EAZA Best Practice Guidelines

Gelada baboon (*Theropithecus gelada*)

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Under the remit of the Gelada baboon EEP (EEP coordinator: Achim Johann) and the EAZA Afro-Eurasian Monkey TAG (TAG Chair: Tjerk ter Meulen, Artis Amsterdam)

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Content

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Preamble

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 set 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 setting 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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Gelada baboon EEP

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These best practice guidelines are based on long-standing experience of husbandry of Gelada baboons in zoos which participate in the EEP for this species as well as research, especially on the behaviour of geladas, both in the wild and in zoos.

The first draft version was written by the EEP coordinator Achim Johann and the zoological assistant Nicolas Brüning MSc. For this purpose, they reviewed participant reports and presentations from the four Gelada baboon EEP workshops (2007 Rheine, 2010 Zürich, 2015 Stuttgart, 2019 Rheine).

A major addition was the chapter “Veterinary” written intentionally by Andreas Pauly, Tierpark Berlin.

The draft version was then circulated to all representatives from the participants of the Gelada baboon EEP. There was a good, representative response with comments and additions. More comprehensive contributions, discussions and reviews were provided by Marianne Holtkötter / Wilhelma Stuttgart, Cordula Galeffi / Zoo Zürich, Sarah Forsyth / Colchester Zoo, Caterina Spiezio / Parco Natura Viva, Bussolengo, Dorothée Ordonneau / CERZA Lisieux, Colleen McCann / Bronx Zoo, New York, and Sandy Distatte and Dean Gibson / San Diego Zoo.

We are grateful for Stephen J. Bridgewater for proof reading of the final edited version.

Photo credits are NaturZoo Rheine (Eva Bruns and Achim Johann) and Achim Johann if not quoted specifically. A few photos could not be linked to the photographer anymore and are marked with “unknown”.

We regard these Best Practice Guidelines as a collective work from the participants of the Gelada baboon EEP. It is a living document and will be updated when appropriate.

Introduction

Realising that the species may disappear from zoos, an international studbook and an EEP for the Gelada baboon was recommended and subsequently implemented in 1989. By that time there were only 56 geladas in 6 European zoos, with a similar number in zoos in the USA.

The Gelada baboon EEP gave emphasis on adequate husbandry from the start and adapted management to the social structures and behaviour of the species. Improvements in housing, nutrition, and social management, as well as a growing interest in this primate species, led to a growth of the ex-situ population. Today (2021) appr. 465 geladas are kept in 30 zoos worldwide. All are part of the EEP. Nowadays, this population is regarded as “safe” by population biologists’ calculations.

Initially, improved husbandry and social management were key for achieving the goal of population growth, however, nowadays the EEP is faced with the challenge of balancing and maintaining the population at its current level. Implementation of population management tools is quite new for this species and we must learn from recent experiences and take care not to lose the achievements of the past three decades, namely, a prospering ex-situ population of a unique primate species. We must also save the husbandry expertise to propagate the gelada.

These Best Practice Guidelines are regarded as a ‘summing up’ of our experience and knowledge of husbandry and management of geladas so far. They are also meant as a documentation for up-coming generations of responsible persons (curators, keepers, population biologists etc.) which may no longer gain sufficient hands-on expertise and live experience with some husbandry techniques - especially regular breeding.

These Best Practice Guidelines should provide basic information for those who start with keeping geladas. They are also intended to be reference when encountering problems with the maintenance and management of these primates. Finally, there is a wealth of information and links for further reading for anyone who is interested in Gelada baboons.

Section 1 Biology and Field Data

A. Taxonomy and Distribution

KINGDOM	Animalia
PHYLUM	Chordata
CLASS	Mammalia
ORDER	Primates
FAMILY	Cercopithecidae
GENUS	*Theropithecus*
SPECIES	*gelada*

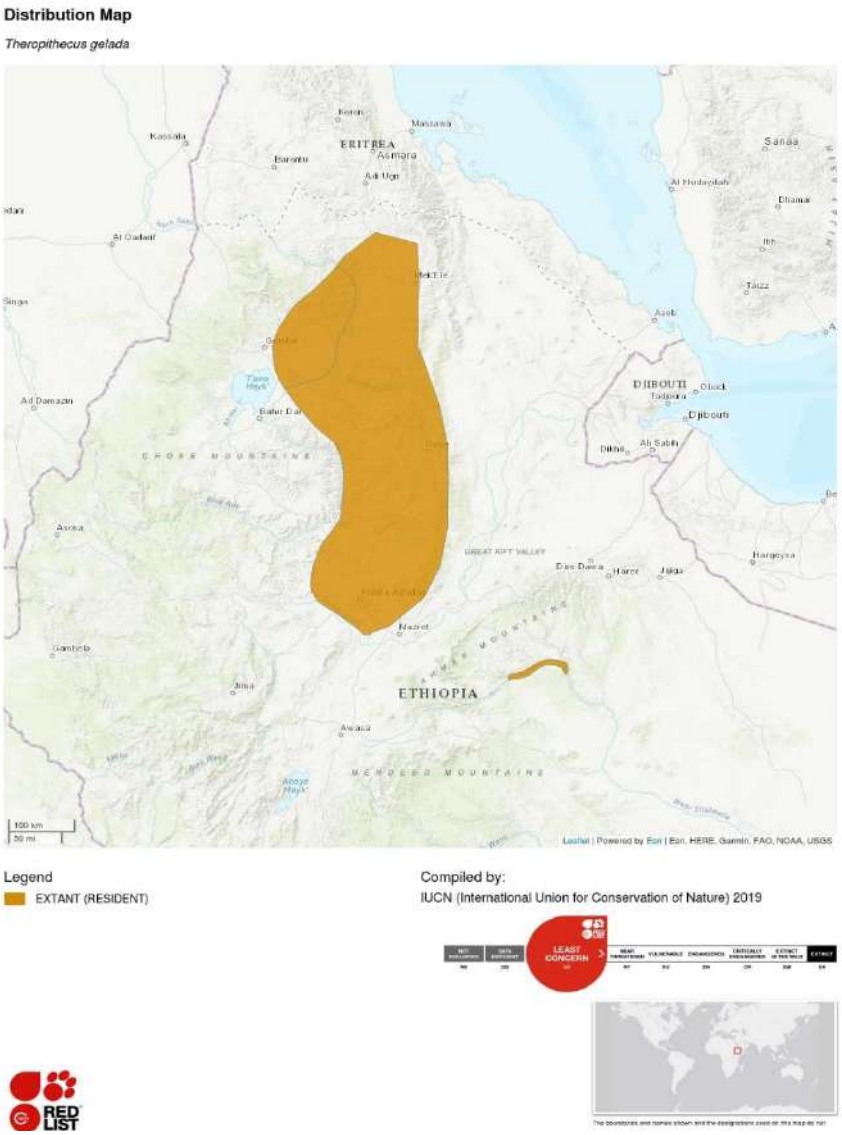
Common name(s): Gelada baboon, Gelada

The authority of the taxonomic classification is Rüppell, 1835

The gelada is the only living species of the genus *Theropithecus*, which also includes several extinct species that lived from Africa to India. (Jablonski, 1993; Pickford, 1993; Delson, 1993; Dunbar, 1998)

Today's wild populations are restricted to the Ethiopian plateau. (Dunbar, 1993)

Two subspecies have been traditionally accepted: *T. g. gelada* and *T. g. obscurus.* (Groves, 2005) The nominal form is limited to north of Lake Tana and west of the Takkazzé River. Respectively *Theropithecus gelada obscurus* is found south of Lake Tana and east of the Takkazzé River. (Gippoliti, 2010)



Distribution Map of Theropithecus gelada

B. Morphology

Geladas are large primates with specific features in adaptation to the highland habitat.

Adult Males weigh around 25-30 kg while adult females weigh around 12-15 kg. Both sexes have a similar body length of 50-70 cm, with a tail length of 30-50 cm. (Ankel-Simons, 2007). Besides weight and size, the sexes are also morphologically different with males having an impressive, long cape of hair on their backs and white hair around the skin-patch on the chest. The males` canine teeth are considerably larger than those of the females.

Geladas are covered in coarse, light to dark brown hair. The skin of the hairless face is dark apart from the eyelids which are pale. The face itself has a short muzzle, giving it a more chimpanzee-like resemblance than that of baboons. On the arms and legs the hair is usually darker than on the rest of the body. The hair of new-born geladas is very dark, almost black. The colour changes at an age of approximately six to eight weeks.

The distinguishing feature of the gelada is the red hourglass-shaped patch on its chest. The ischial callosities are well developed, but not as prominent as in baboon species.

In oestrus, the female chest colour intensifies and shiny knobs of skin surrounding the patch appear during the peak. This is equivalent to the swollen buttocks common to most baboons experiencing oestrus. Knobs might appear around the ischial callosities but to a lesser extent than around the chest.

Short fingers and toes characterise geladas as ground and cliff-dwellers.

Fig. 1 Head of male with mane

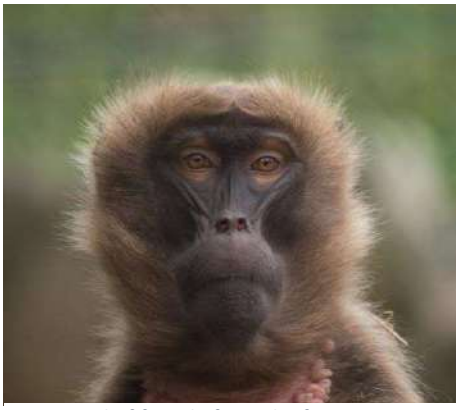


Fig 2 Head of female from the front

Fig 3 Head of female in profile

Fig 4 Hourglass-shaped chest of male

Fig 5 Hourglass-shaped chest of female in oestrus

Fig 6 Short fingers on front extremity

Fig 7 Short toes on hind extremity

Fig 8 Yawning male showing the long canine teeth

Fig 9 Female with new-born

C. Physiology

Very little is known about physiological parameters of either wild or captive geladas.

There has been a data collection of body temperatures of captive geladas in Rheine in the past. The results of which are shown in Table 1

Table 1 Body Temperature of different geladas at Naturzoo Rheine in 2007

Name	Sex	Age	Body temp °C
Afra	F	28	38.3
Aurora	F	17	38.4
Alice	F	7	39.6
Antonia	F	6	39.8
Bosso	M	4	40.1
Bafra	F	3	38.6
Bruno	M	2	39.9
Genesis	M	13	36.5

D. Longevity

In Grzimek's Animal Life Encyclopaedia (Grzimek, 1990) the average lifespan of a wild gelada baboon is described as 20 years. A quote in Wikipedia mentions 15 years as average lifespan. Apart from these references there are very few data published about the longevity of geladas.

Based on studbook reports, geladas can live longer in zoos. Longevity records for geladas in zoos are held by a female that in October 2020 lived for 30 years and four months and a male that lived for 30 years and 6 months. In general females live longer than males. Reproductive lifespan for females ranges between approximately 4 and 16 years.

The age-pyramid for the current (31.12.2019) living zoo-population of geladas gives an idea of animals per age class.

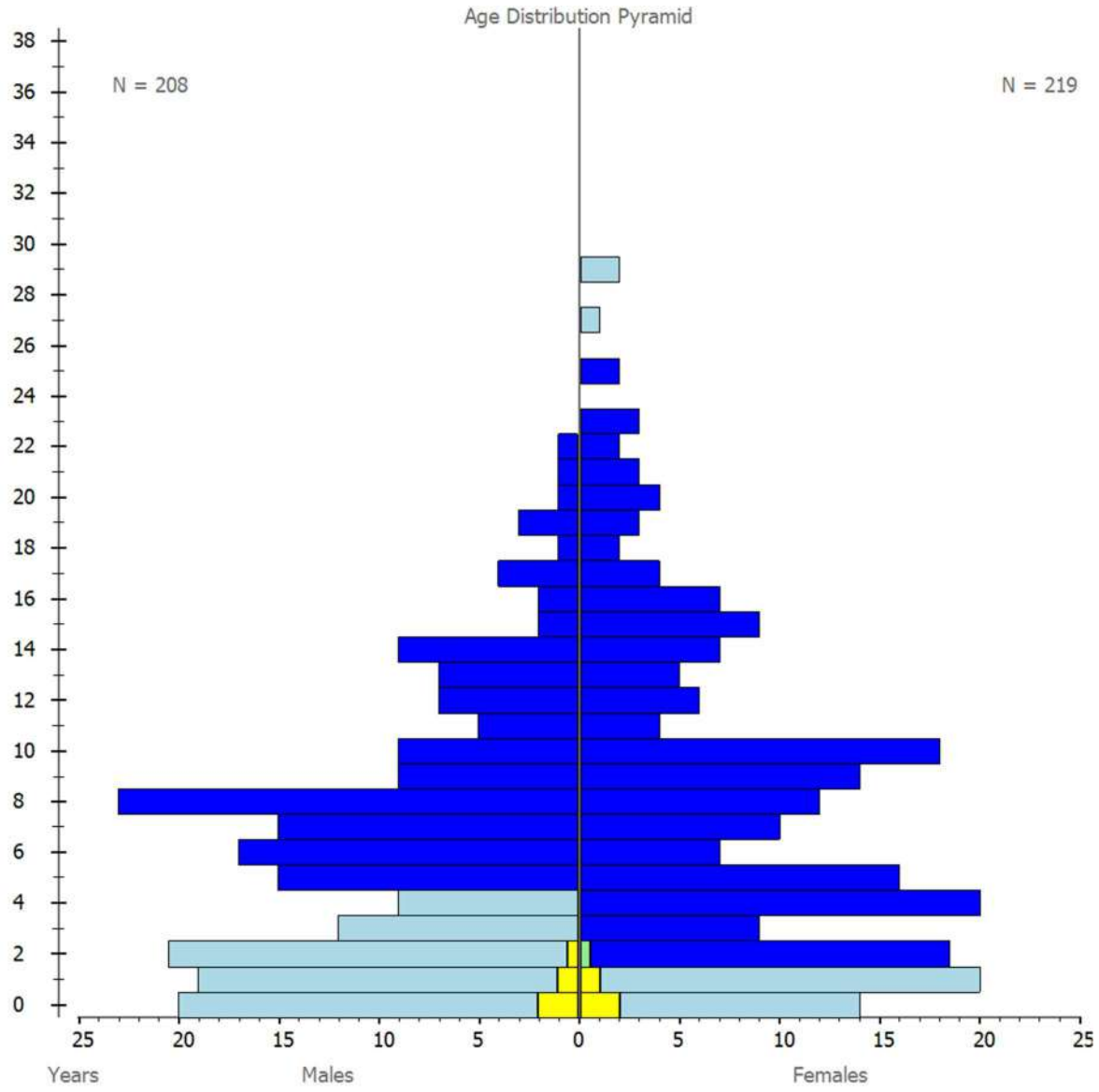


Fig 10 Age-pyramid of ISB population 31.12.2019

E. Zoogeography, Conservation and Ecology

• Habitat & Ecology

The geladas live in Afroalpine grasslands adjacent to deep gorges and cliffs at altitudes between 1,800 and 4,400 m. (Gippoliti, 2010; Jablonski, 2005)

Geladas are almost entirely terrestrial and generally do not climb trees. (Dunbar, 1983)

Geladas are diurnal. They spend the night hours on the ledges of cliffs and travel to the plateaus after sunrise to feed and socialise. During the day they spend most of their time foraging. (Dunbar, 1997a)

• Population

Geladas are widespread throughout much of their present range, although they are probably not as abundant as they were in the 1970s, when an aerial survey of the central Ethiopian Highlands yielded a population estimate of 440,000 individuals. (Dunbar, 1997b)

A concurrent alternative estimate based on known ground densities from a small proportion of the gelada's geographic range and the total area of gorge face on the plateau yielded a figure of 884,000. Detailed ground surveys at five sites yielded overall densities varying between 15 and 69 animals/km², although densities of animals within their home ranges typically reached 70–80/km². (Dunbar, 1977b)

A recent estimate for what is believed to be the largest remaining population of geladas, in and around Simien Mountains National Park, was ~4,300 individuals, down from ~10,000 individuals in the 1970s. (Beehner, Berhanu, Bergman, & McCann, 2007; Bergman & Beehner, 2013).

- Conservation Status

Classified as Least Concern by the IUCN in 2008 due to the large geographic range, the populations are suspected to be declining. (Gippoliti, Mekonnen, Burke, Nguyen, & Fashing, 2019)

The overall range of the Gelada baboon is being eroded by agricultural expansion resulting from rapid human population growth in the Ethiopian highlands. Conversion of gelada habitat to farmland and livestock grazing is common (Bergman & Beehner, 2013) and soil erosion is a serious problem throughout the region. (Nyssen, et al., 2015) Grazing pressure is intense, and competition from domestic livestock has forced the gelada to remain on the less productive gorge slopes in some areas (e. g. eastern Arsi). (Abu, Mekonnen, Bekele, & Fashing, 2018)

Government-sanctioned trophy hunting of geladas by tourists is currently allowed in controlled hunting areas, although the extent and impact of this practice are unknown. (Gippoliti, Mekonnen, Burke, Nguyen, & Fashing, 2019).

More recent and thorough surveys on population sizes and distribution are essential to re-evaluate the conservation status.

Fig 11 / 12 Decreasing habitat from humans´ use for agriculture (E. Palagi, University Pisa)

F. Diet and Feeding Behaviour

Geladas are the only extant graminivorous (grass-eating) monkeys. They feed primarily on the leaves (blades) of graminoids (grasses and sedges) and forbs and occasional (seasonal) herbs of their natural habitat. They also consume subterranean foods including roots, corms, tubers, and rhizomes, which they dig for with their hands. (Abu, Mekonnen, Bekele, & Fashing, 2018; Fashing, Nguyen, Venkataraman, & Kerby, 2014; Jarvey, Low, Pappano, Bergman, & Beehner, 2018)

Members of the Theropithecus genus show several dental, gnathic, and postcranial characteristics related to chewing and food harvesting. They have an elongated thumb and a foreshortened index finger, which permits precise and efficient plucking and pinching of grasses. (Jablonski, 1986; Jablonski, Leakey, Kiarie, & Antón, 2002). Another specialisation are high-crowned teeth for mastication of tough food items. (Krentz, 1993; Eck & Jablonski, 1987)

Due to their intestinal morphology, geladas can ferment cell wall material coming from grass as efficiently as zebras in terms of fermentation. How exactly the gelada`s fermentation patterns can be characterised is currently unknown, with the colon being the most likely part of the geladas digestive system to contain cellulolytic microorganisms. (Mau, Johann, Sliwa, Hummel, & Südekum, 2010)

Geladas spend most of their daytime activity foraging. They feed in a seated position (“shuffle gait”) and use their hands to harvest the blades, seeds, and rhizomes of grasses. (Dunbar, 1977a)

The feeding of geladas in zoos must be adapted to this specialised nutrition and foraging. (See chapter J. Feeding)

Fig. 13 Geladas foraging in natural habitat (Alastair Rae, flickr)

G. Reproduction

1. Sexual maturity

Females reach sexual maturity at an age of approximately 3 years, with males at around 5 years. The males develop their long, heavy cape of hair and big canine teeth during puberty. They are fully grown when they are approximately 8 to 9 years old. (Hayssen, van Tienhoven, & van Tienhoven, 1993)

2. Reproductive cycle of females

There is a very distinct characteristic to determine whether a gelada is in heat: bright red colouration of the hourglass-shaped patch on the chest with shiny knobs of skin surrounding the patch are the typical physical indications that a female is in oestrus. To a lesser extent, knobs and swellings appear also at the callosities. When conceived the chest remains bright red, but the knobs disappear. In a later stage of pregnancy, the upper part of the chest patch swells and bulges appear. After giving birth the chest loses its red colour and is soft pink. Outside of her oestrus the chest of a female has the same pink colour.

Fig 14 Development of oestrus in a female gelada

Fig 15 Female geladas showing signs of oestrus (left) and late pregnancy (right)

3. Seasonality

Gelada baboons do not have a specific mating season, though it has been noted that the birth rate is higher during the rainy season. (Kawai & Szalay, 1979)

In the captive population there is no significant seasonality. Slightly more births happen in April and in the months from October to January in comparison to the rest of the year.

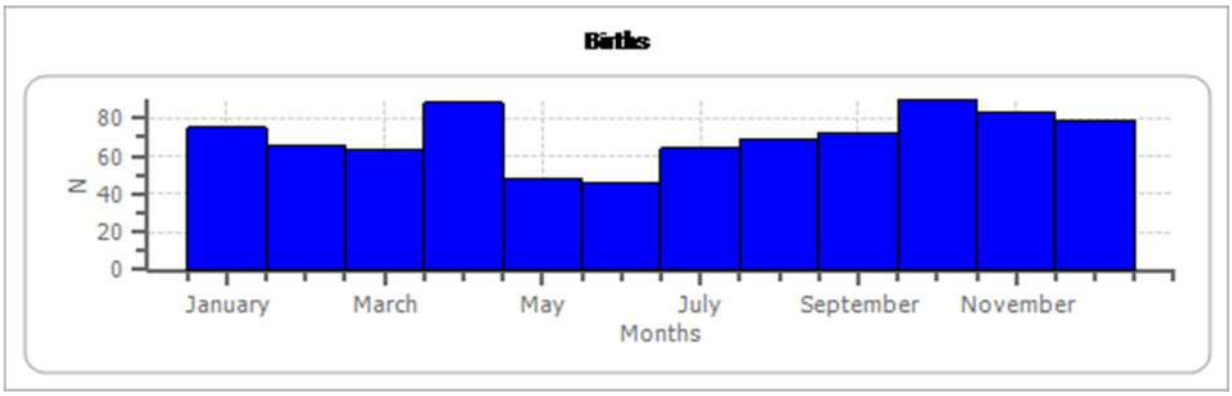


Fig 16 Seasonality of birth in zoos. Data taken from the gelada studbook.

In zoos a peak of births might appear when females synchronise oestrous after introduction of a new harem-leader. This is also reported from the wild.

4. Gestation period

Gestation length in Gelada baboons is estimated at 5 to 6 months. From long-time experience in zoos, 180 days / 6 months can be used as the reference value for gestation period. Females generally give birth to one infant at a time and females with infants are anoestrus. (Kawai & Szalay, 1979). Only four cases of twin-births are registered from zoos over all the years of data collection in the studbook.

Fig 17 Gelada twins born 15 December 2020 in NaturZoo Rheine; photo at one day old

5. Development

In the first 4 to 5 months the infant is carried by the mother or sometimes other members of the group. As they grow older, they start forming play groups with other geladas of similar age. Infants are weaned at 12 to 18 months. (Hayssen, van Tienhoven, & van Tienhoven, 1993)

While females stay in the natal group (harem-females are related – matrilines), males leave their natal unit when they reach puberty. They might follow or form bachelor-groups and may become harem-leaders.

Fig 18 Female with her offspring and other young geladas in different stages of development

H. Behaviour

1. Activity

Observations have shown that geladas spent more time foraging compared with time allocated to other activities (Ejigu & Bekele, 2014). The percentage of time spent foraging ranges from around 40% to around 65%. This may vary due to availability and quality of food (Iwamoto, 1993). Most of that feeding time (~78%) is spent foraging on grass. The least amount of (day)time was devoted to resting and a similar amount of time was spent moving. Time spent with social activities is relatively higher in adults than in other age classes (Ejigu & Bekele, 2014).

The daily routine of a gelada can be summarised as follows. In the morning, the animals move up to the plateau from their sleeping ledges below. There they spend some time engaged in social activity before feeding becomes the predominant activity. This continues through the middle of the day until late in the afternoon. When the animals have arrived at one of their sleeping cliffs later in the day, movement and feeding decline in frequency and a small peak in social activity is observe before the animals descend to their sleeping ledges. (Dunbar, 1977a)

In general, a shift in the abundance and duration of certain behaviours occurs when, for example, the amount of green graze available is considerably reduced in the dry season. (Dunbar, 1977a)

2. Locomotion

Gelada baboons use different types of locomotion when traveling between sites and climbing on rocks and cliffs. Mostly travelling quadrupedally, they have also been seen moving bipedally in the normal course of their activities. Geladas seem to be more sitting than standing when they travel bipedally and may even touch the ground with their buttocks (“shuffle gate”). They use bipedal locomotion only for short distances. (Wrangham, 1980)

Geladas are also adapted to climb on rocks and cliffs. They rarely climb on trees, which are only exceptional in their habitat anyway. When climbing on trees, tree trunks or poles in zoos, geladas appear clumsy, whereas they show amazing climbing abilities on structures made of rocks or walls made of stones.

3. Predation

There are not many studies on predation of Gelada baboons. Attempted predation on geladas by leopards and domestic dogs have been recorded. Predation does not seem to be a strong limitation factor for population size, furthermore it is discussed that living in multilevel societies may represent an adaptive response by geladas to predator pressure. (Lin, et al., 2020; Iwamoto, Mori, Kawai, & Bekele, 1996)

Leopards, hyenas, jackals, servals, and foxes seem to be natural enemies of geladas as they are the largest living predators of their natural habitat, but it seems that domestic dogs are an even higher threat to them. (Abie & Bekele, 2016)

More than predators, the limiting factors on gelada populations are climate and habitat (accidents in the cliffs), social conflicts (fights among males, infanticide), conflicts with humans (grassland used for livestock) and parasite infections (tapeworms).

4. Social behaviour

Gelada baboons live in groups consisting of one male with several females and their offspring. These groups are called harems or one male units (OMUs). Another form of organisation are groups consisting entirely of males, named all-male units (AMUs). (Stammbach, 1987)

Together these groups form the basic population unit of the social structure, namely a band. Each band consists of several harems and all-male groups and occupies a home range which overlaps to varying extents with the ranges of neighbouring bands. The band itself, however, does not necessarily constitute a foraging unit, which is called a herd. These organisations may consist of all or only some of the units of the band and in areas of home range overlap may even consist of the units of two or more bands (Dunbar, Feeding ecology of gelada baboons: a preliminary report, 1977).

Fig 19 Composition of a herd of geladas; social structure

Herds resp. bands can be as large as several hundreds of individuals. Living in large social communities requires a complex communication system. Geladas communicate via vocalisation (some 28 different sounds are identified) as well as gestures and facial expressions.

Fig 20 Communication by facial expressions

5. Sexual behaviour

Gelada baboons have a polygynous mating system. Copulation is usually initiated by the female and occurs between the fervent females of a group and the group's leading male. (Stammbach, 1987)

The females can be considered as the true leaders within a harem. If an outside male attempts to take over the group by supplanting the male using physical force, the females may choose to support or oppose either male. The females can chase the unwanted male from the group with their own show of physical force, regardless of who wins the fight. Since only the male associated with the harem is in the position to mate, the females have indirect control over male reproductive success. (Smuts, 1987)

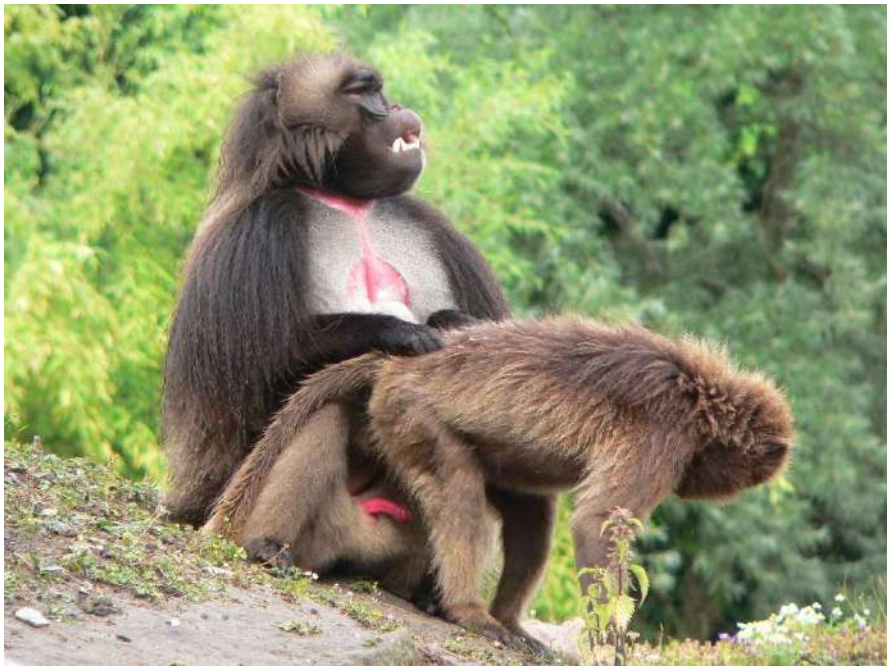


Fig 21 / 22 Female presents to a male inviting mating

Section 2 Management in Zoos

The state of the Population (From the Long-Term Management Plan LTMP 2019)

The EEP population has been growing rapidly and the birth rate in the last few years is three times higher than the expected death rate. Unless the birth rate is reduced significantly, the EEP population will grow with hundreds of individuals in a few years. The population is at present still genetically healthy with 92% genetic diversity. With the current genetic parameters, the population will be reduced to less than 90% genetic diversity in 56 years. Active management will slow down the loss of genetic diversity, but only up to several decades.

The future roles of the Gelada baboon EEP population are:

- To allow studies and development of methods that can get applied or transferred to the wild population and training of researchers.
- To act as ambassador for the endemic fauna of Ethiopia, allowing opportunities to fundraise for Ethiopian conservation initiatives.
- To provide, as active species with a unique ecology and social structure, an attractive and educative exhibit.

The EEP needs to work towards decreasing the birth rate by a factor three in the coming years to avoid overshooting its target population size of 550 individuals based on space capacity provided by current and recently incoming new holders. It is not yet clear, however, how this can be achieved without negatively impacting social group dynamics. Therefore, to design a reproductive management strategy for the EEP, well-tested methods need to be developed. Until then, the birth rate needs to already be decreased significantly to gain time for the EEP to develop well-tested contraceptive methods before it reaches its target population size. This is also essential to avoid conflict with animal welfare and ethics in animal management as well as EAZA`s standards for population management.

A growing population size will also mean more males, so the EEP will continue to investigate male management options to provide sufficient housing.

Genetic management in the EEP population will mainly focus on getting the most genetically valuable males installed as breeding males.

I. Enclosure

The layout of a facility to house geladas should consist of three units:

- An outdoor enclosure of a size which will allow maintaining a well sized group of geladas of at least 15, favourably around 30 animals (breeding-groups / harem-groups) or appr. 6 animals (all-male groups).
- Connected outdoor space (cage or smaller enclosure) for animals / groups temporarily separated (i.e surplus males before getting transferred to other destinations; seasonal, when in winter the boundary – water-moat - of the main enclosure isn`t safe to keep the geladas in the enclosure; for introduction of new animals)
- Indoor space (heated house) with at least two compartments. Indoor space should allow comfortable space for the animals in times when temperatures outside are very cold (freezing) for a longer time-period. Also, indoor space may be essential for handling of the group (shifting, separation, controlling of animals).
  Note that for the management of all-male groups it is favourable (essential) to have indoor accommodation made of several compartments which allow shifting and separating individuals or bonded animals ('buddies'). This maybe temporary or routine for training.

Main enclosure, separate outdoor space and indoor rooms must all be connected to each other, allowing a flexible shifting of the animals.

Also, on a general note: keep in mind that geladas are living in an open-space habitat. Spacious enclosures allow for distance that provides the animals comfort and a feeling of safety.

1. Boundary

In general, geladas are very conservative and not exploring; enclosure boundaries become well accepted, and escapes of animals are very rare.

A combination of wire mesh and electric wire is well proven as boundary for large-sized enclosures. An example of a very well-functioning boundary: The fence is 3,10 meters high with an overhang at around 2,5 meters. Electric wire placed at different hights on such a mesh-fence should have a voltage of about 3000 V.

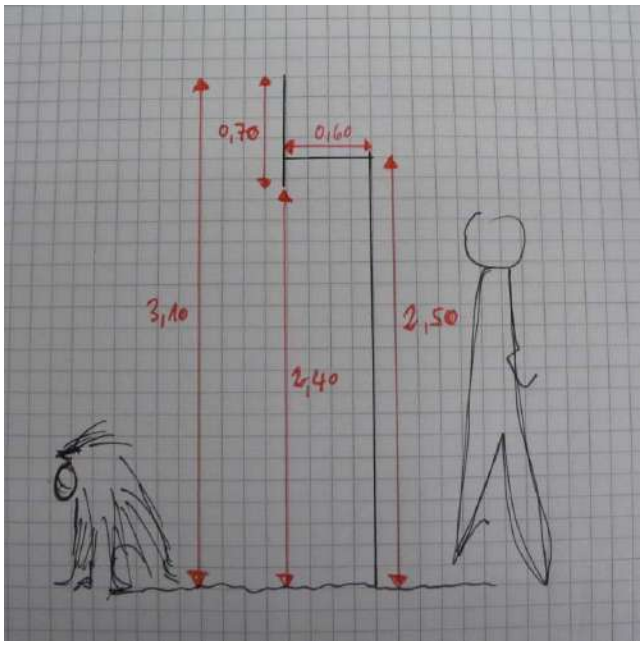


Fig 24 Schematic depiction of a fence with measurements

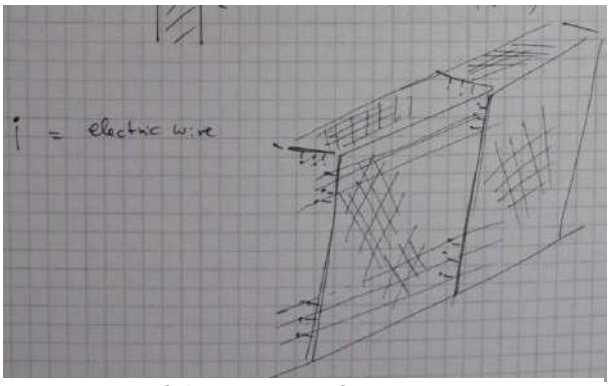


Fig 25 Position of electric wires on fence


Fig 26 Fence with overhanging structure / NaturZoo Rheine

Fig 27 Boundary made of electric wires alternating with earth wire (Photo unknown)

Fig 28 Another example of a boundary made of a mesh fence with additional electric wire / Edinburgh Zoo (photo unknown)

Fig 29 / 30 Boundary made of a mesh fence with additional electric wire / Wild Place, Bristol

Fig 31 Glass and walls as boundary. Note that there are also electric wires on the ridge of the wall as immature males jumped out occasionally / Wilhelma Stuttgart

If high rock structures are present in the enclosure the gap to the fence or surrounding wall should be at least 4,0 to 4,5 meters.

Islands are also working well; water-moats with width 4,00 - 4,50 m are well respected. Water moats should favourably have a shallow edge on the animals' side and gradually descend to at least 1,20 m on the visitors' side.

Fig 32 Water-moat as boundary / La Vallée des Singes, Romagne (photo unknown)

Fig 33 Semi-island enclosure / Parco Natura Viva, Bussolengo (photo Parco Natura Viva)

2. Substrate

In outdoor enclosures natural soil with grass and herbs is recommended. As geladas are graminivores the natural vegetation can be used to forage. However, because of selective foraging the grass will disappear over the time whereas weeds will stay, and the exhibit will keep a natural look. This might get considered when planning or constructing new exhibits. The EEP recommends that enclosure design should be adapted to group-sizes (reflecting a naturally composed group) and not the other way round. This means that a more “unnatural appearance” of the enclosure can be very well accepted if the dimension and structures support maintenance of a larger-sized group of two harems for example.

For indoor rooms concrete floor or otherwise “hard” ground is recommended. This should be sealed (tiles, epoxy- or acrylic paint or other) to allow easy cleaning and a higher level of hygienic standard if needed. Additional substrates can be saw dust, wood chips, straw or hay which bind excrements and can serve as an enrichment tool. Note that hay (and seasonally fresh grass) is also an essential food item and must be replaced daily.

3. Furnishing and Maintenance

Geladas` adaptation to spend most of the time on plain ground and climbing on rocks must get considered in enclosure design. The landscape should be modelled with a mixture of plain area, hills and climbing structures. The latter should preferably be made of rocks and reach up to a height which allows outlook to the surrounding area. Elevated outlooks are essential for the wellbeing of geladas: If rocks (mountain of rocks) can`t be provided, a structure of wooden poles and several platforms at varying heights is an alternative. Elevated outlooks – preferably not just one but several vantage points – are important features when geladas “manage” their social dynamics during conflicts and in aggressive situations.

Niches in the mountain of rock, or wooden structures where two or three sides and the top are covered, are used as shelters during inclement weather or when resting.

Shady areas are essential as geladas suffer from heat and full insolation in hot summer temperatures.

The floor of the outdoor enclosure should be natural soil or sand. A concrete or otherwise “hard” floor can also be very suitable when additional features like an area of sand are incorporated. Climbing structures (terraces, steep sites, elevated plateaus etc.) are regarded as much more essential than the natural floor. In this way ‘old style’ enclosures made mainly of concrete can be suitable for holding geladas.

Grass is ideal as vegetation on the ground of outdoor enclosures. Keep in mind that the grass-blades will be consumed over time. The composition of the vegetation will therefore gradually shift from grasses to herbs. Trees in or around the enclosure will provide shade. Geladas are not keen to climb on trees but there are reports that they do so in enclosures which otherwise lack climbing structures and elevated overlooks or vantage points.

Shallow water – maybe as part of the water-moat boundary or as a small separate pool – is a kind of enrichment as geladas like to ‘appear impressive’ by splashing the water. In a very similar behaviour, they throw sand and soil in such kind of display.

In indoor-rooms, elevated shelves of a decent size to allow a huddled group of geladas (harem, several animals) resting together are the most important feature. Again, an elevated platform (size appr. 1 – 2 m^2) and some poles in horizontal position are suitable structures.

Shifting between indoor- and outdoor-compartments might be achieved via overhead walkway-cages, which can also serve for confining individual animals or for training. Furthermore, small compartments for individual separation are favourable installations for veterinary treatment, training or weight-control etc.

Fig 34 / 35 Indoor rooms for the geladas as seen from the zoo-visitors` perspective. There are additional rooms that are not visible for visitors. / NaturZoo Rheine

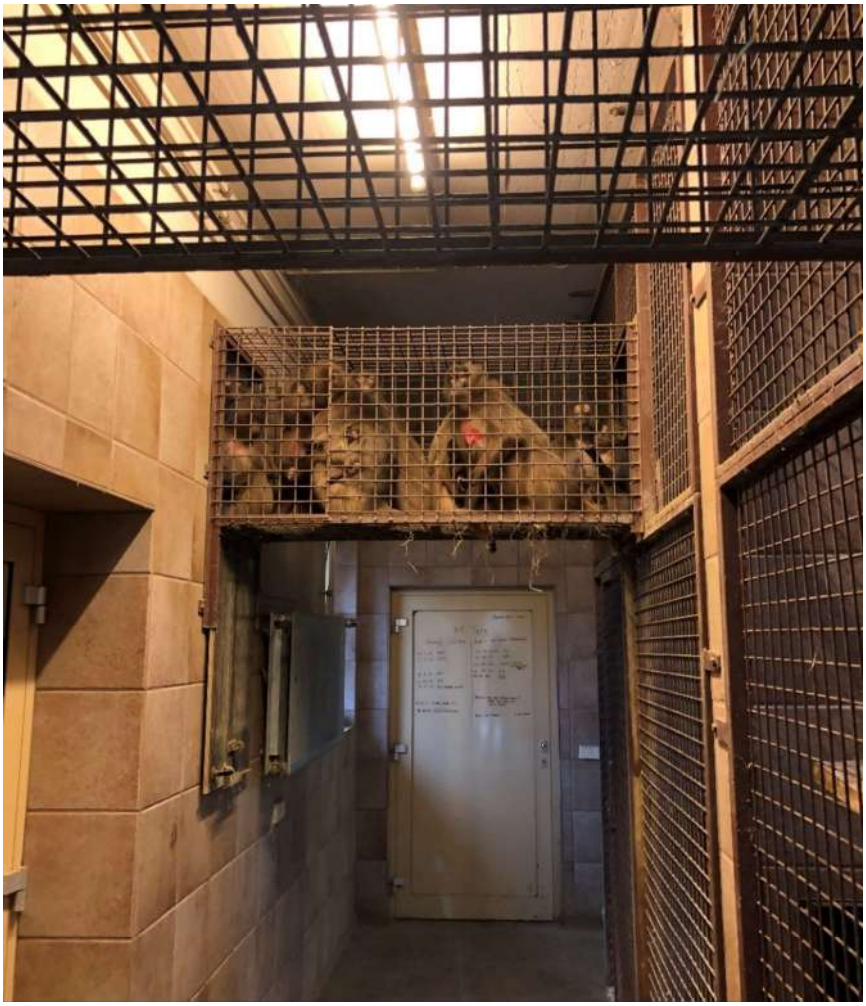


Fig 36 Overhead walkway-cages are well suited to move the animals between compartments and to separate individuals for training or treatment / NaturZoo Rheine

4. Environment

Beside Japanese macaques, Barbary macaques and Golden snub-nosed monkeys, geladas are the primate species best adapted to colder temperatures and sometimes harsh weather conditions. They can stand periods of freezing temperatures but should have free access to warmer indoor quarters. Indoor room temperature in winter can be approximately 12° C.

A not too humid climate in indoor facilities proved to be favourable. Cleaning routine can be done as 'dry cleaning' by sweeping out all substrate (sawdust, hay), faeces and left-over food and using a little amount of water (for cleaning shelves, windows). When hosing indoor rooms regularly one must take care for a suitable ambient room-climate especially when the room-temperature is kept low.

Geladas should have 24/7 access to all parts of the enclosure (outdoors and indoors) all year round and choose freely where to stay. Staying outdoors will be preferred.

As mentioned previously, geladas may suffer from heat and therefore should be able to hide from the sun during hot weather.

5. Dimensions

The dimensions of an enclosure for geladas depend on the group composition. For housing an all-male group, the proposed size for an outdoor enclosure is 300 m² (for appr. 4 animals). When housing a breeding group, the enclosures must be more spacious to allow growth to a naturally sized social group. A proposed size is 1.000 m². However, long-time practical experience proves that enclosures of smaller size than here indicated might be well – exemplarily - suited for maintaining larger, naturally composed gelada groups (given a favourable layout of the enclosure and essential structures).

It is essential to have an indoor facility with at least two connected compartments. Room size must be adequate for group size; however, one should also keep in mind the overall maintenance concept: When geladas have 24/7/365 'free choice' of where to stay – outdoor enclosure and indoor facilities – the indoor rooms will likely function only as sleeping and feeding sites in the colder season.

A system of multiple interconnected indoor rooms is also regarded as essential for housing and managing all-male groups – even when keeping just two males together. All indoor rooms should have direct access to / from the outdoor enclosure or have multiple ways to provide access to / from indoor/ outdoor enclosures.

Windows to all directions are recommended as geladas feel uncomfortable in closed rooms.

Table 2 Enclosure sizes in different institutions

Institution	Outdoor enclosure	Indoor facilities	Group size
NaturZoo Rheine	2 enclosures of ~1.500 m² each; four outdoor cages of 35 m² each.	House with 3 rooms of 30 m² each and 4 rooms of 10 m² each	2 x ~30 individuals (goal). Facilities support up to 90 individuals as of November 2020.
Edinburgh Zoo	~ 7.400 m²	~ 15 m²	~ 35 individuals
Besançon Museum	~ 4.000 m²	~ 60 m²	~ 10 individuals
Zurich Zoo	2.200 m² plus 3 holding pens of 45 m² each	4 rooms, each 25 m²	1 harem with 15 animals, 1 harem with 25 animals
CERZA Lisieux	~ 4.000 m² plus two holding pens (cages)	4 rooms, total 75 m²	

Fig 37 In Zoo Besancon a bachelor group of geladas (up to 10 animals) live in a castle moat (3.000 m²) which allows manifold climbing structures. (photo M. Rolfs)

Fig 38 Enclosure on a hill slope / Edinburgh Zoo

Fig 39 High raising wooden structures allow the geladas elevated positions and outlook / Colchester Zoo

J. Feeding

1. Basic Diet

As geladas are the only extant graminivorous primate species, their diet in zoos must strongly reflect this nutritional specialisation.

Grass in summer and grass-hay and hay-cobs / hay-pellets all the year are the essential basic food, however, this must be supplemented daily with a variety of vegetables.

The diet must be rich in fibre but very low in starch and sugar. It is recommended not to feed any sweet fruits or vegetables rich in starch (potatoes, sweet potatoes). Other vegetables with a medium content of starch or sugar (carrot, parsnip etc.) must be limited to small amounts.

Seeds (grain mixture incl. wheat and oats) should be added with caution and very limited as geladas exploit nutrients of these foodstuffs very (too) well, easily becoming overweight with a daily grain-mixture! Note that scattered seed-mixtures are not treated as an additional enrichment feeding in geladas but are substantially contributing to the amount and composition of the basic diet.

No bread is given, and monkey pellets must be very limited (for example once a week).

NO! NO! NO!

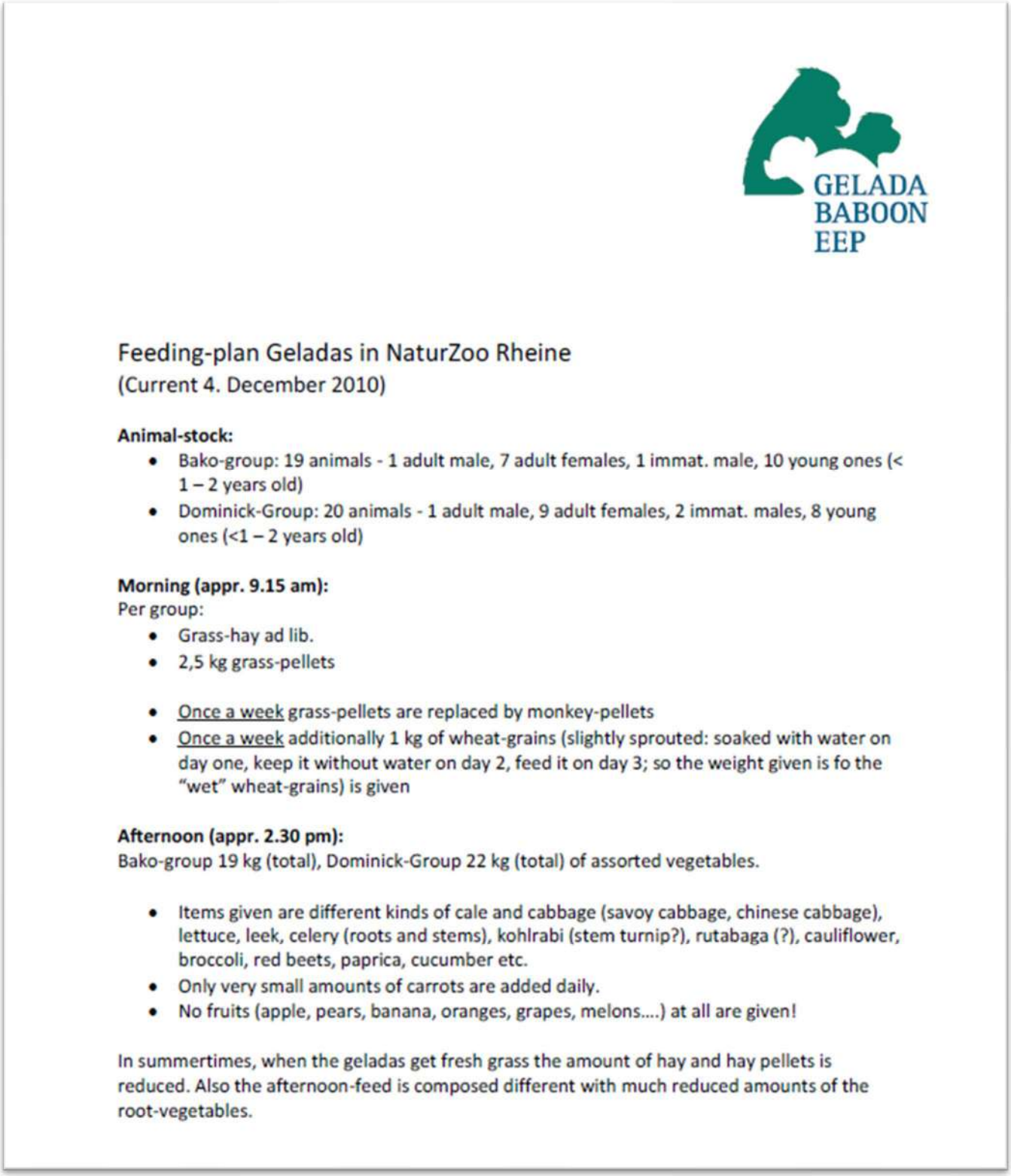
GELADA BABOON EEP

What about?

GELADA BABOON EEP

Try it. There is evidence that geladas occassionally dig for invertebrates and there are observations on eating locusts in the wild. It will be just a supplement.

Fig 40 Feeding plan NaturZoo Rheine (example)



GELADA
BABOON
EEP

Feeding-plan Geladas in NaturZoo Rheine
(Current 4. December 2010)

Animal-stock:

- Bako-group: 19 animals - 1 adult male, 7 adult females, 1 immat. male, 10 young ones (< 1 – 2 years old)
- Dominick-Group: 20 animals - 1 adult male, 9 adult females, 2 immat. males, 8 young ones (<1 – 2 years old)

Morning (appr. 9.15 am):
Per group:

- Grass-hay ad lib.
- 2,5 kg grass-pellets

- Once a week grass-pellets are replaced by monkey-pellets
- Once a week additionally 1 kg of wheat-grains (slightly sprouted: soaked with water on day one, keep it without water on day 2, feed it on day 3; so the weight given is fo the "wet" wheat-grains) is given

Afternoon (appr. 2.30 pm):
Bako-group 19 kg (total), Dominick-Group 22 kg (total) of assorted vegetables.

- Items given are different kinds of cale and cabbage (savoy cabbage, chinese cabbage), lettuce, leek, celery (roots and stems), kohlrabi (stem turnip?), rutabaga (?), cauliflower, broccoli, red beets, paprica, cucumber etc.
- Only very small amounts of carrots are added daily.
- No fruits (apple, pears, banana, oranges, grapes, melons….) at all are given!

In summertimes, when the geladas get fresh grass the amount of hay and hay pellets is reduced. Also the afternoon-feed is composed different with much reduced amounts of the root-vegetables.

Note that geladas may gain additional food items from the enclosure. For example, acorns from oak trees in or around the enclosure can be a substantial addition to the diet in autumn. This must be considered by adapting the food ration.

2. Special Dietary Requirements

There is evidence that mineral supplements must be given regularly. See veterinary aspects.

3. Method of Feeding

As foraging is the main activity (> 60 % of daytime activity) in wild geladas, feeding practice should allow the animals to take in food all day. Hay and, in the season, grass should be always available. Vegetables should be given at a feeding time, favourably around midday.

A well proven schedule at NaturZoo Rheine can be seen from the example feeding plan.

When a group consists of two or more harem units, feeding sites (spread food) should be at two or more separate, distant places in the enclosure. Food should be scattered at each place.

For larger gelada groups, food-items (vegetables) should be chopped, however, as proved from experimental studies and practical experience, the pieces can be quite large chunks. No significant aggressive competition for food appears. When the groups are smaller and for all-male-groups the food items must get chopped to a smaller size and widely scattered to ensure balanced distribution to individuals and to avoid aggressive competition.

Food-competition and consequently aggression might be higher in all-male groups, therefore, it is recommended to feed all-male groups with amounts which are calculated with a surplus. There is also good experience in separating individual males or buddy-units from the group for the time of feeding to ensure less aggression.

Changing the methods of feeding (size of food items, scattered vs. clumped) might be implemented as an enrichment method.

Fig 41 Fresh cut grass is an essential food in the season

Fig 42 / 43 Feeding grass and hay enhances foraging behaviour

Fig 44 There is comparatively little competition for food in large groups of geladas.

4. Water

Drinking water must be available, preferably from a bowl. Geladas will drink also from the water-moat (boundary), of course.

K. Social Structure and Group-management

1. Basic Social Structure

As mentioned in section 1.H, geladas live in groups consisting of one male with several females and their offspring. Note that the females are related to each other (matrilines). These groups are called harems. Harems are regarded as the 'core-unit' of a more complex gelada-society. Several harems form a second level of organization called a 'band'. Groups consisting entirely of males (bachelor-groups or all-male groups) are also part of the band.

These natural structures can – and should - be recreated in the zoo environment. Any holder of geladas should aim for housing and managing a breeding group of two (or more) harems or a bachelor (all-male) group. Holders of all-male groups are essential for the overall functioning and success of the breeding programme. All-male groups must not be kept in close proximity to breeding groups (harem units) – at least out of sight in close proximity. Also, keeping harem-units and a bachelor group in one enclosure might function only when the male-group is still in formation and when such males are quite young. There are so far no experiences with keeping such a band – a group consisting of several harems and a bachelor group – and it might require a very large enclosure, specific separation areas and dedicated management of such a complex group.

2. Harem Group

Creating and managing a breeding group works as follows. First a core-group of females should be identified. It should contain 2 - 4 females that ideally are known to each other and related (siblings, half-siblings, mother-daughter). A core-group with females that are not known to each other should consist only of animals that are not older than 3 – 4 years. At this age the females are still more 'socially flexible' and can arrange or adapt to a hierarchy.

To such a female unit an unrelated male will be added. It should always be considered to add 2 – 3 males (related or known to each other and with a clear age-hierarchy). The dominant male of the group will most likely become the new leader of the harem. The 'surplus' males might have a chance to 'acquire' females later when they are mature (in fact, females might choose to move to the male) or they must be separated and transferred in due course, as aggressive competition with the harem-leader increases.

The harem-group should then be left in this constellation for 5 – 6 years to allow it to grow and produce offspring from all the initial females. After this time, the harem-leader must be replaced.

For this purpose, all males that are older than 3 years should be removed from the group (including the dominant male) and 2 – 3 males (unrelated to the females) must be introduced as described above.

Infanticides and abortions after each introduction of new males to female-units are to be expected. (see Infanticide / Infant Mortality)

It is important to note that introducing females to existing groups (harem-units with established matrilinear hierarchy) should never be considered. Even combining just 2 unrelated adult females is very difficult to achieve and can cause severe aggression and stress among individuals.

3. Bachelor (All-male) Group

In the wild, bachelor groups are composed of young-adult males from several harems. Males in bachelor groups exhibit a dominance hierarchy. As a result, all-male groups are dynamic by nature and change continuously as males leave an all-male group to become harem leaders.

What we know of bachelor groups in the wild and in captivity is that there are closer bonds between individuals within the group resulting in dyads which have a hierarchy in themselves and in relation to other dyads of the group. This hierarchy between sub-groups is expressed in spatial dominance and priority access to food and sleeping sites. It is also clear that changes in dominance and bonds might occur because of various factors, for example, the removal or addition of one or more individuals, or changes in age and relationships. Dominance, as well as physical appearance (cape, canine teeth), is not always related to age and may be influenced by a male´s alliances. Older and 'retired' males, who had been harem leaders before, are calmer than younger males. It is important to note that injuries resulting from conflicts might be very subtle and can occur in each constellation, even when only two males are kept together.

This knowledge leads to the management practices that bachelor groups should consist of even numbers of males so that the animals can form dyadic bonds. Males that form a bachelor group should be familiar with one another and be considerably different in physical development and age. Age-graded groups allow males to reach sexual maturity at different times which can lessen the amount of aggression seen when competing for dominance. In addition to that the age and physical state should be considered when males are added to existing all-male groups. Old, retired males and immature ones might be better suited to be added to an existing group as they pose the least amount of threat to males in their prime.

The care of all-male groups requires the same level or even greater expertise and dedication by keepers and curators in comparison to the management of breeding groups. The most serious issue that has occurred are the cases of deaths of individuals that may result from injuries caused by just one fatal bite or infections, septicaemia and myasis derived from non-detected wounds. To detect potential aggressions and fights early enough careful observation and close monitoring is critical to understand the social dynamics in the group. Several feeding sites, wide scatter feeding, or even individual feeding is essential and can mitigate tensions among an all-male group during feeding. This should be balanced with weight control. Measures should be taken to ensure that all individuals receive an appropriate amount of food so that less dominant males are not deprived of their essential diet. It is important to realise that the general nutritional condition of a gelada male is difficult to define by visual inspection alone because the cape which will mask the true body condition. Additionally, the behaviour of the animals might not provide an indication that an aggressive interaction occurred or that an individual is wounded.

Training is a good tool in management for all-male groups. Training topics might be 'physical inspection' (to detect wounds), 'scale training' (to monitor body weight), 'medical training' (to treat wounds; other treatments) and 'temporary separation' for feeding or resting. See also Training under M. Behavioural Enrichment and Welfare.

Chemical castration was applied with the aim to reduce aggressive behaviour of individuals, however, generally this did not prove to be a promising method in achieving better compatibility within an all-male group, unless they are already living together in a natal group and have been chemically castrated before sexual maturity. Those males that have already been chemically castrated before sexual maturity and then put into an all-male group should continue to be re-implanted to maintain low levels of aggression. (see also Contraception / Applied Contraceptive Methods)

For housing conditions which are favourable or essential to manage all-male groups see chapter I. Enclosures

Fig 45 Gelada males form dyadic bonds when kept in all-male groups

Fig 46 Enclosures for all-male groups should provide vantage points for each bonded unit / Wild Place, Bristol

L. Breeding

Reproduction in geladas is a regular occurrence. For three decades the breeding-programme (EEP) allowed an 'unlimited reproduction' for population growth. Now (2020) as the population has reached capacity limit (appr. 450 animals) in the zoos, invasive population management tools must be applied to maintain the population at this level.

Reproductive data can be found in chapter G. Reproduction.

Some general statements based on observation and experience must be mentioned:

In the gelada EEP population the percentage of being reproductively successful is close to 100 % both in females and males. This means: all animals (females and males) which have been theoretically able to reproduce (by age and mate access) did so. (From review of the time before invasive population management tools were applied).

Best maternal behaviour was found in all but five females (considering data from 30 years for all the EEP population). These five females showed a behaviour of mistreating babies (rolling on ground), some repeatedly / continuously. These females were prevented from breeding (removed from group, sterilised) so that the behaviour was not taught to other individuals. The bad maternal behaviour improved in one animal after a change of social constellation.

Inter-birth intervals are on average ~ 1.5 years. Shortest noted were 13 months; in these cases, the previous young ones showed a behaviour of being most 'irritated' with whining and looking for close contact to the mother who rejected these approaches. Inter-birth intervals of 2 years or even longer must be regarded as normal. Rank of female might be a factor for the length of inter-birth intervals (higher rank – shorter term) and there is evidence that in larger groups the inter-birth intervals are shorter when immature animals act as 'baby-sitters' and mothers can afford to be less protective to their babies.

1. Mating

In Gelada harems the females tend to initiate sexual interactions. The structure of the social system demands that the males compete for long-term hegemony over a complete harem rather than competing for access to individual females when they come into oestrus. This means that the male's access to the females tends to be on an `all-or-none' basis. (Dunbar, 1978)

When in oestrus the females present themselves to the male to initiate sexual interactions.

Observations on behaviour of geladas after introduction of a new male showed that highest ranking females request 'first access' to a male. They deny access to the male towards lower ranking females. The intentions of this behaviour might be 'selfish' but also could be interpreted as 'shield -behaviour' to protect other females with dependent offspring so to prevent infanticide. There were cases when the highest-ranking female was post-reproductive and it took a longer time until the lower ranking females gained access to the male, mated, and conceived. Summarising, failed or delayed reproduction after forming a group or introduction of a new male is behaviour induced. It might take some time until the social situation has settled and mating results in successful reproduction.

2. Pregnancy

For calculations, an average gestation period of 180 days is assumed. Indicator for pregnancy are the changes of the bare chest: when after mating the chest stays red pregnancy can be assumed. In a later stage of pregnancy (appr. 6 weeks before parturition), the upper part of the chest patch swells and bulges appear. (see also chapter G. Reproduction)

3. Birth

Births occur within the group. Very few births have been observed which leads to the assumption that births take place late in the day or early morning hours.

Geladas normally give birth to one baby. There are four cases of twin-births registered (one a miscarriage).

Birthweights (from fully developed stillbirths) are between 700 – 830 grams.

In general, no pre-birth management or preparation is required. More intensive observation after birth is recommended as kidnapping can be an issue (see Infanticide / Infant Mortality).

Fig 47 New-born geladas are born with black hair which gradually changes to brown over a period of appr. 6 to 8 weeks

4. Development and Care of Young

Under normal circumstances, the mother takes good care of her young and carries it around for the first months. The first days after birth, mothers – especially primiparous ones – shield the baby from other group-members. Older siblings show greatest interest in a new-born.

The hair of new-born geladas is very dark, almost black. The colour changes to brownish at an age of around six to eight weeks.

Infants are weaned between 12 to 18 months. After about 4 - 5 months the young geladas form play groups with conspecifics of similar age. These groups can span over the borders of harems and the older the young are the further they move from their mothers and the group.

Neonatal mortality is around 10 % for the age group 0 – 30 days. 10 % of all new-borns do not survive past one year. The two main causes for this are kidnapping and infanticide.

5. Kidnapping

Infant deaths in the first weeks of life could originate from kidnapping. The behaviour has been frequently observed, especially in smaller harem groups when female dominance is more directed to other individual females. High-ranking females without a baby steal babies from low-ranking females. The mother does not dare to take back her baby although she follows the situation in full and it is her intention to get her infant back.

The babies don`t protest or give otherwise indication about the situation. More so, they are silent, and they suckle from the nipples even though they might not get milk. In fact, they might starve and die while suckling.

In one case the kidnapping female had lost her own baby. She was therefore lactating and succeeded in rearing the kidnapped infant.

Kidnapping might happen within the first two to three weeks after birth of an infant. After three to four weeks the baby can return to the mother. This is not the case when younger. It is recommended to observe closely over the first three weeks after birth if a new-born is with its mother. If it is found clinging to another female one should monitor the situation over 24 hours. If it is still with ‘the kidnapper’ after 24 hours, one has to separate the (for this purpose sedated) kidnapper, take away the baby and offer it to the also separated mother by placing it in the room; the mother will take it back immediately. Both females must be returned to the group afterwards. Continue close observations as kidnapping can happen several times.

6. Infanticide

In general, infanticide – the intentional killing of infants - is a natural phenomenon within the gelada population. It is described from the wild (Beehner and Bergman, 2008).

Infant mortality following male takeovers in wild geladas

Jacinta C. Beehner, Thore J. Bergman

First published: 30 September 2008

Since Sugiyama's [1965] first observations of infanticide, empirical evidence from a multitude of primate species has supported the sexual selection hypothesis—the idea that males enhance their reproductive success by killing nonrelated, unweaned infants to hasten the mothers' return to fertility. Like other primates that live in social groups where paternity certainty is high, the social structure of geladas [Theropithecus gelada] suggests that infanticide by males could enhance their reproductive success. Nevertheless, empirical evidence for infanticide in this species is limited to anecdotal accounts. Using the timing of infant mortality and female reproductive and behavioral data collected across 26 months from a population of geladas living in the Simien Mountains National Park, Ethiopia, we test whether sexually selected infanticide occurs in this species. We also examine two additional hypotheses [noninfanticide hypothesis and generalized aggression hypothesis] for this population. Results suggest that sexually selected infanticide in geladas may, indeed, be a threat to females with dependent infants. First, male takeovers—the most likely time for infanticide—were associated with subsequently elevated rates of infant death [a 32-fold increase] comprising nearly 60% of all infant mortality. Second, females who lost infants during this period returned to fertility more quickly than if infants had lived [IBIs were 50% shorter], and third, all of these females were observed to mate with the new male. We found little to no support for other hypotheses. Finally, these results raise the possibility that anecdotal reports [from previous studies and this study] of pregnancy termination, accelerated weaning, and deceptive sexual swellings may represent female counterstrategies to male infanticide in geladas.

Am. J. Primatol. 70:1152–1159, 2008. © 2008 Wiley-Liss, Inc.

Fig 48 Infants died in consequence of infanticide

Infanticides happened frequently (in nearly all cases) when male geladas took over a harem, no matter if the males were raised in the group or when introduced.

Infanticides happened…
…whether the male was full-adult or young-adult
…whether the process of introducing the male took a longer or shorter time
…on infants ranging in age from new-born to >2 years old
…on infants sired by a predecessor and on infants sired by the male who performed the infanticide
…on male and on female infants
…on infants from high-ranking and from low-ranking females
…at the day of introduction or up to a year after introduction of the male
…one time or several times during the introduction process

For the Gelada baboon EEP infanticide is fully acceptable also in term of the population management (i.e., the loss of infants through infanticide has no negative impact on the population development).

Recommendation by the Gelada baboon EEP on infanticide

(expressed by the EEP coordinator and supported by the participants of the Gelada EEP meeting March 2015.)

The occurrence of infanticide must be accepted as a natural behaviour when male geladas become harem-leaders.

There must not be an intervention after an infanticide no matter if the target-animal (attacked infant) is dead or still alive.

In case of death the victim should be left with the mother within the group for at least one day (in case the mother is still carrying the corpse).

In case that the victim is still alive it must be left with the mother within the group as long as it dies (or survives). Separating a wounded but still alive infant (and its mother) will lead to hand-rearing or separation and later re-introduction with risk for a repeated attack. This is contradictory to our idea of geladas` welfare: Being kept separate / alone and with a disputable perspective is not in accordance to the species` complex social behaviour.

The EEP coordinator will support individual participants in case of negative public response.

When keeping a breeding group an institution needs to be aware that zoo-visitors should get informed about the incident. A strategy and tools for information should be available in form of, for example information panels, trained keepers or trained educators/ interpreters that are present on site.

7. Hand-Rearing

There have been five occasions of hand-rearing of gelada new-borns / infants over the past 30 years. In two cases the mother died immediately or shortly after birth, in three cases the females showed poor maternal behaviour and mistreated the babies.

In two reported cases a milk formula for humans was used from start on. The infants showed very early directed interest in solid food items. The infants were very much imprinted to one person and it was difficult to include more persons in the practical work of the rearing (feeding, general care). Introduction to a group was impossible in these two mentioned cases because of the group size and the general management routine for these groups, however, combination with younger animals (immature) was easy when the hand-reared gelada was 4 – 6 months old.

A hand-reared female developed well and became fully socialised and bred and reared successfully.

A hand-reared male who lived in several all-male groups showed increasing anomalies in social and other behaviours. He had to be euthanised at an age of 13 years as his physical and psychological welfare was no longer assured.

The EEP does not recommend hand-rearing of geladas. It is not regarded essential to support the population of geladas in the EEP (neither for quantity nor genetic quality). More so, the experience has shown that the welfare of hand-reared geladas (especially males) is questionable because of imprinting on humans and deficiencies in social behaviour.

M. Population Management Methods

As the capacity within EAZA zoos and including non-EAZA EEP participants is limited (by space as well as number of holders and enclosure size) to around 500 animals, invasive population management methods must be applied to balance the population size.

There is so far only preliminary experience with invasive management methods to control reproduction and the consequences for geladas and this EEP. In general, 'unlimited breeding' would ensure the animals` general wellbeing, enhanced natural social behaviour and group stability as the babies are important for 'agonistic buffering' in social relationships.

However, different national laws (on animal welfare), EAZA standards, individual ethical, emotional, and pragmatic attitudes, as well as public perceptions, set the framework for handling a 'surplus' of animals when space capacities come to an end.

1. Castration

Castration (chemical and physical) of males was implemented to explore if those males can be kept in natal groups / breeding groups (being non-competitive with breeding males, having a role in the group, showing behaviour indicating an acceptable level of wellbeing). Castration was also used to test if the level of aggression between males in all-male groups can get reduced.

In one case study the group leader (11 years old) was vasectomised. A subdominant male at the age of around 6 years and an undeveloped young male at an age of around 2 years of the same group were physically castrated. While the vasectomised male did not change in his appearance the subdominant male changed drastically. His shoulder mane disappeared while the canines seemed to stay big. He had no chance to attract females and his social contacts were limited but consistent. The effects of the young males' development can be summarised as follows: His body was slender and juvenile, and he was significantly less developed than other males of this age. Apart from that he was well integrated in the group and had lots of interactions with young animals. Higher level of aggression was not observed in either male. Both avoided conflict situations with dominant males and followed in the periphery or were integrated in one harem group and had their buddies.

Castration is therefore only recommended at a young age to handle the surplus of males (by keeping the males in the natal groups), not to reduce population growth.

There is so far no experience of introduction of early castrated males to all-male groups.

Fig 49 Group leading male 1.5 years after being vasectomised (right) / Zurich Zoo

Fig 50 / 51 Subdominant male 1.5 years after being castrated (left) and a not castrated male of the same age (right) / Zurich Zoo

Fig 52 Young male 1.5 years after castration / Zurich Zoo

One institution tried to tackle the aggression between males in a merging event of 4 males with 5 new males through chemical castration. The physical appearance of the males only changed marginally and disappeared after the effect of the castration wore off. One of the males who was castrated continued to be aggressive and had to be separated from the group.

In another institution Suprelorin was used to try keeping one male offspring in its natal group. The male was 7 years old when the implant was placed. After the chemical castration, the aggression was ongoing, and the male had to be removed from the group.

In the same institution 2 males were then first implanted with Suprelorin at 5.5 years old and have remained in the natal group since. They are re-implanted approximately every 1-2 years (depending on their behaviour) and at 9 and 10 years of age accepted a new breeding male into the group with little to no aggression seen. All male offspring in the group have since been chemically castrated with

Suprelorin at around 5.5 years of age and all have remained peacefully in the natal group until being moved on to other collections.

This leads to the conclusion that aggressive behaviour is not only induced through hormones and a chemical castration is not effective when dealing with aggression, however, if chemical castration is carried out before sexual maturity it can prevent the onset of aggressive behaviour and can be effective at keeping male offspring in natal groups, allowing the successful introduction of new breeding males.

For chemical castration of males Deslorelin acetate (Suprelorin) is used. 1 x 9.4mg at around 5.5 years old and repeated every 1-2 years appears to be the most effective programme of chemical castration. Every animal must be treated as an individual case as they can all respond differently and repeat implants should be carried out depending on the individual`s behaviour.

Fig 53 / 54 / 55 Gelada male before (left), during (middle) and 5 years after (right) chemical castration / Bronx Zoo, New York

2. Contraception

Contraception of females should be done with Etonogestrel (Implanon/Nexplanon). The duration of efficacy is approximately 2.5 – 3 years but this can vary individually.

Implanon is designed to be fully reversible, however, there is currently no information for this species on reversal. In other Cercopithecidae species a reversal effect was shown, with times to conception ranging between 1 month and 3 years. It is recommended to remove the implant facilitating reversal; therefore, the implant should be placed subcutaneously in an area where it is easily located and that facilitates removal. For primates, the inner arm close to the armpit is recommended.

When determining which animal should be placed on contraception, choose females that have already successfully reproduced and ideally have babies at the time of implantation. This will set the duration of contraception up to 4 years incl. the weaning of the baby.

Contraception of females for the purpose of reducing the birth-rate and population growth has been applied first in the year 2018; therefore, no specific experience of short or long-term effects can be reported (2020).

3. Vasectomy

Vasectomy – the surgical transection of the spermatic duct – has been conducted in several cases in recent times. Males defined for this population management method were those who had been in the position of a harem leader and / or had sired a substantial number of living offspring. The idea is that such males stay in their position as harem leader and fulfil all behavioural tasks but can no longer sire offspring; therefore, contributing to a drop in the reproduction rate and respectively a gap in the population growth in this specific group and overall.

Those males must stay in the role of leading male for three years after the vasectomy. It has shown that two years is not long enough to result in a drop of the birth-rate: by that time, all females were ready to conceive and the birth curve went up steeply. The timespan with a vasectomised male at the helm should also not exceed three years to ensure that young geladas can learn rearing behaviour by watching and assisting experienced mothers.

Vasectomising harem leaders will be effective for a short term drop of the population growth but not for a continuously flattening the growth curve for individual groups and the overall population.

4. Separating Sexes

Keeping sexes separate for the purpose of reducing / inhibiting reproduction is not recommended. Geladas have no seasonality and no synchronicity in reproduction; therefore, a short or mid-term separation would have no effect on the reproduction rate. More so, this practice is contrary to the natural behaviour of gelada baboons and their wellbeing.

Keeping all-male groups is one tool to manage the surplus of males.

5. Culling

Culling can be considered as a population management method following the EAZA Culling Statement.

EAZA Population Management Manual

4.2.8 Culling

If after having considered alternative solutions, it is deemed necessary to cull an animal, the technique used must ensure an absolute minimization of suffering of the animal during the process of ending its life. Culling is considered appropriate where the only alternative is permanent transfer to accommodation which cannot assure a proper level of welfare for the animal and which cannot be improved within a short interval agreed by the responsible EAZA authority.

Any culling procedure by an EAZA Member must conform to the national legislation of the country in which it is located.

Under certain conditions culling can be considered as a population management tool.

Please refer to the **EAZA Culling Statement** (EAZA Population Management Manual, Appendix 28) for further information

N. Animal Welfare & Behavioural Enrichment

We understand that enrichment and animal welfare are interconnected and should not be considered exclusively. This chapter summarises gelada welfare and enrichment aspects deriving from the various husbandry techniques and tools.

For a more concise overview these are compiled in an exemplary table which can also be used as a welfare assessment checklist:

Table 3

Husbandry aspect and goal **What do we want to achieve for the animals` general wellbeing?**	**Essential** **What must be provided? What must be done?**	**Effect** **How does it support animals' general wellbeing and enriched behaviour?**
Group composition • **Multiple harems group** • **Close to natural group size and structure**	• Adequate size of enclosure • Adequate number and size of management space (indoor and separation facilities) • constant breeding in accordance with breeding program	• Intraspecific interactions • Reproductive behaviour and rearing of offspring • Social dynamics
Group composition • **All-male group**	• Adequate size of enclosure • Adequate number and size of management space (indoor and separation facilities) • Equal number of animals • Defined training methods	• Close to natural solution for managing surplus males • Positive social bonding (dyads)
Outside enclosure size • **Allows maintaining multiple-harem group or all-male-group** • **Allowing vegetation growth (grass, herbs) to encourage natural foraging** • **Allowing the animals to perform a variety of behaviours**	• Adequate size of enclosure • Adequate number and size of management space (separation facilities)	• Intraspecific interactions • Reproductive behaviour and rearing of offspring • Close to natural solution for managing surplus males • Natural foraging behaviour • Physical exercise (running, playing)
Boundaries outside enclosure • **Providing the animals with varying distance to zoo visitors (comfort, safety, exploration)**	• Combination of different boundaries (maybe water moat and fence)	• Choice of distance to visitors (far away – close) • Play in shallow water • Splashing shallow water (to impress) • Watching action outside the enclosure

• **Allowing lookout (safety, comfort, exploration)** • **Stimulation of other behaviours (play, impressing)**		
Outside enclosure design • **Allowing the animals to perform a wide variety of behaviours (foraging, physical exercise, play)**	• Diversely designed climbing structures (preferably made of rocks) with multiple levels and ledges • Steep climbing structures • Elevated platforms / outlooks • Niches, shelter • Shady areas • Natural soil with vegetation	• Natural foraging behaviour • Natural physical exercise (climbing on rocks) • Comfort (rest, lookout, shelter, ambient temperature) • Object play (stone handling; other items) • Impressing behaviour (digging, throwing sand) • comfort temperature
Indoor enclosure Size • **Allows maintaining multiple-harem group or all-male-group** • **Providing the animals with essential comfort (rest, shelter, retreat)** • **Allowing the animals to perform a variety of behaviours (seasonal alternative to outside enclosure)**	• House with multiple rooms / compartments of adequate size	• Intraspecific interactions • Reproductive behaviour and rearing of offspring • Close to natural solution for managing surplus males • Seasonal alternative to outside enclosure
Indoor enclosure boundaries • **Allowing lookout (safety, comfort, exploration)** • **Stimulation of other behaviours (physical exercise)**	• Mix of boundaries (walls, glass / windows, grate / mesh)	• Safety and retreat • Lookout • Physical exercise (climbing)
Indoor enclosure design • **Allowing the animals to perform a variety of behaviours (resting,**	• Shelves and platforms • Robust climbing structures • Hay-bedding • Temperature control	• Resting • Shelter • Comfort • Physical exercise (climbing)

comfort, feeding, physical exercise, play)		• Enriched feeding-behaviour
Feeding • **Adequate quality and quantity of food** • **Close to natural time spent for feeding / foraging**	• See nutrition and feeding • Note importance to feed hay and grass	• Close to natural nutrition and feeding activity • Close to natural amount of time spent with feeding
Mixed Species • **Enriched behaviour for both species** • **Interspecific interactions** • **Neutral behaviour of both species**	See Mixed species	• Primarily positive interspecific interactions • Expanded food source • Mild competitive behaviour (food source)
Additional behavioural enrichment • **To further increase the behavioural variety** • **To compensate deficiencies of other enclosure and maintenance practice parameters**	*No reports*	*No reports*
Additional environmental enrichment • **To further increase the behavioural variety** • **To compensate deficiencies of other enclosure and maintenance practice parameters**	*No reports*	Can encourage play behaviours amongst young and contracepted males. Occupies time in a less dynamic exhibit.
Training • **Goals of training to be defined** • **Training MIGHT be a kind of enrichment** • **Training CAN (MUST) contribute to general animal welfare**	• Defining purpose and goal of specific training • Evaluate necessity and feasibility under specific circumstances (group size, enclosure design, general husbandry policy, safety policy) • Purposed room or structures (training room) • Time for keepers to train animals	• Health check and physical inspection of individuals (especially in all-male groups) incl. scale-training • Weight check (scale training)

General care and maintenance • **Contribute and support to above mentioned goals**	• To be defined individually Example: Free choice of staying outside or indoors for 24 hours / 365 days	All time availability of all resources
Other		

The following photos show examples of applied husbandry techniques and enclosure structures to support geladas` varied behaviour and welfare.

Fig 56 Rock element in gelada enclosure / Naturzoo Rheine

Fig 57 The wall of the house allows the geladas climbing exercise. Shelves are preferred places for resting and sleeping. Note the windows which allow the animals to look out when indoors (and in when outdoors) / NaturZoo Rheine

Fig 58 Very well-structured enclosure which provides very good conditions to maintain a larger group of geladas / Wilhelma Stuttgart

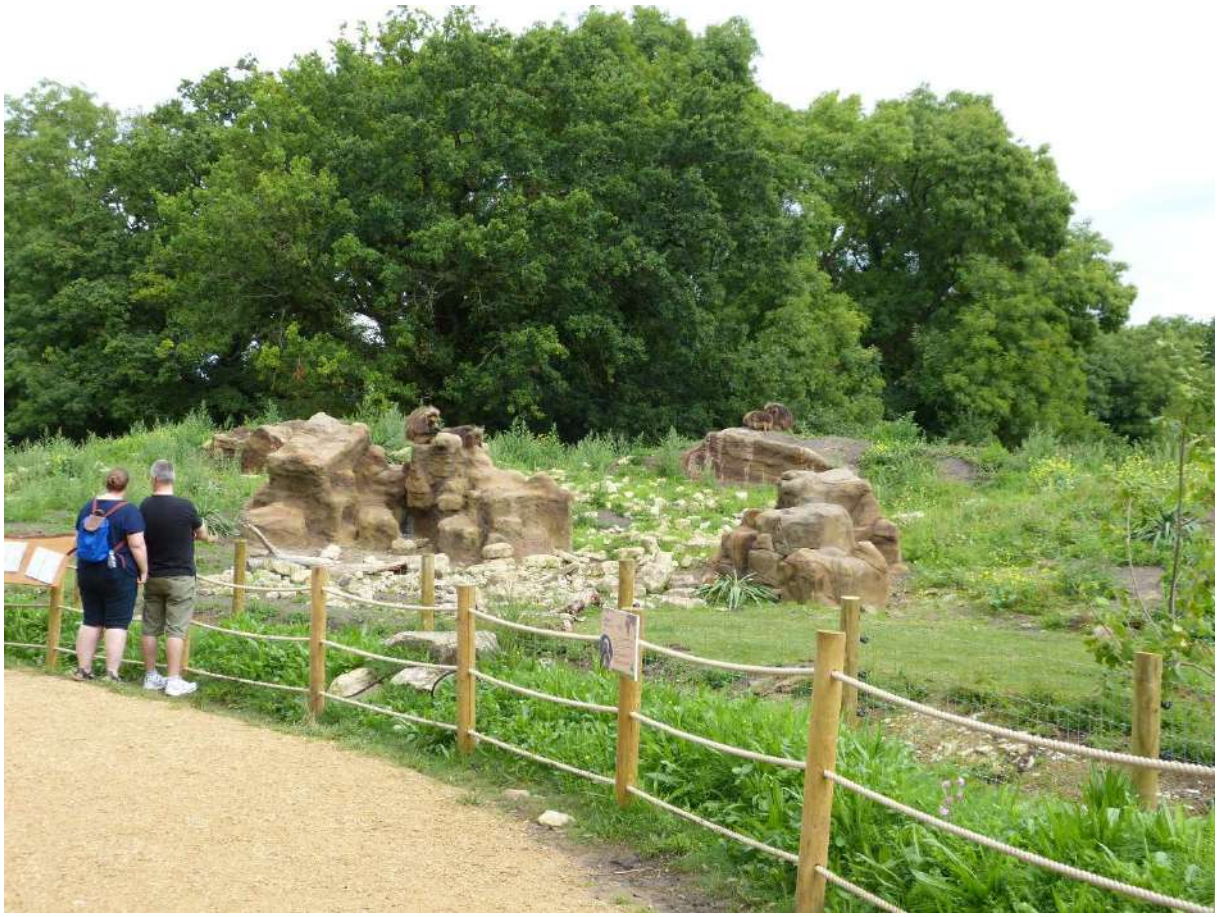


Fig 59 Several vantage points are essential structures in enclosures for all-male groups / Wild Place, Bristol

Fig 60 Normally geladas are not keen to climb on trees, however, if they lack other structures for outlook, they might make use of them in the enclosures. / Dartmoor Zoo (photographer unknown)

1. Mixed Species Enclosures

The geladas´ peaceful and wary character makes them, in general, well suited for housing with other selected species. As in any such case, the process of mixing must be carefully planned and closely monitored.

Keep in mind the animals` given (or not) previous experience of cohabiting with another species. For example, keeping geladas together with Barbary sheep (*Ammotragus lervia*) works very well in general, however, when new individuals of either species are introduced, one must expect conflicts and habituation when these animals are not used to the presence of another species. There are also reports of aggressive conflicts with cases of deaths of geladas when Barbary sheep were changed for an Ibex species. The geladas did not adapt quickly to the more robust and tough nature of the ibex and suffered injuries from the ibexes` horns.

Keeping geladas together with other primates is not recommended based on negative experiences of mixing with Patas monkeys and Mona guenon.

Table 4 lists some more experiences made with keeping geladas together with other species.

In any case keep in mind that appropriate feeding/ access to the right diet for both species must be assured. Also keep in mind the individual needs for environmental conditions (temperature, enclosure structures).

There are so far no reports of or experience with specific hygienic issues or inter-specific contagious diseases for the mixed-species cases mentioned.

Table 4 Mixed-species experiences and recommendations

Geladas mixed with…	Comment / Experience	Recommended
Barbary sheep	A generally well working mix. Enrichment for both species; playing behaviour initiated by both species (young animals); geladas grooming barbary sheep. Very few / single occasions of failures: A gelada male died after an attack by a male Barbary sheep; a younger Barbary sheep suffered from injury after a bite from a gelada. Reports of maltreatment of young Barbary sheep (also leading to their death) mostly by immature males. Educational value	Yes
Nubian ibex	Ibexes might be more robust than Barbary sheep. Introduction of younger ibexes to the geladas is recommended. Take care when new animals are added / introduced. Educational value	Yes
Markhor	One case reported. Terminated soon as the Markhor were very aggressive towards the geladas.	No
DikDik	One case reported. Worked very well.	neutral

Patas monkeys, guenon	Aggressive interactions between the species. Conflicts out of 'jealousy' among the males and females (female Patas monkeys presented to male geladas); access to inadequate food; housing requirements differ (Patas monkeys need warmer conditions)	No
Rock hyraxes	Hyraxes are very confident. Reports of maltreatment of young hyraxes (also leading to their death) mostly by immature males. Educational value.	Yes
Griffon vultures, Marabou stork	Worked well at the start. Increasing aggression towards vultures. Competition for nest site / resting site. Terminated in two cases.	No
Blue-winged geese	No problems reported. Educational value	Yes
Abyssinian ground hornbill	One case. Reported to work very well.	neutral

Fig 61 Mixing geladas with Barbary sheep is mostly a positive experience for both species / Wilhelma Stuttgart

Fig 62 Keeping geladas together with Rock hyrax is reported as a positive mixing of species from several zoos / Wilhelma Stuttgart

Fig 63 Ground hornbills kept together with a large group of geladas. No problems are reported. / CERZA Lisieux

Fig 64 Peaceful food sharing between two very different species / NaturZoo Rheine

Fig 65 Geladas are kept together with Nubian ibexes at several places. Care must be given when introducing the two species: Ibexes should be young and therefore not to aggressive towards the geladas. / Bronx Zoo, New York

2. Training

We define animal training as the act of teaching or encouraging animals` specific responses to specific conditions or stimuli. In principle positive reinforcement training is the recommended method. For more information we refer to the EAZA Animal Training Working Group.

Training geladas may be for purposes such as improved husbandry, veterinary practices, safe working practices, enrichment or support of conservation technologies and research projects. Based on current experience, specific training is recommended for the husbandry and management of all-male groups.

Table 5 gives some ideas about training geladas (purposes, goals, experience). This is a 'living document' and additions will be added as appropriate.

Table 5 Training for Gelada baboons

Training Purpose and goal	Comments	Reported by
Moving locations (from outside enclosure to indoor rooms; between indoor rooms)	Geladas are in general very cautious and wary. It is difficult to move them between sections of an enclosure (outside – indoors) on a 'voluntary' basis, especially when the general management concept allows the animals 24/7/365 free choice where to stay (in and out). Training methods and success might depend on group size.	San Diego Zoo Zoo Amneville Parco Natura Viva Zoo La Bourbansais Colchester Zoo
Moving into compartments (similar to crate training). Prerequisite for further training goals.	Geladas are in general very cautious and wary. Males and immature animals might be more 'cooperative'. Having single animals in small compartments will allow medical treatment (injections; even without further training) and regular inspection (identity, physical condition)	Edinburgh Zoo San Diego Zoo Zoo Amneville Colchester Zoo
Temporary separation of individuals or social units.	Might be helpful to manage all-male groups. Single animals or bonded individuals ('buddies') can be separated for feeding or for night rest.	Zoo La Bourbansais Parco Natura Viva Zoo Amneville Colchester Zoo Sand Diego Zoo
Scale training. Gaining regular weight control.	In all-male groups 'hidden weight loss' (and consequential death) was noted when dominant males monopolise food. Their physical state was 'hidden' by the cape; weight control would have indicated the condition. Recommended when managing all-male groups	Colchester Zoo San Diego Zoo

Physical inspection. Animals cooperate in physical inspection without restraint.	Especially in males (kept in all-male groups) severe wounds can occur and might be hidden under the thick coat / cape. A regular inspection by lifting the cape with a long and sturdy tool will help to detect wounds and lead to appropriate treatment.	San Diego Zoo
Wound care. Animals cooperate in voluntary wound care.	Training to allow voluntary treatment of wounds when necessary. This includes cleaning of a wound via flushing or spray application or applying ointment to a wound.	San Diego Zoo
…		

Case report

Gelada Training at Parco Natura Viva *(provided by Caterina Spiezio)*

Numerous efforts have been done to train an all-male group of geladas (N = 6) in Parco Natura Viva, Italy. Food competition is clearly the main problem. Geladas are smart, and high-ranking individuals will find a way to monopolize all food rewards. Isolating low-ranking individuals in specific areas or rooms for training purpose is difficult and hazardous as other group members would not be so kind when the lucky rewarded gelada will be back with them. So, isolation training is not recommended.

However, it is possible to provide medicine or food items for routine check when working in teams with the whole group. One person can reward the dominant male and habituate him to station and retrieve pleasant food (e.g. carrots) from the hand, while a second person (or more if the group is bigger) provide food to other group members. Do not allow the dominant male to accumulate food, as he knows perfectly that nobody will touch it and he will start stealing food from other geladas, even in other rooms of the enclosure. And be prepared because he will find a way to accumulate food. Based on Parco Natura Viva's experience with the all-male group of six geladas, it was possible to provide medical treatments (e.g. antibiotic hidden in pleasant food, specifically a small piece of apple) to an individual only in the indoor enclosure, with the group divided in dyads occupying separated rooms: a dyad with the individual that needed the medicine in one room, the other two dyads in other rooms. To avoid arousal situations and noisy complaints, one person provided food to the dyad with the treated individual while a second person scattered the same food to other dyads. If the treated gelada is liaised with a friendly and calm individual, only one person can reward these both individuals. If the companion of the treated individual is bossy and greedy, two persons are needed to successfully deliver the medical treatment.

As routine the dyads of geladas are separated in different rooms over the evening and night hours. So, the medical treatment was provided immediately after the geladas entered the indoor enclosure and thus remained separated from the rest of the group until the next day. If the medicine had to (or could) be provided in the morning, before moving the geladas outdoor, the best strategy was to move all dyads outdoor except for the dyad with the treated subject, that was "released" after medicine provision. If possible, this is the best option. Importantly, to be calm and cooperative, the treated gelada needs to be with a companion or should see at least one conspecific in the adjacent rooms.

Geladas are selective and do not really like the taste of antibiotics or other nasty medicines, that can be meticulously removed from the food with skilful fingers. Thus, if possible, it would be better to give food rewards in the morning, before the "breakfast meal", so that the motivation to retrieve food is higher and the aftertaste is less important.

Case report

Gelada Training Program at the San Diego Zoo *(provided by Sandy Distatte)*

The gelada training program at the San Diego Zoo relies solely on positive reinforcement training techniques, is founded on trust, and is mindful and flexible of social hierarchy and groupings. This approach facilitates both their daily care and allows for voluntary wound care, which are all performed through protected contact.

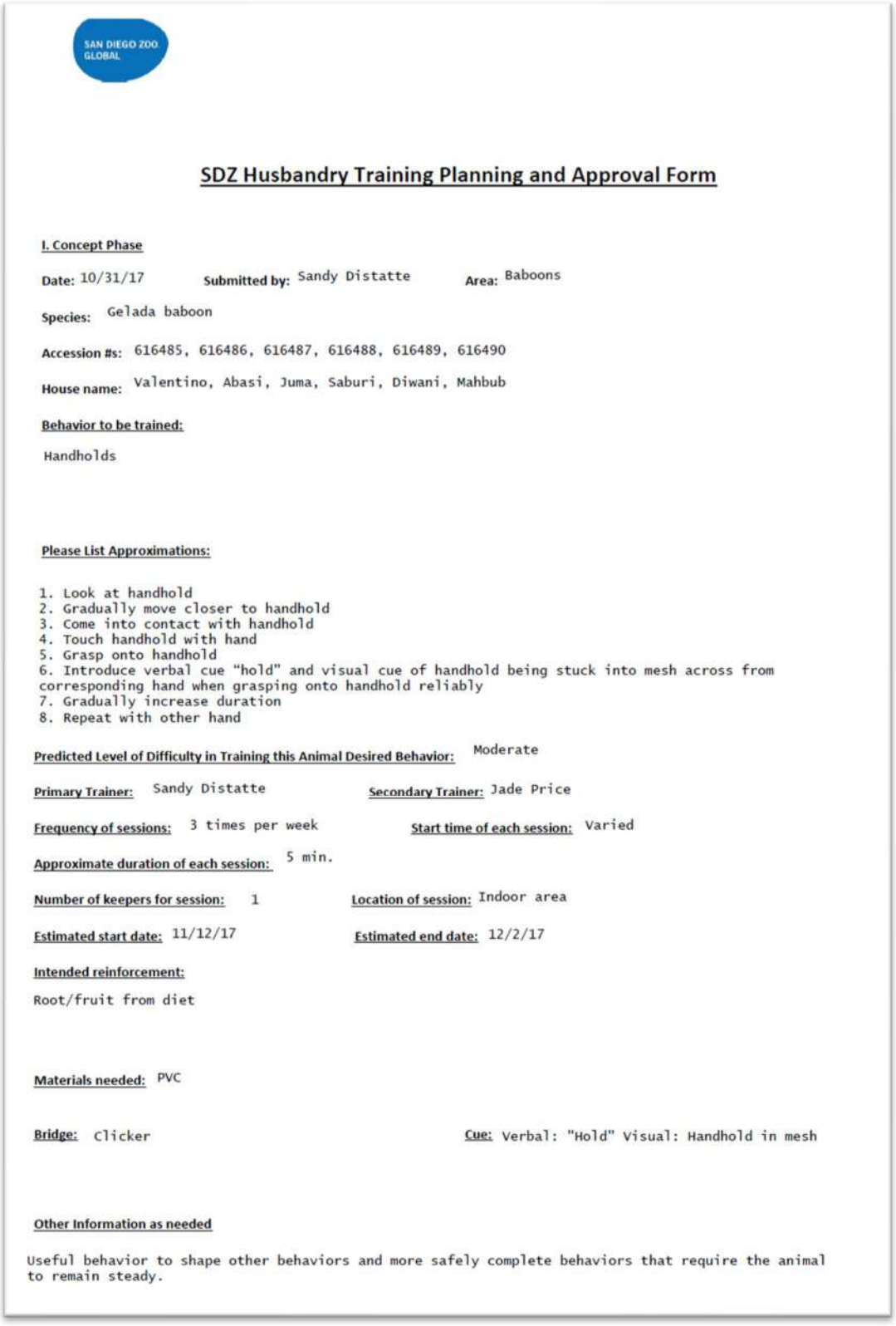
The San Diego Zoo houses an all-male group of geladas (N = 6), which arrived from the Wilhelma Zoo in September of 2016. The geladas were within the age range of four to five years at the time. Immediately upon their arrival, the geladas entered a mandatory CDC quarantine at the San Diego Zoo Safari Park hospital for 43 days, which required any persons entering the area to wear a Tyvek suit and all the other required PPE (mask, gloves, etc.). Throughout the duration of the geladas' quarantine, one of the baboon keepers from the zoo was responsible for their care on most days. It was during this time that we were able to start laying down the foundation to what would eventually become a successful training program. It was clear from the start that the geladas were innately cautious and wary, and that the development of our training program would hinge on patience and the reinforcement of small successes. Our initial goal was to start building a relationship with the geladas by beginning to bank up trust and maintain that trust through continuous replenishment. This trust was formed in part by introducing basic training to the dominant gelada. As his comfort level with the keepers began to increase, the others became less wary of the keepers' presence. Since all of our work with the geladas is through protected contact, it was crucial to introduce a recall cue, a bell, almost immediately. This training was initiated by pairing the sound of the bell, rung softly at first, with the presence of food and has transferred over extremely well from one location to another. However, compliance to this cue is dependent on the geladas' level of trust and various exposures. As their nervousness around shift doors became apparent within the first day, another useful technique we applied was to cue the movement of doors just prior to their opening or closing using the simple cue "door". The geladas caught onto this within a few days of consistent use. Moreover, establishing the general rule to never "race" or attempt to "trap" the geladas has greatly reduced their flightiness around shift doors and led to reliable shifting. Although we were quite limited with what we were able to do with the geladas while in quarantine, the combination of all the above techniques provided us with a solid foundation of trust to build on.

Our training limitations were greatly reduced upon their relocation from the San Diego Zoo Safari Park to a temporary enclosure with no public access at the San Diego Zoo. Our priority became to begin to establish the training basics with the subordinate individuals and quickly thereafter begin crate training. Our goal was to simultaneously and voluntarily crate each gelada individually for their move to the habitat in the all-new Africa Rocks area of the zoo. This goal was quite a challenge to tackle despite the geladas remaining in one cohesive group with a simple hierarchy at the time. To accomplish this goal, it was important that we had a clear understanding of the social dynamics in order to access the subordinate individuals without repercussion. Having multiple trainers would simplify the process, but in the case that multiple trainers were not available, we found that working with the more dominant individuals first and then providing them with some form of enrichment fixed in place was enough to discourage them from disciplining the subordinate individuals following their

training session. The crate training itself was relatively straightforward with certain geladas progressing more quickly and others requiring us to take smaller approximations. Surprisingly, once crate training was established, it carried over to Africa Rocks with very little regression. What ultimately required the most patience and frequent readjustments was figuring out the order in which to crate them as well as the configuration of the crates. We were fortunate in that we had access to a long chute, which included a built-in scale, with multiple areas to secure crates in addition to being able to secure crates to the enclosure itself. This allowed for variations in visual access. Once we discovered a configuration that all of the geladas were comfortable with, our training program began to rapidly evolve as we were able to work with all of them individually more regularly. It is during this time that we began to establish a lot of the body presentation behaviours that would be beneficial in the event of wounding. Additionally, as we felt that the geladas were becoming more confident, we began to encourage changes in their daily routine and exposed them to various elements to build up their resiliency to whatever they may encounter in our care.

Since the geladas moved to Africa Rocks in November of 2017, we continue to progress with their wound care training by expanding on their repertoire of body presentation behaviours and introducing tools for hair manipulation and wound treatment such as spray/squeeze bottles and cotton swabs. We have also built onto their shoulder presentation behaviour to be able to successfully administer voluntary injections. Our biggest challenge since their move to Africa Rocks has been adapting to the numerous changes in the hierarchy as well as the split into two to three groupings, which have varied over time. We initially tried to avoid separating the groups while secured inside, a significantly smaller space, but eventually found it to be too much of a risk. However, we have had no issues with reintroductions of the groups in the habitat after only being separated for the morning maintenance of the habitat and again briefly in the afternoon to reset the habitat. To continue with training, we have dealt with these changes by only retaining the group we wish to work with inside for the duration of the training session. Additionally, we have taken a similar approach to training as we did prior to their move to Africa Rocks by separating individuals and/or having multiple trainers in order to work with dominant individuals while simultaneously working with subordinate individuals. We ensure the more dominant individuals are worked with first and then provide them with some form of enrichment fixed in place to occupy them while we work with the remaining geladas. During periods of social tension and rearrangement, we put a hold on any unnecessary training in order to not inadvertently disrupt the changes.

Fig 66 / 67 Gelada trained to a handhold / San Diego Zoo (photo Sandy Distatte)



SAN DIEGO ZOO GLOBAL

SDZ Husbandry Training Planning and Approval Form

I. Concept Phase

Date: 10/31/17 **Submitted by:** Sandy Distatte **Area:** Baboons

Species: Gelada baboon

Accession #s: 616485, 616486, 616487, 616488, 616489, 616490

House name: Valentino, Abasi, Juma, Saburi, Diwani, Mahbub

Behavior to be trained:

Handholds

Please List Approximations:

1. Look at handhold
2. Gradually move closer to handhold
3. Come into contact with handhold
4. Touch handhold with hand
5. Grasp onto handhold
6. Introduce verbal cue "hold" and visual cue of handhold being stuck into mesh across from corresponding hand when grasping onto handhold reliably
7. Gradually increase duration
8. Repeat with other hand

Predicted Level of Difficulty in Training this Animal Desired Behavior: Moderate

Primary Trainer: Sandy Distatte **Secondary Trainer:** Jade Price

Frequency of sessions: 3 times per week **Start time of each session:** Varied

Approximate duration of each session: 5 min.

Number of keepers for session: 1 **Location of session:** Indoor area

Estimated start date: 11/12/17 **Estimated end date:** 12/2/17

Intended reinforcement:

Root/fruit from diet

Materials needed: PVC

Bridge: Clicker **Cue:** Verbal: "Hold" Visual: Handhold in mesh

Other Information as needed

Useful behavior to shape other behaviors and more safely complete behaviors that require the animal to remain steady.

Fig 68 Example of a training protocol – handhold / San Diego Zoo


Fig 69 / 70 Training for physical inspection / San Diego Zoo (photo Sandy Distatte)

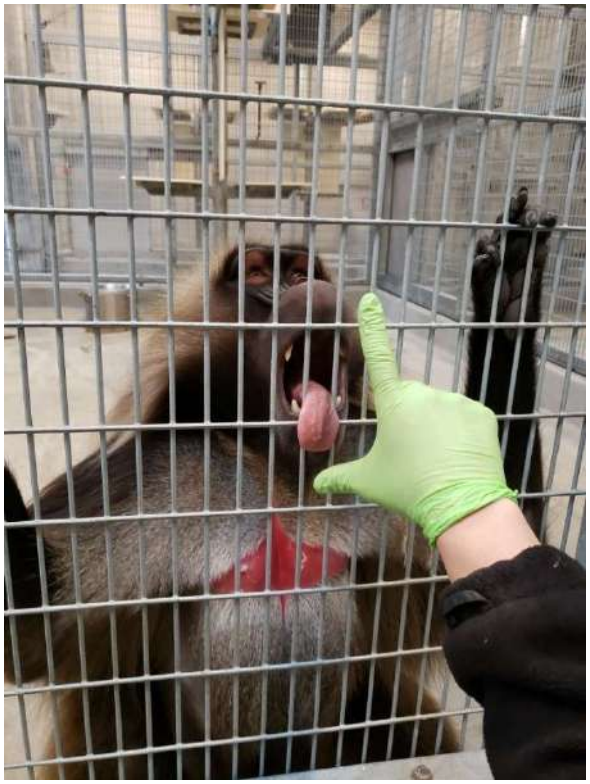
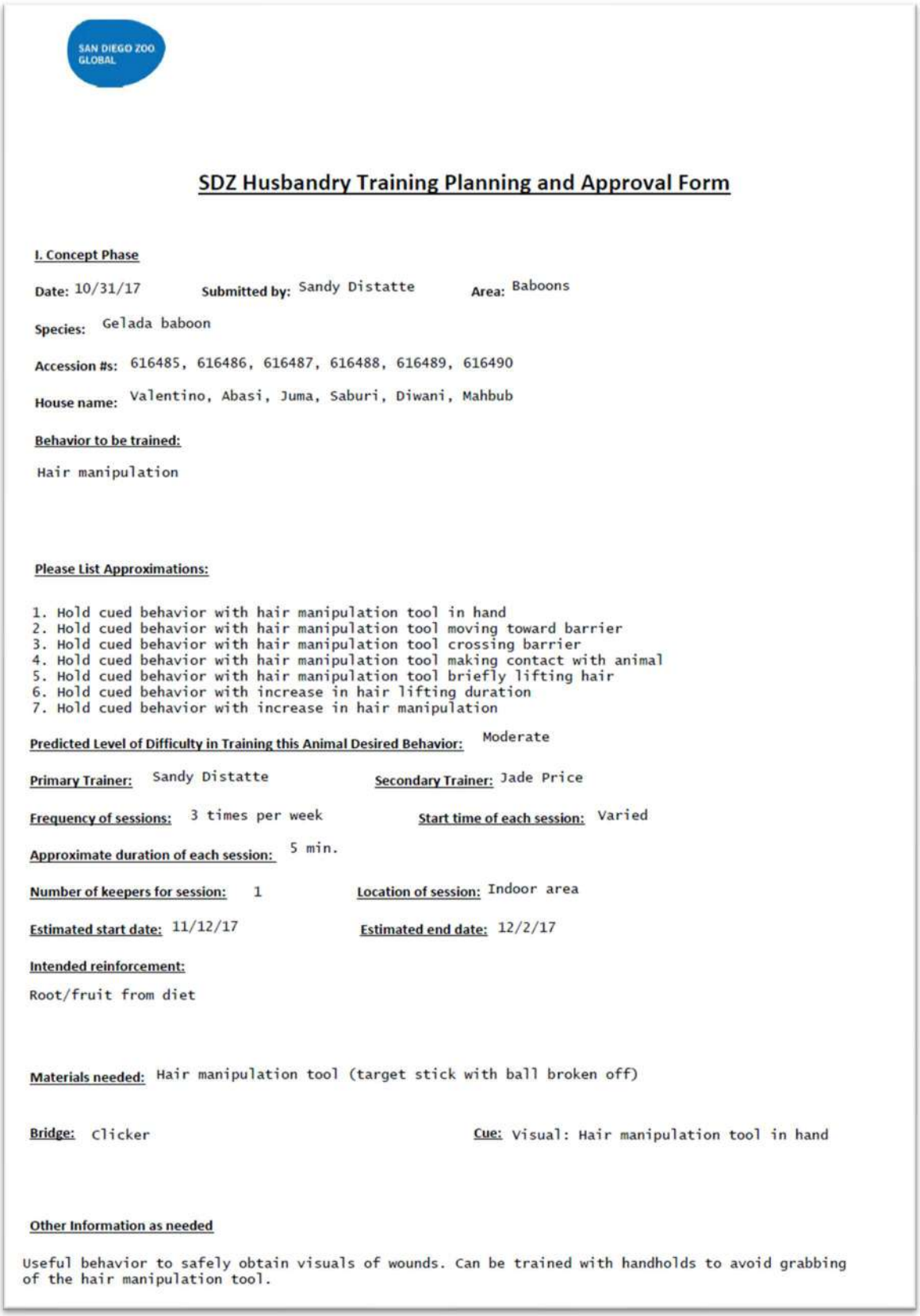



Fig 71 / 72 Training for physical inspection and medical treatment / San Diego Zoo (photo Sandy Distatte)



SAN DIEGO ZOO GLOBAL

SDZ Husbandry Training Planning and Approval Form

I. Concept Phase

Date: 10/31/17 **Submitted by:** Sandy Distatte **Area:** Baboons

Species: Gelada baboon

Accession #s: 616485, 616486, 616487, 616488, 616489, 616490

House name: Valentino, Abasi, Juma, Saburi, Diwani, Mahbub

Behavior to be trained:

Hair manipulation

Please List Approximations:

1. Hold cued behavior with hair manipulation tool in hand
2. Hold cued behavior with hair manipulation tool moving toward barrier
3. Hold cued behavior with hair manipulation tool crossing barrier
4. Hold cued behavior with hair manipulation tool making contact with animal
5. Hold cued behavior with hair manipulation tool briefly lifting hair
6. Hold cued behavior with increase in hair lifting duration
7. Hold cued behavior with increase in hair manipulation

Predicted Level of Difficulty in Training this Animal Desired Behavior: Moderate

Primary Trainer: Sandy Distatte **Secondary Trainer:** Jade Price

Frequency of sessions: 3 times per week **Start time of each session:** Varied

Approximate duration of each session: 5 min.

Number of keepers for session: 1 **Location of session:** Indoor area

Estimated start date: 11/12/17 **Estimated end date:** 12/2/17

Intended reinforcement:

Root/fruit from diet

Materials needed: Hair manipulation tool (target stick with ball broken off)

Bridge: Clicker **Cue:** Visual: Hair manipulation tool in hand

Other Information as needed

Useful behavior to safely obtain visuals of wounds. Can be trained with handholds to avoid grabbing of the hair manipulation tool.

Fig 73 Example of a training protocol – physical inspection; hair manipulation / San Diego Zoo

It is important to remember that every interaction between an animal and a human is a training experience.

When applying specific training one should consider potential conflicts with other husbandry practices because of the implied closer contact and more intense 'relationship' to a human (keeper, trainer). For example, it is general practice in some zoos to enter enclosures in the presence of the geladas for routine work (cleaning, feeding). When doing so it is recommended not to interact with the animals (acting neutral, not attracting with food etc.). Experience showed that animals with previous specific training experience are less reserved towards humans and behave less distant.

As shown training can be an important tool in the care of geladas. Goals for training geladas may be specific for the individual institution, therefore, every holder must decide individually on needs for specific training and the applied methods depending on the local situation (routine working practice, constellation of the gelada group, facilities, staff capacities etc.)

O. Handling

1. Individual Identification

Individual identification of animals is essential to ensure correctness of data in the studbook and any other files as well for permission processes (CITES permits, health certificates). Also, for observation of the animals and internal communication (reporting among keepers, to curator, veterinarian, registrar) there is need for identifying individuals in an appropriate way.

Geladas lack easily recognizable natural features. This makes individual identification very difficult and even impossible especially when geladas are kept in larger groups (see further down). Therefore, artificial tools must be applied to facilitate observation, data collection and ensuring correctness and completeness of these data widely.

For individual identification, a combination of transponders and tattoos is recommended.

Transponders should be placed between the shoulders, however, there are significant cases of losses of transponders when checking at a later date. It must be assumed that geladas are effective in removing the transponders when these are located near the surface of the skin.

Tattoos – numbers, letters or signs - can be positioned on the inner thighs where the hair is sparse and the skin is pale. Although not easily, these tattoos may also be seen when animals are sitting with splayed legs. These tattoos will mainly work as back-up identification when transponders are lost.

Tattoos (dots) may also be positioned in the pale upper eyelids (eyebrows). However, this will allow only a limited number of different identifications. Tattoos are not easily seen when on the dark facial skin and therefore this is not appropriate for identification.

Tattooing of the bare skin of the breast / chest was attempted once but failed as the high blood supply to area caused the ink to split and considerable bleeding. There is currently another such trial in progress; the results and experience of which will be communicated in due course.

Identification of individuals from a distance based on features and physiognomy is working reliably only with smaller groups, especially as immature animals often lack ‘identifying features’ and are also more flexible in relationships (so that behaviour cannot be used to conclude ‘who is who’).

Sheep ear tags of different shapes and colours have been used on geladas in CERZA, Lisieux. If the geladas accept them, such tags are a tool to identify individuals in a large breeding group, however, if used on individuals that are too young, which are very playful, the tag can be lost or torn out. Also, a tag can easily entangle in the net during capture. Because of the size of the tag, they cannot be fixed on very young and still small individuals.

Shaving hair at defined parts of the tail can be helpful for short-term identification.

Fig 74 / 75 / 76 Use of ear tags for individual identification / CERZA, Lisieux

2. Catching / Restraining

Whenever there is a need to do so, adult male geladas must be handled only when immobilised. Immobilisation can be achieved after separation of a male in a compartment cage (see chapter N.2 Training). This might then be accomplished also without further restraint (squeeze cage). Alternatively, injection from a distance with a blowpipe can be applied.

Adult females and males up to the size of an adult female can be caught with a net or a scoop after having been separated from the group. If needed, a sedation / immobilisation can be administered by injection while the animal is in the net.

When separated and shifted into a compartment the animal can be immobilised there as described for adult males.

Fig 78 It is possible to treat geladas by injection when separated in such compartments

3. Transportation

Geladas should generally be transported singly. Exceptions are females with suckling youngsters and newly weaned juveniles which must not be separated from their mothers. If moving 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 of a crate.

For construction and layout of a transport crate 'Container Requirement 33 and 34' as described in the IATA Live Animal Regulations can be used as a guideline.

Specific details for crates might be required according to standards in individual countries or as expressed by responsible authorities.

4. Safety

Geladas` character is generally wary and peaceful. They are always suspicious towards changes and can be described as ‘conservative’. At least, they normally show no general aggressive behaviour towards humans and obviously see no ’competitor’ or ‘rival’ in a zookeeper. Of course, in a state of forced proximity, adult male geladas must be regarded as dangerous animals when defending themselves. Their strong and sharp canine teeth are especially powerful weapons.

Note that hand-reared geladas (especially males) and (very few) single individuals must be regarded as dangerous when coming in direct contact with them. This is based on these animals` imprinting and therefore demonstrating rival-attitudes towards humans.

It is often common practice that keepers enter the large outside enclosures for geladas for cleaning and feeding as part of the routine work. Geladas may even ignore the presence of the humans. Requirements for this are: Spacious enclosure (so that the geladas always feel safe by retreating), no enhanced contact between keepers and geladas (for example, no individual feeding, no attracting animals). Care must be taken with geladas which might have a ‘closer connection’ to individual humans because of training experience and hand-reared geladas.

Entering enclosures of adult geladas in confined spaces (for example indoor rooms) must not be done except for catching or restraining individual females or immature males.

Escaped single geladas most likely stay around the enclosure and can be chased back.

It is not expected that escaped geladas will attack people. More so, they will be ‘happy to be back’ in their enclosure and with their group.

So far, there is no reported case of a group of geladas escaping.

P. Veterinary

By Andreas Pauly, veterinarian Tierpark Berlin (veterinary advisor Gelada baboon EEP)

1. Anaesthesia

Gelada baboons can be completely immobilised with 1.0 mg/kg BW xylazine combined with 10.0 mg/kg BW ketamine i.m. or with 0.05 – 0.1 mg/kg BW medetomidine combined with 10 mg/kg BW ketamine i.m. If alpha 2 agonists (xylazine or medetomidine) are used one can decrease the dosage of ketamine and only use 6 mg/kg of ketamine

The effect of xylazine and medetomidine can be antagonised with atipamezole i.v., i.m. or s.c. The immobilisation can be prolonged using isoflurane.

2. Blood collection

Blood samples can be easily collected from the saphenous vein. This vein is directly located under the skin in the middle of the calf. References of blood values are listed in the species 360 database (https://zims.species360.org).

3. Traumatic diseases

The most common disease seen in geladas are skin and muscle wounds due to bites as result of intraspecific conflicts. Deep muscle wounds or wounds of the face should be sutured after cleaning and irrigation, as long they are fresh (not older than 6 hours). All other skin and muscle wounds usually heal without any therapy. Infected wounds should be covered with a systemic antibiotic therapy.

4. Infectious diseases

4.1 Bacteria

As with all other primates, Gelada baboons can suffer from diarrhoea caused by pathogenic bacteria. If a gelada shows clinical symptoms of an intestinal disease, stool samples should be tested especially for *Shigella*, *Camyplobacter*, *Yersinia*, *Salmonella* and endoparasites (s. parasites). These examinations should however be done before any transfer to another institution. Enteritis caused by pathogen bacteria should be treated with antibiotics according to an antibiogram.

Gelada baboons are susceptible to tuberculosis, therefore, intradermal TB test with mammalian old tuberculin (MOT) should be done before any transfer between two institutions.

4.2 Parasites

The most common endoparasites found in Gelada baboons in zoological institutions are nematodes of the genus *Trichuris*. Treatment with a benzimidazole or an avermectine is effective. Please note that a 'low sugar-high fibre' diet can enormously reduce the amount of *Trichuris* in the gut, so that an antiparasitic treatment is not necessary in any case.

In the natural habitat of the Gelada baboon infections with the tapeworm *Taenia serialis* are widespread. The final hosts of this tapeworm species are carnivores such as the Ethiopian wolf (*Canis simensis*) and the African wolf (*Canis anthus*). These wolves are distributing the eggs of the tapeworm with their faeces. Because the gelada baboons feed primarily on grasses, there is a high chance of an intake of tapeworm eggs with the food. Once arrived in the gut of a Gelada baboon the

larvae hatch and are distributed by the bloodstream in different organs. There, the larvae grow to large tapeworm cysts called *Coenurus serialis*. Depending on the affected organ the gelada will die sooner or later, because the cysts lead to a cell atrophy and organ failure. In the population at Gussa (Ethiopia) approximately 17 % of the Gelada baboons are affected by tapeworm cysts (Nguyen et al. 2015). Even though *Taenia serialis* currently plays no role in zoological institutions in Europe and the USA, there were many cases of a cysticercosis in other primate species in European zoos in the last years caused by the tapeworm species *Taenia crassiceps*. The very common red fox (*Vulpes vulpes*) and other European carnivore species are distributing the tapeworm eggs with their faeces. If you see any tumescence in a Gelada baboon kept in a zoological institution, please think of the possibility of a cysticercosis caused by *Taenia crassiceps*. A surgery with radical removal of the cystic structures only makes sense if you find cysts under the skin or in the muscles. It is very difficult to remove cysts completely from the inner organs. In these cases, euthanasia of the animal is probably unavoidable.

5. Vaccination

The use of vaccines is not generally recommended in Gelada baboons. It depends on the pathogens in each institution. If you often see cases of tetanus as result of infected wounds in your collection, a vaccination of your Gelada baboon stock against tetanus can be useful to prevent further cases. Then, the animals should be inoculated with a tetanus toxoid vaccine every 5 to 10 years.

6. Other remarkable diseases

Gelada baboons can suffer from epileptic seizures due to electrolyte imbalances (hyponatremia, hypochloremia, hypocalcemia). Some cases occurred in old males and some perinatal in females. It is strongly recommended to substitute the food with sodium chloride and calcium to prevent such seizures. In acute cases the treatment with 1.0 mg/ kg BW Diazepam i.v. or i.m. and an intravenous infusion with calcium is very helpful.

7. Zoonosis

Zoonotic pathogens can be transmitted between Gelada baboons and humans as in all other Cercopithecidae monkeys. Examples for zoonosis are: *Giardia*, *Entamoeba histolytica*, *Trichuris trichuria*, influenza A, hepatitis A and B, tuberculosis, *Yersinia*, *Shigella*, *Salmonella*, zoonotic *Escherichia coli* strains and *Campylobacter*. There is still no evidence, that humans can transmit SARS-Cov2 to geladas and vice versa, but it is very likely, therefore, an effective hygiene concept is recommended. This should include the wearing of latex gloves during preparation of food and cleaning the enclosures and the wearing of face masks, if there is a close contact to geladas, e.g., during training sessions.

For further information on zoonosis in old world monkeys, please have a look at the transmissible diseases handbook of EAZWV (www.eazwv.org).

Q. Research

As mentioned in "Section 2 Management in Zoos – The state of the population (From Long-Term Management Plan LTMP 2019)" one role of the Gelada baboon EEP population is "…to allow studies and development of methods that can get applied or transferred to the wild population and training of researchers.".

Indeed, over the past three decades the geladas kept in zoos have contributed significantly to the knowledge of the biology and especially the behaviour of this species. In recent years methods and knowledge gained from studies on geladas in zoos have been applied for those in the natural range of geladas.

The table lists exemplary scientific publications and theses based on studies of geladas in zoos (EEP):

Table 6

Palagi, E., Leone, A., Demuru, E. *et al.* High-Ranking Geladas Protect and Comfort Others After Conflicts. *Sci Rep* 8**,** 15291 (2018). https://doi.org/10.1038/s41598-018-33548-y
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Mau, Marcus & Fashing, Peter & Sliwa, Alexander & Jorge, Joao & Kaiser, Thomas & Südekum, Karl-Heinz. (2010). Salivary proteins and their role in primates feeding ecology.
Palagi, Elisabetta & Leone, Alessia & Mancini, G & Ferrari, Pier. (2009). Contagious yawning in gelada baboons as a possible expression of empathy. Proceedings of the National Academy of Sciences of the United States of America. 106. 19262-7. 10.1073/pnas.0910891106.
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Denise Schmid	Untersuchungen zum Trichuris-Befall bei Dscheladas und Japanmakaken in der Wilhelma	2018	Bachelorarbeit
Marion Fuhrmann	Play behaviour in immature Gelada baboons (Theropithecus gelada) - The significance of age, sex and kin	2009	Masterarbeit

Other studies of geladas in the natural habitat were supported or made feasible by financial or staff contribution of individual zoos (EEP participants)

Table 7

Nguyen, Nga & Lee, Laura & Fashing, Peter & Nurmi, Niina & Stewart, Kathrine & Turner, Taylor & Barry, Tyler & Callingham, Kadie & Goodale, Charles & Kellogg, Bryce & Burke, Ryan & Bechtold, Emily & Claase, Megan & Eriksen, G. & Jones, Sorrel & Kerby, Jeffrey & Kraus, Jacob & Miller, Carrie & Trew, Thomas & Venkataraman, Vivek. (2017). Comparative primate obstetrics: Observations of 15 diurnal births in wild gelada monkeys (Theropithecus gelada) and their implications for understanding human and nonhuman primate birth evolution. American Journal of Physical Anthropology. 163. 10.1002/ajpa.23141.
Nguyen, Nga & Fashing, Peter & Boyd, Derek & Barry, Tyler & Burke, Ryan & Goodale, Charles & Jones, Sorrel & Kerby, Jeffrey & Kellogg, Bryce & Lee, Laura & Miller, Carrie & Nurmi, Niina & Ramsay, Malcolm & Reynolds, Jason & Stewart, Kathrine & Turner, Taylor & Venkataraman, Vivek & Knauf, Yvonne & Roos, Christian & Knauf, Sascha. (2015). Fitness Impacts of Tapeworm Parasitism on Wild Gelada Monkeys at Guassa, Ethiopia. American Journal of Primatology. 77. n/a-n/a. 10.1002/ajp.22379.
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The Gelada baboon EEP supports and initiates studies on geladas in the zoos as in the natural habitat to enhance knowledge of the species and in doing so to contribute to the conservation of this unique primate taxon.

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