slides and door are operated from keeper areas. De Brazza monkeys have the potential to cause severe bite

injuries using their canine teeth. In addition, the risk of zoonotic disease must be considered. It is recommended that staff use masks and gloves when handling animals.

2.7.3 Capture and Restraint

2.9.3.1 Crush Tunnel Systems

Ideally enclosures should be built with a crush tunnel system in place. Through regular use and training this is probably the easiest and safest way of restraining a De brazza monkey.

An example of a crush tunnel is shown here:

Situated across the width of the middle room of three in the enclosure, the crush tunnel works well to capture and restrain De Brazzas. This method can carry less risk to animal and operator compared to direct contact if using a net, as guillotine slides at each end of the tunnel are controlled with wire connected handles in the staff corridor area meaning you don't have to enter their space. The monkeys can be trained to enter the tunnel using positive re-enforcement allowing them to be habituated to using the system thus further reducing stress when required.

After the animal is in the tunnel, metal slides can be inserted either side of the front middle plastic slide, as well as into a third runner if required, to contain the animal into individual crush areas. The vertical bar handles at the front of the crush areas are connected to the wooden walls at the back of the tunnel and are manually pulled forward, pinning the animal against the inch mesh at the front. This technique allows for good control of the pressure exerted on the animal preventing injury, and stops movement, helping when choosing a suitable injection site. The animal can then be filtered through and the process repeated if working with a group.
The tunnel is approximately 2.5 metres in length and the vertical and horizontal dimensions are 40x40 centimetres.

2.7.3.2 Netting

Netting may be undertaken by a confident and experienced keeper. The animal should be separated into a small enclosure as to avoid keepers being attacked by cage mates whom may protect the focus animal. Google, face mask and thick leather gloves should be worn. The animal should be removed from the net and held by pulling the upper arms of the animal behind it's back and holding them with one hand, inserting a finger between the arm to improve the hold. The other hand restrains the legs and extends the body. Care must be taken to prevent twisting that may fracture the humerus.

2.7.3.3 Chemical restraint via darting

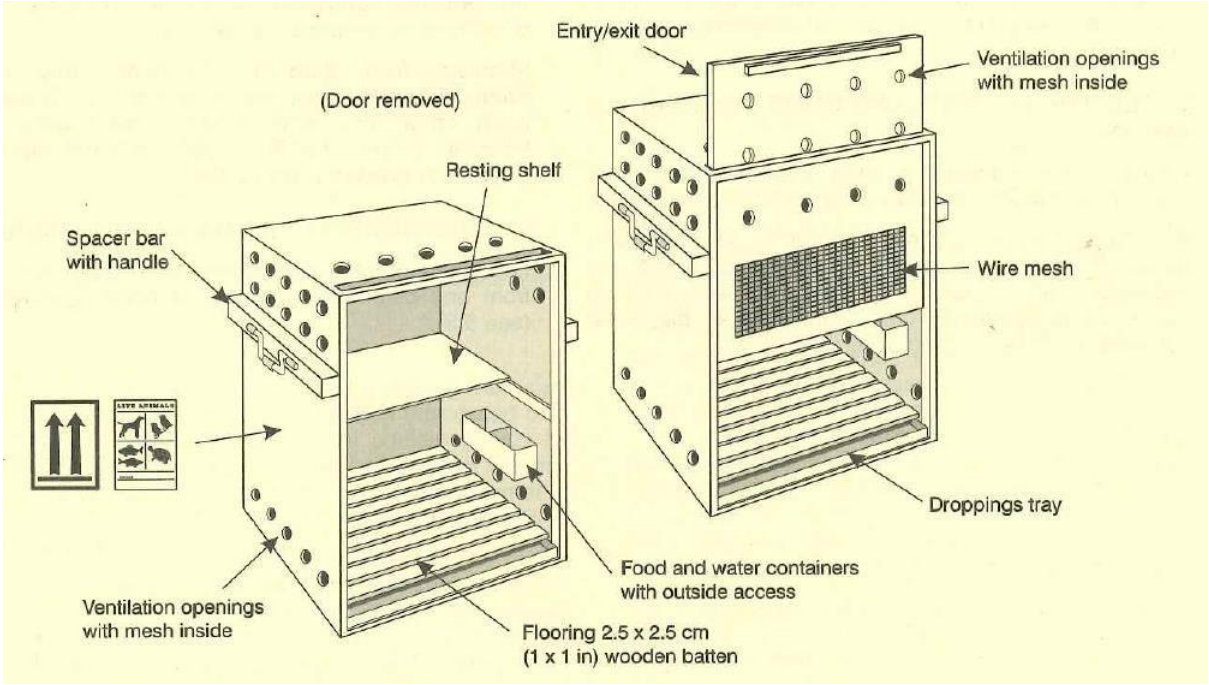
If no other alternative is available, adult De Brazza's and can be darted using a blow pipe or very carefully with a dart gun using low pressures to avoid fracturing the limbs. The dart should be fired into the upper leg musculature. The subject should be separated from the group into a small enclosure. Premedication with an oral sedative (e.g. midazolam) may help facilitate darting and induction.

2.7.4 Transportation

De Brazza monkeys should generally be transported singly, although suckling youngsters and newly weaned juveniles should not be separated from their mothers. If travelling a group it is comforting for the animals to be in sight and sound of each other although they should not be able to reach fingers or tails that protrude through the mesh.

The transport crate must have sufficient ventilation. A layer of sawdust will soak up any urine produced. Shredded paper or straw (depending on any agricultural product restrictions by destination) can be provided as bedding. Water can be provided in a sipping bottle if the animal is familiar with drinking in this way. A water bowl is not suitable due to spillage so soft fruits can be provided to provided fluid.

For general transportation over short distances a large sky kennel is suitable. For air travel the crate must meet IATA standards as shown below.



2.8 Veterinary Care

2.8.1 Sedation and Anaesthesia

Injectable anaesthetics such as dissociative agents (ketamine, tiletamine-zolazepam) are most commonly used. Combination with alpha-2 agonists (xylazine, medetomidine) provides a partially reversible anaesthesia and helps shorten recovery times. Alternatively, tiletamine-zolazepam (Zoletil®, Telazol®) is a safe non-reversible combination, with fast induction but prolonged effect. Intubtation is straightforward and so gaseous anaethsia can be used for longer procedures.

2.8.2 Preventive Medicine

The preventive medicine program should be risk-based and follow the institution's policy, specifically that for OWM. A basic preventive medicine program includes:

- **Vaccination**: vaccination against tetanus and or rabies, as determined by risk-based analysis and official guidelines.

§ **Endoparasites**: regular faecal parasitological examinations (including floatation and larval sedimentation) should be performed on a six month or yearly basis (more often if clinical data warrant it). Antiparasitic treatments should be administered as appropriate.

▪ **Routine examinations**: Exams should be thorough and include complete physical examination, standard haematology and biochemistry, and diagnostic imaging (incl. ultrasound gynaecological examination). Aged or diseased animals may warrant programmed examinations.

▪ **Opportunistic testing** for tuberculosis, viral and bacterial pathogens is advisable (see specific guidelines for Simian Immunodeficiency Virus in Appendix 2)

2.8.3 Health Examinations during Animal Transfers

Animal transfers must be subjected to risk-based health screening. Under EC Directive 92/65, they can be exempt from pre-shipment tests and quarantine. Animals originating from uncontrolled or unknown conditions should be subjected to intense screening and prolonged quarantine. Further tests and conditions may be required by official veterinary authorities.

A basic set of tests for cercopithecines includes:

1. General physical examination under general anaesthesia, including a careful assessment of the teeth, eyes, reproductive organs and method of identification (transponder, tattoo, etc.). Whole-body X rays are recommendable.
2. Haematology and serum biochemistry profiles.
3. Serum and EDTA whole blood samples should be stored at ≤20ºC for future testing if warranted.
4. Tuberculosis test: there are several TB tests for primates, although not all are readily available. Standard Mantoux (intradermotuberculinization) is acceptable for screening (a compared assay should be performed). Other acceptable tests are antibody (Primate STAT-PAK®) or interferon gamma (Primagam®) assays.
5. Assessment of internal and external parasite burden.
6. Faecal culture for enteropathogenic bacteria such as *Yersinia*, *Shigella* or *Salmonella*.
7. Where pathogenic parasites or bacteria are detected, appropriate treatment should be administered and its effectiveness confirmed by further tests during the quarantine period.
8. All incoming untested De Brazzas should be tested for SIV.

2.8.4 Infectious Diseases

Guenons are susceptible to the same infectious diseases that most Old World Monkeys. In some cases, these are relevant because of their zoonotic potential. All infectious diseases of guenons should be considered potentially zoonotic. Although assays developed for human beings can be used for diagnosis in OWM, extreme caution must be exercised when interpreting results, as false negative results are a major risk. Where possible, OWM-validated assays should be used.

2.8.5 Non Infectious Diseases

Lacerations and bite wounds are not uncommon even in stable groups. Damage to the tip of the tail, often due to frost bite is very common and results in amputation. Common geriatric diseases warrant regular examinaions. These include teeth problems and cardiac disease. The most common reported reproductive problem is stillbirth, the cause of which is usually unknown, followed by injury/trauma and infection causing neonatal mortality. Pyometra and endiometritis has been reported. Diabetes Mellitus has been reported in De Brazza monkeys are can be treated using oral or injectable products.

2.8.6 Necropsy protocol

A thorough post mortem examination should be carried out on all primates dying in a collection, whether or not the cause of death is “obvious”. Necropsy should include gross and microscopic evaluation of all body systems, including the central nervous system. It is a requirement to send the necropsy results to the EEP Coordinator.

2.9 Recommended Research

1. Effects of group size, later dispersal of sub-adults and selected contraception on reproductive success in different guenon species.

2. Use of hormone implants in male guenons to modify pubescent sexual behaviour and facilitate bachelor group stability.

3. Prevalence, pathology and transmission of viral pathogens in guenons.

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4.1 Appendix 2 – Simian Immunodeficiency Virus in De Brazza Monkeys.

Risks and Management of SIV in De Brazza Guenon *(Cercopithecus neglectus)*

NB: This paper is produced specifically for SIV in De Brazza Monkeys. There are significant species differences and therefore the recommendations and information contained within should NOT be used for other species. This is particularly important for L'Hoests Monkey and Mandril which have their own SIV with significant differences to SIV in De Brazzas.

A. Background

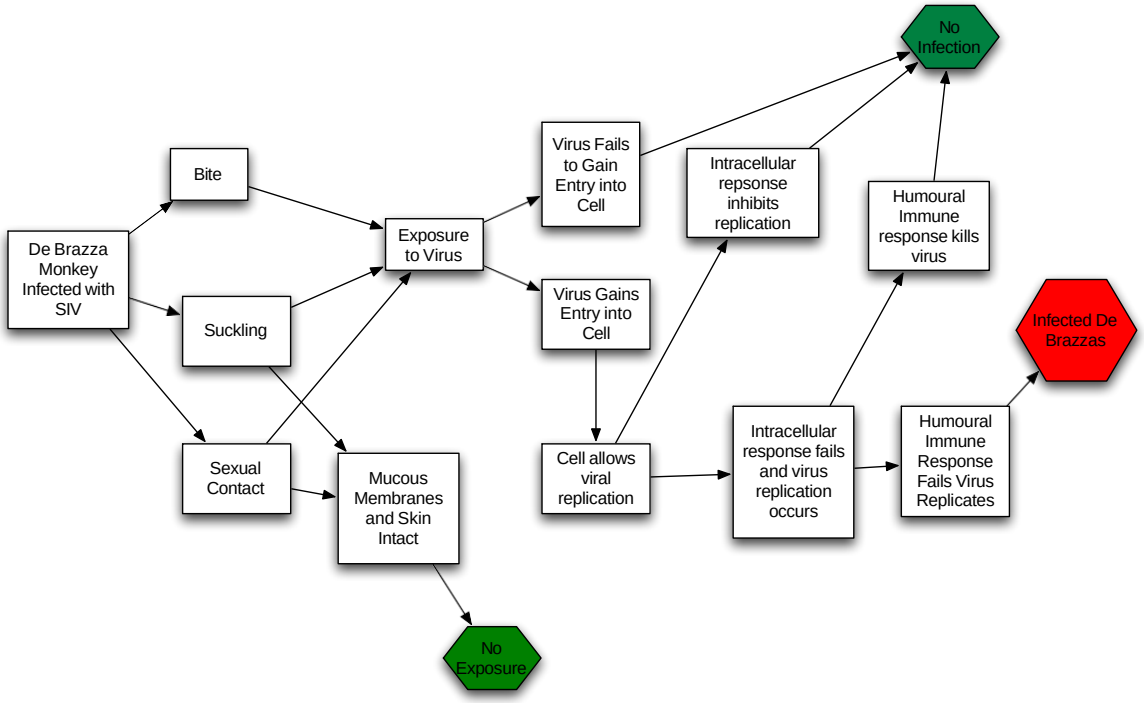
Simian Immunodeficiency Viruses (SIV) are primate lentiviruses which infect a wide variety of non-human primates species in sub-Saharan Africa. The evolution of the lentiviruses is very complex but there is some evidence to suggest that the virus are ancient and co-evolved with specific species. The virus that naturally infects the specific species does not cause clinical disease causing lifelong but unapparent infection. However there is significant evidence of multiple cross species infections. In African primates these rarely cause clinical disease but in Asian primates clinical disease characterized by immunosuppression, meningioencephalitis, lymphoproliferative disease.

B. Managing SIV in Debrazza Guenons

The De Brazza is naturally infected with its own SIV virus SIV_{deb} which is very distinct from other guenon SIV viruses (Bibollet-Ruche et al, 2004). It is non-pathogenic to De Brazzas. Research suggests that up to 30% of this species are infected in the wild (Peeters et al, 2002). It is therefore quite possible that a similar number are infected in captive populations.

The virus is primarily transmitted horizontally through bite wounds and less commonly through sexual contact and breast milk. Indeed the virus can rarely be isolated from semen, cervical secretions and breast milk (CDC,1988). This does vary between species with research suggesting that SIV in sooty mangabey's is definitely spread sexually and that SIV in Mandrils is transmitted in breast milk more commonly that in other species.

The risk scenario tree – the pathway of transmission between an infected De Brazza and an uninfected animal is shown in figure 1.



This raises a number of issues for captive management.

Recommendations for the EEP ;

1. There is NO justification for euthanasia of De Brazza monkeys testing positive for SIV – this should be a direct instruction for all participants.
2. All Debrazzas should be tested for SIV prior to being moved and introduced to new animals.
3. When a movement recommendation has been made and an animal that tests positive is due to join a new group the receiving zoo should test their animals. If their animals are also positive then the move should continue.
4. When ever possible zoos should routinely screen for SIV so a known status for each animal is obtained.
5. Due to the difficulty in breeding this species – stable family groups do NOT need to be broken up if one of the animals tests positive. This positive result has no implications for the health of the group and indeed, an increased risk of SIV transmission will be caused by disrupting the group and increasing the likelihood of fighting.
6. It should not be assumed that offspring of positive parents will be positive – they should be tested for confirmation.
7. Only in view of acceptance for some participants – if new groups are being established every effort should be made to pair animals of the same status.

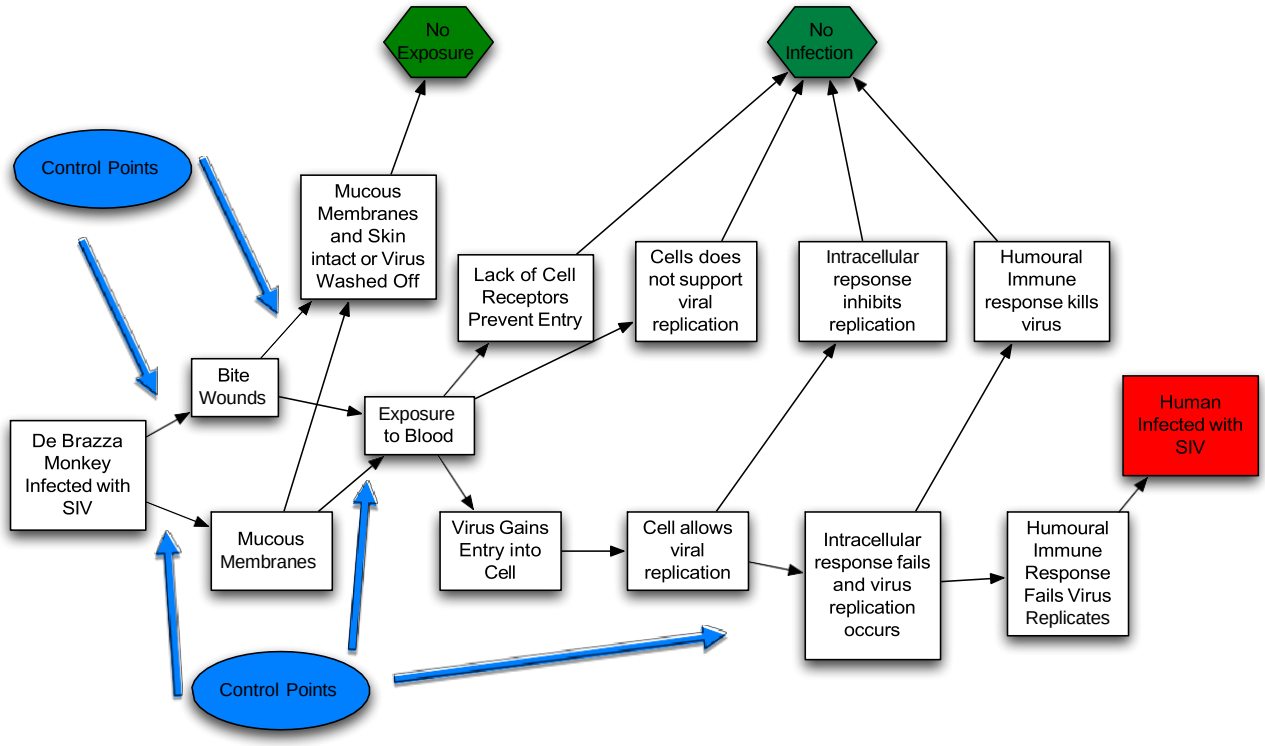
Recommendations for managing an SIV positive De Brazza Monkey Group are:

1. Due to the low but possible risk of cross infection SIV positive animals should not be housed in a mixed exhibit with other primates and should not have direct contact with other primates. (these animals pose no risk to other animals).
2. The greatest risk of SIV transmission is through biting – stable family groups are at a lower risk. The group should be managed to encourage this.

3. It must not be presumed that all animals in a group are SIV positive – each animal should be tested individually. It is possible that offspring are negative and can be moved to a new group following EEP recommendations.
4. It is equally possible that one animal in a pair is negative the status of this animals should be monitored to detect seroconversion on an annual basis.
5. If one animal tests positive for SIV the whole group should be tested. If only a single animal is positive then this animal could be potentially rehomed to a known positive group but this needs to be balanced against risks of aggression and fighting.

C. Human Risks Associated with SIV in Debrazza Guenon

Transmission Pathway from SIV Infected De Brazza to a Human



Can SIV Infect Humans ?

Cross species infection from the natural host to other species can occur and can result in pathological disease. Cross species transmission of the specific Chimpanzee and Sooty Mangabeys to humans has been linked to the origin of the HIV-1 and HIV-2 virus respectively. It is thought that the SIVs entered human cells, underwent genetic changes, which then allowed human to human transmission. This is supported by the fact that humans in Africa have been exposed for centuries to SIVs and yet the HIV epidemic has only apparently emerged in the second half of the last century, which suggests that some other factor influenced the virus. This suggests that viral cross –species transmission is in itself not the only factor required for development of pathological disease.

Despite the large exposure of humans to SIV-infected primates in central and west Africa, through consumption of bushmeat, extensive molecular epidemiological studies have shown only 10 cross-species transmission events during the last century only four of these resulted in epidemic transmission.

Experimental cross species infection of SIVs in different species of primates has shown that in many cases the virus is harmless or cleared by the new hosts immune system

Can SIV_{deb} Infect Humans ?

There are over 40 SIV species specific virus and only those from chimpanzees SIV_{cpz} and sooty managabeys SIV_{sm} have been shown to be associated with HIV. Indeed SIV_{deb} is one of the most genetically distinct viruses and is not similar to these two SIV viruses.

The general experimental approach to determine this is to try and grow virus in human cells (human peripheral blood mononuclear cells, PBMCs) *in vitro.* Although many SIV virus have been shown to grow in PBMCs most of the cercopithecine SIV virus do NOT grow in human PBMCs (References)

None of the cercopithecine SIV viruses have been identified in humans (Apetrei et al, 2004).

What route would SIV_{deb} be transmitted to humans by ?

A study of people with occupational exposure to primates was conducted by the USA CDC. 3,000 samples from people potentially exposed to SIV were tested only two demonstrated antibodies cross reactive to SIV, a prevalence of less than 1%. One of these people handled known (experimentally) SIV infected material without gloves whilst having an severe dermatitis of the hands and forearms. The second person had suffered from a needle stick injury whilst handling known experimentally infected blood.

Both of these people had virtually undetectable levels of virus and this explains the lack of AIDS like symptoms as a high circulating viral load is required for disease and transmission in HIV infected humans.

Evidence of SIV infection in zoo keepers has not been reported (Switzer et al, 2004).

Epidemiologic surveys of 1800 persons from nine villages in Cameroon suggested very high (>60%) exposure to primate blood and body fluids and demonstrated that 1% of exposed individuals were seropositive for SIV of three different nonhuman primate origins (Wolfe et al., 2004). Despite the fact that these events clearly demonstrate that human-primate contact occurs commonly, and can result in primate to human retroviral transmissions, human exposure to SIVs resulting in patent infections has been extremely rare. Therefore, exposure of humans to SIVs does not *a priori* result in successful cross-species infection.

Seropositivity merely demonstrates exposure to SIV and a subsequent immune reaction. It does not demonstrate infection.

Managing Risk of Infection to Humans:

The above evidence suggests that routine precautionary measures should be implemented for working with known SIV infected animals.

- The risk of transmission from urine and faeces is negligible.

- SIV virus is susceptible to household bleach and disinfectants, which should be used routinely for general cleansing.
- Blood is the main risk to humans. SIV positive De Brazzas should not be handled when conscious to avoid biting injuries and should not be netted but should be darted or a crush cage and then anaesthetic should be used.
- As with all primates – latex gloves should be used when handing De Brazza Monkeys
- During blood collection or other invasive procedures on SIV positive animals goggles and face masks should be worn to prevent mucous membrane contamination.
- Should humans be bitten or have mucous membranes contaminated by SIV infected primate bodily fluids the area should be immediately washed with Chlorhexidine. Post Exposure Prophylaxis with anti-retroviral drugs may be indicated (Weston Murphy et al, 2006).

Risk Assessment:

Stage in Risk Pathway	Bite Wound or MM Exposure	Virus Infects Cell	Virus replicates in Cell	Virus causes active disease in human
Mitigating Action	Handling Precautions, Gloves, Goggles, Face Mask, Washing,	Post Exposure Prophylaxis	Cells do not have correct receptors or cellular function to allow virus to replicate	None
Further Evidence		In both occupational at risk workers and bush meat hunters seroprevalence was less than 1%. Infection in Zoo keepers has not been reported.	Cercopithecine virus do not replicate in human PMBCs.	Despite regular and widespread exposure cross for centuries only 10 incidences of cross- species infection have been identified and only 4 of these have resulted in human disease.
Risk	Low	Very Low	Negligible	Very Low
Uncertainty	Low	Medium	Low	Medium

Overall Risk Assessment = Very Low

Uncertainty = Medium to Low.

D. References:

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