Husbandry Guidelines
for

Hamadryas Baboon

Papio hamadryas

(Mammalia: Cercopithecidae)

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Date of Preparation: February 2009
Western Sydney Institute of TAFE, Richmond
Course Name and Number: Certificate III in Captive Animals, RUV30204
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DISCLAIMER

These husbandry guidelines were produced by the compiler/author at TAFE NSW – Western Sydney Institute, Richmond College, N.S.W. Australia as part assessment for completion of Certificate III in Captive Animals, Course number 1068. Since the husbandry guidelines are the result of student project work, care should be taken in the interpretation of information therein, - in effect, all care taken but no responsibility is assumed for any loss or damage that may result from the use of these guidelines. It is offered to the ASZK Husbandry Manuals Register for the benefit of animal welfare and care. Husbandry guidelines are utility documents and are 'works in progress', so enhancements to these guidelines are invited.

OCCUPATIONAL HEALTH AND SAFETY RISKS

Caution should always be taken when working with Hamadryas Baboons, *Papio hamadryas.* They are generally not aggressive animals and usually not harmful to humans unless provoked, and as a species they could be regarded as a hazardous animal. This is not to say that caution should not be taken when working with this species, as they possess incredibly sharp teeth, are surprisingly fast, are remarkably strong and will attack you if provoked. Using this description *P. hamdryas* could be classed as a relatively dangerous animal as it could be likely to cause serious injury and even death. It is possible that individuals may be regarded as dangerous or relatively dangerous, but this will need to be determined for each particular animal. All keepers must always consider each animal's full potential, i.e. an animal's strength must never be underestimated.

Keepers should also be aware of zoonoses (refer to chapter 8.4 and 8.5) such as Herpes B virus, endo and ecto-parasites, Hepatitis A and B, Tuberculosis, Measles etc and take reasonable precautions to prevent these.

As some species can inflict serious injuries, all primate handling must be done by experienced trained personnel. Animal care staff must be aware of the potential for injuries and ways to prevent them

It is the employer's responsibility to ensure that all staff, prior to being exposed to nonhuman primates, have had an appropriate course of immunisation and a pre-employment medical assessment. Continued and regular testing should be undertaken.

It is strongly recommended that all personnel in direct contact with primates have a Mantoux skin test to determine prior exposure to tuberculosis and a pre-employment chest x-ray to detect the possible presence of tuberculosis. This chest x-ray should be repeated if the person develops respiratory problems.

There must be a written protocol for dealing with bite and scratch wounds from *P.hamadryas*, including arrangements with the local hospital.

Enclosures should have clear signs outlining the risk of handling and/or coming into contact with this species so all keepers and staff members understand the risks involved and safety measures needed. Appropriate Personal Protective Equipment (PPE) should be used when handling this species. When working with Hamadryas Baboons, various hazards exist and these must be reduced or eliminated wherever possible. There are six groups hazards may fall under: physical; chemical; biological; ergonomical; psychological; and radiation.

Many hazards will depend on the design and access of the enclosure, however there are general hazards that will exist for all Hamadryas Baboon's kept in a captive institution. These hazards as well as actions to reduce them are summarised in Table 1.

Table 1: Occupational health and safety risks related to carrying out husbandry needs for the Hamadryas Baboon *Papio hamadryas* and actions to reduce these risks

Risk Categories	Type of Risks	Actions to Reduce Risks
Physical	Sharp teeth and strong jaws – may tear your skin or a limb off; Enormous body strength – can grab you and may cause lacerations by bites or scratches	• Minimise the handling of baboons or not going near the baboons when cleaning the enclosure and letting them naturally get away from where you are cleaning. • Close them off to an area where you are so they can't get access to you. • Know the behaviour of the species and also of the individual animal. • Make sure people are trained in the correct handling techniques and also that that have the correct PPE on of long pants, long shirt, closed in shoes, minimal jewellery and hair tied back. • Treat and report bites and scratches.
Physical	If the enclosure mesh cage is to have sharp edges or bits sticking out, it could seriously hurt you and cut you	• Regular maintenance of cage mesh • Report anything that can't be immediately fixed to your supervisor.
Physical	Can injure or strain yourself by if carrying a baboon under general anaesthetic or by carrying food for feeding out to the baboons	• Getting someone else to help you with any heavy lifting • Using aids such as a wheeled hydraulic trolley/table, wheelbarrows or doing small parts at a time. • Using the correct lifting technique.
Physical	Dehydration - you could become hot from the elements of the environment while cleaning and maintaining the baboons enclosure	• This can be avoided by taking a break and having a drink of water if it becomes too hot. So drink plenty of water and keep your fluids up.
Chemical	Exposure to all chemicals used in cleaning - hospital grade disinfectant; medicines used for treatments – antibiotics, analgesics,	• Wear appropriate PPE – gloves, face mask, scrub top; • Use correct dilution; • Make sure you wash your hands thoroughly after handling the chemicals

	S8 drugs; agents used in maintaining equipment/machinery - WD40. Can irritate your skin or damage your eyes if gets in contact with your eyes.	and also make sure all of the chemicals are wiped off properly if using them in the enclosure; • Ensure labels easily visible and present on all chemicals/ medications; • Always read instructions and have MSDS sheets available.
Biological	Contracting zoonoses from the baboon by either bites, touch or through urine or faeces e.g. Herpes B virus, endo and ecto-parasites, Hepatitis A and B, Tuberculosis, Measles	• Wearing PPE such as gloves, a face mask, closed in shoes and a scrub top if handling any baboon or cleaning its cage and also making sure you wash your hands thoroughly after handling the baboon or any urine and faeces. • Staff being appropriately vaccinated and also baboons being vaccinated. • Regular health checks of baboons. • Clean any wounds obtained from a baboon thoroughly. Also if an animal has a zoonotic disease, then veterinary treatment should be carried out and the animal also should be isolated from others, so it does not pass the infection onto other animals.
Ergonomical	Injure yourself by twisting and turning while maintaining the enclosure	• Having the right posture when maintaining the enclosure and doing things slowly. • The design of the enclosure to not only suit the animal's needs but also to be keeper friendly in that most things that are to be cleaned are near the door.
Psychological	Administering medicines for sick or injured individuals, as well as the possibility of having to euthanase a baboon in your care. A baboon being found dead in daily checking of a colony	• Experienced personnel should carry out euthanasia; • Experienced staff to administer medicines; • Training of employees.
Radiation	Exposure to ultraviolet radiation from the sun;	• Wear protective clothing – long sleeves, hat and wear sunscreen.

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1 Introduction

Hamadryas Baboons *Papio hamdryas* have a very interesting background into their history. One of the common names 'Sacred Baboon' is derived from the fact that the Egyptians believed the Hamadryas Baboon is the incarnation of Thoth, the ancient Egyptian God of scribes and scholars. Thoth (Djhuty, Djehuty, Tehuty) was the wisest of the Egyptian Gods, the baboon and ibis god of the moon. There are a number of photographs about this topic as and it is very interesting about how the Hamadryas Baboon came to be known as the 'Sacred baboon.' (Tour Egypt 2010)

Fig 1: Hamadryas Baboons being used in the Ancient Egyptian times (Tour Egypt, 2010)

The very word 'baboon' may be derived from ancient Egypt, perhaps from a linguistic root that characterised its sexual activities. (Tour Egypt 2010)

In the Late Period in Egypt (664 – 332 BC), buried in the cemeteries were various such animals including Hamadryas or the Sacred baboon (*Papio hamadryas*). (Tour Egypt 2010)

From this time we probably do not completely comprehend the significance of monkeys and baboons in Egyptian religious symbolism, but there is no doubt that they were kept as ritual animals since the earliest periods of Egyptian history. The fact that baboons displayed human characteristics may have contributed to the early identification of the deceased ruler with the animal. It is even possible that mummified baboons were used to represent the deceased royal ancestors of the Predynastic (5,500 - 3,100 BC) chief of a tribe. (Tour Egypt 2010)

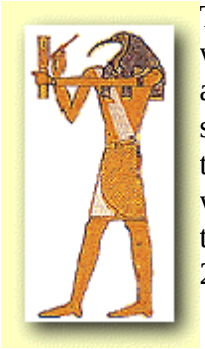

Fig 2: Thoth (Tour Egypt, 2010)

Thoth was usually depicted as an ibis headed man or as a full ibis, or with the face of a dog-headed baboon and the body of a man or, again, as a full dog-headed baboon. The ibis, it is thought, had a crescent shaped beak, linking the bird to the moon. The dog-headed baboon, on the other hand, was a night animal that was seen by the Egyptians who would greet the sun with chattering noises each morning just as Thoth, the moon god, would greet Ra, the sun god, as he rose. (Zoom Info 2010)

Thoth appears in the Book of the Dead Papyri, recording the weighing of the heart, the test by which the deceased was judged worthy of entry into the afterlife. Egyptian ships carried hundreds of live Hamadryas Baboons from their southern homelands in Ethiopia and the Sudan to the temples on the Nile. They are heavily depicted in the Egyptian hieroglyphics and large stone sculptures have been found at Hermopolis magna, Thoth's main cult centre. (BBC 2010)

Monkeys were also readily used as decorative elements on three dimensional objects, such as toilet articles and toys. They also appear on scarabs and as statuettes. (Tour Egypt 2010)

Fig 3: A large stone baboon sculpture (Tour Egypt, 2010)

Hence, from the beginning of Egyptian history through at least the beginning of the Christian period, baboons held a very consistent and important role in ancient Egyptian religion, in many different aspects, from demon to protector. They became associated with a number of the most important Egyptian gods, as well as the king, even though through most of the period, they would have had to be imported from abroad. (Tour Egypt 2010)

From their history until now, Hamadryas Baboons *Papio hamadryas* have been highly researched, from being used in biomedical research to beahvioural and conservation research. Two names that have done extensive research on this species in the wild are Dr. Hans Kummer and also Larissa Swedell Ph.D. Columbia University 2000. (Baboons Online 2010)

1.1 ASMP Category

The ASMP Status for the Hamadryas Baboon *Papio hamadryas* is:

- Population Management Program; Management Level 1a which means:

This category comprises species which are not contributing directly to conservation, but which require regional coordination for other reasons. Most species held in ARAZPA zoos are there primarily for the purpose of educational display. Population management can improve the ability of the captive population to sustain itself, thereby reducing the number of animals that need to be collected from the wild or imported over the period of the program. (ASMP Census and Plan 2009)

The categories are designed to indicate at a glance the role or status of a taxon in the regional collection, whether or not regionally coordinated management is being applied, and if so at what intensity.

The Management Level is 1a which means:
High Intensity Management
Characteristics:

- high intensity genetic and demographic management aimed at maximising gene diversity, minimising inbreeding and controlling reproductive rate
- population is managed by a species coordinator
- a SPARKS studbook is required
- regular reproductive pairing and specimen transfer recommendations are circulated
- institutions are required to commit to the program and to follow species coordinator recommendations.

(ARAZPA 2010) (ASMP Census and Plan 2009)

Suitable for:

Species for which specimen-level management is possible and practical, and for which genetic targets are important, e.g. taxa which are:

- conservation program species requiring close genetic and demographic management or
- listed in an IUCN category of threat or on CITES Appendix I or
- difficult/expensive to acquire or
- in need of this level of regional management/coordination for any other reason agreed by the TAG (e.g. research).

(Hamadryas Baboon Annual Report and Recommendations 2009)

1.2 IUCN Category

The IUCN status for the Hamadryas Baboon *Papio hamadryas* is LC or LR/lc which is Least Concern which means there are many in the wild. This is because this species is widespread and abundant, and there are no major range-wide threats believed to be resulting in a significant decline. This was last assessed in 2008. (IUCN Redlist 2010)

1.3 EA Category

Interstate Permits

- Department of Primary Industries form and paperwork
- Ethics committee paperwork
- ARAZPA permission if coming to and from an ARAZPA member place
- AQIS to get approval to move the animal. The animal may have to be quarantined before being transported
- Must complete a Shipper's Certification for Live animals for each shipment. Two copies of the certification form must be completed and signed. One copy will be retained by the carrier which accepts the shipment from the shipper and the other signed copy will be sent with the shipment and attached to documents for the final destination.

Regional Permits

- Department of Primary Industries form and paperwork
- Ethics committee paperwork

Local Permits

- Department of Primary Industries form and paperwork
- Ethics committee paperwork

Please see **section 7** for transport requirements.

Please see **APPENDIX 1** of import and export information and an application for a permit paperwork.

(ARAZPA Guidelines on Animal Transport 2005) (Zoo Imports and Exports pdf file)
(International Air Transport Association IATA 2000)

1.4 NZ and PNG Categories and Legislation

The paper work and permits involved in transporting Baboons is speaking with the following organisations or following their standards:

International

- ARAZPA permission if coming to and from an ARAZPA member place. (ARAZPA Guidelines on Animal Transport 2005)
- AQIS to get approval to move the animal. The animal may have to be quarantined before being transported (Animal Health 2008)
- Must complete a Shipper's Certification for Live animals for each shipment. Twocopies of the certification form must be completed and signed. One copy will be retained by the carrier which accepts the shipment from the shipper and the other signed copy will be sent with the shipment and attached to documents for the final destination. (International Air Transport Association 2000)
- CITES document of either an export permit, import permit, re-export certificate, certificate of origin, certificate of captive breeding (ARAZPA Guidelines on Animal Transport 2005)

1.5 Wild Population Management

Population Management Program; Management Level 1a. (ASMP Census and Plan 2009)

Their principal predators are man, the lion, both the spotted and striped hyenas and the leopard for babies, although they are tough prey for a leopard and large males will often confront them by flashing their eyelids, showing their teeth by yawning, making gestures, and chasing after the intruder/predator. (Answers 2010)

1.6 Species Coordinator

ARAZPA – Claire Ford
AZA – Joe Knobbe, St Louis Zoo

(ASMP Census and Plan 2009)

1.7 Studbook Holder

AZA (Association of Zoo and Aquariums) Studbook Keeper: Jodi Wiley, ASHEBORO, jodi.wiley@nczoo.org Data current to: 30/06/1996. (ASMP Census and Plan 2009)

2 Taxonomy

2.1 Nomenclature

Class - Mammalia
Order - Primates
Family – Cercopithecidae
Genus - *Papio*
Species - *hamadryas*

Papio is the Latin genus name for baboon (Free Dictionary 2010). The word "baboon" comes from "babouin," the name given to them by the French naturalist Buffon. (New World Encyclopedia 2010). Some consider the word baboon to have been derived from the name of the Egyptian baboon-god Babi. The word *hamadryas* means 'the sacred baboon of Egypt (Cynocephalus Hamadryas)'. (Encylopedia2 2010)

Fig 4 below shows that the Hamadryas baboon *Papio hamadryas* is a member of the Old World Monkey division known as the Catarrhini (nostrils facing downwards). Included in this group are the other subspecies of baboons, as well as the many species of Macaques, Guenons and Vervet monkeys mainly found in Asia and Africa. The main feature that distinguishes them from New World Monkeys (found in Central and South America) is the lack of a prehensile tail (tail not used as a fifth limb when climbing). (Heffernan, S., 2006)

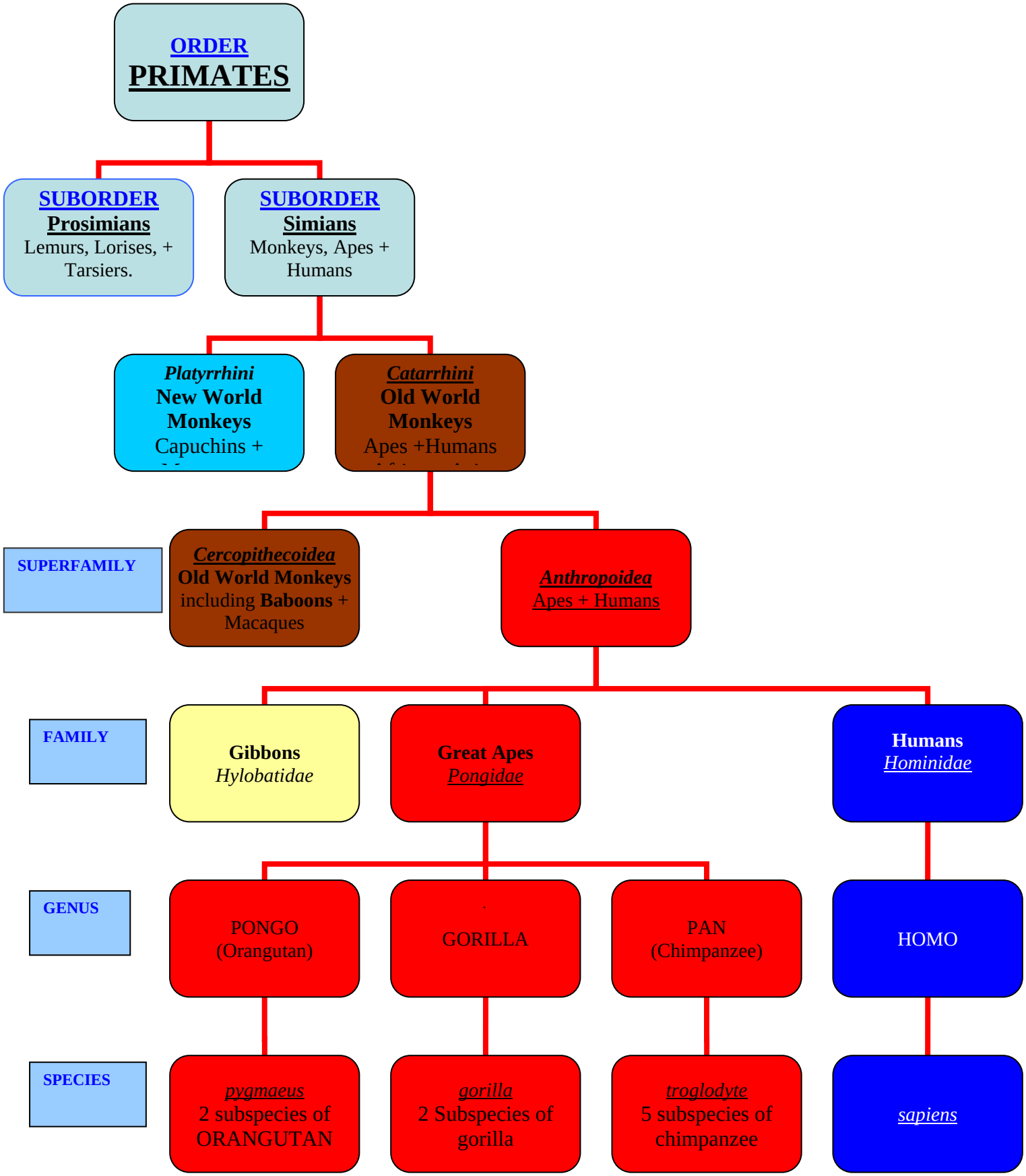

Fig 4: Classification of Primates. As you can see baboons fall into the box coloured brown (Heffernan, S. 2006)

2.2 Subspecies

Five species of *Papio* are commonly recognised, although there is some disagreement about whether they are really full species or subspecies. They are:

- *Papio hamadryas* (Hamadryas Baboon, found in the Horn of Africa and south-western Arabia),
- *Papio ursinus* (Chacma Baboon, found in southern Africa),
- *Papio papio* (Western, Red, or Guinea Baboon, found in the far western Africa),
- *Papio anubis* (Olive Baboon, found in the north-central African savannah), and
- *Papio cynocephalus* (Yellow Baboon, found in south-central and eastern Africa).

(Wikipedia 2010) (New World Encyclopedia website)

However, there is some disagreement about whether these five groupings are really full species or subspecies. Some consider baboons to be a single species, which is designated *Papio hamadryas* (Comuzzie et al. 2003). In this taxonomic scenario, there are five subspecies: *Papio hamadryas hamadyas* (Hamadrayas Baboons), *Papio hamadryas cynocephalus* (Yellow Baboons), *Papio hamadryas ursinus* (Chacma Baboons), *Papio hamadryas papio* (Red Baboons or Guinea Baboons), and *Papio hamadryas anubis* (Olive Baboons). (Answers website)

Many authors distinguish *Papio hamadryas* as a full species, but regard all the others as subspecies of *Papio cynocephalus* and refer to them collectively as "savannah baboons." However, while behaviourally and physically distinct from other baboon types, the Hamadryas baboon is known to hybridise with Olive Baboons, and recent evolutionary tree studies of *Papio* show Hamadryas baboons to be more closely related to Guinea and Olive Baboons than to Chacmas (Newman et al. 2004).

The traditional 5-form classification probably mis-represents the variation within *Papio.* Some commentators (Jolly 1993) would argue that at least two more forms should be recognised, including the very small Kinda Baboon (*P. kindae*) from Zambia, the Democratic Republic of Congo, and Angola, and the Gray-footed Baboon (*P. griseipes*) found in Zambia, Botswana, Zimbabwe, Mozambique, and northern South Africa. However, current knowledge of the morphological, genetic, and behavioural diversity within *Papio* is too poor to make any definitive, comprehensive judgments on baboon taxonomy. (Allaby, M. 1999)

2.3 Recent Synonyms

As mentioned above in 2.2, because of the taxonomic discussion into the classification of the Hamadryas Baboon *Papio hamadryas* they can also be referred to as *Papio hamadryas hamadryas.* This is because the other baboon species are thought of as being sub-species of Hamadryas Baboons. In 1758 Hamadryas Baboons were classified by Linnaeus as *Papio hamadryas.* (Groves, C. 2001)

2.4 Other Common Names

Sacred Baboon (Kummer, H. 1968)
Mantled Baboon (Groves, C. 2001)
Arabian Baboon (Britannica 2010)

3 Natural History

Fig 5: Showing the ischial callosities of Hamadryas Baboons (dsphotographic.com, 2010)

The *Papio* genus have:

- Large heads
- Cheek pouches,
- A long, doglike muzzle
- Rough spots on their protruding buttocks, called ischial callosities. These calluses are nerveless, hairless pads of skin that provide for the sitting comfort of the baboon.
- They walk on all fours, carrying the tail in a characteristic arch.
- They are diurnal which means they are active during the day and are mostly terrestrial which means they spend most of their time on the ground.
- They are found mainly in drier savannah and rocky areas, and they feed on a variety of plants and animals.
- They are highly social and intelligent and they travel in large noisy troops, communicating by calls.
- They may destroy crops, and their enormous canine teeth and powerful limbs make them dangerous opponents.

(Wikipedia 2010)

As mentioned above in 2.2 there are 5 species in the *Papio* genus, some with their own sub-species which is debatable.

Papio hamadryas is:

- A large aggressive non-human primate which has been extensively used in biomedical research.
- One of the most interesting and unique features of this species, is its complex social structure compared to the other species of baboons.
- They are found in what is called One Male Unit's (OMU). This consists of an adult male with a harem of 2-10 females and their young. These OMU's are easily distinguished from each other when seen in the daytime foraging for food**.**
- They are a diurnal species. The basic group size averages around 12 individuals with these groups coming together to form groups of up to 750 individuals.

(Wikipedia 2010)

There has been extensive medical research carried out using this species such as hypertension in pregnancy, insulin dependent diabetes, male infertility, renal disease, cardiovascular, nephrology, transplant studies and developmental biology at the Australian National Baboon Colony (Hennessy, A. 1993), as well as numerous field studies done by people such as Dr. Hans Kummer who pioneered the first ever field study of Hamadryas Baboons in the 1960's. From 1960 through 1980 he and his students

combined field studies (Zoom info 2010). More recently in the last 10 years Larissa Swedell, Ph.D. Columbia University 2000, has had a keen interest in researching this species (Baboons Online 2010).

3.1 Morphometrics

3.1.1 Mass And Basic Body Measurements

Males:
Adult males between 20-30 kg
Body measurements cranial to the base of the tail is 500 – 760mm
(National Baboon Colony 2009/2010)

Females:
Adult females weigh between 10-15kg
Body measurements cranial to the base of the tail is between 400 – 460mm
(National Baboon Colony 2009/2010)

The tail adds an additional 382 to 610 mm. (Groves, 2001; Napier and Napier, 1985; Nowak, 1999; Primate Info Net, 2002)

Neonates:
Male babies weigh between 798g and over 1000g (Kirkwood, J. 1992)
Female babies weigh between 760g-830g (Kirkwood, J. 1992)
Measurements for neonates at birth can range, but from two hand-reared neonates from the Australian National Baboon Colony (ANBC), where the author works, the measurements are:
Goliath

- Cranial to rump length = 20.2cm
- Head circumference = 21cm
- Chest circumference = 18.5cm
- Abdomen circumference = 15cm
- Femur length = 7.5cm

Wilfred

- Cranial to rump length = 21cm
- Head circumference = 23cm
- Chest circumference = 21.5cm
- Abdomen circumference = 15.5cm
- Femur length = 6.5cm
- Weight = 700g

Table 2: Outlining measurements and other information on baboons. For each species this information ranges. (Department of Primary Industries 2010 taken from the Policy on exhibiting Primates in NSW, 2000)

Species/ genus (common name)	**natural habitat**	**head body length (mm)**	**tail length (mm)**	**weight of adult (kg)**	**oestrous cycle (days)**	**gestation (days)**	**number of off-spring**	**age sex. maturity females (years)**	**age sex. maturity males (years)**	**lifespan captivity yrs (in wild)**	**groups in the wild**
Papio spp. (Baboons)	deserts	550 - 840	380 - 840	Females 12.9-16.8 males 20.4 - 28.3	30	170 - 173	single	5 yr	7	30 +	complex social groups, larger groups - up to 700 may split into smaller groups and forage in single male, multi-female groups

3.1.2 Sexual Dimorphism

In Hamadryas Baboons *Papio hamadryas* there is pronounced sexual dimorphism, not only in size but also colour or and canine development (Scott Heffernan pers. comm. April 2010).

ADULT MALES: (> 7 years old). The most striking feature is its well developed silver shaggy cape or mane. The hair follicle consists of very definite, black and grey striations giving an ashy grey appearance washed with brown (Fig 6). They possess a red face and snout, some darker than others, and a large reddish pink anal area (Fig 7). The adult male also possesses a set of large canines that they use to protect the group against predators such as leopards and for fighting over possession of females (Heffernan, S. 2006)

Fig 6: Adult male Hamadryas Baboon *Papio hamadryas* showing the silvery mane (Lauren Turner 2010)

Fig 7: Adult male Hamadryas Baboon *Papio hamadryas* showing the large reddish pink anal area (Lauren Turner 2010)

ADULT FEMALES: (> 5years old). The females are obviously smaller than the adult male and olive-brown in colour and possess no mane (Fig 8). They are darker in the face and exhibit monthly swelling of the red perineum after puberty. (Heffernan, S. 2006).

Fig 8: Adult female *Papio hamadryas* (Lauren Turner 2010)

Fig 9: Sub-adult male *Papio hamadryas* starting to develop a mane (Lauren Turner 2010)

SUBADULT MALES: (4 - 7 years of age). Apart from the obvious differences between male and females the sub-adult male lacks the shaggy mane and black and gray striated hair (Fig 9). As they start to go through puberty at approximately 4.5 –5 years of age, there is a noted growth spurt and the mane and colour along with the large canines slowly develop up until the age of 7 when they are considered a full adult (Heffernan, S. 2006)

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SUBADULT FEMALES: (4 - 7 years old). Young females start cycling at an average age of 3.5 - 4.0 yrs old. Apart from not having reached their maximum weight and size they are similar in appearance to adult females and young males (Fig 10). (Heffernan, S. 2006).

Fig 10: Sub-adult female *Papio hamadryas* (Lauren Turner 2010)

JUVENILE MALES AND FEMALES: (3months – 4 years old). They are very playful and cheeky and olive-brown in colour (Fig 11). Apart from the obvious difference to distinguish male and female of being able to see the genitals of the male, young females are not cycling at this time (Heffernan, S. 2006).

Fig 11: Juvenile *Papio hamadryas* (Heffernan, S. 2006)

NEONATES: (0-3 months). Totally dark black in colour (Fig 12) and dependent on their mothers. The dark colouring makes them instantly recognisable to the rest of the group, so that more care is taken around them. Adult males have been known to use young animals as shields when aggressive situations break out. Other animals are reluctant to attack when a young animal is present (Heffernan, S. 2006).

Fig 12: Neonatal *Papio hamadryas* showing early black colouration (Heffernan, S. 2006)

3.1.3 Distinguishing Features

Apart from the striking size difference between the sexes (males are often twice as large as females) which is common to all baboons, this species also shows sexual dimorphism in colouration unlike other species of baboons. As mentioned above in **3.1.2** males are silver-white coloured and have a pronounced cape which they develop at the stage of puberty, while the females are cape-less and olive-brown. All individual faces range in colour from red to tan to a dark brown (Wikipedia 2010). Please also see **section 9.2** on One Male Units (OMU).

Hamadryas Baboon *Papio hamadryas* are instantly recognised from other species of baboon because the other species look different.

An **Olive baboon's *Papio anubis*** coat at a distance, is a shade of green-grey. At closer range, its coat is multi-coloured, due to rings of yellow-brown and black on the hairs. The hair on the baboon's face, however, is finer and ranges from dark grey to black. This colouration is shared by both sexes, although males have a mane of longer hair that tapers down to ordinary length along the back. The tail almost looks as if it is broken, as it is held upright over the rump for the first quarter, after which it drops sharply (Fig 13). (Wikipedia 2010)

Fig 13: A male Olive Baboon (Wikipedia 2010)

Fig 14: A Chacma Baboon (Wikipedia 2010)

Chacma Baboon *Papio ursinus* is generally dark brown to gray in colour, with a patch of rough hair on the nape of its neck. Chacma males do not have a mane. Perhaps the most distinctive feature of this baboon is its long, downward sloping face (Fig 14). (Wikipedia 2010)

Guinea Baboon *Papio papio* has reddish brown hair, a hairless, dark-violet or black face with the typical dog-like face, which is surrounded by a small mane, and a tail carried in a round arc. The Guinea Baboon is the smallest baboon species, weighing between 13 and 26 kg (Fig 15). (Wikipedia 2010)

Fig 15: A Guinea Baboon (Wikipedia 2010)

Fig 16: A Yellow Baboon (Wikipedia 2010)

Yellow Baboon *Papio cynocephalus* has a slim body with long arms and legs and a yellowish-brown hair. It resembles the Chacma Baboon but is smaller and its muzzle is not as elongated. The hairless face is black, framed with white sideburns (Fig 16). Males can grow to about 84 cm, females to about 60 cm. It has a long tail which grows to be nearly as long as the body.

3.2 Distribution and Habitat

Fig 17: Above a world map of the distribution of *Papio hamadryas* (orvillelloyddouglas 2010)

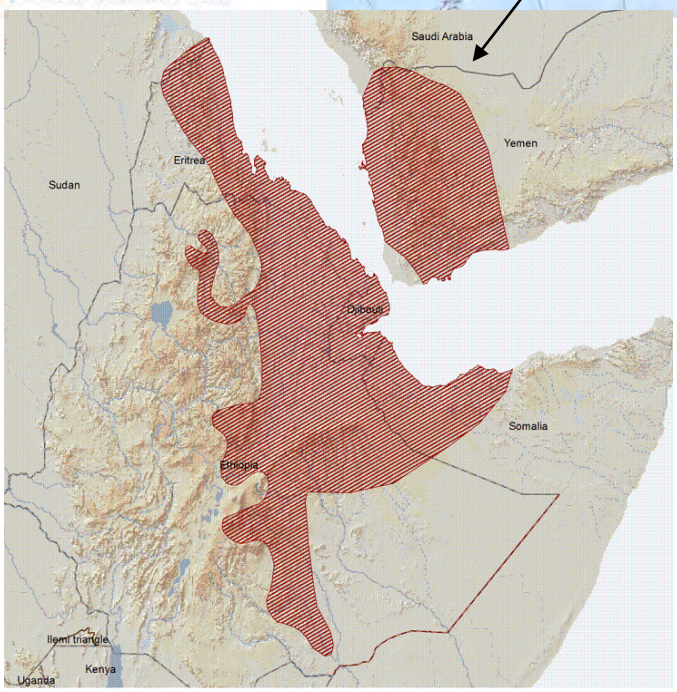


Fig 18: A magnified view of the distribution of *Papio hamadryas*

Papio hamadryas is found on the African continent in the area of the southern Red Sea, in Ethiopia, Somalia, Djibouti and Eritrea. This species also occurs in the Palaearctic region, in Saudi Arabia and Yemen. The latter populations often occur in close association with humans, and, although considered endemic to the region, were probably introduced there accidentally at some point during the height of the ancient Egyptian Empire (Animal diversity 2010) (BBC 2010).

Hamadryas baboons are found in sub-desert, steppe, alpine grassy meadows, plains, savannah woodland up to 2600m and short-grass savannahs. Their distribution is limited by the availability of watering holes and appropriate sleeping rocks or cliffs. In parts of Ethiopia, they are found in agricultural areas and are considered crop pests (IUCN Redlist 2010).

An article titled, Use of palm trees as a sleeping site for Hamadryas Baboons (*Papio hamadryas hamadryas*) in Ethiopia written by Larissa Swedell and Amy Schreier reports ‘an usual practice of Hamadryas Baboons sleeping in Doum Palm Trees at the Filoha site in lowland Ethiopia instead of the usual safety of cliffs. The reason seems to be that the site offers access to Doum Palm fruit and provides enough protection from other predators when cliffs are not available. (Swedell, L. 2008)

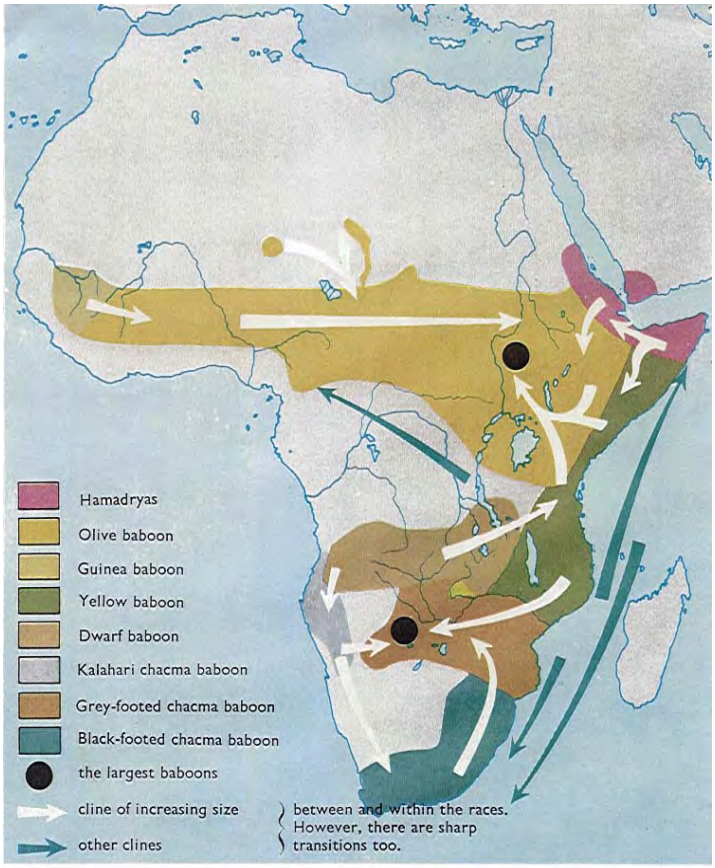


Fig 19: Map of Africa, showing approximate distribution of five allotaxa used in this study (Heffernan, S. 2006)

They forage on the plains through the day and retreats to steep cliffs and rock ledges generally from 15 to 25 meters high at night for protection from predators such as lions, both the spotted and striped hyenas and leopards. This limits where it can live and forage. (The Primata 2010)

Fig 20: Typical Hamadryas Baboon habitat (Heffernan, S. 2006)

Fig 21: This high rocky outcrop serves as an ideal sleeping place (Heffernan, S. 2006)

3.3 Conservation Status

The IUCN status for the Hamadryas Baboon *Papio hamadryas* is LC or LR/lc which is Least Concern which means there are many in the wild. This is because there are no threats for this species as listed on the IUCN Redlist and they have a large range of location and habitat. This was last evaluated in 2008.
A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category. (IUCN Redlist 2010)

Although in recent years there are conservation efforts to save baboon species because of habitat destruction (Baboons Online 2010).

The Hamadryas Baboon *Papio hamadryas* falls under CITES in Appendix II which means:

- Appendix II includes species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilisation incompatible with their survival.

(CITES 2010)

3.4 Longevity

3.4.1 In the Wild

It has been recorded that in the wild Hamadryas baboons can live for over 35 years (Nowak, 1999). But the average life span in 20-30 years (BBC 2010) (Wikipedia website 2010).

3.4.2 In Captivity

Maximum recorded lifespan in captivity is 37 yrs (Newsome 1967; Jones 1968; Kirkwood, J. 1992), but at the Australian National Baboon Colony they live for an average of around 20-30 years. (Scott Heffernan pers. comm. Sept 2009)

3.4.3 Techniques Used to Determine Age in Adults

In captivity, which is done at the Australian National Baboon Colony where the author works, records of their date of birth and parentage are kept up to date and on file, so therefore their exact age is always known, but if a wild individual was caught and examined, the only way to estimate their age is a dental examination. As *P. hamadryas* gets older their teeth start to wear down, they get tartar build up and some teeth are missing. Other things to go on if records are kept and are researched are growth rates and body measurements, but really the only way is a dental examination (Scott Heffernan pers. comm. March 2010)

Please see **section 3.1.2** above to determine and identify neonates, juveniles, sub-adult and young adult baboons.

Please see **APPENDIX 8** for an example of a dental chart for *Papio hamadryas*.

4 Housing Requirements

4.1 Exhibit/Enclosure Design

Hamadryas Baboon *Papio hamadryas* enclosure design should include the following:

- This species is found in Africa and they are mainly a terrestrial species so sufficient space must be provided, both horizontally and vertically to enable the animals to exercise, to protect animals from undue dominance or conflict and to provide for their social, breeding and behavioural needs. Sufficient exhibit furniture must be provided to meet the requirements. Perches and logs and swings should be set up so they can swing and jump around.
- Primate enclosures must be constructed so that the enclosed animals can rest at least 2 body lengths above the eye level of any member of the viewing public. Monkey pits are therefore not acceptable housing for any primate species. (Department of Primary Industries 2010)
- Enclosures may be open, semi-enclosed or totally enclosed or consist of islands surrounded by water (moats). (Department of Primary Industries 2010)
- Enclosures must be well constructed and maintained in good repair. Particular attention must be given to eliminating sharp edges and broken wires.
- Enclosures (except island enclosures) must be provided with a vestibule or other arrangement to ensure that there are always two doors between the primate enclosure and the building corridor or the outside (an airlock). All doors must open in towards the enclosure.
- Primates must be exhibited in a setting which will educate the public about the primate's natural habitat and provide for its behavioural and physical well-being.
- Make sure they have access to fresh water. Unlike other primates, baboons like water and can swim, so if construction of a moat is used to contain them in the enclosure, external moat walls need to be included (Please note that minimum note dimensions are still stated in **section 4.3**).
- They do however like to sleep in rocky outcrops and cliffs at night so part of the enclosure should mimic this sleeping place.
- They are a highly sociable species and require the company of other individuals of the same species as they need sensory stimulation, otherwise they can develop behaviour problems. Please see **section 9.5**.
- If keeping OMU's together in one big enclosure, this needs to be taken into consideration as the OMU's needs their own space, so fighting is not a regular thing. With this in mind, escape routes and hiding places need to be included. Also if they are set up this way in a big group, then genetics is hard to manage.
- If the OMU's are to be housed alternatively, they should be separated by weaned groups of males and female juveniles that had not started their sexual development. This arrangement allows mating between cages to be controlled as well as mimicking

the social structure which is so important to the Hamadryas Baboon. (Heffernan, S. 2006)

- The public need to be able to view this species if being kept in a zoo environment, so places where the baboons like to play or relax where the public can see them should be included.
- Make sure the enclosure is escape proof. Primates very strong are very smart and should never be underestimated. Therefore lights and any other fittings must be recessed or inaccessible, while nuts and other fasteners should be outside the exhibit and inaccessible or welded closed.
- Make sure the enclosure has adequate ventilation so being housed outside is ideal.
- The substrate provided should be of that found in their natural habitat or of something such as a lot of medium sized pebbles so that natural foraging can be carried out.
- A behavioural enrichment program which stimulates all five of the animals' senses must be established to provide for the behavioural and psychological needs of the group.
- As a legal requirement, if exhibiting this species to the public a graphic has to be included on or next to the exhibit which has to include a picture of the animal, a distribution map, a small description and the common and scientific name of the animal.
- The enclosure should be keeper friendly as well as animal friendly. Keeper access has to be provided so they are not in danger of being attacked by an individual baboon. Therefore sections of the enclosure should be able to be closed off from animals entering so the keeper can clean or provide maintenance to the exhibit. Routine feeding, watering and movement of animals between enclosures must be able to be carried out by the keeper with minimal disturbance to the group.
- If needing to catch up or treat any individual baboons, there should be a good system in place to provide this. (Please see **section 7.3** for capture and restraint of baboons)
- The majority of the enclosure must be out of visual range of any neighbouring exhibits housing potential predator species or other groups of the same primate species if the species is territorial. Where visual contact is available, and signs of distress are observed, action must be taken to alleviate this distress. This does not preclude the primates from being able to see other groups or potential predators from some parts of the exhibit. Such contact may in fact stimulate normal behaviours and provide for some level of enrichment. The effects will depend on the species and individuals.
- They do prey on small mammals and birds so they should not be housed next to any of these as they may stress those animals. However if they are placed near enough that they can hear these animals (especially birds), or in a way that they do not cause distress to the animals the noises generated could provide good enrichment.
- A gravel base can be provided to encourage foraging and it also acts as a source of environmental enrichment when seeds, corn and a variety of other foodstuffs are thrown into the cages. (Heffernan, S. 2006).

(Department of Primary Industries 2010)

- All exhibit enclosures for primates must include living or fresh vegetation. Although in saying this, plants are hard to keep in the enclosure as this species is destructive and therefore destroy all plants in the enclosure. Therefore large cut branches should be provided. If wanting to plant any plants in the enclosure, have an area electric wired off so the plants can grow and then every now and again the electric wire can be turned off and the baboons can have access to plants (TAFE Class 2009/2010) (Scott Heffernan pers comm. Feb 2010). Plants that can be included can be:
    - Date palm *Phoenix dactylifera* (which if big enough won't be destroyed and can be used as shade)
    - African doum palm, gingerbread palm *Hyphaene thebaica*
    - For eating:
    - Rudraksha, Gum Acacia, Gum Arabic Tree, or Gum Senegal Tree *Acacia Senegal*
    - Governors or Madagascar Plum, Batoko Plum *Falcourtia indica*
    - Prickly Pear *Opuntia species*
    - Broad Bean, Fava Bean, Horse Bean *Vicia faba*
    - Spiral Ginger *Costus afer*
    - Fiddle-leaf Fig, Banjo Fig *Ficus lyrata*
    - Abyssinian Banana *Ensete ventricosum*
    - Hedge Bamboo *Bambusa multiplex*

(Botanical 2010) (Plant File Online 2010) (Clare Campbell pers comm.) (Emma Yengi pers comm.) (Swedell, L. 2008)

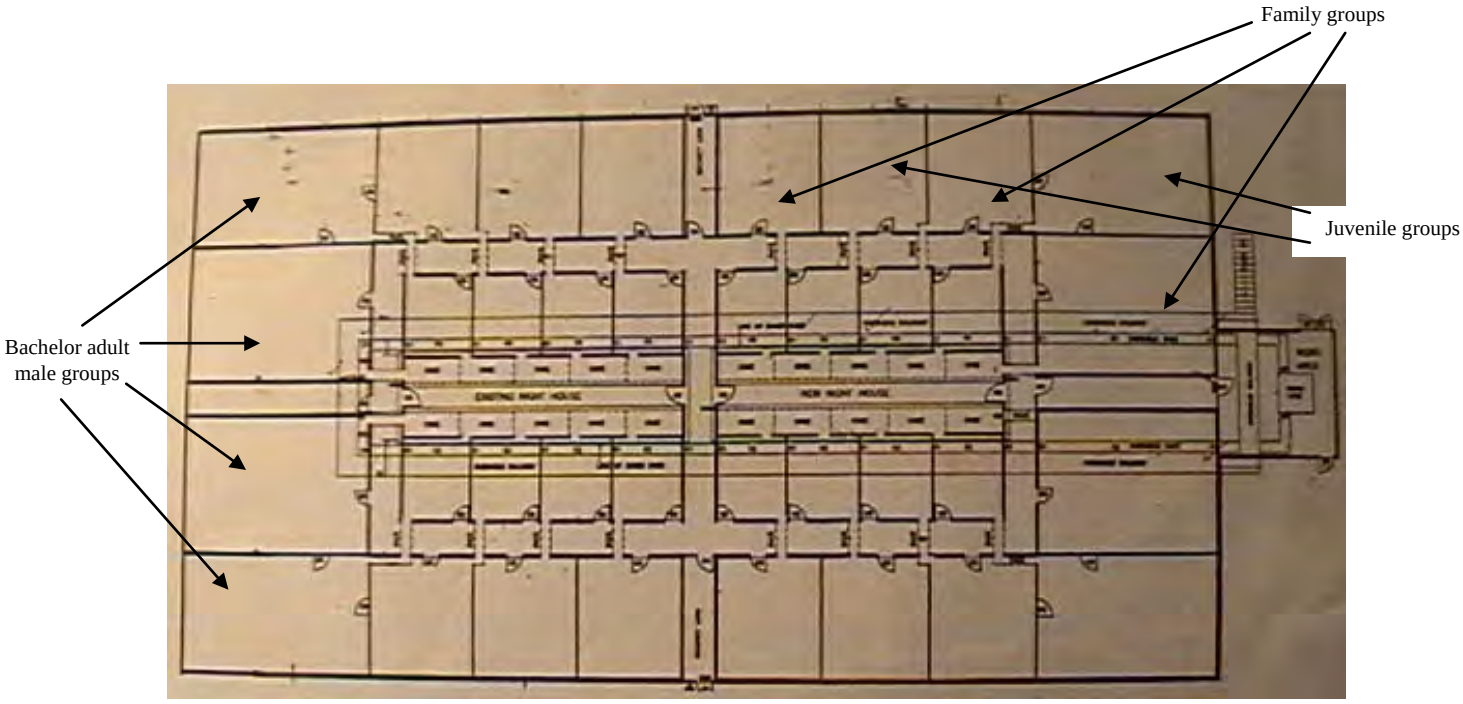


Fig 22: An example of a cage set up for *Papio hamadryas* in a captive institute with segregated cages. (Heffernan, S. 2006)

4.2 Holding Area Design

Rejected Individuals and Off-exhibit Holding

- Off-exhibit holding areas where animals are held for longer than six weeks, or routine management enclosures where animals would normally spend more than half of any 24 hour period, must meet the minimum space, furniture and enrichment requirements for exhibits. Please see section 4.3 for spatial requirements
- Naturalism is not essential in off-exhibit holding enclosures, but is preferred because of the benefits to the animals' health and well being.
- Animals must be held in off-exhibit holding areas for the shortest time possible, except where the off-exhibit facilities meet the requirements for exhibits. All reasonable efforts must be made to place surplus animals at other institutions.
- Substrate can be that of to provide natural foraging such as large pebbles.
- A night-house or sleeping area still has to be provided which is thermo-regulated either using an air-conditioning unit or heat lamps.
- Minimum furniture requirements still have to be met. Please see **section 4.9**.
- Routine management enclosures must be able to be connected to the exhibit area to allow animals to be moved easily between them. The design must minimise the risk that animals can be cornered and attacked by another. Connections must allow the animals to use their normal methods of locomotion, e.g. arboreal species require raised raceways.
- All attempts must be made to integrate solitary animals into a group, whether at the exhibitor's institution or another institution. This species should only be housed as a separate individual for a short period if they are going through quarantine requirements. If possible, the solitary animal should still be able to have visual and auditory communication with others.
- Animals that are constantly rejected by other members of the group must be removed.
- If possible they must be housed where they have visual, auditory and olfactory contact with the rest of the group. Individuals must not be housed long term in isolation from others.
- Depending on the individual animal, continued contact by sight, sound or smell for a rejected animal may be stressful. Therefore rejected individuals should be under daily, long-term monitoring.
- A circular raceway system is useful to ensure that an animal cannot be cornered by other animals and attacked.

(Department of Primary Industries 2010)

Fig 23: A raceway system (Lauren Turner, 2009)

4.3 Spatial Requirements

Table 3: Below are basic minimum dimension standards to house *three* adult animals, or a pair plus dependent offspring (Department of Primary Industries 2010):

Common name	**Maximum body length (head to rump) (cms)**	**Minimum width (m)**	**Minimum length (m)**	**Minimum height (m) (of enclosure roofs/climbing structures)**
Hamadryas Baboon	75	7.5	11.5	4.0

These are basic minimum dimensions. Enclosures must be large enough that all requirements (such as cage furniture) are met. (Department of Primary Industries 2010)

For each additional animal add at least 50 x (maximum body length)^2 to the floor area:
50 x 75cm = 3750cm = 37.5m^2 for every extra animal.

Formulae used to calculate the minimum dimensions (values are rounded to nearest 0.5 metres:

- For group housing of 2 or 3 animals (most species)
- Length of the enclosure = 15 x maximum body length
- Width of enclosure = 10 x maximum body length
- All roofed enclosures Minimum height of roof and fence = 2.4m + (2 x maximum body length)
- All enclosures Minimum height of climbing structures = 2.4m + (2 x maximum body length)

Minimum sizes have been based on the animal's body size and activity patterns, but no internationally agreed formula currently exists to calculate size requirements. These figures are the best fit from information available. They may be subject to change should new information come to light. Exhibitors should refrain from basing enclosure designs solely on the minimum size however. In order to provide an appropriate environment, many factors must be provided for, space being just one of these. The size of the enclosure must be based on ability to provide all of the factors including; social grouping, climbing structures, nesting and feeding station and predicted growth of the group (Department of Primary Industries 2010).

Minimum height of perimeter moat wall above maximum water level
A wet moat requires a perimeter moat wall (e.g. smooth-faced) which cannot be scaled by the primate species kept in the enclosure. The minimum height of the perimeter moat wall above the moat's maximum water level has been calculated for each species by multiplying the maximum body length by 1.2 (for species recorded by Rowe (1996) as having an intermembral index of 90 or greater but less than 120). (Department of Primary Industries 2010) **See table 4**.

Table 4: Minimum dimensions for moat and wire mesh:

Common name	**Intermembral Index***	**Minimum height of perimeter moat wall above maximum water level (m)**	**Minimum depth of water at perimeter moat wall (m)**	**Minimum moat width (m)**	**Minimum mesh wire diameter (mm)**	**Maximum mesh dimensions (mm)**
Hamadryas Baboon	94	0.90	1.35	3.5	4.00	75 x 50

*NB - Intermembral Index: (length of humerus + length of radius) ÷ (length of femur + length of tibia) x 100

Note: approval to utilise a perimeter moat wall lower than the minimum height may be granted if an electric hot-wire is appropriately installed on the perimeter moat wall above the maximum water level of the moat (i.e. above overflow outlets and not able to be touched by members of the public).

Minimum depth of water at perimeter moat wall
The minimum depth of water at the moat's perimeter wall has been calculated for each species by multiplying the maximum body length by 1.75 (for species recorded by Rowe (1996) as having an intermembral index of greater than 80 but less than 100).

The moat shall incorporate an automatic filling device which ensures water levels do not fall below the minimum moat depth. Exhibit moats may be provided with a narrow submerged keeper walkway to provide access across the moat provided that it is not visible to the animals and is at least 20 cm below the water surface.

Minimum mesh wire diameter
A minimum wire diameter of 4.00mm is required for primate species recorded by Rowe (1996) as having a maximum weight of more than 15.0kg but less than or equal to 30kg. Wire mesh fences are not recommended for species recorded by Rowe (1996) as having a maximum weight of more than 30kg. Please see **section 3.1.1**.

Maximum mesh dimensions
A maximum mesh dimension of 75mm x 50mm is required for primate species recorded by Rowe (1996) as having a maximum body length of more than 65cm. Please see **section 3.1.1**. (Department of Primary Industries 2010).

4.4 Position of Enclosures

Hamadryas Baboons *Papio hamadryas* should be exhibited outside, but it should only be encouraged if they were to be housed in their climatic region to provide a natural regime of climatic and seasonal conditions. The position should be so that it is protected from direct sunlight throughout most parts of the exhibit for the duration of the day and it should also have shelter from wind and rain. Setting up the enclosure so the sun rises in the east from the right side and sets in the west on the left side is adequate enough. So the north point of the enclosure should be facing north. Some direct sunlight is okay as this species likes to bask in the sun and access to ample direct sunlight, or artificial light with a similar UV spectrum, is required for maintenance of normal vitamin D levels. (TAFE Class 2009/2010)

Lighting must be adequate for routine health and hygiene checks of animals and for cleaning of the enclosure. (Department of Primary Industries 2010)

Where primates are housed indoors, there shall be sufficient air changes per hour to provide ample fresh air and prevent the build up of odours and noxious gases. Noxious gases may include carbon dioxide and ammonia. Temperatures should be maintained indoors at 22°C – 24°C (Scott Heffernan pers comm. May 2010)

4.5 Weather Protection

Sufficient shelter must be provided to allow protection from wind, rain and extremes in temperature. Access to both shade and sunlight must be provided (Department of Primary Industries 2010). Surrounding trees outside of the enclosure can provide shade or otherwise a large tree that cannot be destroyed such as Date palm *Phoenix dactylifera* (Clare Campbell pers comm.). Otherwise a night-house area can be provided for them to sleep in if they may and for security of the zoo, locked in at night. The night-house should be temperature controlled so the baboons are not affected by the extremities of the weather.

Fig 24: Date palm *Phoenix dactylifera* (Plantfile website, 2010)

4.6 Temperature Requirements

Hamadryas Baboons *Papio hamadryas* are found in natural temperatures in the wild ranging from 5.6^{o}C to 41.7^{O}C. (World Weather, 2010)

Enclosures must provide animals with access to shelter from climatic extreme. So if being housed outside in an area where the temperatures are extreme e.g. snowing in winter or 50°C plus in summer, then areas of the enclosure have to be temperature controlled to mimic the temperature in the wild (Department of Primary Industries 2010).

A designated area, such as a night-house or shelters, should be provided ranging between 18°C and 30°C as an ambient temperature (Scott Heffernan pers comm. March 2010). Heated concrete shelving may be used in shelters to provide appropriate heating. Humidity must be kept at levels appropriate to the species and so that the health of the animals is maintained (Department of Primary Industries 2010).

4.7 Substrate

A mixture of artificial and natural, or all natural substrate must be provided, to allow for normal behaviours, such as foraging and scent marking (Department of Primary Industries 2010). Large pebbles are a good ground cover for foraging which is used at the Australian National Baboon Colony (ANBC). The substrate must be effectively managed to avoid disease, so therefore it needs to provide adequate drainage. It may need regular changing (see **section 5.1** and **APPENDIX 2** for how often to do substrate change) so that it does not become a harbour for parasites such as fleas or intestinal worms especially whipworm *Trichuris trichiura* (see **section 8.3** for health requirements) (Scott Heffernan pers comm. March 2010). Otherwise natural ground cover of grasses and sand can be provided so a more natural feel given to the enclosure. Introducing new substrate or changing entire substrate encourages curiosity of a new texture. Exhibitors may wish to use appropriately managed deep litter as an option for avoiding disease (Department of Primary Industries 2010). The depth of the foraging substrate should be a 15-20 metre covering which is heaped in one pile in the enclosure At Melbourne Zoo they have a concrete base for their *P. Hamadryas* exhibit which is covered with leaf litter and mulch pine bark and the substrate is raked daily and changed every 3 months (Scott Heffernan pers. comm. 25 May 2010).

Fig 25: Large pebbles used as ground cover for foraging in a Hamadryas Baboon enclosure (Lauren Turner, 2010)

4.8 Nestboxes and/or Bedding Material

Each exhibit must allow access to an area such as a nest box, raceway or night den, suitable for the physical isolation of individuals so that animals can be restricted for close examination and veterinary treatment (Department of Primary Industries 2010).

Hamadryas Baboons *Papio hamadryas* do not need bedding material because in the wild they sleep on rocky outcrops or cliffs. In the night-houses, perches to sit on at different levels may be provided and individuals may bring in logs or sticks as they please (Scott Heffernan pers. comm. 25 May 2010). Please see **section 10.10**.

Fig 26: The night-house area at the National Baboon Colony (Lauren Turner, 2010)

4.9 Enclosure Furnishings

- In general, enclosures must be furnished with horizontal, vertical and sloping pathways, shelves and perches above ground level. Perches can be made of natural branches and swings made from chain and tyres. They should be at different levels and can act as protection from the weather (Department of Primary Industries 2010).
- Tree stumps, boulders and large concrete water pipes can be added, which act as shelters and perches.
- New enclosures must include animal access doors at a level which allows the animals to use their normal method of locomotion (i.e. above ground level for arboreal and semi-arboreal species).
- Where more than one species are kept together, the cage furniture must be the sum of that required for each species.
- Surfaces of resting places and perches must be roughened, or otherwise textured, so that they are not slippery when wet. Walls, floors and ceilings must be impervious and easily cleaned.
- Ropes must be maintained in good condition. The ends must be sealed against fraying and be heavy enough to remain taut when the animals are actively using them.
- There must be areas within the exhibit for any animal to withdraw from the group, (e.g. to hide from an aggressor) and from the public. This may be provided by visual barriers. Visual barriers should have escape routes so that animals cannot be trapped by an aggressor. Things such as large concrete half pipes are good for this.

Fig 27: An example of furniture used in a *P.hamadryas* enclosure (Turner, L. 2009)

- Changing or moving of furniture should be done to stimulate inquisitive behaviour.
- Extra climbing equipment can be added or removed e.g. ladders, platforms, barrels with holes in them, but they need to be secure.
- Slippery slides can be added for enrichment

(Department of Primary Industries 2010)

Minimum Exhibit Furniture

- Sitting or sleeping perches at least 1.0 metre above ground and of sufficient number to allow each adult animal to be by itself but also to allow for more than one animal to sit for mutual grooming etc.
- At least 4 horizontal pathways of rigid or semi-rigid materials
- Areas for sitting at or near ground level for the animals to sun themselves.

(Department of Primary Industries 2010)

5 General Husbandry

5.1 Hygiene and Cleaning

- Enclosure walls, floors and fitting should be made of solid materials that can be easily disinfected and cleaned (Department of Primary Industries 2010).
- Hard-surfaced enclosure substrate and furniture must be washed as frequently as necessary to keep them free from contamination.
- Where cleaning will disrupt scent marking behaviour in particular species, areas of the enclosure must be cleaned in rotation.
- Perches, shelves and nest boxes must be cleaned frequently enough to prevent the accumulation of faecal matter and urine.
- Soil or other natural substrates must be spot-cleaned daily to remove organic waste.
- Feeders, watering devices, feeding equipment and other metal or plastic equipment, if disinfected after cleaning, must be rinsed thoroughly.
- Animals must have access to dry areas during and after the cleaning process.

(Department of Primary Industries 2010)

This is a following cleaning regime that the author completes at the Australian National Baboon Colony (ANBC) (Scott Heffernan pers. comm. 2009):

Daily:

- *P. hamadryas* should get clean, fresh drinking water every day, so cleaning of their water ways or water troughs should be done.
- All faeces and urine should be removed from the enclosure daily and branches/rocks cleaned or scrubbed with plain water and a scourer or with a little bit of detergent added to the water. Please make sure that this detergent is washed off from all surfaces with plain water if being used. Branches and rocks should be replaced when heavily soiled or mouldy. Please see **APPENDIX 3** for MSDS sheet and where to get Spree washing detergent from.
- If kept on sand/soil, the area should be raked daily to get rid of faecal matter before the baboons have access to the main area in the morning if they get locked away during the night. Otherwise they should get caught up and kept separate from where you are cleaning and then let back into the area after you are finished cleaning
- The night-house area should also be hosed daily and faecal matter removed and not hosed down the drain.
- If any plants are in the exhibit, they should be watered daily

Weekly:

- The substrate should be turned over either using a shovel or high pressure water cleaner once a week to a month to remove faecal build up underneath the surface.
- All pathways if getting faecal matter or dropped food scraps should be hosed weekly and the waste removed. This includes any build up around raceways etc.

- If the enclosure walls or door is glass or plastic of some kind, it should be cleaned once a week with F10 or glass cleaner such as Windex, sprayed onto some paper towel and then the glass/plastic cleaned with the moistened paper towel. Please see **APPENDIX 4** for MSDS sheets for F10 and Windex.
- Pest control should be carried out weekly with The Norway (Brown) Rat *Rattus norvegicus* being the biggest pests which can carry diseases transmissible to baboons. Lockable bait stations and traps should be used to control rats. These baits should be checked weekly and baits changed when needed. Racumin can be used for rat bait and these are proven not to cause secondary poisoning. Please see **APPENDIX 5** for the MSDS sheet and instructions for Racumin.
- Water troughs/ponds should be drained and scrubbed weekly to monthly.

Monthly:

- The work area, pathways and night-house floors, walls and caging should be gurnied or scrubbed every month because of faecal build up and staining.
- If the cages are filled with large pebbles, the cage perimeter pebbles should be pushed back off the cage. This can be done using a high pressure and steam cleaner. Please see **APPENDIX 6** for information on where to purchase a high pressure water cleaner from.

Bi-yearly:

The biggest job that will need doing is the substrate should be totally replaced approximately every 6 months. This can be done by removing all of the enclosure furniture along with the baboons, temporarily housing the group/s and changing the substrate with all new substrate.

Please see APPENDIX 2 for the Annual Cycle of Maintenance for Hamadryas Baboon *Papio hamadryas*

Lemex can be used as a cleaning agent for baboons. Please make sure that when using this product that it is fully wiped/washed off after use. Make sure the bottle is clearly marked and labeled and the MSDS sheet is on hand. If using disinfectants in enclosures, please remove the animals first and then let them back in when finished. Animal house can also be used to clean such things like water bowls or empty enclosures. Animal house needs to be rinsed off properly and dry before using anything that was cleaned by it again. Please see **APPENDIX 7** for the MSDS sheets for Lemex and Animal House.

Cleaning agents such as bleach or trigene should not be used to clean the *N.amyae* enclosure as these agents are too harsh and strong and could potentially harm not only yourself but the specimen. Trigene is a disinfectant that kills viruses and this product can be used in the instance if viruses and bacteria have to be killed from the enclosure, but this chemical can be quite harsh to your respiratory tract if inhaled. Also it has to be properly cleaned and wiped off before anything can be put back into the enclosure.

See **APPENDIX 7** for Trigene MSDS sheet.

5.2 Record Keeping

Establishments shall keep records of all primates on an individual basis in a form which can be quickly and easily examined, analysed and compared with those kept by other establishments (Department of Primary Industries 2010).

The records shall provide the following information:

- Identification number, common name, scientific name, any personal name and any distinctive markings;
- Origin (details of parents and their origin and of any previous locations) Please see **APPENDIX 8** for an example of a family tree for 'Bart';
- Dates of acquisition and disposal, with details of circumstances and addresses;
- Date of birth;
- Veterinary records, including results of physical examinations, condition of the animal, details and dates of any treatments, results of routine health examinations, treatments such as worming, faecal samples, if drugs were given, the dosage, the route and where on the body if injected etc. Please see **APPENDIX 8** to see an example of what is involved in routine testing and physical examinations and also recording of events for 'Bart'. Also please see **section 8**;
- Breeding (including mating, reproductive and behavioural cycles, parenting ability) and details of any offspring;
- Normal diet;
- Date of death and cause including results of post mortem reports;

(TAFE class 2009-2010)

All documents, records and other information pertaining to each animal including those from previous locations must be kept safely and maintained for the life of the primate plus five years. Animals moving to new locations must be accompanied by copies of all relevant records (Department of Primary Industries 2010).

Record keeping can be in the form of cage cards for each individual animal, a computer based system, a diary and so forth.

5.3 Methods of Identification

Each primate shall be individually and permanently identified by an appropriate method of identification.

Fig 28: A juvenile *Papio hamadyras* with a tattoo on the right inner thigh for identification (Lauren Turner, 2009)

Visual identification or microchips are good methods of identification. From the authors knowledge the best location for a microchip is between the shoulder blades. But baboons should be identified by physical characteristics as well as permanent forms of identification i.e. tattooing which is done at the Australian National Baboon Colony. Tattoos at the ANBC are on the right inner thigh (Fig 28) where the least amount of hair grows. Tattoos allow general identification without having to restrain the animal unlike microchips which need close contact (Scott Heffernan pers comm. 25th May 2010). Facial markings can be used to identify individual animals as well as some may have more of a red face or dark face as another. If young all male and all female groups are housed together, before tattooing, size difference and weight could distinguish the difference between individuals (Scott Heffernan pers comm. 25th May 2010). If the infant is with the parents usually identification of the mother or father will determine the identification of the infant. Also if the young is separated from its parents, the mother and father will react if going near their young or doing other things such as catching up the young. If the infant is being hand-reared, neither the mother nor father will recognise the infant as their own and therefore will not react (Scott Heffernan pers comm. March 2010).

5.4 Routine Data Collection

Any unusual or notable events should be compulsory to record such as:

- Acquisition – where the acquisition was from and the date
- Births and the date of birth
- Any other specific details pertaining to the individual such as changes in behaviour or diet;
- Ovulation cycles of females should be done daily/weekly to help in the maintenance of breeding (Scott Heffernan pers comm. Nov 2009). Please see **APPENDIX 16** for an example of an ovulation cycle for a female. Also please see **section 10.12** for oestrus cycle;
- If any training/conditioning is done with individuals such as squeeze cage training and how they went with training should be recorded in a training diary (Scott Heffernan pers comm. Nov 2009);
- Any other notable event worth noting such as fighting with another animal etc;
- Disposition – where the disposition is to and the date

- Internal movements or transfers – record where moving from/to
- Tagging for identification reasons – what method of identification was used, where it was put and details of the identification e.g. microchip number
- Weights and body measurements – should be done when the animal is acquired or disposed of and should either be done weekly, monthly or quarterly (3 monthly). This can indicate if there are any health problems.
- If mating the species, which individuals were housed together to mate and if mating was successful. Also making sure blood lines are kept separate so there is no inbreeding happening
- Regular temperature checks should be done in the enclosure and in the night-houses and also regular checking of the thermostat and timers should be done if set up. Please see **section 4.6** for temperature requirements.

(TAFE Class 2009-2010)

Please see **APPENDIX 8** for an example of some data recorded for 'Bart'

6 Feeding Requirements

Table 5: A general table for the diet and feeding requirements of *Papio* (Department of Primary Industries 2010 taken from the Policy for Exhibiting Primates NSW, 2000)

species/ genus	diet in wild	diet in captivity	supplements	presentation
Papio spp. (Baboons)	grass seeds, roots, bulbs, insects and larvae, small mammals	vegetables, nuts & seeds, commercial monkey chow, bean shoots, fresh hay, fruits, browse, primate cake	Vitamin B12	provide food twice a day plus activity feeds. Please see **6.2** for quantities

6.1 Diet in the Wild

The Hamadryas Baboon *Papio hamadryas* are classified as onmivours and consume a wide variety of foods, but main sources come from grasses, rhizomes, roots, tubers, and shoots (BBC 2010). They also consume fruits, leaves, flowers, but to a lesser extent. Insects are also a favourite and they are also known to opportunistically eat meat, such things as small rodents, hares, birds and young antelope (The Primata 2010). Food resources are generally widely dispersed. The favourite foods during the rainy season consist of *Acacia* flowers and grass seeds (Stammbach, 1987).

According to the article Composition and Seasonality of Diet in Wild Hamadryas Baboons: Preliminary Findings from Filoha written by Larissa Swedell; Getenet Hailemeskel; Amy Schreier in 2008 suggests 'The two largest contributors to Hamadryas Baboon diet were *Hyphaene thebaica* and *Acacia senegal*, and these were the only plant species found in the diet during every month of the year. Other relatively major contributors to the diet, such as *Cyperus grandibulbosus*, *Seddera bagshawei* , *Tribulus cistoides* and *Typha latifolia* , showed a seasonal pattern.' It went on to list in a table other species of plant they eat and they are:

- Blackthorn or Swaarthaak *Acacia mellifera*
- Rfaudraksha, Gum Acacia, Gum Arabic Tree, or Gum Senegal Tree *Acacia senegal*
- Umbrella Thorn Acacia or Israeli Babool *Acacia tortilis*
- Desert date *Balanites aegyptiaca*
- *Barleria spinisepala*
- *Cyperus grandibulbosus*
- Gingerbread Tree *Hyphaene thebaica*
- *Pentarrhinum insipidum*
- *Psilotrichum gnaphalobryum*
- *Seddera bagshawei*
- *Tribulus cistoides*
- Bulrush, Common Bulrush, Broadleaf Cattail, Common Cattail, or Cat-o'-nine-tails *Typha latifolia*

From the Nutrient Requirements of Nonhuman Primates: Second Revised Edition (2003), the following tables were taken (NAP 2010):

Table 6: Non-colobine Cercopithecine Feeding Ecology:
Omnivorous but predominantly frugivorous(depending on habitat) - Exceptional Diets

Scientific Name	Common Name	Diet	Behaviour	Body Weight	References
Papio hamadryas	Hamadryas baboon	Only one study found quantifying diet: fruit or pods with seeds 44%, fig fruit 13%, grass seeds 6%, grass plants 17%, leaves 10%, flowers 6%, roots 5%; prey consumption not quantified	Diurnal, terrestrial, fission-fusion, 1 male + multifemales, group size foraging 25-38, troops up to 750	12.0 kg female, 21.3 kg male	Boug et al., 1994; Fleagle, 1988; Wolfheim, 1983

An interesting paragraph stated 'Hamadryas baboons (*Papio hamadryas*) are found in desert regions of the Horn of Africa and southern Arabia. In contrast with non-desert species, these baboons were able to maintain normal activity after 2 days of water deprivation in a warm environment by conserving blood-plasma volume at the expense of losses from other fluid compartments (Zurovsky and Shkolnik, 1982).'

6.2 Captive Diet

Table 7: Diet at the **Australian National Baboon Colony** for 130 baboons which the author feeds in the following way (Scott Heffernan pers comm. June 2009):

DAY OF THE WEEK	MORNING	AFTERNOON
Monday	Bucket of nuts*	4 x 10kg bags primate pellet feed or 2 and a half 20kg bags sunflower seed
Tuesday	Bucket of nuts*	3 x wheelbarrows full of fruit and vegetables
Wednesday	Bucket of nuts*	120 loaves of white and whole meal bread feed
Thursday	Bucket of nuts*	3 x wheelbarrows full of fruit and vegetables
Friday	Bucket of nuts*	120 loaves of white and whole meal bread feed
Saturday	Bucket of nuts*	Alternate between pumpkin seed/sunflower seed/corn/peanut/sultana, primate pellet feed (2 to 2 and a half 20kg bags)
Sunday	Bucket of nuts*	3 x wheelbarrows full of fruit and vegetables

- *Nuts include peanuts, almonds, brazil nuts, macadamias and walnuts

- Fruits and vegetables include apples, pears, carrots, bananas, rock melon, cucumber, zucchini, celery, spinach, lettuce, capsicum and cauliflower. They are roughly chopped up and scatter fed throughout the colony enclosures.
- Each adult male baboon gets 1 and a half shovel full scoop of fruit and vegetables. For seed and pellet feeds, family groups get 3-4 scoops altogether.
- Each female gets 1 scoop each. If females are pregnant or lactating then they need to get more (approximately half to one scoop more each). For seed and pellet feeds, family groups get 3-4 scoops each.
- Sub-adults get ¾ to 1 scoop each of fruit and vegetables
- Juveniles get half a scoop each of fruit and vegetables. For seed and pellet feeds, juvenile groups get 2-3 scoops altogether.
- Bread feeds – family groups get 8 loaves in total of wholemeal and white, adult groups get 1 loaf each (half wholemeal and half white) and juvenile groups get 4 loaves in total depending on the number of juveniles in the group.

NB: These are just guides to the amount being fed. Weight and health of all individuals should be assessed regularly and the diet and amount changed to suit requirements.

At the **Australian National Baboon Colony** the author also feeds grasses and browse which are offered every week (for example willows, banana palms, *Ficus spp* can be offered). Avoid Australian natives with high volatile oil content (e.g. *Eucalyptus, Melaleuca and Leptospermum spp*). Sometimes they do catch small birds and mammals around their enclosures to eat.

I have also found that *P. hamadryas* show individual preferences to flavours. For instance most individuals like bananas, but others may like cauliflower or rock melon.

There is no variation in seasons for diet because they breed all year round and therefore do not require food triggers for breeding (Scott Heffernan Pers comm. Nov 2009).

Please see APPENDIX 9 for the details of where to get food supplies such as fruit and vegetables, bread, sunflower seed, cracked corn, pumpkin seed, peanuts, almonds, walnuts and primate pellets from.

At other institutions such as at **Melbourne Zoo** in Victoria, Australia, they feed their Hamadryas Baboons 'Acacia, Poplar, Bamboo, Chinese Elm and Ash, *Dietes iridoides* (Spanish Iris), *Acanthus molus* (Oyster plant), *Pheonix reclinata* (Senegal Date Palm) (Bec J. Primate Keeper pers comm. 25th March 2010) (Joanne Edwards Melbourne Zoo Horticultural department pers comm. March 2010). These species of plants can also be fed to Hamadryas Baboons if caring for them also.

At **Healsville Sanctuary** in Victoria, Australia an email from Emma Yengi in the Primate Department on 12th March 2010 wrote 'they especially love Acacia foliage and the pods that fall into their exhibit. We regularly feed them *Ficus spp* branches (all species) and lots of deciduous browse, ginger plant, banana palm and bamboo.'

Table 8: At **Perth Zoo** they feed their Primates (Clare Campbell Perth Zoo pers comm. 16th March 2010):

Plant GENUS	SPECIES	COMMON NAME
Acalypha	*wilksiana*	Acalypha
Bambusa	*multiplex*	Common Bamboo
Bambusa	*ventricosa*	Budda Belly Bamboo
Bambusa	*vulgaris*	Bamboo
Chameacytissus	*palmensis*	Tree Lucerne **(without seed)**
Coprosma	*repens*	Mirror Bush
Coprosma	*picturata*	Mirror Bush
* *Ensete*	*ventricosa*	Abyssinian Banana
Feijoa	*sellowiana*	Feijoa
Ficus	*bengalensis*	Banyan Fig
Ficus	*benjamina*	Benjamins Fig
Ficus	*carica*	Edible Fig
Ficus	*hillii*	Hills Weeping Fig
Ficus	*longifolia*	Narrow-leaf Fig
Ficus	*rubiginosa*	Port Jackson Fig
Fraxinus	*excelsior*	Ash tree
Hibiscus	*rosa-sinensis*	Hibiscus
Hibiscus	*tiliaceaous*	Native Hibiscus
Ipomoea	*batatas*	Sweet Potato
Malvaviscus	*mollis*	Turks Cap
Morus	*nigra*	Mulberry
* *Musa*	*acuminata*	Banana
Nasturtium	*officinale*	Nasturtium
Olea	*europaea*	Olive tree
Phyllostachys	*nigra*	Black Bamboo
Phyllostachys	*aurea*	Yellow Bamboo
Phoenix	*canariensis*	Canary Island Date Palm
Platanus	*acerifolia*	London Plane Tree
Sacchrum	*officinarum*	Sugar Cane

* *Salix*	*babylonica*	Weeping Willow
* *Salix*	*chiliensis*	Chilean Willow
Vitis	*vinifera*	Grape (leaves)

* These spp. should only be used occasionally (no more than once every 2 weeks)

At **Honolulu Zoo** they make up some recipes for enrichment and they include (Honolulu Zoo 2010):

Monkey Brownies (Primates)

3 cups mashed banana
2 TBS baking powder
4 eggs (raw)
2 tsp. baking soda
l cup nuts
l cup milk or water
l cup raisins
4 cups monkey chow dust
l/4 cup honey
*optional: may replace honey with yogurt or molasses.
Blend bananas, eggs, oil, milk or water. Stir together remaining ingredients and pour in blended mixture. Combine. Pour batter into well oiled baking pan. Bake at 180°C for about 35 minutes.

Fig 29: Roll mixture in an edible leaf and serve.

Please see **APPENDIX 9** for what monkey chow is and where to buy it

Pumpkin Paste (Primates)

Blend the following:
4 cups oatmeal
1/2 cup peanuts
1/4 cup peanut butter
1/2 cup hulled sunflower seeds
3/4 cup raisins
1 lb can pumpkin
1/4 cup honey
Dash of cinnamon, ginger, allspice.
Add orange juice to create paste consistency.
Form into logs.

Pumpkin Brownies (Primates)

Mix the following:
4 cups monkey chow dust
1/2 cup peanuts
1/4 cup peanut butter
1/2 cup Sunflower seeds
3/4 cup raisins
1 lb can pumpkin
1/4 cup honey
Dash of cinnamon, ginger, allspice, and nutmeg.
Spread mixture into cake pan. Allow to harden in refrigerator for several hours or overnight. Cut into squares or roll into balls.

Oatmeal Paste (Primates)

Mix the following:
2 cups oatmeal
1 cup non-fat milk
1/4 cup raisins
1 cup fresh fruit
1/4 cup honey
1/2 cup peanut butter
1 cup cereal.
Add water to form a paste consistency. Dab around enclosure.

Please see **section 6.4** for enrichment

6.3 Supplements

Primates must be fed a nutritionally balanced diet, rather than relying on artificial vitamin and mineral supplements so supplements are not given to Hamadryas Baboons. The only supplements primates may require are Vitamin B12 Vitamin C and Vitamin D, in accordance with veterinary advice (Department of Primary Industries 2010).

Daily energy requirements for an adult baboon is 64-80 kcal/kg or about 120 to 150kcal/d per kg $^{0.75}$ (Kirkwood, J. 1992).

Fig 30: Source of Vitamin B12

Fig 31: Vitamin B12 tablets

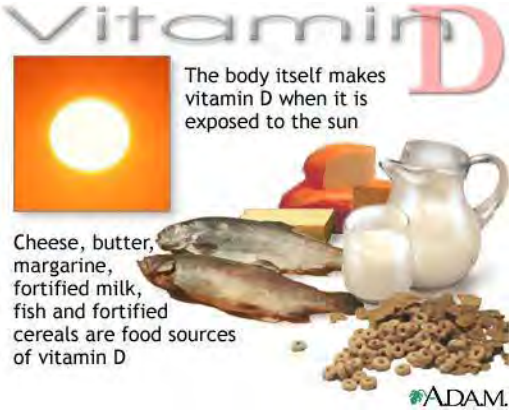


Fig 32: Source of Vitamin D

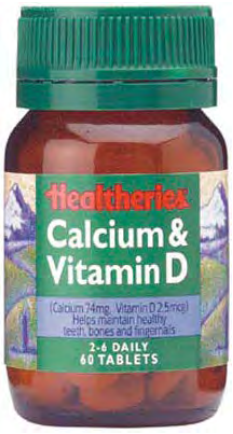


Fig 33: Vitamin D tablets

Fig 34: Source of Vitamin D

Fig 35: Vitamin C tablets

6.4 Presentation of Food

- Exhibitors must provide diversity in the taste, colour, size and nutritional value of food items fed to primates. Food offered must meet the nutritional requirements of the species as determined by the natural diet in the wild. Commercial monkey diets must be supplemented with fresh items such as fruits, raw vegetables and browse on a daily basis (Department of Primary Industries 2010).
- Food preparation and feeding of primates must be carefully planned to satisfy the nutritional requirements of all group members, including growing and lactating animals.
- Primates must be fed in small portions at least twice a day, with additional activity feeds offered on a daily basis
- Food must be presented in a manner appropriate to the feeding behaviour of the species and designed to prolong feeding and foraging, whilst at the same time minimising contamination. The feeding regime must minimise the amount of uneaten food accessible to rodents overnight.
- Food should not be left out over night where rodents can gain access, due to the risks of disease, such as Encephalomyocarditis (EMC) virus (a virus which causes heart failure and is spread in the urine of feral rodents) being transmitted. To minimise contamination, over-ripe, liquid and semi-liquid foods should be offered in feeding trays or handed out individually to each primate.
- Food must be presented in several areas to ensure that all members of the group have sufficient access. The exception is where food is being used to entice animals into a catching cage, nest box or night area.
- A behavioural enrichment program which stimulates all five of the animals' senses must be established to provide for the behavioural and psychological needs of the group. The aim of these programs is to create novel situations. These may include such things as activity feeds, presenting foods whole rather than chopped, seasonal variations in fresh food and browse. Items need to be presented randomly and unpredictably for them to continue to be novel.
- Activity feeds may include puzzle feeders such as artificial termite mounds, high fibrous food such as non toxic tree branches and other browse, or small food items hidden in the substrate throughout the exhibit. Manipulative objects may be in the form of coconut shells or clean shredded paper.
- To maximise time on display for this species they should be scatter fed where the view of the public mostly is.

(Department of Primary Industries 2010)

Enrichment strategies that the author uses at the Australian National Baboon Colony (ANBC) include:

- Scatter feeding every feed (Fig 36). All of this food should be scattered around the enclosure daily to mimic their natural foraging behaviour and fruit/vegetables can be fed whole or roughly cut in big pieces. Also scatter feeding also allows all individuals to get a chance to consume food (Heffernan, S., 2006).
- Kongs which are rubber toys with a hole inside so food can be stuffed inside them. This gives them a toy of concentration while getting rewarded for playing with it.
- Enrichment PVC pipe tubes with small holes in random places or cardboard boxes with random holes in (Fig 38). Treats like seeds and nuts can be put inside and when manipulated food falls out.

Fig 36: Example of scatter feeding of fruit and vegetables used at ANBC (Lauren Turner, 2010)

- Milk crates with food such as fruit/vegetables enclosed in them either put into the cages or hung with rope on the outside of the cage. If inside the baboon can manipulate it to get the food out, otherwise if outside of enclosure then the baboons have to pull on the rope and try to manipulate it to get food out. (Scott Heffernan pers comm. Feb 2010)
- Seeds and treats enclosed in layers of paper mache.
- Coconuts and whole cobs of corn can be fed out so they have to manipulate them to get them into their enclosure (Fig 40 and 41).
- Also throwing in branches from trees and cut grass on top of their enclosure let them consume their natural diet (Fig 45).
- Frozen blocks of ice with big chunks of fruit and vegetables inside (Fig 42 and 43).

PLEASE SEE **SECTION 9.7** OF BEHAVIOURAL ENRICHMENT FOR MORE ENRICHMENT IDEAS.

Fig 37: An example of fruit and vegetables cut up for a fruit and vegetable feed at the National Baboon Colony (Turner, L. 2010)

Fig 38: Enrichment tubes being used at ANBC (Turner, L. 2010)

Fig 39: Primate pellets, pumpkin seeds, cracked corn, sunflower seeds, peanuts, dried fruit mix and almonds used at ANBC (Turner, L. 2010)

Fig 40: Whole coconuts being fed for enrichment (Turner, L. 2009)

Fig 41: Whole corn cobs being fed for enrichment (Turner, L. 2009)

Fig 42: Frozen blocks of ice with fruit and vegetables in (Turner, L. 2010)

Fig 43: A female *Papio hamadryas* eating the fruit and vegetable frozen blocks (Turner, L. 2010)

Fig 44: Browse put into a plastic crate for enrichment (Turner, L. 2010)

Fig 45: *Papio hamadryas* eating browse (Turner, L. 2010)

7 Handling and Transport

7.1 Timing of Capture and Handling

Primates should be transported and handled early in the morning because they are affected by temperature changes and severely affected by temperature extremes (ARAZPA Guidelines on Animal Transport 2005). Care must be taken to ensure that they are not subject to drafts as this can be fatal (International Air Transport Association IATA 2000). Also they must be protected from extreme heat to prevent dehydration or heat exhaustion. The different climatic factors prevailing during a journey must always be considered when arranging the routing and carriage of live primates (Department of Primary Industries 2010).

7.2 Catching Bags

Catching bags are not recommended for Hamadryas Baboons *Papio hamadryas* as they are strong and can easily bite and rip the bag open (Scott Heffernan pers comm. Feb 2010). Also they need to be able to visualise what is going on when being transported as this reduces stress. Also if using a catching bag, this can easily stress the animal out and possibly suffocate the individual. If anything is to be used in aiding to catch up a Hamadryas Baboon, nets can be used (Department of Primary Industries 2010).

7.3 Capture and Restraint Techniques

- Restraint may take the form of chemical or physical restraint or a combination of both, such as catching in a race or night box and subsequent sedation (Department of Primary Industries 2010). Please see **section 8.2.1** for chemical restraint drugs and doses.
- It must be undertaken in the manner least stressful to the animal and should not result in injuries.
- Restraint must be under the supervision of a senior keeper with extensive primate handling experience or an experienced veterinarian.
- Immobilisation by remote injection (darting) is the method of choice in a zoo environment for animals heavier than 8-10 kg. For animals of smaller body weight, netting prior to anaesthesia is preferred due to the risk of trauma associated with remote injection.
- Attempts to immobilise an animal that becomes drawn out must be abandoned before they cause distress to the animal or group members.
- Primates that have been sedated or anaesthetised must be allowed to recover in a separate area, nest box or night cage without any risks from other animals, of falling or of other injuries.
- Anaesthesia, sedation, tranquillisation and analgesia must be used to minimise pain and distress, as determined by the veterinarian. Please see **section 8.2.1** for chemical restraint.
- Many primate species are prone to overheating during chemical immobilisation. This can be reduced by monitoring the temperature of the animal while under anaesthetic and using cool wet towels to cool their body temperature down. If their body temperature is too high, then a heat mat or hot water bottles can be used to warm them up.

- Regularly used races between enclosures or nest boxes provide a low stress mechanism for capture. Training and conditioning baboons to the raceway system helps in further reducing the stress of being caught up (International Air Transport Association IATA 2000).

(Department of Primary Industries 2010)

Primates pose a risk to handlers because their reactions are frequently unpredictable. There are significant dangers to staff due to the strength, tenacity and aggressiveness of many individuals (ARAZPA Guidelines on Animal Transport 2005). As the author knows *Papio hamadryas* may also grab loose clothing as they have an extended reach due to long limbs. Therefore due caution must be exercised. The target animal should first be isolated from the rest of the group. All individuals defend themselves by biting with their strong jaws and large teeth, particularly adult males because they have large canine teeth. They can also inflict deep and painful scratches (Scott Heffernan pers comm. Nov 2009). Thick protective gloves are not recommended as they obstruct handiness and create a false sense of security (Department of Primary Industries 2010).

Table 9: Shows methods of handling and behaviour characteristics needing to take into consideration when catching up (Department of Primary Industries 2010):

Species/ genus	methods of identification	methods of handling	relevant behavioural characteristics
Papio spp.(Baboons)	microchips, tattoos	isolation of target animal, darting of males, capture by netting carried out by appropriately trained and skilled personnel, may be followed by hand injection through the net	very strong and aggressive, males have large canine teeth can inflict severe wounds

Table 9 above is taken from the Policy on exhibiting Primates in NSW and this states that the best way to capture and restrain a Hamadryas Baboon is to isolate the individual, and dart the animal if 8-10kg or if under, capture the individual by a net and give a sedation injection through the net and then transported as needed. Please see **section 8.2.1** for chemical restraint. Chemical restraint allows undisturbed handling of the physically free, yet unconscious research subject. This method is suitable in environments where the baboons are kept in large groups out in open enclosures, but in the author's point of view, enclosures should be designed with appropriate catch up facilities.

Distributors for nets:
http://www.netmaker.com.au/
http://pin.primate.wisc.edu/idp/idp/products
Or look in **APPENDIX 11** for more information on nets

Although the easiest way to capture and restrain Hamadryas Baboons, and the technique used at the National Australian Baboon Colony by the author is:

- Being conditioned to a work area which can be accessed by the baboon by a raceway from their cage (Fig 46).
- They can then be separated from the rest of the group into a squeeze back cage (crush). Such cages are equipped with a special back-panel that can be moved in such a way that the animal is forced to come to the front of the cage (Fig 47) and trained/conditioned to turn their backs to you with positive reinforcement.
- Then they can tolerate being partially or completely immobilised to facilitate blood taking, injection, close-up examination and other procedures.
- Also if being conditioned to this crush, they can be transferred into a transport box without being sedated for transportation.
- The transport box is put in front of the crush and there is a flap at the front of the crush which can be lifted up and the individual can run into the transport box.

CRUSH

Fig 46: The work area at the Australian National Baboon Colony showing the squeeze cage (crush) (Turner, L. 2010)

Fig 47: The squeeze cage (crush) with a flap that slides upwards (Turner, L. 2010)

Other forms of restraint are that can be used but are not ideal are (Reinhardt, V., 1995):

- ***Manual restraint*** - During manual restraint non-human primates are usually held by two people to allow sample collection, drug administration or physical examination.
- ***Restraint boards*** - Rather than holding an animal down with the hands, some investigators strap its extremities or its waist on specially designed restraint boards to allow sample collection, electrocardiographic or ultrasonographic recording.
- ***Restraint chairs*** - Restraint chairs maintain an animal in a sitting position with restraint being affected by pillory type attachments at the neck and waist.
- ***Nets etc*** - The removal of laboratory non-human primates can be achieved not only with transfer boxes or modified restraint boxes but also with the help of heavy gloves, poles, leashes or nets. They teach the subject fear through association and are likely to trigger apprehensive distress responses. Being captured in a net, for example, is probably a distressing experience on its own. Caught monkeys often become entangled, requiring forceful removal, and incidents of acute diarrhoea, rectal prolapses and lacerations are common.

(Reinhardt, V., 1995)

Training

Training non-human primates to cooperate rather than resist during manipulations avoids the need for physical and chemical restraint. The subject has considerable control over the situation, by maintaining freedom of movement. So as part of their daily routine primates must be accustomed to enter a night area, nest box or race where they can be safely restrained. The ability of primates to learn can be utilised by training animals to accept temporary restraint in reward for food (Department of Primary Industries 2010).

7.4 Weighing and Examination

At the author's workplace at the Australian National Baboon Colony, weighing is done in the work area. One of the cages in the work area is set up as scales, and the individual needing to be weighed can be separated from the others and locked into the scales, where the weight is easily read. Therefore there is no need to sedate the individual to obtain their weight which is ideal.

Segregated cage for weighing which have scales attached

Fig 48: The work area at the Australian National Baboon Colony showing the scales cage (Turner, L. 2010)

Alternatively if this process cannot be done because a work area is not set up, then the individual animal if chemically restrained and then can be weighed. Or if the individual is going to be transported then the transport box can be put on the scales first and tared (put to 0) and then the individual put into the box to get the weigh (Scott Heffernan pers comm. Nov 2010).

Distance examinations can be done to each individual and if using the squeeze-cage system the individual can be squeezed up and examined more closely (Scott Heffernan pers comm. Nov 2010).. If doing a detailed examination please see **section 8.2**.

7.5 Release

When releasing the species of *P.hamadryas* the best time to release it would be early morning again, for the same reasons as mentioned in **7.1**. At the National Baboon Colony, the baboon/s being transported and released back into the colony is released the following way by the author:

- Make sure the transport box is the correct one with the correct species in it. Therefore read the labels on the box.
- When the correct box has been located, keep the right way up. There should be stickers to indicate the right way up on the box.
- Put the transport box next to the squeeze cage flap to be lifted up. Make sure it is flush with the squeeze cage and there are no ways the individual can escape.
- Open up some cage doors in the work area so the baboon/s can run into an open area and escape from you.
- Open up the flap to the squeeze cage first and then open the flap to the transport box
- Either the specimen will eventually enter the work area itself or you will have to help it along by putting food around the work area such as bananas. Either way one person should always be holding the transport box steadily flush with the squeeze cage so there is no chance of escape.

(Scott Heffernan pers comm. Nov 2009)

If it is a new addition to the colony, please see **section 9.8**.

7.6 Transport Requirements

According to the IATA Live Animal Regulations some general points about primates include:

- For primates which are obviously disturbed by the shipment, reducing the light within the container and the noise level within its vicinity will usually be sufficient to quieten the animal.
- There are a number of contagious diseases carried by primates that are communicable to man, consequently, care must be taken to avoid physical contact with the animal and full personal hygiene precautions must always be taken.
- Primates from different continents must not be shipped together nor come in airborne contact with each other in aircraft holds, airport cargo warehouses, animal holding facilities, and during all phases of ground transportation.
- It is natural for primates to investigate their surroundings and try to escape. With very few exceptions, primates do not willingly accept confinement. They become frustrates and will often make determined efforts to escape.
- Laboratory monkey shipments must be kept isolated from any other shipment of primates at all times
- The container must be correctly labelled and marked with the consignee’s name, address and telephone number. Labels must not block ventilation holes. The container

must be marked 'LIVE ANIMAL' (Fig 49) and have 'THIS WAY UP' labels (Fig 50) affixed to all four sides. Reptiles must be noted on the 'LIVE ANIMAL' label.

- Shippers name, address and telephone number and a list with the scientific names and quantities of each species contained must be attached to the outside of the container or printed on the outside of the container.

(International Air Transport Association IATA 2000)

Fig 49: Live animals sticker.(s7d5.scene7.com, 2009)

Fig 50: This way up sticker (theboxwarehouse.co.uk, 2009)

Some general points from CITES Regulations:

- With many species, box training well in advance of the planned transport date can reduce the stress involved with containment.
- Animals should generally be transported singularly to prevent injury from cage mates.
- Ambient temperature during transport should be suitable to the species' physiological requirements. Where possible, air conditioned transport should be used and the temperature should range from 22-25°C.
- The transport conditions should be such that adequate ventilation is provided, whilst at the same time animals are protected from draughts. For example, transport boxes/containers should not be stacked against one another, but be placed such that air can circulate freely.
- Transport boxes/containers should be adequately anchored during transport to ensure movement is kept to a minimum
- Exhaust fumes should not be able to enter the animals' holding area.
- Animals should be checked during transport if possible and conditions (e.g. ambient temperature) adjusted as required.
- Where possible and/or appropriate food and water should be provided to animals during transport.
- Providing a comfortable, quiet environment where possible excluding strong smells, vibration and excessive noise.
- Ideally, staff accompanying animals should have available the means of communication (i.e. mobile phone) in case of emergencies.

(CITES 2010)

Please see **APPENDIX 12** for IATA Live Animal Regulations

7.6.1 Box Design

General design

- Primates must be carried in well constructed closed containers which must be able to withstand other freight damaging it or causing the structure to buckle or bend (International Air Transport Association IATA 2000).
- The container must be rigid enough to prevent the animal from escaping through gaps at the seams or joints
- The container must be constructed of non-toxic material
- The container must be suitable to keep the species inside at all times and protect it from unauthorised access and the door/lid must be constructed so that accidental opening cannot occur, either from the inside or the outside.
- The container must not cause the animal to injure itself and all inside edges must be smooth or rounded.
- If the container is to be re-used then it must be thoroughly cleaned and either disinfected or sterilised prior to use
- The container must be easy to handle and protect the handler from being clawed or bitten by the animal.
- Space bars must be provided to facilitate handling and preventing the ventilation openings from becoming blocked by other freight. Handles must be attached on three (3) sides of the container in addition to space bars
- The container must be adequately ventilated on at least three (3) sides with the majority of ventilation being provided on the upper part of the container
- The ventilation openings must be small enough so that any part of the animal cannot protrude from the container and they must be covered with light material such as muslin or other light material to prevent possible inhaling of infectious droplets from monkeys by handlers
- The container must be correctly labelled. Labels must not block ventilation holes.

(International Air Transport Association IATA 2000)

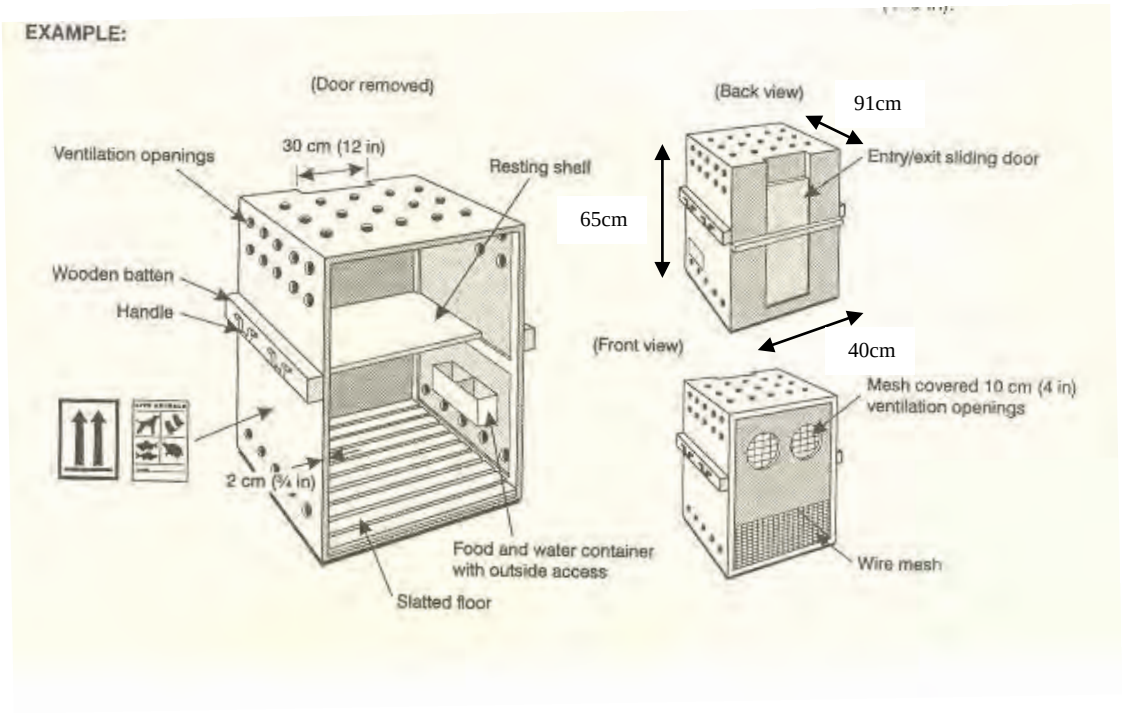
Dimensions

- Must in general allow the animal to stand, turn and lie down in a natural manner
- The recommended space per animal must not be less that $0.5m^3$ ($17.63ft^3$) in multiple containers.
- Forklift spacers must be provided when the combined weight of the container and content exceeds 60kg.

(International Air Transport Association IATA 2000)

- ***For young/sub adult Baboon's:***
    - The front must consists of 2.5cm weld or mesh or chain link which must be attached to the frame with a steel strip. Behind the mesh 2cm bore steel tubes must be sunk into the top and bottom frame to a depth of approximately 2.5cm at a distance of 7.5cm apart, centre to centre
    - The distance between the bars and the mesh must be such that the animal cannot poke its fingers outside the container.
    - A solid $^{2}/_{3}$ panel with $^{1}/_{3}$ mesh at its lower portion and two 10cm observation openings in the upper part must be placed in front of the weld mesh/chain link.
    - Meshed ventilation openings, approximately 2.5cm in diameter must be provided along the base, in the upper $^{1}/_{3}$ of the sides and rear and on the top of the container. Whenever openings are covered by mesh care must be taken that there are no sharp edges present within the container, all edges must be covered with smooth material that is tamper proof.

(International Air Transport Association IATA 2000)



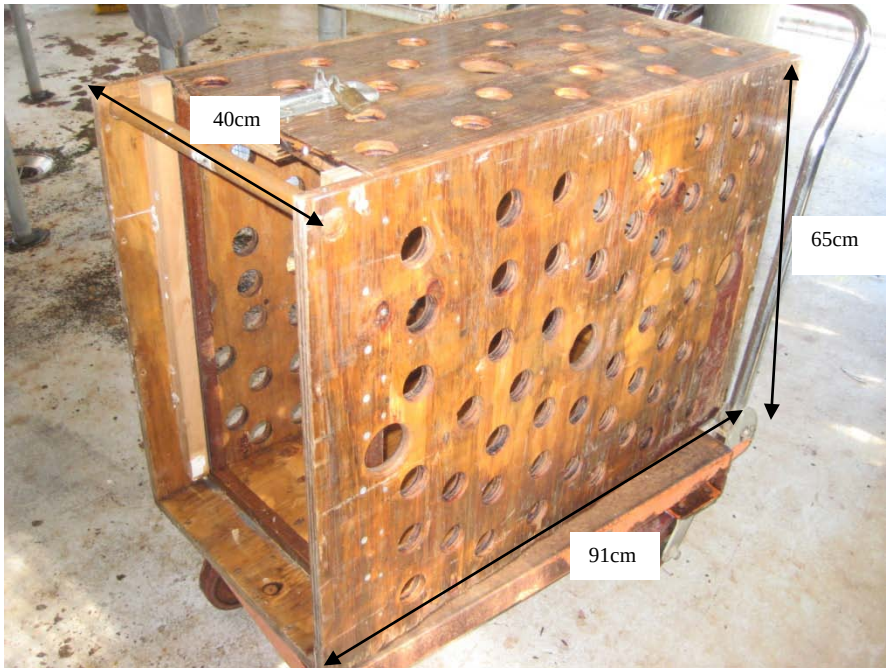


Fig 51: A transport box at the Australian National Baboon Colony for juvenile/sub adults (Lauren Turner, 2010)

- ***For adult Baboons:***
  - The container must either allow the animal to turn around completely and easily or not to be able to turn at all. The height of the container must allow the animal to stand fully upright with its head extended and the length of the container must allow it to lie down in the fully prone position
  - The frame must be welded metal lined with smooth wood or other similar material of a minimum thickness of 1.2cm
  - Additional strengthening braces must be present on the sides of the container when the total weight is more than 60kg
  - The front must consist of strong iron bars, spaces in such a manner that the animal cannot push its arms through the bars. The bars must have a sheet of welded mesh fixed at a distance of 7.5cm on front of them
  - A wooden shutter with slots or holes for ventilation must cover the whole front in order to reduce the amount of light inside the container as well as to reduce the disturbance to the animal and to protect the handling personnel.
  - The other three sides, one which is the door, must be solid with ventilation openings
  - Handles must be provided on three sides of the container (please see illustration)
  - Meshed ventilation openings, approximately 2.5cm in diameter must be provided at heights that will give good ventilation at all levels but particularly when the animal is in a horizontal position. Ventilation must cover the sides, rear and top as well as the sliding shutter and they must have exterior mesh screening.

(International Air Transport Association IATA 2000)

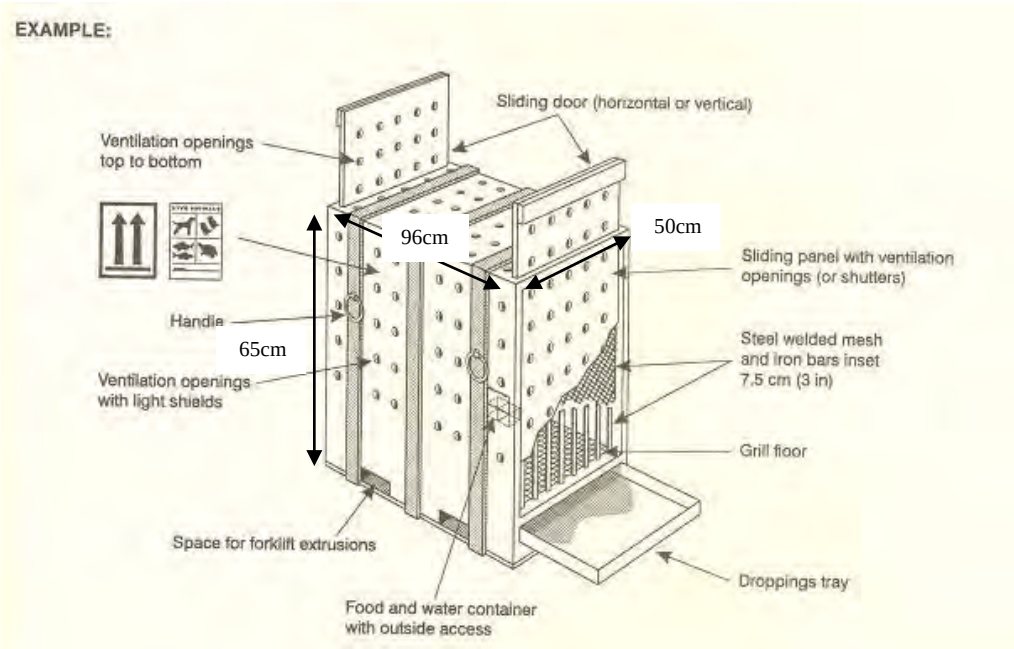


Fig 52: A transport box at the Australian National Baboon Colony for adults (Lauren Turner. 2010)

7.6.2 Furnishings

Inside the container:

The base of the container must be solid and leak-proof and covered with an absorbent material such at wood shavings or shredded paper to a depth of at least 10-15cm. A resting shelf of $^{1}/_{3}$ the length of the container must be provided, at the rear, if required by the species being transported (International Air Transport Association IATA 2000).

Alternatively the floor can be constructed in a grill form with a liquid-proof tray fitted in a manner to permit the excretions to fall through the floor into the tray.

7.6.3 Water and Food

In general:

- Food and water containers must be provided, either revolving or fixed. If fixed inside the container they must be placed at a height that does not allow the animal to sit upon it and there must be an outside access for filling and emptying which does not allow the animal any chance of escape (International Air Transport Association IATA 2000).
- Water containers must only be filled to demand and must be emptied after use as primates will splash themselves and become wet and chilled. Alternatively a wet sponge in the water container will supply water to the individual being transported without spilling it.
- The containers must be made of non-toxic material and must have rounded edges
- Shipper's instructions for feeding and watering must be given in writing at the time of acceptance and they must be affixed to the container and a copy, accompany the documents.
- Any feed or watering must be recorded on the container instructions with the date and time of supply
- Food must not be in breach of any regulations of the country of transit or importation
- They do not normally require additional feeding or watering during 24hrs following the time of dispatch.
- The animal should be provided with food and water as soon as practical once released into its enclosure.

(International Air Transport Association IATA 2000)

Types of food

According to the IATA Regulations bread with butter, jam or honey can be provided and also lump sugar, cake and biscuits. Soft fruit and vegetables must be fed sparingly since if taken in excess can cause the animal discomfort. With animals such as the Hamadryas Baboon they are desert dwelling species and therefore they don't have to be provided water if being transported not too far. If food has to be provided, juicy food such with high water content can be provided only if being transported a short distance because as mentioned before it can cause the animal discomfort (International Air Transport Association IATA 2000).

7.6.4 Animals per Box

According to the IATA Regulations for young/sub adult baboons a transport box should normally hold one animal per container, unless the animals live together. Young primates must not be separated from one another as this increases stress. They must be in portioned containers or in separate containers loaded adjacent to each other. As mentioned before the recommended space per animal must not be less that $0.5m^3$ ($17.63ft^3$) in multiple containers (International Air Transport Association IATA 2000).

Baboons of the same species and size may be shipped together without a divider in the same container only if they have previously been contained together. Otherwise they must be completely separated. Care must be taken to prevent any possibility of snapping and disturbing one another. The partitions can take the form of metal grills, each compartment must abide by all regulations (International Air Transport Association IATA 2000).

Fig 53: Female adult Hamadryas Baboons which can be transported together

Accepting females while they are in oestrus (in heat) can upset mature males when they are present so this must be avoided whenever possible. If it is necessary to accept sexually mature male and females, they must be stowed as far apart as possible from each other. If it is necessary to accept males and female primates, it is preferred that the animals be of the same sex (International Air Transport Association IATA 2000).

Fig 54: A mother and infant Hanadryas Baboon

The carriage of mammals with suckling young is not recommended because some females sensing danger may cause harm to their young. This also applies with pregnant females as they can potentially abort their foetus.

Young animals must not be separated from others of the same species as this increases stress. They must be in partitioned cages or in separate cages loaded adjacent to each other (International Air Transport Association IATA 2000).

7.6.5 Timing of Transportation

Primates should be transported early in the morning because they affected by temperature changes and severely affected by temperature extremes. Care must be taken to ensure that they are not subject to drafts as this can be fatal. Also they must be protected from extreme heat to prevent dehydration or heat exhaustion. The different climatic factors prevailing during a journey must always be considered when arranging the routing and carriage of live primates (International Air Transport Association IATA 2000).

7.6.6 Release from Box

Please see **section 7.5.** The most important parts to remember for release from the box is to make sure you there are no escape routes and ways that the individual cannot turn around and attack you. Make sure that you take your time in the procedure. Also you should release the baboon into an open space or area to escape to so it can run away to a hide to 'feel' safe (Scott Heffernan pers comm. Nov 2010).

8 Health Requirements

8.1 Daily Health Checks

As done by the author at the Australian National Baboon Colony, daily health checks should be carried out first thing in the morning on all baboons and a final check should be done at the end of every day to look for abnormal signs or ill health. This can be done by distance examinations (TAFE Class 2009) and include looking for things such as:

- Changes in normal behaviour for the individual
- Activities of the animal - are they lethargic and slow to move, or lying quietly or are they active. Being lethargic could indicate ill health.
- Their hair or coat looks untidy, ruffled up or unclean or they show signs of hair loss
- They look like they are losing weight or they are underweight (body condition)
- They have blood on them or they have a wound on them
- Their skin looks scabby
- Coughing or sneezing
- Discharges from their eyes, nose or ears
- Faeces around their backside or an unclean anus
- Their faecal matter is sloppy, has mucous, blood, or worms in it
- They are straining to go to the toilet
- Excessive urination
- Excessive drinking
- They are being picked on by other baboons
- When they are being fed, they aren't competing for food or they are uninterested in eating or they are having trouble eating
- They can't climb properly
- They aren't reaching for things such as food
- They are lame (limping) on a limb
- For mothers nursing - their nipples appear to be red and swollen and have a discharge or they leaving the baby unattended

(Scott Heffernan pers comm. Sept 2009)

8.2 Detailed Physical Examination

8.2.1 Chemical Restraint

To perform a detailed examination of *P.hamadryas* the individual needs to be sedated or anaesthetised for this to occur. Other reasons for *P.hamadryas* to be chemically restrained that the author is involved in is to take blood for things such as routine health checks once a year, for procedures such as suturing wounds, or if an individual is suspected to be ill (Scott Heffernan pers comm. Sept 2009).

The main drug used for this procedure and also at the Australian National Baboon Colony (ANBC) is Ketamine. Ketamine can be used in conjunction with Medetomidine (Domitor), as Medetomidine can be reversed using Atipamezole (Antisedan) or it can be used by itself. The route is intramuscular usually using the thigh muscle.

The dose rate used at the ANBC of Ketamine/Domitor combination is 40ug/kg of Domitor and 4mg/kg of Ketamine.

The dose of Ketamine (100mg/ml) by itself is 5-8mg/kg intramuscularly which is also used at the ANBC.

Please see **APPENDIX 13** for a sheet on dose rate for anaesthetic combination of Ketamine and Domitor, and also a table for chemical restraint and anaesthetic agents and analgesics.

For more major procedures a Ketamine constant rate infusion can be used along with Metoclopramide (Maxalon) to aid in nausea and vomiting, Atropine to reduce bradycardia and salivating, Buprenorphine (Temgesic) intravenously for analgesia and Penicillin or Tobramycin intravenously as antibiotics. For major surgeries *P.hamadryas* can be intubated with an endotracheal tube and then a gaseous anaesthetic agent such as Isoflurane can be used (Zoonoses 2009).

Ketamine has a wide safety margin in non-human primates and the on-set after injection intramuscularly is usually about 5 minutes. A single bolus will provide chemical restraint for 15-30 minutes and complete recovery occurs within 1 to 2 hours depending on dosage used. (Popilskis. S.J 1997)

Please note the occupational health and safety risks when dealing with needles as a needle stick injury could possibly occur. Dispose of all needles, scalpel blades etc in suitable ‘sharps’ containers immediately after use. Where a ‘sharps’ container is unavailable, used needles, scalpel blades etc should be safely stored until they can be disposed of. Used needles should be disposed of immediately in the shapes containers right after use. **Do not** attempt to re-cap the needle or do not bend them by hand.

8.2.2 Physical Examination

In the author's opinion the only physical examination that can be done on *P.hamadryas* when it is conscious is a distance examination by looking at the eyes, nose, mouth, ears, body condition, coat condition etc without touching or restraining the animal. No attempt should be made to restrain and perform a physical examination while *P.hamadryas* is conscious as they are very dangerous and could easily hurt you (Wolfensohn, S. 2005).

When *P.hamadryas* is sedated or under general anaesthetic a full work up can be done, which is done at the ANBC. The key things for a physical examination are to check:

- Body score by scoring the muscle over the hip bones (please see **APPENDIX 14** for body scoring)
- Check and feel if lymph nodes are presenting – they should not be obvious/swollen
- Check overall body condition – check there are no wounds on body
- Palpate the abdomen gently – take note if there is any discomfort or grunting when this is performed. Even if under sedation or if they are under light sedation, they should let you know if they are uncomfortable.
- Check eyes, ears and nose are all clear and free from discharges
- Check teeth – how much wear there is and if there are any cavities. Please see **APPENDIX 8** for a baboon dental chart.
- Check their temperature using a digital thermometer via the anus. Their temperature should be between 36°C – 39°C (Penny Farrell pers comm. 8th June 2010) but from the authors experience from routine testing of 100 plus baboons, under general anaesthetic/sedation their temperature ranged from 37°C – 39°C.
- Check their mucous membrane colour and capillary refill time. Their mucous membrane colour should be nice a pink. If pale or a muddy colour or a blue colour, please call the vet. If the capillary refill time is more than 2 seconds, please also call the vet.
- Check their pulse rate via the femoral artery and their respiratory rate per minute by watching their chest rise and fall. Their pulse rate should be the same as their heart rate and depending on the size of the animal. In the authors experience the heart rate will range from 100-154 beats per minute. Their respiratory rate also depends on the size of the animal but it should range from 12-40 breaths per minute.
- Take 5mls blood for full biochemistry work up
- Weight of the animal (kgs)

Please see **APPENDIX 8** for an example of a blank routine testing and physical examination sheet, a filled out physical examination sheet for 'Bart' and baboon dental chart sheet.

8.3 Routine Treatments

As done by the author at the ANBC routine worming of *P.hamadryas* should be done every 2-3 months as a preventative against endoparasites, mainly Whipworm *Trichuris trichiura*. It can be done using injectable Doramectin or Ivomectin subcutaneously and the dosage is 0.03ml/kg as used by the author at the ANBC. This regime can be increased to once a month in the colder months of winter as infestations can worsen at these times.

If an individual presents with endoparasites, they can be treated using oral Mebendazole (Combantrin) tablets, twice a day for three (3) days, orally as used at the ANBC.

Ectoparasites should be eliminated before release by applying pyrethrin-based acaricides and by administering an Avermectin. Sarcoptic mange will require two consecutive treatments with an Avermectin, followed by a negative skin scraping (Wolfensohn, S. 2005).

All *P.hamadryas* are susceptible to tetanus and should be vaccinated before release (Scott Heffernan pers comm. Sept 2009). Standard human tetanus toxoid is suitable. A combination human vaccine containing diphtheria, pertussis (whooping cough) and tetanus (DPT) is sometimes used but since non-human primates are not susceptible to diptheria or pertussis the use of this combination product is unnecessary. Vaccination schedules from birth are they should receive one injection at 1 year, a booster 6 months later and another booster at 2 years and then every 10 years after that. A Mantoux tuberculosis test should also be done yearly. Like all mammals, *P.hamadryas* is susceptible to infection with rabies virus. Vaccination in rabies-enzootic areas is recommended. A killed, inactivated vaccine, as recommended for human use, can be used but is expensive. Imrab 3 (Merial Ltd.) has also been used (Quarantine in translocation PDF file – EduCampus TAFE NSW Richmond Campus 2009).

8.4 Known Health Problems

Parasitic Diseases

Giardia lamblia, Entamoeba histolytica, Escherichia coli, Balantidium coli, Enterobius sp., Whipworm (*Trichuris sp*.), Hookworm, *Hymenolepis nana* and *Schistosoma mansoni* are most of the parasitic disease that are to be found in *P.hamadryas* (Scott Heffernan pers comm. Sept 2009).

Whipworm *Trichuris trichiura* or *Trichocephalus trichiuris*

Whipworm *Trichuris trichiura or Trichocephalus trichiuris* is one of the main endoparasites infecting *P.hamadryas*.

Aetiology – *P.hamadryas* become infected if they ingest soil contaminated with whipworm eggs. The ingested eggs hatch, and the whipworm embeds in the wall of the large intestine (Hennessy, A. 1993).

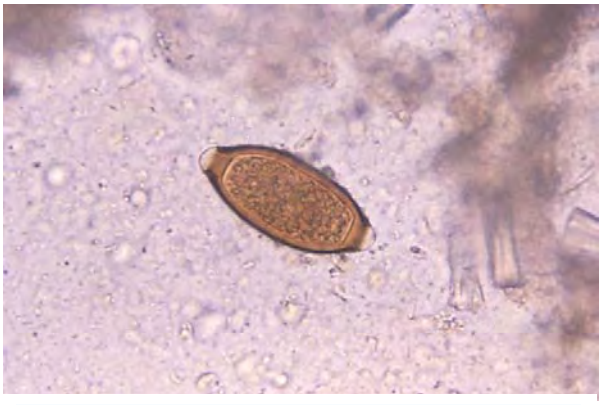


Fig 55: *Trichuris trichiura* egg

Signs – Diarrhoea is associated with lethargy, loss of appetite and weight loss, dehydration and infection. Heavy infestations may have bloody diarrhoea or visable worms. Long-standing blood loss may lead to iron-deficiency anemia. Rectal prolapse and death is seen in severe cases (Hennessy, A. 1993).

Treatment - Oral treatment with mebendazole twice a day for three (3) days is commonly used in symptomatic infections (Scott Heffernan pers comm. Sept 2009).

Prevention

- Regular anti-helminth treatments
- Replacement of substrate in enclosures where possible
- Sunlight
- Regular cleaning and hosing of nighthouses
- Good husbandry and hygiene protocols in the workplace
- Regular faecal screening of baboons
- Water supply free from faecal contamination

(Scott Heffernan pers comm. Sept 2009)

Viral Diseases

Simian T-cell Lymphotrophic Virus (STLV)

Lymphoma is the most common spontaneous neoplasia in non-human primates including *P.hamadryas* and has been implicated as the causal agent of T-cell lymphomas (Graves, L. E. 2005).

Aetiology - STLV a member of the BLV-HTLV retroviruses. It can involve many organs such as the skin, lymph nodes, liver, spleen and lungs as well as causing anaemia and leukaemia (Williams, S. 2001).

Transmission is unknown but sexual contact, fighting and maternal transmission to offspring through milk has been assumed. Also contact with blood or other biological material from infected animals may establish infection (Graves, L. E. 2005).

Signs – Wasting, regional lymph node enlargement, skin sores and respiratory distress including dyspnoea (difficulty breathing), coughing and pneumonia-like signs. Also ocular and nasal infections, anaemia, diarrhoea, ear infections can be present (Graves, L. E. 2005).

Treatment – There is currently no treatment available. Possibly treatment with antibiotics (Graves, L. E. 2005).

Prevention

- Euthanasia of positive infected animals
- Females that are cycling can be housed with vasectomised males for socialisation and behavioural enrichment although if the males are STLV positive they could transfer STLV to the females (isolation)
- Blood testing of animals of unknown status, including white cell counts
- Retesting of negative animals
- Housing STLV positive females with STLV positive males (isolation)
- Avoid breeding from STLV positive females to reduce incidence in offspring from the spread in maternal milk.

(Graves, L. E. 2005) (Williams, S. 2001)

Herpes B Virus (*Herpesvirus simiae)*

Aetiology - Herpes B is a viral infection which is a very serious zoonotic disease that can be passed to humans and is usually fatal in humans. Herpes B virus is the endemic simplexvirus of monkeys. B virus is an alphaherpesvirus, which consists of a subset of herpesviruses that travel within hosts using the peripheral nerves. As such, this neurotropic virus is not found in the blood (Romich, J. A. 2008).

Fig 55: A monkey infected with *Herpesvirus simiae.* Note the ulcers in the inner mucosal surface of the lower lip.

Signs - Animals show few or any clinical signs. If signs are present they are similar to the signs seen in humans with herpes simplex virus such as vesicles and ulcers on the tongue and lips and in the mouth. Occasional vesicles may appear on the skin and conjunctivitis may also be seen (Krauss H. 2003).

Symptoms in humans: Local infection and vesicular rash at the site of transmission, muscle weakness, paralysis of infected limbs, conjunctivitis and difficulty eating. As the disease progresses, encephalitis, nausea, headaches, neck stiffness, fever, vision problems, ataxia, the virus can enter into the central nervous system where it can cause necrosis of the spinal cord and ascends to the brain and death can be caused by respiratory paralysis (Romich, J. A. 2008).

Transmission: Humans contract it by direct contact with the virus containing secretions from bite wounds with infected saliva, scratches or needle stick injuries, indirect transmission from fomites and aerosols (Romich, J. A. 2008).

Monkeys contract the disease through oral, ocular or genital contact of mucous membranes or breaks in the skin. It can be shed in bodily fluids of semen, milk and saliva in aerosol form (Krauss H. 2003).

Treatment: If one individual is bitten, scrub and/or wash the site for at least 15minutes with sterile saline or rapidly flowing water and a soap solution, iovone or chlorhexidine. Obviously sedation would have to be used if this was the treatment. Anti-viral therapy could be helpful.

Prevention:

- Caesareans can be performed on pregnant monkeys and immediate separation of females from their offspring can avoid infection in the newborn.
- Quarantining of new animals to colony.
- Regular testing for the disease.
- Avoid potential bites and scratches.
- Clean any bite wounds within 5 minutes of exposure.

(Krauss H. 2003) (Romich, J. A. 2008)

Hepatitis A

Aetiology - Hepatitis A (formerly known as infectious hepatitis) is an acute infectious disease of the liver caused by the hepatitis A virus (HAV), which is most commonly transmitted by the faecal-oral route via contaminated food or drinking water and in conditions of poor sanitation and overcrowding (Wikipedia 2009). Hepatitis A does not have a chronic stage, is not progressive, and does not cause permanent liver damage. Following infection, the immune system makes antibodies against HAV that present immunity against future infection (Wolfensohn, S. 2005).

Signs - Early symptoms of hepatitis A infection can be mistaken for influenza, but some exhibit no signs at all. Symptoms can return over the following 6–9 months and include lethargy, diarrhoea, not eating and therefore weight loss, depression, jaundice, (a yellowing of the skin or whites of the eyes) and itching (Wikipedia 2009).

Treatment - There is no specific treatment for hepatitis A. Possibly rest, feeding a well-balanced diet, and trying to keep the animal hydrated (Wikipedia 2009) (Wolfensohn, S. 2005).

Prevention - The disease can be prevented by vaccination, replacement of substrate in enclosures where possible, regular cleaning and hosing of night houses good husbandry and hygiene protocols in the workplace, water supply free from faecal contamination (Wolfensohn, S. 2005).

Hepatitis B

Aetiology - The hepatitis B virus primarily interferes with the functions of the liver by replicating in liver cells, known as hepatocytes and causes an inflammation called hepatitis. Transmission of hepatitis B virus results from exposure to infectious blood or body fluids containing blood. Possible forms of transmission include unprotected sexual contact, blood transfusions, re-use of contaminated needles and syringes, and vertical transmission from mother to child during childbirth (Wikipedia 2009).

Signs - General ill-health, loss of appetite, vomiting, fever, dark urine, and then progresses to development of jaundice (Wikipedia 2009).

Treatment - Acute hepatitis B infection does not usually require treatment because most can clear the infection spontaneously. (Wolfensohn, S. 2005)

Prevention - The disease can be prevented by vaccination, regular cleaning and hosing of night houses good husbandry and hygiene protocols in the workplace, water supply free from faecal contamination (Wolfensohn, S. 2005).

Tetanus

Aetiology - Tetanus affects skeletal muscle, a type of striated muscle used in voluntary movement. Infection generally occurs through wound contamination and often involves a cut or deep puncture wound (Wikipedia 2009).

Signs - Unable to move the mouth (lock-jaw), stiffness of the neck, difficulty in swallowing, and rigidity of pectoral and calf muscles. Other symptoms include elevated temperature, sweating, elevated blood pressure, and rapid heart rate (Wikipedia 2009).

Treatment - The wound must be cleaned. Dead and infected tissue should be removed by surgical debridement. Metronidazole treatment decreases the number of bacteria but has no effect on the bacterial toxin. Diazapam can also be used to relax the skeletal muscles Tetanus immunoglobulin can be given intravenously or intramuscularly, and a

tetanus vaccination can be given (Scott Heffernan pers comm. Sept 2009) (Wikipedia 2009).

Prevention - Tetanus can be prevented by vaccination with tetanus toxoid. Recommendations are a booster vaccine be given every ten years. Instant cleaning and debridement of wounds (Scott Heffernan pers comm. Sept 2009) (Wikipedia 2009).

Measles

Aetiology - Measles is a very infectious disease which can be spread from man to monkey, man to man and monkey to man. Measles is excreted from the mucous membranes of the eye and pharynx and later from the respiratory and urinary tracts (Romich, 2008).

Signs - Rash, fever, facial oedema, giant cell pneumonia, conjunctivitis, nasal discharge

Treatment: Vaccination is available. Isolation of infected animals (Romich, 2008).

Prevention

- Vaccination is available
- Good husbandry and hygiene protocols in the workplace

(Romich, 2008)

Tuberculosis

Aetiology - It is due to either *Mycobacterium tuberculosis* or *M. Bovis*. It does not occur naturally in *P.hamadryas* and outbreaks are generally caught initially from humas and then spread within *P.hamadryas* populations. Infection occurs via the inhalation route and occasionall by digestion (Wikipedia 2009).

Signs - Clinical signs may be absent until the disease has become advanced and the most common sign is a cough (Wikipedia 2009).

Treatment – It could possibly be controlled by 40–80 mg/kg daily dose of Isoniazid (Wikipedia 2009).

Prevention - New animals should come with health profiles that have at least 3 negative tuberculin tests before arrival or they should be quarantined and screened on arrival. Any animal that has contacted a known human case should be effectively quarantined for at least 6 months until it is proven not to have contracted the disease. Control visitors. Personel working should have Mantoux TB screenings (Scott Heffernan pers comm. Sept 2009).

P.hamadryas can be screened using an intradermal skin test on the eyelids. Thoracic radiographs can be carried out. At the Australian National Baboon Colony, on routine testing of all individual baboons, Mantoux TB intradermal tests are done on the left upper eyelid, unless there is a mole or lump on the left eyelid, then the right eyelid is used and the site which is injected is always noted. Please see **APPENDIX 8** on the physical examination sheet outlining the

Fig 56: A Mantoux TB test on the right eye of this primate which is positive (Tufts University 2010)

Mantoux test.

Bacterial Diseases

Conjunctivitis

Aetiology – The cause could be due to viral infections, bacterial infections, allergies, injuries or foreign bodies.

Signs – Eye redness, watering, swelling, irritation, eye discharge or gunk (Wikipedia 2009).

Treatment – Non-steroidal anti-inflammatory medications and antihistamines may be given. Some patients with persistent allergic conjunctivitis may also require topical steroid drops (Wikipedia 2009) (Scott Heffernan pers comm. Sept 2009).

Prevention - Conjunctivitis is usually contagious and although a cause may not be determined, it is recommended that optimum hygiene to prevent spreading it to others be practiced and also isolation of the infected animal be carried out. Non-contagious conjunctivitis could be from foreign bodies or eye injuries so should then just be treated (Scott Heffernan pers comm. Sept 2009) (Wikipedia 2009).

Traumatic Injury

Fight injuries, muscle strains, broken appendages all usually from fighting and conflicting individuals (Scott Heffernan pers comm. Sept 2009).

Signs - Animal may try to hide the wound/injury, lameness on limbs, wounds, blood on hair, swelling on site of injury, animal cowering in the corner (Scott Heffernan pers comm. Sept 2009).

Treatment - Sedation and suturing of wounds or just general cleaning and disinfecting of wounds. Possibly antibiotics and analgesics. Possible surgery and amputation of limbs (Scott Heffernan pers comm. Sept 2009).

Prevention – Try not to house conflicting animals together. Be observant with animals and know their individual behaviours. Treatment of traumatic injuries should be carried out immediately to prevent infection (Scott Heffernan pers comm. Sept 2009).

Enviromental

Environmental factors can play a role if an individual falls ill or not

Hypothermia

Aetiology - Hypothermia results when body heat loss exceeds body heat production. Hypothermia is most common during cold weather or immersion in cold water, but it may occur when the animal is immobile on a cool surface (e.g., when under anaesthetic) Hypothermia is a core body temperature of below 35° C (Wikipedia 2010).

Signs - Intense shivering occurs initially, but it ceases below about 31° C, allowing body temperature to drop more precipitously. CNS dysfunction progresses as body temperature decreases; Lethargy and clumsiness are followed by confusion, irritability, sometimes hallucinations, and eventually coma. Pupils may become unreactive. Respirations and heartbeat slow and ultimately cease. Initially, sinus bradycardia (slowed heart rate) is followed by slow atrial fibrillation; the terminal rhythm is ventricular fibrillation or asystole (Wikipedia 2010)..

Treatment – Mild hypothermia requires a warm environment and insulating blankets (passive rewarming). Severe hypothermia requires active rewarming of the body surface (e.g., with forced-air warming systems, radiant sources) or core (e.g., inhalation, heated infusion and lavage, extra bodily blood re-warming). Inhalation of heated humidified O_2

(40° to 45° C) via mask or endo-tracheal tube eliminates respiratory heat loss and can add 1° to 2° C/hr to the re-warming rate.

Prevention – Make sure there is an area for all baboons that is temperature controlled and if the enclosure is in an environment that is not close to their natural temperature environment, then every effort has to be made to mimic this temperature. Also shelter has to be provided in the enclosure for the animal to escape the harsh elements of the weather. (Merck, 2010)

Hyperthermia

Aetiology - Hyperthermia is an elevated body temperature (greater than 39°C) due to failed thermoregulation. Hyperthermia occurs when the body produces or absorbs more heat than it can dissipate. When the elevated body temperatures are sufficiently high, hyperthermia is a medical emergency and requires immediate treatment to prevent disability and death (Wikipedia 2010)..

Signs - Hot, dry skin is a typical sign of hyperthermia. The skin may become red and hot as blood vessels dilate in an attempt to increase heat dissipation, sometimes leading to swollen lips. An inability to cool the body through perspiration causes the skin to feel dry (Wikipedia 2010).

Other signs include vomiting, low blood pressure, ataxia. Heart rate and respiration rate will increase as blood pressure drops and the heart attempts to supply enough oxygen to the body. The decrease in blood pressure can then cause blood vessels to contract, resulting in a pale or bluish skin colour. Eventually the animal will fall into a coma

Treatment - Mild hyperthemia treatment includes drinking water and resting in a cool place. A cooled room (air-conditioned) area can be provided to the animal if possible. Intravenous fluids at a steady constant rate can be administered if possible to aid in re-hydrating the animal.

Prevention – Make sure the animal has plenty of fresh water available to drink. Make sure there is an area for all baboons that is temperature controlled and if the enclosure is in an environment that is not close to their natural temperature environment, then every effort has to be made to mimic this temperature. Also shelter has to be provided in the enclosure for the animal to escape the harsh elements of the weather (Wikipedia, 2010)

Miscellaneous

Dermatitis

Dermatitis is a blanket term meaning any 'inflammation of the skin' (e.g. rashes, etc.). There are several different types of dermatitis. The different kinds usually have in common an allergic reaction to specific allergens. Dermatitis can be from insect bites, allergies, fungal infection, bacterial infections etc (Wikipedia 2009).

Signs - Itchiness and redness of the skin. Hair loss. Scaly thick skin

Treatment - Cortisone creams with anti-fungal/anti-bacterial agents and local anaesthetics in, cortisone tablets, anti-histamines.

Prevention - Try to find the cause of the dermatitis and try to rectify the problem (Scott Heffernan pers comm. Sept 2009)

Pneumonia

Pneumonia is an inflammatory illness of the lung. Frequently, it is described as lung parenchyma/alveolar inflammation and abnormal alveolar filling with fluid (Wikipedia 2009).

Aetiology - Pneumonia can result from a variety of causes, including infection with bacteria, viruses, fungi, or parasites, and chemical or physical injury to the lungs. Its cause may also be officially described as idiopathic, meaning unknown when infectious causes have been excluded. Pneumonia can be caused by microorganisms, irritants and unknown causes. When pneumonias are grouped this way, infectious causes are the most common type (Wikipedia 2009).

Signs - Typical signs associated with pneumonia include cough, in severe cases they may cough up blood, fever, and dyspnoea (difficulty in breathing), not eating, lethargy, blueness of the skin, vomiting, increased respiratory rate, low blood pressure, a high heart rate, or a low oxygen saturation. Diagnostic tools include radiographs (Wikipedia 2009).

Treatment - Treatment depends on the cause of pneumonia; bacterial pneumonia is treated with antibiotics. Vaccines to prevent certain types of pneumonia are available.

Typically, oral antibiotics, rest, fluids, and home care are sufficient for complete resolution (Scott Heffernan pers comm. Sept 2009) (Wikipedia 2009).

Prevention - Isolation of infected animals (Scott Heffernan pers comm. Sept 2009)

8.5 Quarantine Requirements

If *P.hamadryas* have been held captive and in close contact with humans, care must be taken to screen them for all those diseases that are transmissible between human and non-human primates. Information about such diseases on a regional basis can be obtained from local medical authorities but it is important to remember that if foreign research workers or tourists have had access to the individual, exotic infections acquired overseas may occur in both the human and non-human primates.

The risk of zoonotic disease transmission, in both directions, is greatly reduced if all attendant staff always wears facemasks, gloves and gowns when in contact with *P.hamadryas*. Also if keepers' protective outer clothing has been heavily soiled whilst caring for *P.hamadryas* which is in quarantine, they must be soaked in an appropriate disinfectant prior to being sent for washing. A footbath containing an effective disinfectant must also be used prior to entering all *P.hamadryas* quarantine enclosures, or areas containing quarantine enclosures and its use strictly adhered to by all personnel.

In view of the high risk of *P.hamadryas* carrying zoonotic diseases, quarantine requirements are severe. They should be held in strict quarantine for at least **30 days** after arrival and before any further relocation. Many institutions insist on **60 days** of quarantine and increase this to **90 days** for animals of unknown medical histories, those with known exposure to infectious disease, or for wild-caught animals. While in quarantine the tests that need to be carried out for each individual of *P.hamadryas* is as follows:

- Faecal examination (direct and flotation) for endoparasites, which often infect *P.hamadryas*, causing diarrhoea in animals subjected to stress. Since endoparasites are shed intermittently, several samples should be examined. Primates should have three consecutive negative faecal examinations before release.
- Faecal culture for *Salmonella sp., Shigella sp., Campylobacter sp.* and *Yersinia sp*. The need to carry out these tests should be based upon the history of the animal and their origin. Since these organisms are often shed intermittently by primates, which may exhibit no clinical signs of infection, three consecutive faecal cultures may be required.
- Appropriate serology, based on history and origin, for toxoplasma, retroviruses, parainfluenza, measles, cytomegalovirus, Simian Immunodeficiency Virus (SIV) and Hepatitis A, B, C (HAV, HBV, and HCV). All Hepatitis virus infections in *P.hamasryas* are diagnosed serologically. Personnel working with non-human primates should consider vaccination for both HAV and HBV.
- All *P.hamadryas* should be serologically tested for *Herpesvirus simiae* (Herpes B). The quarantine period for Herpes B infection in *P.hamaryas* is **42 days.** Due to the lethal potential of Herpes B virus for other primates, **including humans**, precautions must be taken to prevent exposure.
- Carry out serum/plasma chemistry profile.
- Carry out urinalysis if possible.
- Carry out complete Blood Count and PCV.
- Blood smears should be examined for *Filaria sp*. and *Plasmodium sp*. (malarial parasites). Filarial Infections, however, seem not to be pathogenic.
- Three negative tests for tuberculosis should be performed at two-week intervals using a tuberculin containing at least 1500 units/0.1 ml (eg. Mammalian human isolate, Coopers Animal Health, Kansas City, Kansas, USA) or “old mammalian tuberculin” (Pasteur Institute, Paris, France). The tuberculin should be injected into the upper eyelid.

(Quarantine in translocation PDF file – EduCampus TAFE NSW Richmond Campus 2009)

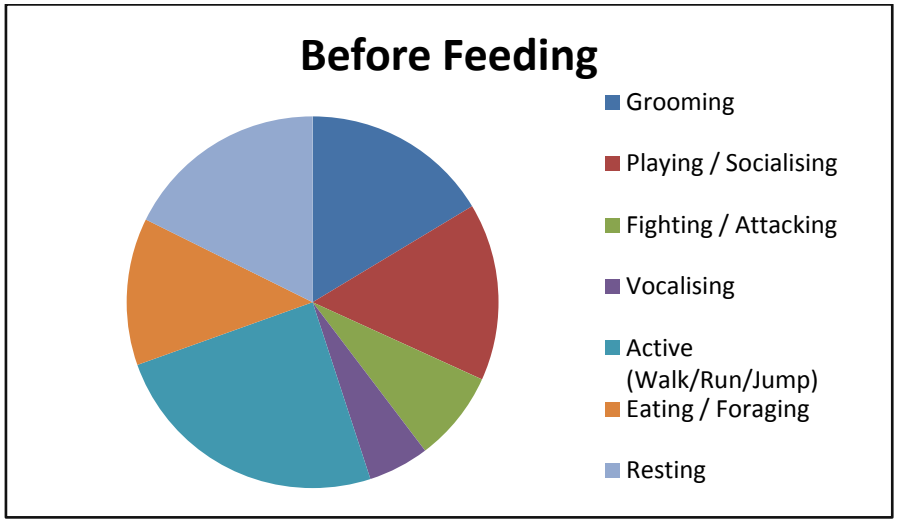
9 Behaviour

9.1 Activity

Fig 57: A male *P.hamadryas* foraging (Turner, L. 2009)

- Hamadryas baboons are quadrupedal (having four feet), diurnal (active during the day) and mostly terrestrial (spend most of their time on the ground).
- They feed during the day, mostly foraging.
- Clans of *P.hamadryas* come together in search for food each day.
- They must travel large distances to find food and water on a daily basis. The daily range of *P.hamadryas* varies from 6.5 to 19.6 km. (Nowak, 1999)
- The maximum home range size for *P.hamadryas* is approximately 40 square km. (Nowak, 1999)
- They sleep on rocky outcrops at night in troops for protection against predators.
- They don't have a time of torpor (hibernation).
- As in all primates, *P. hamadryas* can spend a significant amount of time engaged in social grooming. Social grooming is thought to help develop and maintain social bonds between animals. Most social grooming is performed by females and is directed toward the leader of the One Male Unit (OMU). Other forms of tactile communication in this species include reassuring touches and embraces, as well as a variety of agonistic bites and slaps. (Kummer, 1968)

Below is an activity table constructed from family groups of captive *Papio hamadryas* at the Australian National Baboon Colony before feeding. Here you can see the daily time taken in a few different tasks (ANBC, 2009)



Graph 1: Activity of Hamadryas Baboons before feeding (Turner, L. 2009)

9.2 Social Behaviour

P.hamadryas are highly social animals, which display a complex, multi-level social structure. The basic unit of social organisation is:

- One Male Unit (OMU)
- Clan
- Band
- Troop

(Kummer, H. 1968)

The OMU, or one male unit, is where a central male, the leader, aggressively herds and controls from 2 to 10 females and their offspring. Members of a OMU forage together, travel together, and sleep together. Males typically restrict the social interactions of females and juveniles within their OMU, suppressing aggression between females, and maintaining nearly exclusive reproductive access to the mature females. A single OMU may be comprised of from 2 to 23 animals, although the average is 7.3 animals per OMU (Kummer, 1968; Stammbach, 1987) (Heffernan, S. 2006).

Fig 58: An example of a One Male Unit (OMU) (Heffernan, S. 2006)

Please see **APPENDIX 15** for more information regarding a OMU.

Fig 59: An example of a clan of baboons (Heffernan, S. 2006)

Two to three OMUs come together to form clans. The males found in a clan are thought to be close genetic relatives of one another. Social interactions occur with greater frequency within, than between clans. Also, clans form unified foraging groups, often separating themselves from other clans during foraging. (Kummer, 1968; Primate Info Net, 2002; Stammbach, 1987)

Two or three clans form a single band. Bands exhibit stable membership, even if membership in lower levels of social organisation is not stable. Males and females typically do not disperse beyond the boundaries of the band. Male OMU leaders suppress any attempts of infants or juveniles to interact with like-aged animals in different bands and therefore OMU leader males are the main fighter. (Kummer, 1968; Stammbach, 1987)

Fig 60: An example of a band of baboons (Heffernan, S. 2006)

Please see **APPENDIX 15** for more information regarding bands.

Troops of *P.hamadryas* may contain several bands. Troops are masses of baboons which utilise the same sleeping cliffs or rocks. It is unlikely that the troop has any social significance each other. They come together because of a limited number of sleeping sites available in the habitat. This level of organisation appears to be an artifact not of the affiliative tendencies of the species, but the limited number of sleeping sites available in the habitat. (Kummer, 1968; Stammbach, 1987)

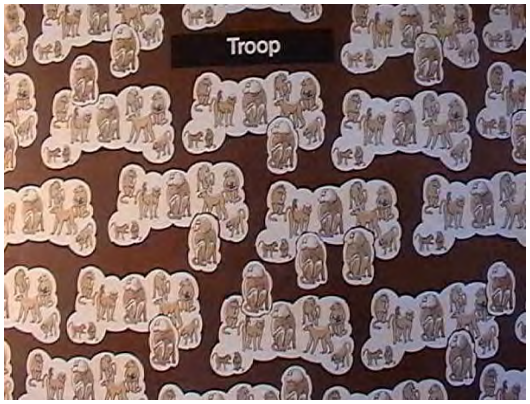


Fig 61: An example of a troop of baboons (Heffernan, S. 2006)

Fig 62: This high rocky outcrop serves as an ideal sleeping place for troops of *P.hamadryas*

Please see **APPENDIX 15** for more information regarding troops.

In comparison, the other baboon species tend to form very loose groups and are not as structured as the Hamadryas society. For example, the Olive Baboons society consists of a loose association of animals mostly females, usually 20-50 in number with up to 5 adult males, that work together to lead and protect the group (Shefferly, N. 2004). However there is constant aggression and struggles for dominance to determine breeding rights to the majority of the females. (Heffernan, S. 2006)

The Hamadryas Baboon *Papio* hamadryas, as the author has seen from working with them have a very unique and extensive range of communication techniques (Heffernan, S. 2006):

Vocal communications

- **Rhythmic grunts:** This is a series of low soft grunts heard throughout the day as the group spreads out to feed, while travelling, during friendly social interactions, and as they settle into the sleeping site in the evening (Ransom 1981; Smuts 1985).It is used by all Hamadryas baboons except infants. It is used also used when approaching another member of the group or troop to signal friendly intentions.
- **Roar-grunt:** Is heard in displays by adult males, this call is given through closed lips and is deep in pitch and sounds like a low humming.
- **Two-phase bark:** This is a deep penetrating loud call which sounds like “wa-hoo”. It is used by adult males to announce their presence and when predators are in the area such as low-flying birds. It is also used during times of distress, such as when a baboon is separated from the group and trying to regain contact, and at night at the sleeping site in response to neighbouring groups. In a captive intuition this ‘wa-hoo’ is also heard as a warning to let others know that food is coming and the colony starts to vocalise and move around.
- **Disjointed coughing:** This vocal is like a fake cough and is designed to indicate submission or disinterest in any aggression.
- **Shrill scream or bark:** This is an alarm call used mainly by females and juveniles when there is a predator in the area such as a snake. All members of the troop will flee immediately to higher ground when this call is used. (Heffernan, S. 2006). It is also used in startled responses from other group members or other things also in response to intense emotion including pain, fear, and aggression (Ransom 1981; Strum 1987).
- There are a few calls given only by juveniles and infants including **"moans"**, **"basic gecks"**, and **"panting"**. Both **"moans"** and **"basic gecks"** are distress calls given in times of discomfort, fear, separation from the mothers, weaning, and during tantrums. "Panting" is heard during rough-and-tumble play, presumably when young that are having fun, and sounds like breathy laughter (Ransom 1981).
- **Lip-smacking:** This is when the lips are protruded, then smacked together repeatedly. This is a reassuring display between individuals. Like the "grunt" vocalisation, "lip-smacking" is a common behaviour heard in a variety of social contexts including grooming and sexual behaviour. It conveys a connection, reassurance, resolution, submission, and comfort (Easley & Coelho 1991).

(Heffernan, S. 2006)

Visual Communication

Aggressive displays:

- **Staring:** This is a unique primate behaviour which consists of direct eye contact from the aggressor followed by raising of the eyebrows to expose the whites of the eyelids. The intention is to warn the intended victim to submit or be attacked.
- **Staring with open mouth:** This behaviour is used as a progressive bluff to ones opponent, starting with staring than a slow yawn showing no teeth. This then progresses to the next stage which is tension yawning.
- **Tension Yawning:** This display is getting serious, the mouth is fully extended in slow deliberate movement designed to show off the size and ferocity of the canines. The length of their canines is exaggerated and when given in operation with eyebrow raising it indicates increasing levels of threat (Ransom 1981; Strum 1987).
- **Pumping mouth and cheeks:** All of the above displays are shown, then followed by a fast and furious pumping of the cheeks. Usually followed by the two aggressors rushing at each other and attempting to get the upper hand.
- **Head bobbing:** This is another threat display sometimes associated with the staring and yawning.
- **Neck Bite:** Neck biting is the method used by the male Hamadryas Baboon to reprimand his females if they do not follow him or show interest in another male. Therefore encouraging the classic herding behaviour seen in this species.
- **Slapping ground:** This behaviour is usually performed by females or juvenile animals of both sexes, usually when their personal space has been invaded or when strangers come into their territory.

(Heffernan, S. 2006)

Fig 63: A male *P.hamadryas* tension yawning (aiatsis.gov.au. 2009)

Submissive Displays

- **Mock foraging:** This is a displaced behaviour which occurs after a fight to show the aggressor that they have no interest in continuing the fight.
- **Teeth Chattering:** This is done by the male baboon to a female that is presenting.
- Bending elbows and knees while standing
- Crouching (pressing belly to ground)
- Running away

(Heffernan, S. 2006)

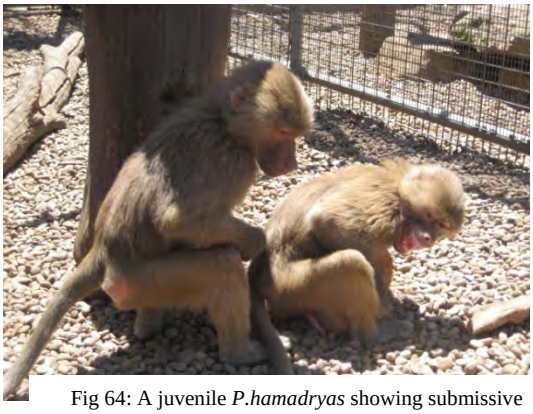


Fig 64: A juvenile *P.hamadryas* showing submissive behaviour to another (Turner, L. 2009)

Affectionate Communication

- **Presenting :** Presenting of rear by a cycling female to a male to initiate copulation
- **Social presenting:** The baboon also uses presenting as a friendly and submissive behaviour. Between males it is referred to as 'notifying' and usually involves a very quick presentation of the rear and a very deliberate retreat as they pass each other.
- **Social mounting:** This is generally a response to signal a friendly reassurance. It is also seen at the end of aggressive encounters.
- **Grooming:** This is when one individual removes parasites and dead skin with their hands from another individual. It is used to reinforce social bonds. Animals often just go through the motion of grooming even if there are no parasites or wounds that need cleaning.
- **Hugging:** This is used as a protective gesture between adults as well as adults and juveniles.

(Heffernan, S. 2006)

Please see **APPENDIX 15** for more information of communication in Hamadryas Baboons

9.3 Reproductive Behaviour

Reproductive behaviour in *P. hamadryas* is closely tied to social organisation. With the basic breeding unit of the OMU, the leader male aggressively herds females, keeping them from straggling during the foraging march, and preventing them from socialising with other males. Females typically spend most of their social time in proximity to the leader male. This gives him the right to breed with her and only her as well as the rest of his females. Most social grooming within the OMU is focused on the leader male, with females grooming him, especially his mane, face, and buttocks. The pelage characters of males can therefore be thought of as strong mate attractants, and seem to function in the maintenance of the OMU. (Kummer, 1968; Stammbach, 1987; Shefferly, N. 2004)

Fig 65: A female *P.hamadryas* grooming her leader male of the OMU (Turner, L. 2009)

Fig 66: An example of a neck bite but in juveniles (Telegraph, 2010)

The male Hamadryas uses strong discipline, such as neckbites, aggressive displays of the teeth (slow yawning) eyebrow raising and flashing the whites of their eyelids to keep his group together or if females show an interest in other males. The female Hamadryas is taught to follow and respect the male from a young age, if they lag behind when the group is moving the male will make aggressive eye contact with the offender, running aggressively towards them, encouraging them to follow him. If they do not respond this it will be followed by a prompt bite to the neck. This behaviour ensures exclusive breeding rights to his females. (Heffernan, S. 2006)

Courtship displays for male

The male when wanting to breed with the female will keep her close to him, he will continually smell and touch the perineum and he makes her follow him. He also protects her from other males. He will vocalise lip-smacking of reassurance and interest to her and there will be increased mounting by him (Scott Heffernan pers comm. Oct 2009).

Courtship displays for female

The female will stay close to the male and vocalise reassurance to him. She will also be continually presenting her perineum to him to initiate copulation (Scott Heffernan pers comm. Oct 2009).

Fig 67: A male touching a cycling females perineum during courtship (Heffernan, S. 2006)

Please refer to **section 10** of breeding for more information.

9.4 Bathing

As seen by the author, *P.hamadryas* like other baboons, enjoy fresh water bodies. Especially juveniles as they are often seen jumping around and playing in them. Therefore half shell plastic pools can be provided in enclosures as well as their drinking water to allow for this excitement of playing in water. (Scott Heffernan pers comm. Oct 2009).

Fig 68: Plastic half shell pool with a juvenile baboon playing on it (Turner, L. 2009)

9.5 Behavioural Problems

- **Head swivel and pacing** caused by frustration. It is more present in females and hand raised animals. Can be avoided by movements, a change of scenery, furniture movements and environment enrichment (Heffernan, S. 2006).
- **Over-grooming** or hair pulling of oneself is possibly due to boredom from being isolated before going into a proper colony set up. Females tend to groom more and therefore can over-groom. It is hard to rectify but can possibly be helped by environment enrichment (Heffernan, S. 2006).
- **Rocks in cheek pouches** in consequence stretches the skin immensely. This is a learnt behaviour. It is hard to say whether this is an abnormal behaviour from boredom or a normal behaviour to fit more food into their cheek pouches (Heffernan, S. 2006).
- **Fighting** between bachelor males or other males from trying to get the attention of a female. This can be controlled by choosing compatible cage mates and also movements (Heffernan, S. 2006).
- **Aggression toward keepers** is not considered a behavioural problem. This is because it is in their genetic make-up to defend and protect each other or in a OMU instance, the male to protect his females and young. When being challenged, this is the natural reaction which happens in the wild. There is no need to change or try to rectify this problem. The only time aggressiveness would be a problem is when the animal is overly aggressive for no reason or grabs the keeper every time they walk past. This could possibly be because of being mistreated from keepers. To help or try to resolve this problem, keepers need to be wary and they need to learn visual and vocal threats from the baboons but also threatening gestures from themselves to the baboons. Also the problem animal can be conditioned and trained more using food reward and they should also try to have more human contact (Heffernan, S. 2006).
- **Not competing for food.** This maybe because of a very dominant cage mate, the social structure in the group or it is a very submissive animal. To control this, movements of individuals can be done so the cage mates have more suitable companions. Otherwise the individual may be unwell by such things as intussusception or an overload of parasites. Treatment of parasites or the cause of the baboon being unwell should be investigated (Heffernan, S. 2006)..

Please see **APPENDIX 15** for more information on behavioural problems.

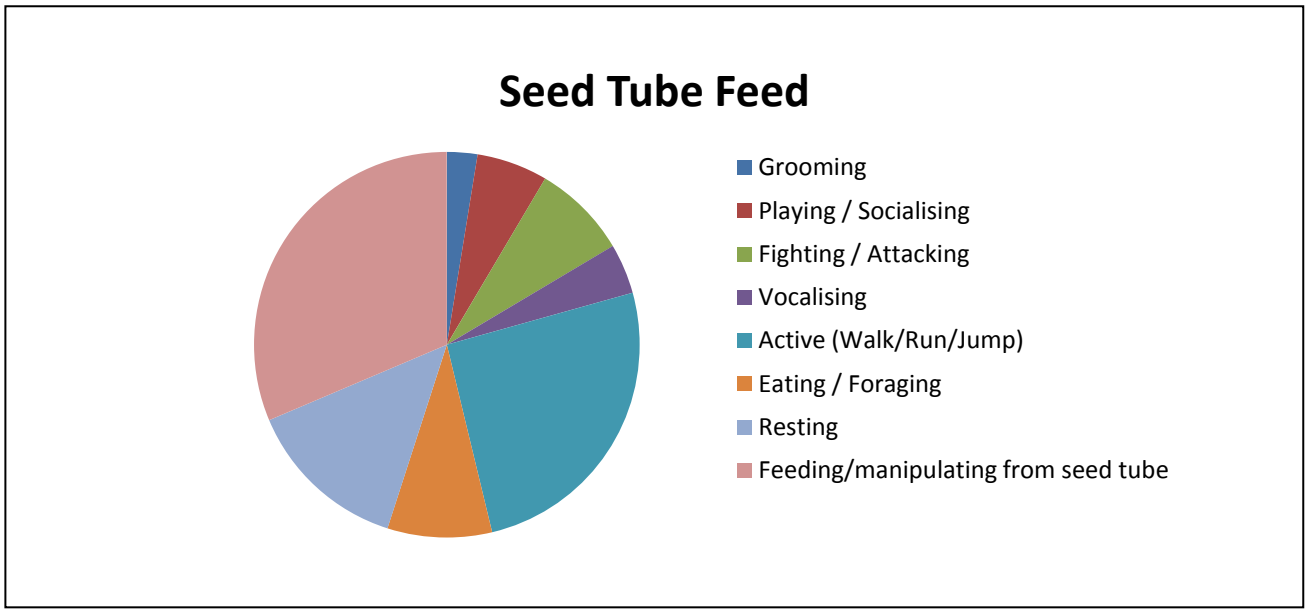
9.6 Signs of Stress

- Defecating and urinating
- Aggression especially with the males trying to protect his females and young
- Displacement aggression where the leader male in the OMU is aggressive toward his females and young because of being stressed
- Screaming
- Running away
- Refusing to obey your dominance and therefore what you want them to do
- Calling out
- Mother with an infant will push or pull her infant off of her
- Weight loss
- Not eating

If signs of stress are recognised in an individual, these issues need to be addressed. The cause of the stress needs to be established and a resolution for reducing stress needs to be enforced (Heffernan, S. 2006).

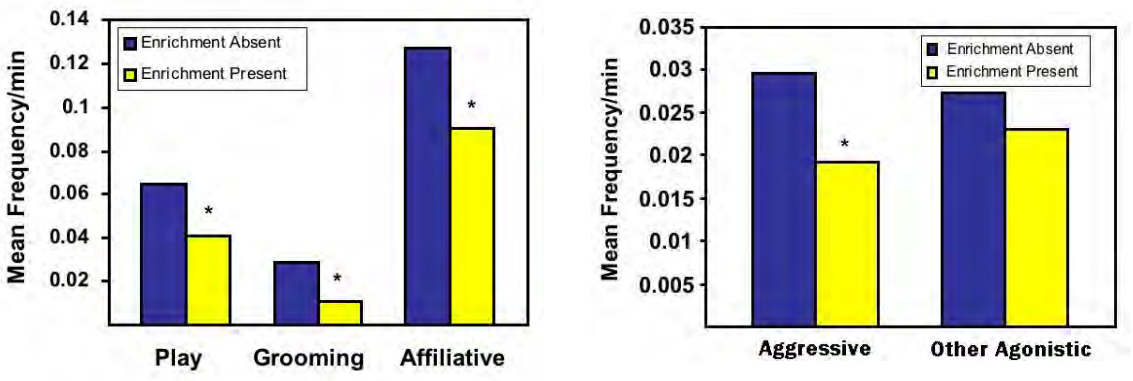
9.7 Behavioural Enrichment

Below is an activity table constructed from family groups of captive *Papio hamadryas* at the ANBC during an enrichment seed tube feeding. Here you can see the difference from **Graph 1** in **section 9.1**, that the other activities/behaviours decrease and activity and feeding from the seed tube increases (ANBC, 2009).



Graph 2: Activity of Hamadryas Baboons when giving them seed tubes for enrichment (Turner, L. 2009)

Below are some other graphs taken from a primate website indicating the difference in behaviours before and after enrichment. As you can see again behaviours decrease because of enrichment.



Graphs 3: Indicating different behaviours for primates before enrichment and after enrichment. You can see a noticeable difference in behaviours being reduced when enrichment is introduced because they would be spending time concentrating on the enrichment present (www.brown.edu)

MECHANICAL DEVICE ENRICHMENT

Used by the author at the ANBC and can include:

- Half shell plastic pool. Filled up with water and used as a pool. Used mostly for juveniles in times of heat and playing. Food can be put into the bottom of the pools to encourage use of the pool.
- Balls of all sizes can be used for all types of games and excitement. Hard plastic should mainly be used so they can't be destroyed in minutes. Also balls with rattles in them can bring excitement to see what is inside.
- Tire swings hung from the roof for entertainment and swinging on.
- Natural log swings
- Raceways from one enclosure to another and flaps open at separate times to allow exercise and playing.

Fig 69: A tire swing attached to the inside of a cage (Lauren Turner, 2009)

Fig 70: Juveniles running in a raceway (Turner, L. 2009)

Other enrichment devices may include:

- ACRYLIC SHEET FEEDER - 1/2 inch thick acrylic strips cut to 5 by 8 inches. 1/4 inch holes are drilled randomly throughout and filed smooth. Food or mealworms are spread in the holes (jam holds the mealworms in place). (Enrichment online)
- FORAGING PAN - A box is made with a hole in the hinged lid. The box is filled with natural litter and food items. Drill a hole into the hinged lid on the box. Secure the lid to the box with a hasp and a clip. Fill the box 2-3 inches deep with natural litter such as Breeder Choice Cat Litter. Add food items, such as grapes or raisins (Enrichment online). Please see **APPENDIX 10** for where to buy Breeders Choice Cat Litter.
- ACTIVITY BOARD - A wood board with drilled holes that you can attach chain and "activity" items to. Drill 4-5 holes along the length of the board. The top hole is used for attachment to the exhibit, while the other holes can be threaded with chain or sisal. You can use extra locks to keep the chains on, which ends up being one more "toy" to play with. Everything else can be varied that is attached to it. (Enrichment online)
- Newspaper or phone books can be used for manipulation although the baboons may consume these. (Enrichment online)
- MEALWORM BAGS - Bags that mealworms are delivered in are given to the animals with a few worms inside them. (Enrichment online)
- FEEDER BOXES - Boxes made of plexiglass, wood or plastic sheets with holes drilled throughout and food placed inside. (Enrichment online)
- Automatic feeder boxes – With live insects in them or other food items. These boxes can be place just outside of the cages and a timer can be set when it is set to open and therefore some insects coming out.
- Logs or natural items stuffed with food. This gives them a toy of concentration while getting rewarded for playing with it.

SENSORY STIMULATION

- Visual stimulation in that they should be able to see other baboons
- They should be able to have access to an outside enclosure to lay in the shade or bask in the sun
- Television set up on one side of the enclosure to stimulate visual senses. This could be of kids programs and cartoons. Animal footage could be tested although this may have a negative effect
- A mirror set up so they can see the reflection of themselves and to aid in curiosity
- Putting posters up of different animals around and moving them from time to time
- Putting up mobile cut outs of different shapes or pictures so they move
- Sounds of other animals can stimulate their natural environment or create curiosity of new sounds. Mostly sounds of birds etc should be played. Other baboon sounds can be tested but this may have a negative effect.
- Sound of the radio can be played. This should be tested to see if this causes a stress response or a curiosity response
- Feathers or fur of other animals as well as scents of other animals around the enclosure can stimulate curious behaviour. This can include faeces and urine of other animals.

- Scents of different herbs to aid in smelling different things
- Smearing food around, scattering food around and burying food around the enclosure to encourage natural foraging.

(Heffernan, S., 2006; Scott Heffernan pers comm. Oct 2009; TAFE Class 2009)

Please see **APPENDIX 16** for an enrichment calendar for one month as an example of an enrichment schedule. Also a blank sheet to observe behaviours before and after enrichment is introduced.

9.8 Introductions and Removals

If introducing any new animal, strict quarantine measures have to be taken so other individuals do not contract any form of disease that the new animal may have. As mentioned in **section 8.5** of quarantine requirements they should be held in strict quarantine for at least **30 days** after arrival and before any further relocation. This means they should be held in a holding yard/enclosure away from the colony. Many institutions insist on **60 days** of quarantine and increase this to **90 days** for animals of unknown medical histories, those with known exposure to infectious disease, or for wild-caught animals (Quarantine in translocation PDF file – EduCampus at TAFE NSW Richmond Campus 2009) (Department of Primary Industries 2010).. While in quarantine numerous tests that need to be carried out for each individual and this is outlined again in **section 8.5**.

After quarantine requirements have been met introductions should be slow especially with males. Introduction must occur in a stepwise manner, increasing contact from sound and smell to sight and finally to physical.Adult males should be housed with a spare cage in between them or a juvenile cage in between them to get used to each other. Then depending how the colony is set up, they can potentially be housed next to each other after a period of getting used to each other, if one of the males does not have any females attached to him. If both the males need to be house in the same cage as a bachelor group, and if all goes well after being in separate cages next to each other, then they can be housed in the same cage. Observations have to be regular and are crucial to make sure no fighting and aggression is to occur. If females are to be introduced to an already established One Male Unit (OMU) then they can be put straight into the enclosure because the male will straight away claim her as his and she will fit into the hierarchy of females straight away. If a female is to be introduced to a just female group then there will be fighting and aggression present so this has to be a slow introduction as well. The process of introduction may take several months. Often the use of a different, neutral cage facilitates introductions/reintroductions. Once given physical contact, the group must be very closely observed for 48 hours with daily monitoring for at least two months (Scott Heffernan pers comm. Oct 2009).

If animals are removed from their groups the animals can get stressed especially if it is a removal of a juvenile or infant from their mother. She will call out to them for a day or two. If it is the leader male from a OMU being separated from his females and young, they will also get stressed and start calling out for him. If he is only away for a day then this time would not have a great impact on the group if they are kept in separate

enclosures. If he is away for a few days then the calling out for him will be picked up by other males and the other males will try and get to the females to steal them. If the male is removed from a clan of OMUs housed together then the females would get stolen by other males straight away. When the male is reunited with his females, enclosures are kept separately, then they will vocalise loudly and bond with him straight away (Scott Heffernan pers comm. Oct 2009).

9.9 Intraspecific Compatibility

P.hamadryas are definitely compatible in regards to housing females with females and males with males. As mentioned above in **section 9.2** they are found naturally in One Male Units (OMUs), clans, bands and troops as they are a highly sociable animal and need companions. In regards to cycling in females, if one female starts cycling, she does not make another female cycle for the fact that each individual is different in their development, growth and hormonal levels. If housing males in bachelor groups, care has to be taken in regards to aggression and fighting between them for trying to get the attention of females and also other triggers that make them fight. Therefore compatible males should be housed together (Scott Heffernan pers comm. Oct 2009).

If housing clans or bands of *P.hamadryas* in one big enclosure then more fighting would be occurring between the leader males of their OMUs. Also it would be hard to determine the parentage of a lot of young as other males can 'sneak' copulations with females and therefore inbreeding can occur. To properly determine their genetics then DNA testing would need to be carried out and this is a major expense as well as being very time consuming (Scott Heffernan pers comm. Oct 2009).

9.10 Interspecific Compatibility

A study done by Deleu, R., Veenhuisen, R. and Nelissen, M. on a mixed species exhibit of African Elephants and Hamadryas Baboons states 'Hamadryas Baboons have been frequently used in housing successful mixed-species exhibits with ungulates, hyraxes (Fig 71) and mongooses (CROTTY, 1981; THOMAS and MARUSKA, 1996). Hamadryas baboons (*Papio hamadryas*) and Barbary Sheep (Fig 72) in Amersfoort, the Netherlands; Hamadryas baboons and Nubian ibex (*Capra ibex nubiana*) at Tierpark Hellabrunn in München, Germany; hybrid baboons (*Papio hamadryas* x *Papio hamadryas*), Nilgai (*Boselaphus tragocamelus*) and Zebra (*Equus burchelli*) in Knowsley Safari Park, U.K. Elephants are generally kept in separate enclosures, but can successfully be combined with other species if the latter have safe areas to get away from the elephants. (STEVENSON, in press)'

Fig 71: A Hyrax (michna.com 2009)

Fig 72: A Barbary Sheep (wikimedia.org 2009)

The study went on to discuss 'since 1994, Hamadryas Baboons (*Papio hamadryas*) and African elephants (*Loxodonta africana*) were housed together in a 1.3ha outdoor enclosure during the daytime in Safari Beekse Bergen, the Netherlands. A detailed description and evaluation of the success of this mixed-species exhibit is presented. The only problem associated with the mixing of species was a one-off cross-contamination with salmonella. However if health of both species is closely monitored, the potential threat of cross-contamination cannot be considered as a major problem. Especially if this problem is weighed against the numerous advantages of the mixed exhibit: a large enclosure for both species, environmental enrichment through frequent direct and indirect inter-specific interactions, behavioural enrichment through promotion of species-specific behaviour and the development of special behaviour, the almost complete absence of stereotypic behaviour in both species and finally more educational and scientifically interesting exhibits.'

Fig 73: Elephant inviting baboons to climb on his back by putting his trunk on the rocks (photo: R. Deleu).

The most interesting thing mentioned in the paper was 'the most remarkable non-agonistic inter- specific interaction between the two species is the riding of (mostly juvenile or sub-adult) baboons on the back of some elephants. This behaviour was first observed at the end of the year baboons and elephants were introduced to each other, but it only became a regular interaction a few years later. The elephants actually invited baboons to climb on their back by putting their trunk on the rocks and staying there until a baboon jumps on its back. When baboons are on the elephants' back and the elephants are moving too much, the baboons quickly jump to the ground. On a few occasions juvenile baboons were seen jumping from one elephant's back to the others. The baboons on the elephants' back rarely even seemed to groom them shortly or else pick seeds, insects or parasites from their back.

Fig 74: Juvenile baboon riding on the back of an elephant (photo: R. Deleu).

For more information on the elephant/baboon exhibit please visit: www.dpz.gwdg.de/pr/pr65/deleu.pdf

9.11 Suitability to Captivity

HUMAN INTERACTION

- *P.hamadryas* are very strong and can be very aggressive so care has to be taken if there is any human interaction. The behaviour of them has to be known well to avoid aggressive confrontation by them. As experienced by the author if a simple human sign like smiling or eye contact is directed at a baboon this is seen as threatening behaviour.
- Human interaction can reduces stress when there are times of human interaction needed such as for catching up or for treatment (Scott Heffernan pers comm. Oct 2009)
- It's a level of social activity
- If needing to catch up, the person needs to be dominant and confronting toward baboons to adhere dominance over them (Scott Heffernan pers comm. Oct 2009).
- They would usually see humans as being a food source so can be very approachable or they are likely to approach you (Scott Heffernan pers comm. Oct 2009).

TRAINING AND CONDITIONING

- Human interaction and building up a relationship with an individual can sometimes work to your advantage but also work to your disadvantage because they sometimes don't want to obey your commands. This is seen by the author mostly with hand reared *P. hamadryas* (Scott Heffernan pers comm. Oct 2009).
- Use food rewards when training and conditioning especially their favourite foods
- Can trial different foods to see which individuals like certain foods and in future these foods can be used
- Favourite food can/should be held out until the day of training or conditioning so they are likely to be more manageable and trainable (Scott Heffernan pers comm. Oct 2009).
- Can be trained and conditioned to raceways and a crush for treatment as done by the author
- Trained to be given injections and to get into transport boxes as done by the author
- The ease of access to the animals for treatment and routine procedures is beneficial to all concerned and less stressful for animals and staff alike

All in all *P.hamadryas* adapt well to captivity given their enclosure and set up is ideal and manageable and they are given plenty of enrichment.

10 Breeding

10.1 Mating System

The Hamadryas Baboon *Papio hamadryas* has a very complex and unique structure when it comes to their mating system because they are separated into their One Male Units (OMU). This consists of an adult male with a harem of 2-10 females and their young (Heffernan, S. 2006), indicating the males are polygynous, meaning the male has more than one female partner during their breeding life. Therefore the females are monogamous meaning they mate only with the male and it involves no extra individuals. Usually the bond operates through their breeding life (Animal Diversity 2009). Otherwise the female can possibly mate with another male in her life, meaning she is polyandrous, because she may be stolen away from her male by another male, or her male might die or be over dominated, therefore being claimed by another male (Wikipedia 2009).

Fig 75: One male unit *Papio hamadryas* with a male follower (Scienceblogs.com)

For males without an OMU, reproductive behaviour is limited, and effort seems to be expended in attempts to establish an OMU. Establishment of an OMU can occur in one of two ways. First, a sub-adult male may attach himself to an already established OMU as a follower. Although he travels with the OMU on the daily foraging and sleeps near the OMU at night, a follower male remains separated from the females of the OMU. There may be some potential for such follower males to mate with females, if such copulations can be carried out without detection by the leader of the OMU. However, the principle goal of followers seems to be to either steal females from the OMU leader, having become familiar to these females through association with the OMU, or to overthrow the OMU leader and take his entire harem of females (Science Blogs 2009).

Otherwise a male forms a harem by adopting sub-adult females and teaching them to follow him. He protects them and in 1–2 years, they go into oestrous and he mates with them (Animal Diversity 2009).

In general, *P.hamadryas* males respect the social bond between other males and their female members. However, rarely within a band, there is intense physical competition between males. This seems to be associated with the turnover of male OMU leaders (Scott Heffernan pers comm. Nov 2009). Please see **section 9.2** of Social Behaviour for the explanation of a band.

10.2 Ease of Breeding

P.hamadryas is easy to breed because like humans the females have an oestrous cycle once a month. There are no triggers to make them breed, a reproductively mature male just has to be paired with a reproductively mature female (Scott Heffernan pers comm. Nov 2009). Where the author works at the National Health and Medical Research Council (NHMRC), Australian National Baboon Colony, there are on average between 10-25 births per year in captivity, usually from 0-4 in one month. These figures have been conducted from 30 breeding females out of 6 breeding groups. This means there is a high ease of breeding if females are paired with males. (Scott Heffernan pers comm. Nov 2009; ANBC, 2009)

Also by looking at the IUCN listing, this species is LC or LR/lc which is Least Concern, which means there are many in the wild. This is because there are no threats for this species as listed on the IUCN Redlist and they have a large range of location and habitat. This was last evaluated in 2008. Therefore they do not have a problem reproducing in the wild either. (IUCN Redlist)

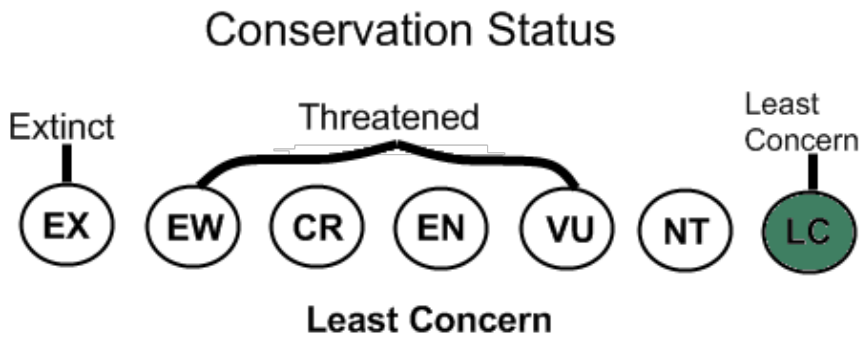


Fig 76: Status of *Papio hamadryas* taken from IUCN Redlist website

10.3 Reproductive Condition

10.3.1 Females

Females don't need a special diet while reproducing. All she may need during pregnancy and lactation is more food. This can be achieved by giving more food to her group daily (Scott Heffernan pers comm. Nov 2009). For example, if her group gets 4 scoops of fruit/vegetables for that day, the cage will get 1 or 2 more extra scoops if she is pregnant or lactating. Please see **section 10.11**. She does need a well balanced nutritious diet, to be in good condition, so not underweight or overweight, free from parasites and also not in ill health, so close monitoring is needed when the female is pregnant or lactating. If the female is lactating, close supervision has to be done to ensure she doesn't develop mastitis, which is the inflammation of the mammary glands. They can become infected and this is painful to her while breastfeeding and so her baby will not be getting fed. Therefore close monitoring has to be done to make sure her baby is being fed. Overall they are very caring and efficient mother and not many problems are observed (Scott Heffernan pers comm. Nov 2009).

10.3.2 Males

Males just need to have good condition on them, so not underweight or overweight and to achieve that, a good balanced diet needs to be provided. When they are sub-adults developing into adults, they have a rapid growth spurt and during this time, their diet needs to be increased to suit their growing needs. Like the female the male needs to be free from parasites and also not in ill health. (Scott Heffernan pers comm. Nov 2009).

10.4 Techniques Used to Control Breeding

The following is done at the Australian National Baboon Colony and these include:

- Separation of sexes so no breeding can occur
- Immuno-contraception's
- Vasectomy of males

Further:

- Culling unwanted individuals could be a method also, but only in extreme circumstances provided good reasoning, but this method is not preferred by the author, nor is it done at the ANBC.

At the ANBC, each animal has a name and a specific tattoo. This information is then used to formulate a family tree for each individual, allowing a breeding plan to be developed in order to avoid any inbreeding. Please see **APPENDIX 8** for the family tree of 'Bart'.

The structure of the baboon colony at the ANBC consists of:

- One Male Unit's (OMUs): Adult males with numerous females and young.
- Juvenile Groups: Weaned groups of mixed males and females.
- Bachelor Groups: Sexually mature males in group of 2-5.
- Vasectomised OMU's: Adult males not required for breeding with old or cycling females that are too young to breed.

Fig 77: An example of a cage full of juveniles to be housed in between breeding OMUs (Turner, L. 2009)

Breeding groups or OMUs are housed separately, that is no intermingling between OMUs so as parentage can be determined easily without DNA analysis. The OMUs are separated by a group of weaned juveniles or an empty cage, and this prevents breeding through the mesh and fighting between OMUs (Scott Heffernan pers comm. Oct 2009; (Heffernan, S. 2006).

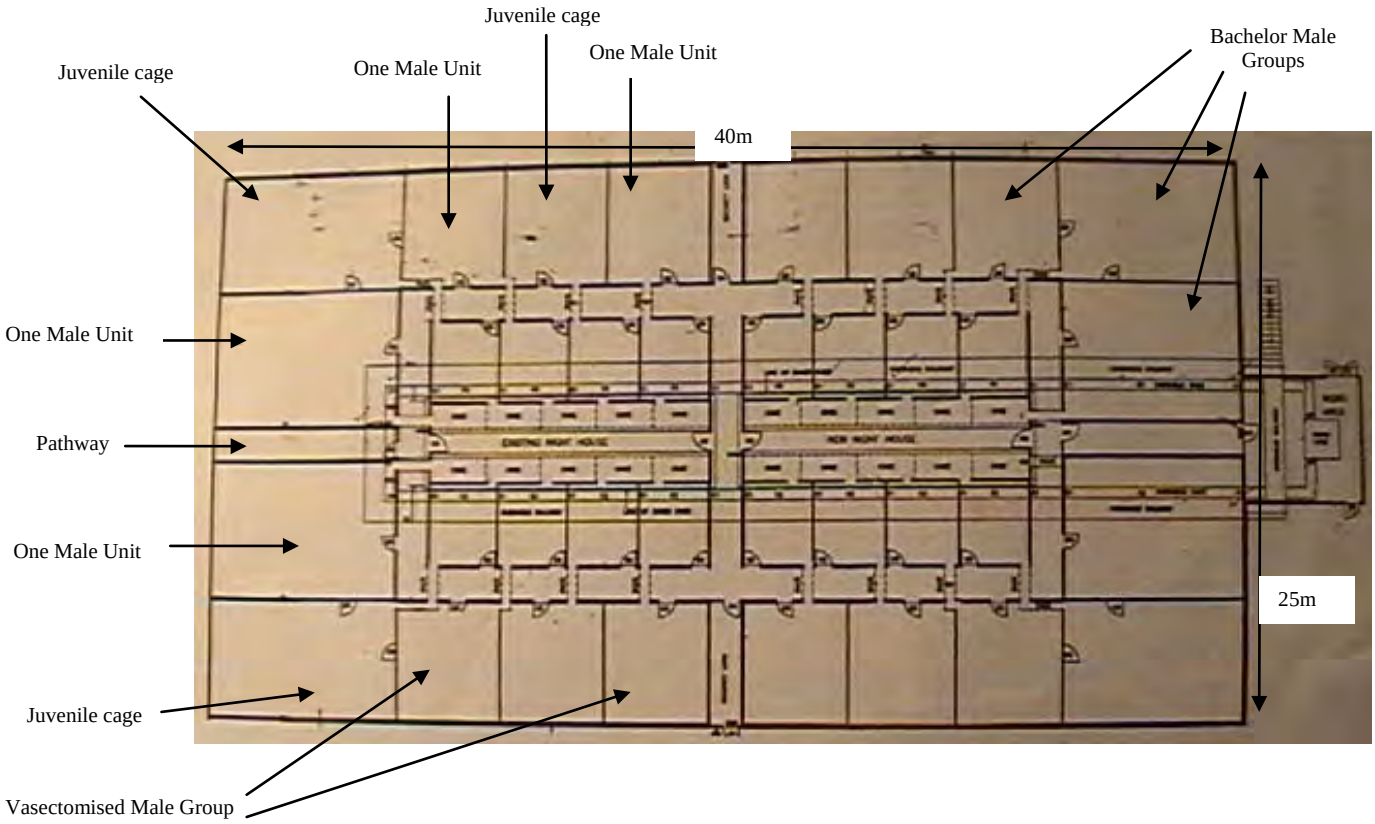


Fig 78: An example of a cage set up for *Papio hamadryas* in a captive institute (ANBC) to control breeding (Heffernan, S. 2006)

As young females develop and have their first cycle they can be placed in with a breeding male if they are wished to be breed from or alternatively they can be housed with a vasectomised male. If young cycling females are left in juvenile groups without an adult male, aggressive fighting is likely to occur between older sub-adult males housed together in bachelor groups even if they are housed at the other end of the colony (Scott Heffernan pers comm. Oct 2009; (Heffernan, S. 2006).

Young males should be moved from the juvenile groups at approximately 4 years of age. This is the time they start to be sexually active and mature. They must be relocated away from the OMUs so no unwanted pregnancies of females occur. As they develop they can be housed in larger sub-adult groups, but it is when they are fully developed and have developed their canines that they need to be organised into smaller compatible bachelor groups. Usually a hierarchy is established and maintained and there is not too much fighting over food. The presence of young cycling females or young females that are very close to cycling is the main cause of aggression between these bachelor groups. If fighting is continuous and is constantly resulting in injuries that need treatment, then more compatible cage mates need to be found meaning movements of animals between cages are done. Siblings generally make better cage mates (Scott Heffernan pers comm. Oct 2009; (Heffernan, S. 2006).

Juvenile animals are kept within their family groups until they are fully weaned from their mothers. They can remain in these groups as long as the numbers in the family group does not outgrow the viability of the cage size (Scott Heffernan pers comm. Oct 2009; (Heffernan, S. 2006).

If females are not wanted for reproducing, they can be removed from their current OMU's and placed with vasectomised males or placed on contraception. Injectable Depo-Provera (Medroxyprogesterone) can be used to suppress female cycles for a short term of usually 3 months or when she starts to cycle again. Otherwise vasectomies in males remain an option for the management of much older males (Scott Heffernan pers comm. Oct 2009; (Heffernan, S. 2006).

Other methods of contraception for females include:

- Progestin contraceptives which include melengestrol acetate (MGA), megastrol acetate (Megace, Oviban: Schering-Plough), levonorgestrel (Norplant: Wyeth) and medroxyprogesterone acetate (MPA) (Provera and Depo-Provera: Pharmacia and Upjohn) (Muson, L., 2005)
- Melengestrol acetate (MGA) subcutaneous implants. According to Portugal, M., 'treatment with MGA can be recommended based on its ability to suppress ovarian cyclicity without causing social disruption. However, because this and other progestins stimulate weight gain, their use is contraindicated in overweight or obese animals.'
- Implantation of all adult females with Norplant® (Progestogen implant), a long-acting contraceptive, expected to be effective for 2–3 years. According to A.B. Plowman, 'Norplant® does not stop normal physical and behavioural signs of oestrous and female Hamadryas Baboons in oestrous tend to become more aggressive, but our results suggest that implantation with Norplant® did not cause a substantial increase in social tension in the group as a whole. However, a small effect could have been masked by the simultaneous and greater effects of changing group size. (Science Direct 2009) (Wiley Interscience2009).
- The oral pill would be impractical to use because of the time it takes to get each female to properly take it and the annoyance of giving it every day.

Fig 79: Depo-provera contraception injection mainly used at the National Baboon Colony which lasts for 3months (Springfield Website)

10.5 Occurrence of Hybrids

In the wild, because of where *Papio hamadryas* and *Papio anubis* (Olive Baboons) are distributed, their range does overlap and there can become hybrids of these species.

Fig 80: A distribution map showing the different ranges of *P.hamadryas* and *P.anubis*. As you can see their distribution is right next to each other. (Heffernan, S. 2006)

Fig 81: An Olive Baboon *Papio anubis.* (Zeller, A. 2009)

This occurs in the range in the Awash Valley, Ethiopia. A study done by Kyoto University 'observed 2 groups of *anubis-hamadryas* hybrid baboons, to make a comparative study of their social organisations. The form and genes of one group (the Gorge group) was closer to *P.anubis*, while the other (the Kerrayu group) was closer to *P.hamadryas*. The entire Kerrayu group was much unified, and had 2 large one-male units, several small one-male units, and 8-9 pair units. The infra-units within the Kerrayu group were spatially more solid than the Gorge subgroups which were often split into several parties without stable membership. In the Gorge group, 8 subgroups were distinguished: 3 multi-male groups and 5 one-male groups.

In both Kerrayu and Gorge groups, the distinctive close bonds, which seemed to be based on kinship, existed among females. The males of the Kerrayu group had a stronger social temper towards each other's closeness than those of the Gorge group. The quality of dominance order among males in Gorge group was more distinctly established than in the Kerrayu group.

In the Awash Valley *P.anubis* and *P.hamadryas* populations have had mutual gene flow. The inflow of *P.anubis* genes into the *P.hamadryas* band has strongly affected the possessive behaviour of *P.hamadryas* males towards females, but has exerted little effect on the mutual bonds among the males. The inflow of *P.hamadryas* genes into the *P.anubis* troop has severely affected its integration. It was concluded that the band to be the basic social unit of *P.hamadryas* baboons, and it was speculated that some sociological and ecological factors promoted the formation of multi-level system of Hamadryas Baboons.' (Sugawara, K. 1982)

An article written by Jane E. Phillips-Conroy and Clifford J. Jolly stated that 'hybrid males are more *hamadryas*-like and hybrid females more *anubis*-like, as would be predicted, because of the capture of *anubis* females by *hamadryas* males.'

Please see **APPENDIX 15** for more information about the occurrence of hybrids.

Therefore in captivity, because of the dominating ways of the male *P.hamadryas* they should be kept separately from different species otherwise crosses of species will develop.

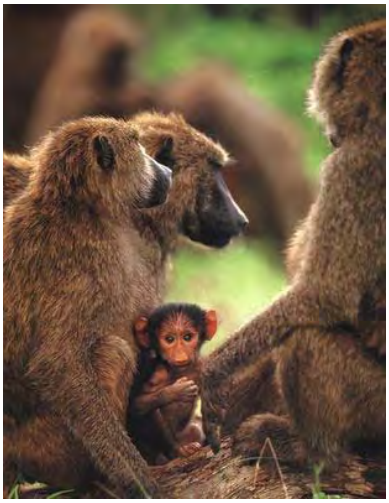


Fig 82: A family of Olive Baboons
Papio anubis. (scienceblogs.com, 2006)

10.6 Timing of Breeding

There is not a specific season that *P.hamadryas* seems to breed more, they are continuous breeders all year around because the females cycle regularly once a month (Scott Heffernan pers comm. Nov 2009).

However, Kummer (1968) did report a peak of births in May/June and November/December.

10.7 Age at First Breeding and Last Breeding

As seen by the author young females develop and have their first cycle at approximately 3 - 4 yrs of age and males start becoming sexually mature at approximately 4 years of age. Although this is the case, females should be at least 5 years and the males 8-10 years in age before breeding. At the National Baboon Colony their usual last breeding age is around 20 years although females begin menopause at around 21 years of age. So potentially their reproductive lifespan is for females is 15 years and for males 10-12 years. If it were the case of breeding them until 21 years then females would be 16 years and males 11-13 years (Scott Heffernan pers comm. Nov 2009).

10.8 Ability to Breed Every Year

P.hamadryas are able to breed every year because they are not seasonal breeders, so can mate throughout the year, provided females are in oestrous (Scott Heffernan pers comm. Nov 2009).

10.9 Ability to Breed More than Once Per Year

The female's gestation period is 6 months (Heffernan, S. 2006). Usually the baby is suckling from the mother until 6-9 months old and if the female is left in a breeding situation she will generally have one cycle and fall pregnant again after the baby is weaned, therefore it is possible for them to have a baby every 13 months if allowed (Scott Heffernan pers comm. Nov 2009). So this will mean that they will not be able to breed more that once per year. If a female loses her baby in the first month of having it, then she can cycle again fairly soon after and therefore she can possibly have 2 babies in one year.

10.10 Nesting, Hollow or Other Requirements

There is no nesting or hollow requirements needed for *P.hamadryas* (Scott Heffernan pers comm. Nov 2009). In the wild usually the female gives birth between night 2200hrs and the early hours of the morning 0600hrs on the rocky outcrops where she sleeps. In captivity she will give birth in the night-house in the early hours of the morning. All that is required are perches at different levels of height.

Fig 83: Perches in the night-house at different levels (Lauren Turner, 2009)

10.11 Breeding Diet

Prior, during or post breeding, the diet doesn't have to change, it just needs to be increased at the time of the female being pregnant and also during lactating. This can be achieved by giving more food to her group daily. As mentioned above in **10.3.1**, if her group gets 4 shovels full of fruit/vegetables for that day, the cage will get 1 or 2 more extra scoops if she is pregnant or lactating. She does need a well balanced nutritious diet of fruit, vegetables, nuts, seeds, cracked corn, pellets and bread (Scott Heffernan pers comm. Nov 2009) (Heffernan, S. 2006).

10.12 Oestrous Cycle and Gestation Period

The *P. hamadryas* has a menstrual cycle similar to that of women (30-35 days).There is a noticeable discharge one to two days prior to commencement of the perineal swelling (Scott Heffernan pers comm. May 2010). During the period around ovulation, the perineum of the female swells, alerting the male to her potentially fertile condition. During mating, there is generally a pattern of serial mounting initiated by the female, who presents her hindquarters to the male. The male mounts the female and thrusts several times. This mounting is followed by other mount/thrust episodes until the male ejaculates. Mating frequencies can be from 7 to 12.2 per hour while the female is receptive. (Hrdy and Whitten, 1987; Kummer, 1968; Stammbach, 1987) (Shefferly, N. 2004)

Fig 84: A pregnant female *P.hamadryas* (Turner, L. 2009)

Their physiology and biochemistry are similar to women as well as their plasma and urine hormone levels during pregnancy. The female baboon reaches sexual maturity at approximately 3 – 4 years of age. This is the average time for her first cycle and it also coincides with a growth spurt. (Heffernan, S. 2006)

Females have a gestation length of approximately 182 days or 6 months (Heffernan, S. 2006). The characteristic swelling of the perineum skin in the female baboon can allow the monitoring of her reproductive status on a daily basis (Fig 85) by staff caring for the animals, which is done at the ANBC. The swelling of the perineal is examined daily and graded using a score from 0-3. When the swelling is at its largest point, it is graded as a 3, and ovulation occurs at this time (See Table 10 on day 18). If mating occurs either side or during this period then a successful pregnancy can occur. This is indicated by the lack of a perineal swelling the following month. This can be used to estimate the conception date which is usually taken as the day before the swelling starts to subside.

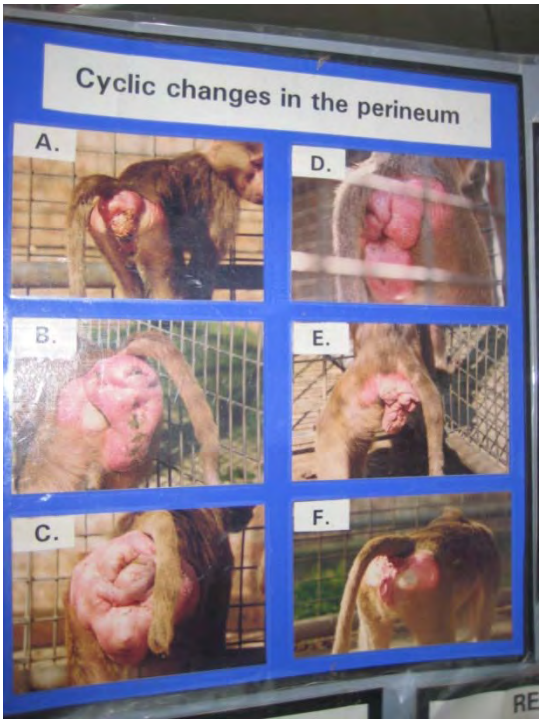
Reproduction / Cycling Records

Year: 2008 **Name:** Chloe

JANUARY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
3																		x	x	x											
2							x	x	x	x	x	x	x	x	x	x	x				x	x	x								
1				x	x	x																		x	x	x					
0	x	x	x																								x	x	x	x	x
Comments	CYCLING																														

Ovulated here

Table 10: This chart shows the perineal swelling of one female baboon over a period of 1 month (Salkeld, J.)



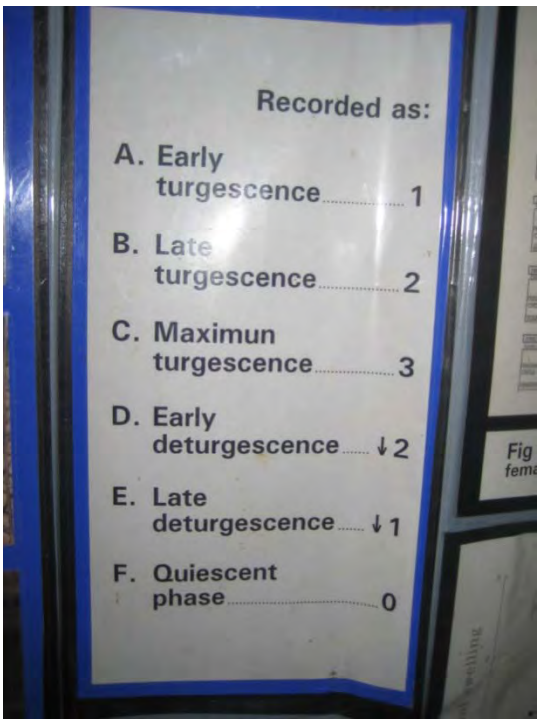


Fig 85: Pictures of the perineal swellings in female baboons. Turgescence (swelling) before ovulating are pictures A. and B., C. is where maximum swelling is and therefore ovulation occurs. Late turgescence is after ovulation shown in D. and E. and F is the period before the female starts to cycle again (Salkeld, J.)

Please see **APPENDIX 17** for records from the ANBC for a whole year of reproduction records for a female named 'Chloe' to indicate cycling and determining pregnancy and also the birth of her baby.

The female baboon instinctively eats the placenta as soon as her baby is delivered, chewing down the umbilical cord until it is about 15 cm from the babies abdomen leaving the rest to dry up and drop off in a few days.

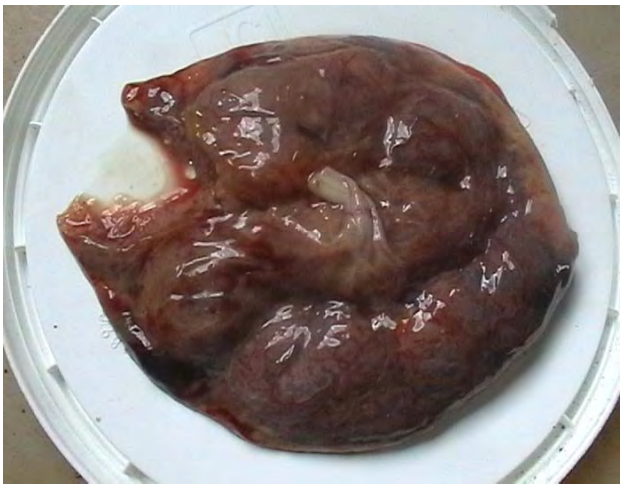


Fig 86: The placenta of a female after giving birth (Heffernan, S. 2006)

Baby baboons are born approximately 182 days (6 months) after mating. They are jet black in colour and are approximately 550-700 g in weight (Heffernan, S. 2006). The black colour allows the baby to be instantly recognised and warns the other adult animals especially the males to be more careful around the infants. The young are generally born in the early hours of the morning in the safety of the night-house (Scott Heffernan pers comm. Nov 2009).

10.13 Litter Size

P.hamdryas are uniparous, raising one offspring at a time (Heffernan, S. 2006). In exceptional incidences they can have twins but it is quite rare (Scott Heffernan pers comm. Feb 2010). The sex ratio that is bred is 50:50 male to female. Currently in 2009 at the National Baboon colony there are 30 juvenile females and 31 juvenile males. These numbers have been taken from 2007 – 2009 internal data:

- 2007 = 11 females and 13 males
- 2008 = 10 females and 4 males
- 2009 = 11 females and 9 males

As you can see there is only a slight difference each year with male and female ratios but overall the numbers become 50:50.

10.14 Age at Weaning

From conversations with Scott Heffernan from the Australian National Baboon Colony (ANBC) 'depending how many young the female has had in the past she breastfeeds for 6 – 9 months. If she is only new to mothering usually she will breast feed her baby for longer, than a female that has had a few babies. The female will then start to cycle again when her baby is starting to wean and she will potentially fall pregnant again. The young also start experimenting with solids at around 6 weeks.' The source of Kummer, 1968; Nowak, 1999; Stammbach, 1987; Walters, 1987 says 'the average length of lactation is 239 days (7.9 months), but the timing of weaning may vary according to maternal condition, ecological variables, and social circumstances. Lactation can last from 6 to 15 months.'

Fig 87: A breastfeeding baboon (Heffernan, S. 2006)

A paper written by Sunderland, N., Heffernan, S., Thomson, S. and Hennessy, A. in 2008, regarding a study done at the Australian National Baboon Colony (ANBC) from 1994 to 2006, for the past review of reproductive records, resulted in 'the overall live birth rate being over 70% for recognised pregnancies. Pregnancy loss was due to equal proportions of spontaneous abortion and stillbirth, and was not affected by maternal age or parity. Stillbirth rates were increased by the use of animals in unusual late pregnancy experimental protocols. Neonatal mortality rates were low overall, but significantly higher in primiparous (a female who has only had one young) compared with multiparous (multiple young) mothers. There were no cases of maternal mortality. CONCLUSIONS: The success of the ANBC breeding program is demonstrated by the low rate of pregnancy loss, high neonatal survival rate and lack of maternal mortality.' (Sunderland, N. 2008).

Reproductive outcomes in *P.hamadryas* from 1983 - 1994 and 1994 - 2006		
Pregnancy outcome	**1983 - 1994** N=239	**1994 - 2006** N=146
Spontaneous abortion	49 = 20.5%	21 = 14.4%
Still Birth	16 = 8%	19 = 13%
Live Birth	174 = 72.8%	106 = 72.6%
Neonatal outcome	174	106
Neonatal death	33 = 19%	16 = 15.1%

Table 11: Outlining the percentages of live births and deaths from reproductive studies (Sunderland, N. 2008)

Schlabritz-Loutsevitch, N. E., 2008 states that 'foetal loss and maternal risk factors associated with stillbirths in baboons were similar to those documented in women.'

In regards to juvenile mortality if several young are raised together, a paper written by Judge, P.G., Griffaton, N.S., Fincke, A.M. in 2006 showed that 'a short-term crowding experiment was conducted on a captive group of Hamadryas Baboons (*Papio hamadryas hamadryas*) to determine whether they exhibited patterns of behavioural change and also to examine whether their unique social system would affect conflict management between particular partners. The results have shown that the pattern of behaviour displayed by this group conforms to an active tension-reduction strategy in which **animals successfully reduce the higher risk of aggression during crowding**.'

In the subject of infanticide a study done by Swedell, L. and Tesfaye, T. in 2003 wrote that 'here we report observations from August and September 2002 of the consequences of two takeovers of known females with black infants. After the first takeover, the respective infant disappeared and was presumed dead within 11 days of the takeover. After the second takeover, the infant incurred repeated severe aggression from its mother's new leader male and eventually died 4 days after the takeover. We interpret these findings as support for the sexual selection hypothesis regarding male infanticide. We suggest that Hamadryas leader males usually protect infants born into their units, but may withhold this protection, or even directly attack and kill infants, after takeovers.' (Am. J. Primatol. 60:113-118, 2003. © 2003 Wiley-Liss, Inc.). Although in this instance, when a new male takes over a female, she may go into deceptive oestrous cycles. This behaviour is likely an adaptation that functions to prevent the new male from killing the offspring of the previous male. (Zinner and Deschner, 2000)

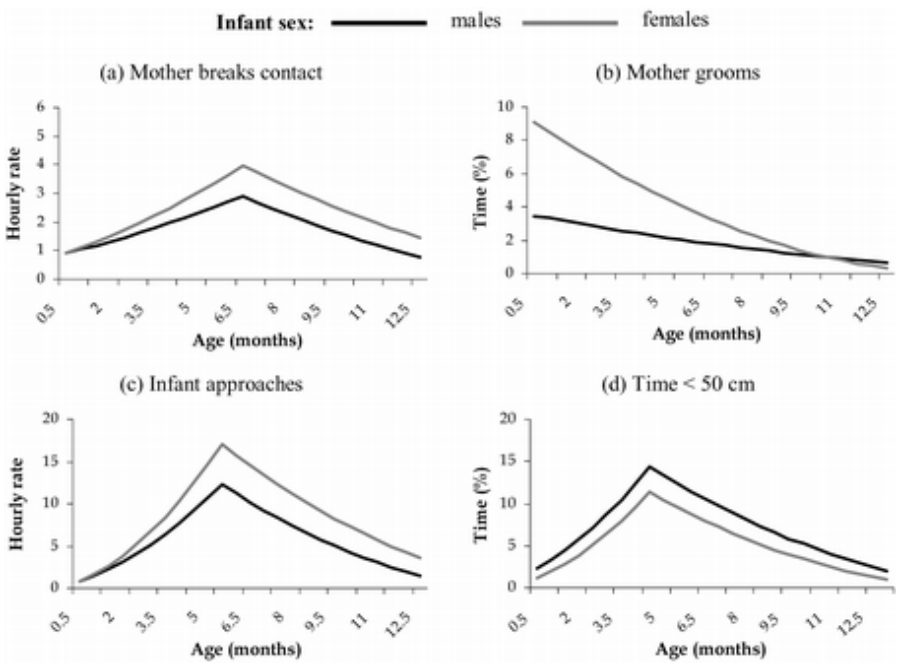
10.15 Age of Removal from Parents

Females typically disperse from their natal group between 1.5 and 3.5 years of age before she starts to cycle. About 70% of females will change affiliation to a new OMU within a period of 3 years, often choosing to join OMUs that contain other females with whom they are already familiar. Through this type of transfer, it is possible for females to maintain bonds with one another throughout their lives. (Stammbach, 1987; Swedell, 2002) (Shefferly, N. 2004)

The period of infant dependence is difficult to assess. Because this species is social, juveniles may continue to associate with their mothers until they disperse at or near adulthood. Also, because young females may be "kidnapped" by males wishing to establish an OMU, it is even more difficult to assess whether or not these individuals could survive without the parental care provided by the kidnapping male. In short, it would be reasonable to put the upper limit of the period of juvenile dependence at the average inter-birth time of 24 months, but to realise that this type of estimation is rough. (Kummer, 1968; Nowak, 1999; Stammbach, 1987; Walters, 1987) (Shefferly, N. 2004)

At the ANBC young males should be moved from the juvenile groups at approximately 2 years of age. In the wild they are usually ran out of the family group by age 4 (Scott Heffernan pers comm. Nov 2009).

If in a captive situation as at the ANBC males and females, if weaned at 1 year of age can be removed from their parents and be housed with other juveniles who in turn look after one another (Scott Heffernan pers comm. Nov 2009).



Graph 4: Sources of variation in the developmental pathways of mother-infant relationships and to search for behavioral discontinuities. The data come from 23 mother-infant relationship of baboons (*Papio hamadryas*), whose interactions were recorded longitudinally during the infants' 1st year of life.
(HernÃ¡ndez-Lloreda, MarÃa Victoria; Colmenares, Fernando 2005)

10.16 Growth and Development

Below is a rough guide to development of young:

- Infants are born fully furred with their eyes open (Kirkwood, J. 1992)
- They develop very quickly, as their teeth come down within a few weeks of birth.
- They start experimenting with solid food at about 2-3 months of age (Scott Heffernan pers comm. Nov 2009).
- Sometimes at one month but mostly at around 3 months they start ride on mothers back and will feed from the breast only when the mother stops moving.
- At approximately 3 months of age they start to lose the black colouration, at this point they cease to be neonates and take on the appearance of a young adult and are referred to as juveniles. They would also be eating a large amount of solid food at this stage**.**
- Young females develop and have their first cycle at approximately 3 - 4 yrs of age and males start becoming sexually mature at approximately 4 years of age.
- Full size is attained in males around 10.3 years of age. Females, which are significantly smaller than males, reach adult size around 6.1 years of age. (Jolly and Phillips-Conroy, 2003; Stammbach, 1987; Walters, 1987)

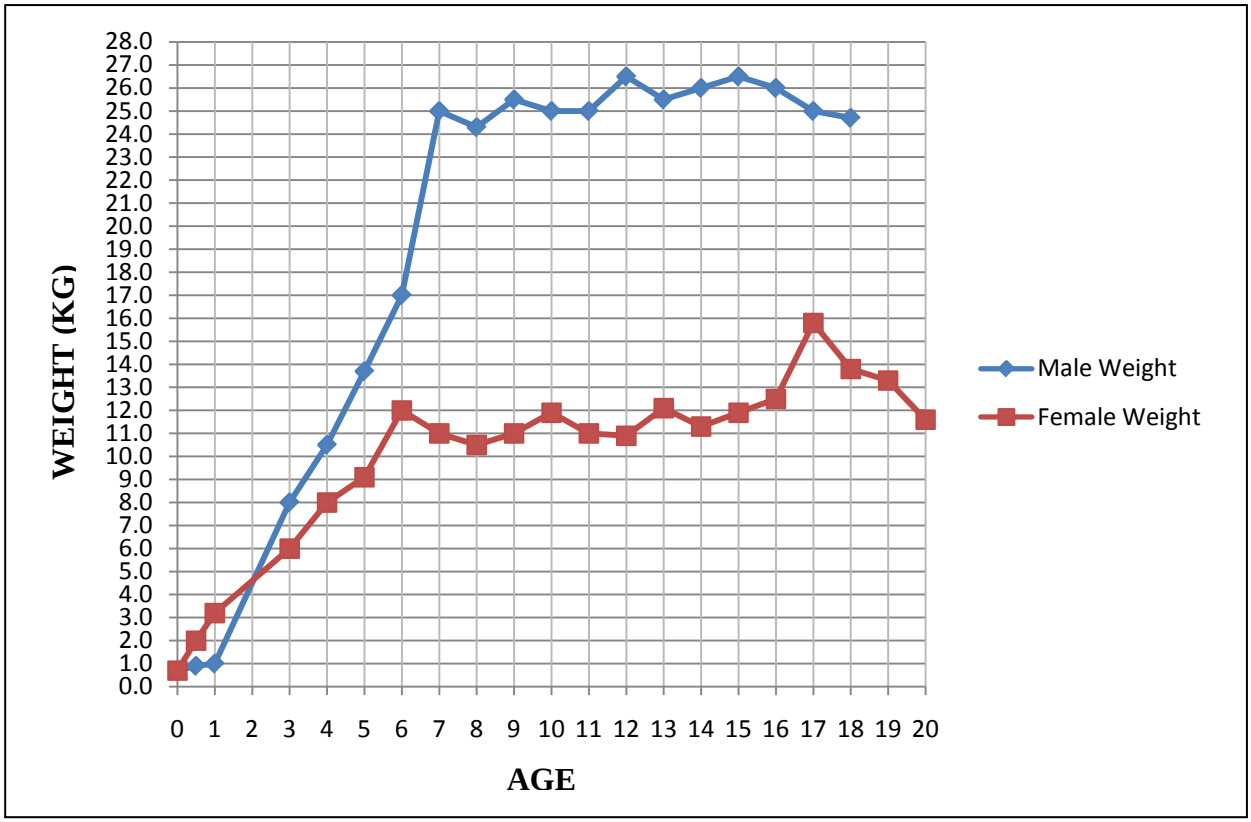
Fig 88: A juvenile starting to lose its black fur and also riding on its mothers back (Heffernan, S. 2006)

(Scott Heffernan pers comm. Nov 2009).

Puberty in males is a lengthy process, and the timing of different developmental events reveals interesting details about the reproduction of these animals. Testicular development does not closely follow male growth in this species. Testes develop rapidly between the ages of 3.8 and 6 years, reaching full size prior to attainment of full adult body size. In contrast, body mass doubles between the ages of 7 and 8 years, after the testicles are fully developed. This pattern of development may indicate that sub-adult males, who do not possess OMUs of their own, but may achieve some "sneak" copulations. Interestingly, the remainder of adult male secondary sexual characteristics, including the silver mane, white cheeks, and pink hindquarters, do not develop until after full adult size is reached. These characteristics are thought to function in the maintenance of the OMU, as they are very attractive to the females of the OMU and extract large amounts of female grooming. (Jolly and Phillips-Conroy, 2003; Kummer, 1968; Stammbach, 1987)

Fig 89: A sub-adult male going through puberty. Notice he has not yet got his full main but is starting to develop it (Turner, L. 2009)

Below is a table of weights taken from the ANBC of one male and one female baboon from birth until 20 years of age. As you can see where the growth spurts occur, for the female between 3 years and 6 years, and for a male between 3 and 8 years of age.



Graph 5: Male and female *P.hamadryas* weights over 20 years to show the growth spurt when sub-adults (Turner, L. 2009; ANBC 2009)

11 Artificial Rearing of Mammals

NATURAL HAMADRYAS BABOON PARENTAL CARE

While both male and female Hamadryas Baboons *Papio hamadryas* take part in caring for infants, the majority of care provided is by their mothers. They are acutely dependent on their mothers for food and travel for the first several months of life (Scott Heffernan pers comm. May 2010). For the first few days of life, the mother physically supports the infant, which may have a difficult time grasping on to her for long periods of time. Within the first week of life, though, its grasp will strengthen and it will be able to support itself, clinging to the mother's fur for long periods of time although they nurse and sleep frequently. As soon as two weeks of age, the infant may break physical contact with the mother to investigate the ground and food items such as grass, but only for a few minutes at a time, and never far from the mother. By three weeks, the infant may try to move away from the mother as it explores its surroundings, but it is quickly retrieved. As the infant gets older the distance between mother and infant quickly increases as the infant ages. Infant baboons also depend on their mothers for transportation. While they initially cling to their mothers' ventrum, around three months of age they transition to riding "jockey style" on their mothers' backs. Riding continues until the end of the first year in most instances and the mother rejects the infant's attempt to cling to her or climb on her after this age (Primate Info Net 2010).

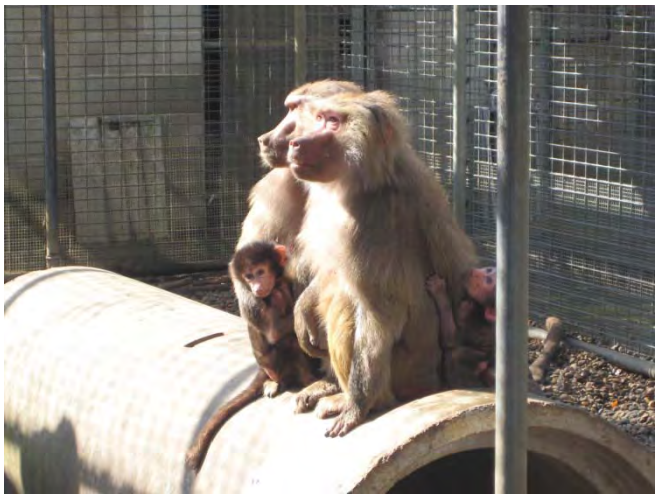


Fig 90: Female *Papio hamadryas* caring for their infants (Turner, 2009)

11.1 Housing

Minimising stress is a major consideration when housing the mother, father and infant, if the infant is with the parents or being hand-reared. Choosing suitable housing can help to create a stress free environment. Several factors should be considered:

- Securing the area from children and other animals
- Maintaining the area in a hygienic manner
- Escape-proofing the area
- Providing a safe area so clearing the area of obstacles and hazards
- Ensure the area offers shelter from the extremities of the weather e.g. a night-house.

(Cole, M. et al 1979)

Fig 91: The infant clinging onto a rolled up towel and wrapped up (Turner, 2010)

The author has found that if hand-rearing an infant supplying a cuddly toy to act as mother e.g. teddy bear or woollen hat or old jumper to cling onto is a good idea If imprinting is not a worry sometimes it will suit the keeper to carry the infant in a bag strapped to the body as this reassures the infant. Or from the authors experience in hand rearing this species you can have a rolled up towel for the infant to cling onto and a towel wrapped around the baboon to keep it secure (Fig 91) (Scott Heffernan pers comm. May 2010).

- From the authors experience a pet pack can be used to house and transport an infant baboon in the first few weeks of its life, if hand-rearing. When it becomes more active, then a small enclosed cage or play pen can be set up for the infant to explore more (Fig 93).
- It can be put into this bigger play cage during the day to get exercise.
- If hand-rearing make sure there is warmth provided such as a regulated heat mat or hot water bottle.
- If the infant is being housed with the mother and father, make sure no adult males are housed next to the enclosure to protect the baby from potentially being attacked and to prevent fights between the mother or father.

(Scott Heffernan pers comm. May 2010).

Fig 92: Housing for the infant of a pet pack with a thermostatic controlled heat mat (Turner, 2010)

Fig 93: As the infant gets more active, during the day it can be housed in a bigger cage kept next to the main colony cages to learn behaviours (Turner, 2010)

11.2 Temperature Requirements

If the infant is separated from the mother a heating source has to be provided in the housing (TAFE Class 2010). Therefore a hot water bottle, wrapped in a towel or blanket, or from the authors experience a heat matt can be used. This heating source should be maintained, using a thermometer, at around the same temperature as the mother's body warmth, which would be 37.5-39°C or an ambient temperature of 31-33°C (Kirkwood, J. 1992). If using a heat matt, this can be regulated using a thermostat .

Fig 94: A digital thermometer (Basal Digital Thermometer website 2010)

If the infant is being cared for by the mother then a designated area, such as a night-house, should be provided for the mother and the infant ranging from 18-30°C (Scott Heffernan pers comm. May 2010).

11.3 Diet and Feeding Routine

Equipment needed for hand-rearing

- Baby bottle and teat – from the authors experience it is good to have 2 of each so there is a back-up. A few smaller 200ml bottles and bigger 300ml bottles are sufficient.
- Cloths and bottle cleaning brushes
- A set of scales
- Thermometer, temperature gun or aqua one digital thermometer
- Kettle
- Formula – Either Wyeth S-26 Step 1 followed by Step 2 at 2-3 months old, Karicare Infant Step 1 followed by Karicare Follow on Step 2 Formula, Bellamy's Organic Infant Formula or Nestle Nan 1 Pro Gold Starter Formula. Personally at the National Baboon Colony we use the Wyeth S-36 brand. Any of these brands of baby formula are available from your local supermarket, corner store or chemist.
- Cotton wool and cotton buds
- Measuring cups
- Measuring spoons
- Storage containers for holding all of the hand-rearing equipment
- Milton's or Viraclean disinfectant for sterilising all hand rearing equipment available from your local pharmacy
- Chux wipes
- Mixing bowl
- Newspaper
- Lots of towels and blankets
- A pet pack

Fig 95: Wyeth S-26 Step 1 formula used at the National Baboon Colony (Shop New Zealand website, 2010)

The diet for the first 3 months of age for a Hamadryas Baboon *Papio hamadryas* is only the mother's milk. From a study written by David H. Buss in 1968 from the journal article titled Gross Composition and Variation of the Components of Baboon Milk during Natural Lactation, says 'primates in general have relatively long lactations, nurse their infants frequently, and produce large quantities of dilute milk,' (Buss, D. H., 1968) and baboon milk comprises of:

Table 12: Composition of natural baboon milk for every 100mls taken from David H. Buss 1968 and ANBC:

DAY	**pH**	**LACTOSE g/100ml**	**TOTAL SOLIDS g/100ml**	**LIPIDS g/100ml**	**PROTEIN g/100ml**	**ASH g/100ml**
0-5	6.98	6.8	14.6	5.1	2.3	0.27
6-11	7.17	7.4	15.3	5.8	1.7	0.25
12-35	7.17	7.7	14.0	4.6	1.5	0.28
36-279	7.18	7.3	14.4	5.0	1.6	0.26

If hand-rearing a baboon, the milk of the mother cannot be expressed unless the mother is sedated or under general anaesthetic. If this is the case then colostrum, if available, can be expressed from the mother and fed to the infant for the first feed. Otherwise a formula has to be used to rear the infant. 'Baboon milk is similar to that of human milk' (Kirkwood, J. 1992) so a human milk replacer can be used such as Wyeth S-26 Step 1 and 2 which is used by the author at the Australian National Baboon Colony. Step 1 is used from birth and Step 2 can be used from 2-3 months of age. The recommended concentration by the author for this product is 1 scoop to 60mls of water, which should make up around 65mls altogether (Scott Heffernan pers comm. May 2010).

Fig 96: An infant *Papio hanadryas* being bottle fed (ANBC 2010)

- When bottle feeding milk, it is important to feed the milk warmed up.
- The best way to warm the milk is when making up the mixture.
- Add two thirds boiled water and one third boiled but cooled water.
- It is important to used boiled cooled water as this gets rid of the chemicals in normal tap water.
- Then using a digital thermometer record the temperature of the milk.
- The milk should be fed at body temperature of between 37°C-38.5^{o}C.
- From the authors experience you can also test the temperature by putting a drop or two on your wrist and if you cannot feel the temperature of the drops then it is at your body temperature.
- When the milk is fed, if there is still a bit left then the rest can be put into the fridge and used again for the next feed.

- After the next feed is done the rest of the milk needs to be discarded so that a bacterium does not form in the milk.
- When heating up the milk a second time, the bottle can be rested in a container of warm/hot water and warmed up to the correct temperature.
- The milk should never be warmed up in the microwave.
- After 4 weeks of age, the milk can be fed at room temperature Scott Heffernan pers comm. May 2010) as it is done by the author at the Australian National Baboon Colony, otherwise you can continue to warm up the milk to body temperature. From the authors experience, even from a younger age of 2-3 weeks, the milk can be fed at room temperature. The only critical stages is the first few weeks of life.

Fig 97: Wilfred, a male infant baboon at 4 days old getting bottle fed (Turner, L. 2010)

There are many variations to feeding schedules in primate infants, but the following table is a general rule that the author has used which is taken from the Australian National Baboon Colony:

Table 13: Feeding schedules:

AGE	HOW OFTEN TO FEED	CALORIES
Birth – 1 day old	5% dextrose or boiled cooled water	
1-7 days old	formula every 2-3 hours	40-80 calories/day
1-2weeks old	formula every 3 hours	80 calories/day
2-4 weeks old	formula every 4 hours	120 calories/day
1-2 months old	formula four times a day	200 calories/day
2-3 months old	formula 3 times and day and introduce solids	240 calories/day
3 months old	formula 1 – 2 times a day and solid food	240-480 calories/day
3 and a half + months	solid food only	

(ANBC 2010)

Table 13 shows that the number of daily feeds changes as the infant develops.

- Very young baboons should be fed every two to three hours around the clock from the author's experience.
- Once the baboon is taking in the required daily volume, night feeds can be reduced.
- Small amounts at regular intervals should be fed to start with.
- Depending on your infant the author suggests trying to start with 10-20mls per feed and as they get older the number of feeds decreases and the volume increases per feed.
- The concentration of the milk can also increase as they get older, otherwise at 2-3 months the Step 2 formula can be used.

Carer's should be cautious at the rate at which milk is being squeezed into the mouth. Make sure it does not exceed the rate at which it is swallowed. Too much milk (a fast milk flow) can result in accumulation of milk into the pharynx, which is sneezed out of the nostrils (TAFE Class 2010).

From experience the author has had, at 4 weeks of age when the infant can be fed room temperature milk, the bottle can be fixed to the area where the infant is being housed, so the infant can drink the milk ad lib (Fig 98). 100mls can be made up at a time and every few hours the bottle checked and the milk changed so it does not go off (Scott Heffernan pers comm. May 2010).

Fig 98: Infant *Papio hamadryas* being fed ad lib from bottles that are fixed to the cage (ANBC 2010)

When infants become more active and their teeth start to develop at around 4-5 weeks of age, this is when they start experimenting with putting things in their mouths, so from the authors experience plastic baby toys can be offered to them to teeth and play with. When they develop their full teeth at 2-3 months of age, solids should be introduced into their diet. Solids of cereal, mashed up bread and softer fruits can be offered such as banana have been tried from the author. Please see **APPENDIX 18** for notes of a hand-raised *P.hamadryas* 'Goliath' for introduction of solids.

11.4 Specific Requirements

Hand-rearing must only be undertaken in exceptional circumstances, in consultation with animal management staff and a veterinarian with primate experience. Hand-reared primates must have visual and olfactory contact with other members of the group at the earliest opportunity and be physically re-introduced to the group as early as possible (Department of Primary Industries 2010). At the National Baboon Colony the infant is re-introduced to the colony at 3 months of age (Scott Heffernan pers comm. May 2010). There must be minimal human contact and use of a surrogate mother is preferred if possible (Department of Primary Industries 2010).

There are many reasons why we might hand-rear an animal and these can include:

- Mistreatment by parents
- Neglect/rejection from mother
- Injury
- The mother is producing no milk or may have trouble feeding due to such things as mastitis
- Experiment orientated
- Orphaned
- Illness/sickness/deformity
- Pets that are unwanted and are donated
- Education purposes
- The infants parents escaped and left the infant by itself
- For TV purposes
- Because it is being bullied or attacked

(TAFE Class 2010)

If hand rearing an infant *Papio hamadryas* the following points should be taken into account:

- If the infant is taken from the mother it is advisable not to give the milk formula to the infant as soon as it comes into care as the stomach may not be able to take the milk straight away otherwise diarrhoea can develop. Plain boiled, cooled water or 5% dextrose is good to give if the animal is dehydrated and glucose or an electolyte mixture can be added (Cole, M. et al 1979) such as Lectade ot Vytrate (please see **APPENIX 19** to make these products up). Otherwise from the authors point of view, subcutanous fluids can be given if the infant won't drink fluids. Signs of dehydration is concentrated urine, sunken in eyes, dry mouth with thick salivia, lethargy and the 'pinch test' on the skin can be done (Wikipedia 2010). If the pinched skin doesn't return to normal in a few seconds, the infant is dehydrated. Please see **APPENDIX 19** for suppliers of Lectade and Vytrate.
- It is not unusual for the infant to get diarrhoea at some stage of the rearing. This can be serious as the animal can become dehydrated quickly (Cole, M. et al 1979). From the authors experience if the infant gets diarrhoea then the milk should be diluted further than what it is by boiled cooled water or completely replaced by an electrolyte liquid. Once the stomach is settled again then the milk can be slowly offered again. The author recommend every second feed in diluted form and then work gradually back to the the original formula every feed. This process should be done over 1 week or so the stomach has time to adjust to the formula again. Sometimes diarrhoea can be a symptom of an illness, so a veterinary examination can be carried out if concerned. The experiences at the National Baboon Colony have been positive and they have found that the infants have not developed diarrhoea because of the improvement over the years with the baby formula.
- It is better to give small quantities often, not big amounts spaces apart as this can cause regurgitation or vomiting or diarrhoea as it puts too much stess on the digestive system. Feeding too much is as bad as not feeding enough (Scott Heffernan pers comm May 2010).

- An approximate amount to feed per day is 10-20% of its body weight to start with and as the infant progresses, the amount can be decided depending how well it if going or not (Cole, M. et al 1979).
- The infant can develop a fungal infection such as thrush in the mouth. It looks like spots or patches of cottage cheese or milk curds in and around the baby's mouth. These patches may appear inside the cheeks, on the roof of the mouth, on the gums, on the tongue. Thrush can also cause a rash on the bottom. If thrush develops, alert the veterinarian and appropriate treatment can be given.
- Rashes can develop from such things as nappies. At the National Baboon Colony, nappies are not used anymore because there have been cases of nappy rash. Because nappies are not used anymore, rashes do not develop. Therefore the area the infant is kept in has to be cleaned a few times a day as they urinate and defecate in the area.
- Other problems that can arise such as pneumonia, trauma and constipation all caused from different reasons and if these problems arise then consult the treating veterinarian.
- It is also important to minimise stress as this is the most common cause of illness in. Stress can be triggered by inappropriate temperature, constant handling and shock (if the infant has been separated from/lost the mother), being fed by different people, and unusual noises, such as traffic and dogs. Smells of predators should also be avoided (Cole, M. et al 1979).

11.5 Data Recording

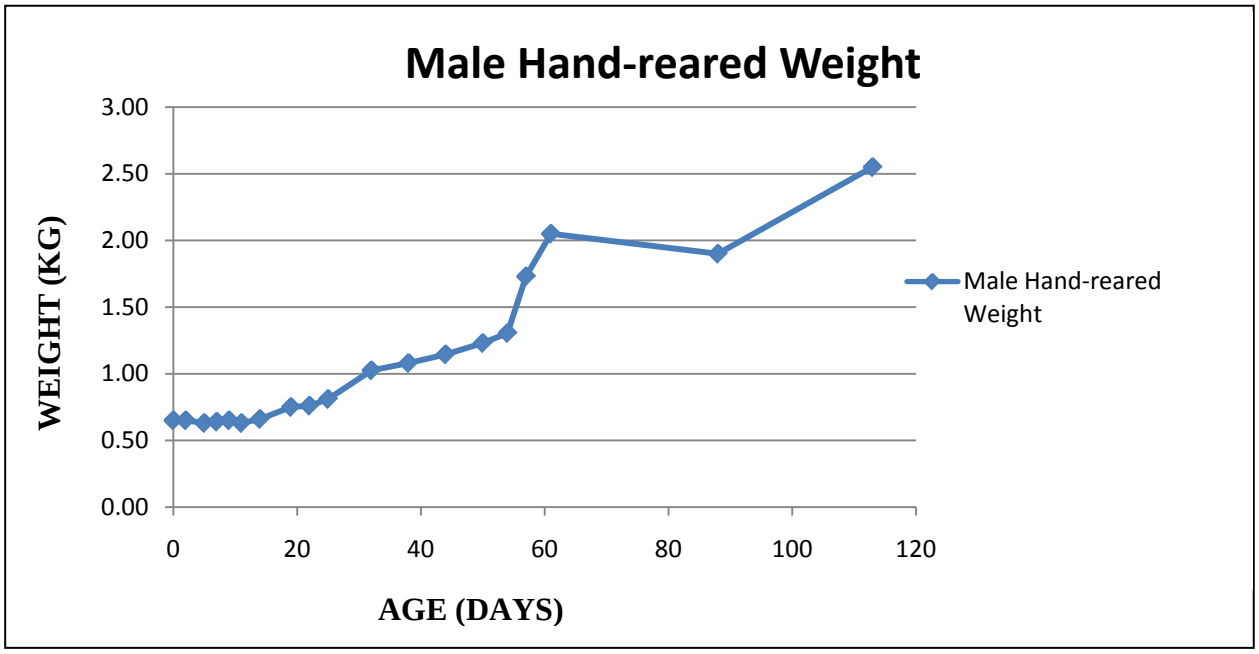
As soon as can be determined, the individuals ID, species, sex, parentage, why the animal lead to be hand-reared, the date of birth (age) of baboon should be recorded (TAFE Class 2010). If the infant is on the mother, the mother will cling onto it tightly to her front for about a week to 3 weeks usually before the sex can be determined. Patience is needed if wanting to determine the sex of the infant if on the mother.

When hand rearing a baboon, the author has recorded important information and the following information should be recorded if hand-rearing any animal:

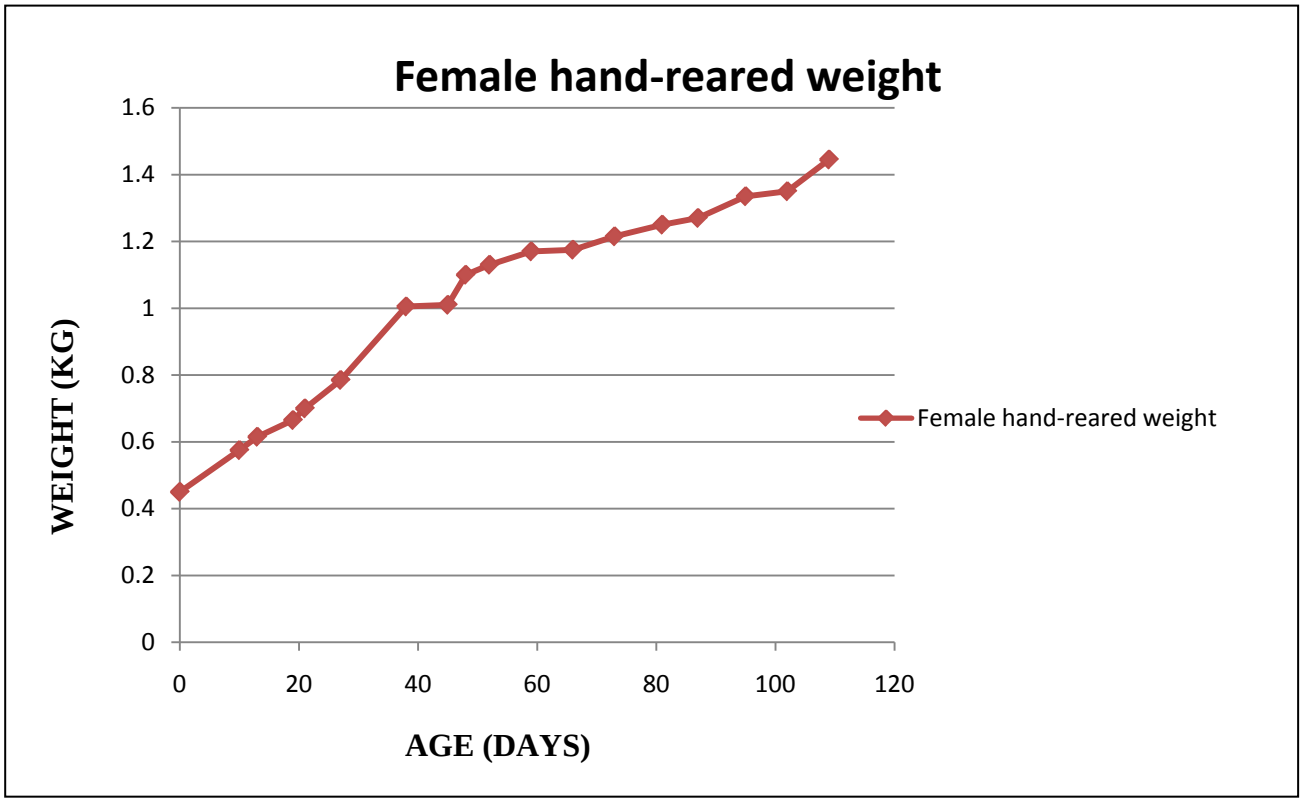
- Date
- Body weight
- Amount of milk formula consumed as well as the amount offered
- General activity and demeanour
- Characteristic and frequency of defecation and urination
- Veterinary examinations and results
- The weight when hand-rearing can be taken every second day for the first week, at the same time every day at the fasting weight (before feeding). After the first week the infant can be weighed weekly, but if the carer thinks there is a problem, daily weighing can be done.
- If any supplements are given or if the animal is on any medication or treatment.
- Colour in the coat change as they get older
- Type of housing they are being kept in and if it moves to other housing auch as a tempory area of housing

- The composition and recipe for the feed also needs to be noted so that it will be the same for each feed. This is particularly important if more than one keeper is helping.

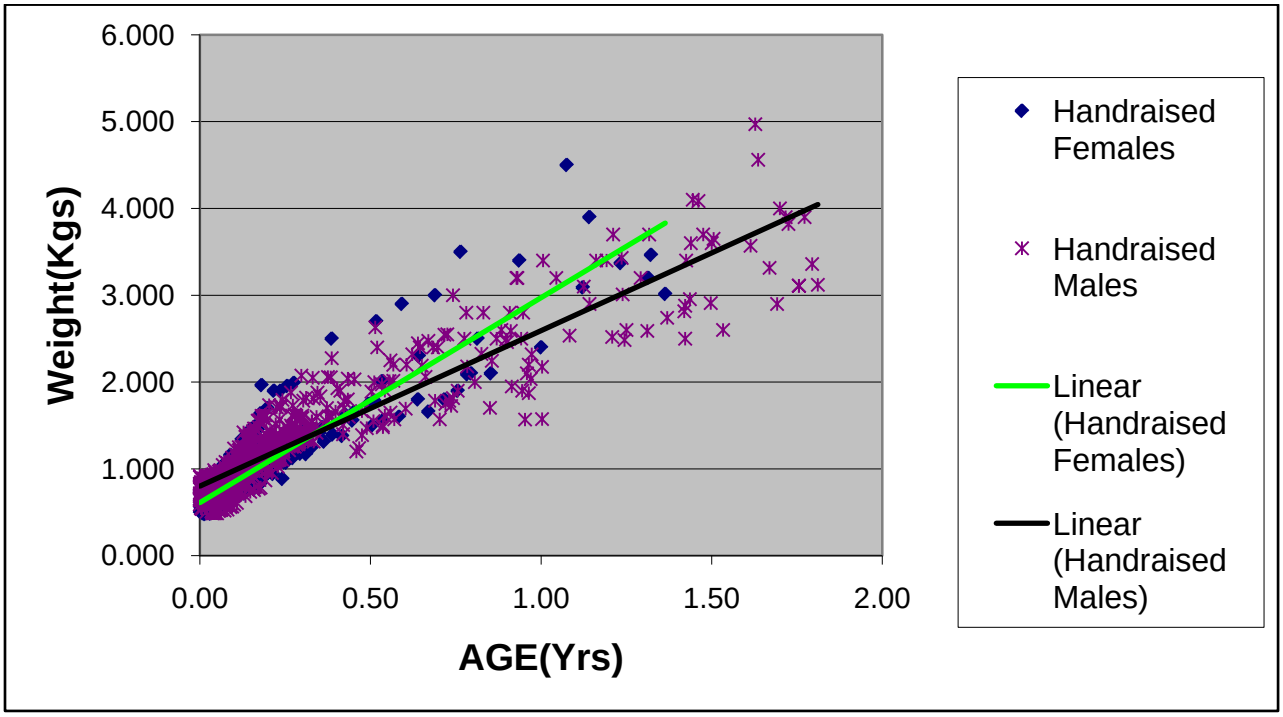
These notes can be used in comparison for the next animal reared. Please see **APPENDIX 18** for the attached records for examples of hand-reared *Papio hamadryas* of 'Wilfred' (that the author has hand reared) and 'Goliath' both from the Australian National Baboon Colony.



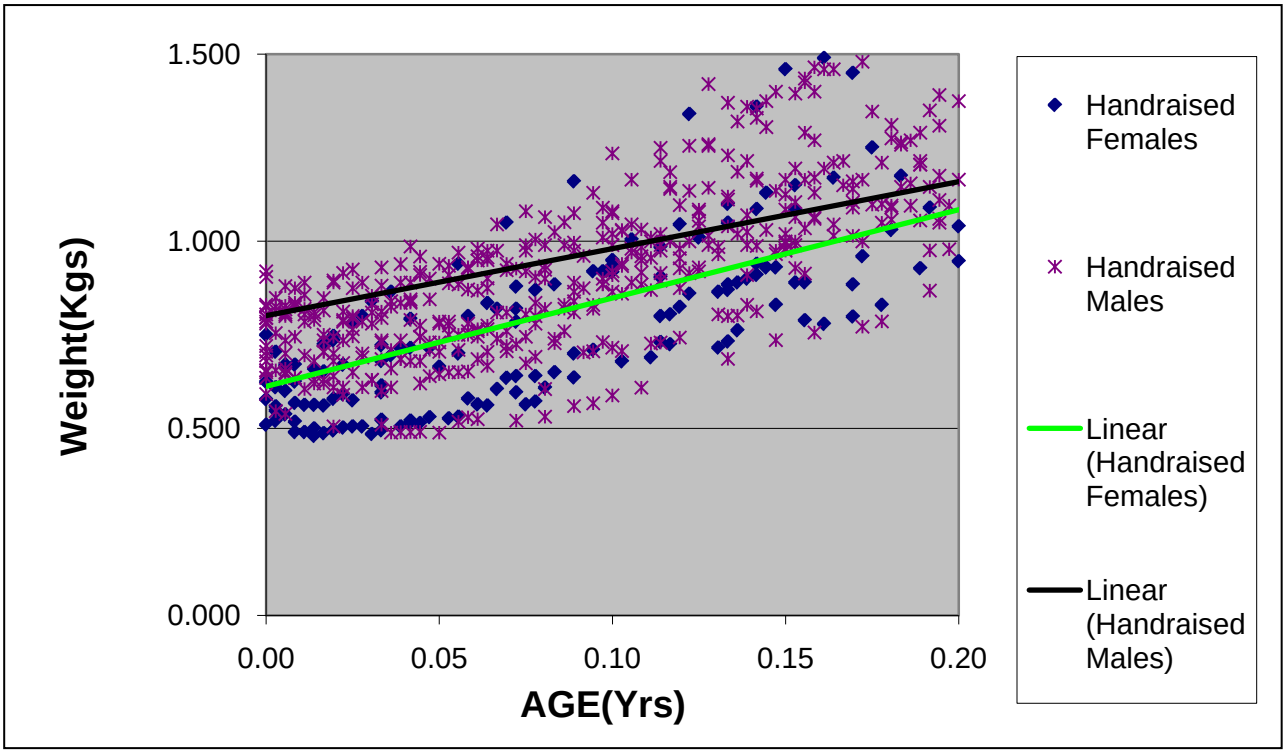
Graph 5: Weight of a hand-raised male *Papio hamadryas* from records that were made during hand raising Lauren Turner 2010; ANBC 2010



Graph 6: Weight of a hand-raised female *Papio hamadryas* from records that were made during hand raising Turner, L. 2010; ANBC 2010



Graph 7: Weight of a hand-raised *Papio hamadryas* compared to parent reared infants up to 2 years old Scott Heffernan 2010; Turner, L. 2010; ANBC 2010



Graph 8: Weight of a hand-raised *Papio hamadryas* compared to parent reared infants but to a smaller scale (only up to 2 months old) Scott Heffernan 2010; Turner, L. 2010; ANBC 2010

From the authors experience measurements can be recorded at birth such as cranial circumference, cranial to rump length, chest circumference, hip circumference, forearm measurement, hip to knee and knee to ankle measurement (Scott Heffernan pers comm. May 2010). These measurements can be taken again every few weeks as the infant develops. Please see **section 3.1.1** for measurements of two hand reared animals from the ANBC.

For parent-reared baboons, observations can be made by keepers. The behaviour of the young and mother-young interactions can be documented (Cole, M. et al 1979). The age the infant starts to ride on mothers back can be recorded as well.

Fig 99: A hand-reared *Papio hamadryas* being more active and inquisitive (ANBC 2010)

From the authors point of view all information should be noted straight away as it is easy to forget the detail quickly. When the rearing is finished, the information should be filed together in the individual animals file. Remember that information from an unsuccessful rearing is as important as one that went well as failures can be learnt from. So it is important to maintain records to help others hand-rearing in the future. These records should be published where possible to aid in hand-rearing attempts (TAFE Class 2010).

11.6 Identification Methods

Please see **section 5.3**. If the infant is with the parents usually identification of the mother or father will determine the identification of the infant. Also if the young is separated from its parents, the mother and father will react if going near their young or doing other things such as catching up the young. If the infant is being hand-reared, neither the mother nor father will recognise the infant as their own and therefore will not react (Scott Heffernan pers comm. May 2010).

Fig 100: A juvenile *Papio hamadyras* with a tattoo on the right inner thigh for identification (Turner, 2009)

11.7 Hygiene

Maintaining a high standard of hygiene is very important to the survival of the infant baboon if hand-rearing, otherwise problems mentioned in **11.4** can occur. Avoid contact with other animals unless you are sure they pose no health risks. The infants bedding needs to be changed if soiled and the bedding needs to be washed and disinfected daily as bacteria can develop in the bedding (Department of Primary Industries 2010).

Any feeding equipment and utensils used is to be washed in warm soapy water with a bottle brush cleaner and sterilised in antibacterial solution such as Halasept, Viraclean or Milton for 30 minutes then rinsed and soaked in boiling water (TAFE Class 2010). Alternatively and from the authors experience the equipment can be boiled in water for ten minutes (Scott Heffernan pers comm. May 2010). After sterilisation, equipment should be washed in cold water.

Fig 101: Milton antibacterial (probiotecpharma, 2010)

Good personal hygiene regime should be implemented by washing and disinfecting hands before and after handling the baboon.

Boiled water and cooled boiled water should be used when making up formulas for young baboons and any spilt milk, faeces or urine from the baboon's skin and fur should be wiped clean as soon as possible and dried. The infant can also be bathed occasionally using warm soapy water which is low irritant (Scott Heffernan pers comm. May 2010). Prepared baboon milk should only be heated up once and leftovers discarded.

11.8 Behavioural Considerations

The extended developmental period of juvenile primates requires older animals to associate with juveniles so that behaviour develops normally. The juvenile animals then learn to function as part of a social group, reproduce and care for young. Artificial rearing disrupts this natural process and often results in socially maladjusted animals which may be difficult to place in a group or lack the skills for normal breeding behaviour (TAFE Class 2010). Hand-reared animals are often harder to introduce to a group as they do not know the signals the other animals are making and may respond in the wrong way. This is because humans imprint their behaviours onto animals. This can be avoided by treating the youngster as a member of its own species and not as a baby human. Imprinting can also be reduced by rearing two or three of the same species at a time so they have companionship of their own species other than the keeper. Behavioural enrichment should be maintained (Department of Primary Industries 2010).

If rearing two or three of the same species cannot be done at the same time then a mobile cage for the infant to be kept in can be put near adult cages of the same species, so the infant being reared can learn off the adult animals how to behave. This can be done at the youngest age possible when the infant becomes more active at a few months old. This will help with re-introduction to the rest of the species especially if going to be housed with the animals it learns behaviour's off. This mobile cage can be set up with appropriate furniture so the infant will get exercise to help develop leg muscles for climbing and jumping (Scott Heffernan pers comm. May 2010).

A standard has to be set if more than one keeper is hand-rearing the infant as well. This is so a routine can be established with the infant and problems don't arise when the infant goes into care from one keeper to the other. For example, one keeper can't carry the infant around the whole time when caring for it if the other one is not going to, because the infant will get more attached to this keeper. Therefore when the infant goes into care with the other keeper, the infant will get stressed out. Also feeding during the day should be on schedule even if the infant is sleeping, so hopefully the infant may sleep more during the night if kept awake for longer during the day (Scott Heffernan pers comm. May 2010).

11.9 Use of Foster Species

There should be attempts made to do other things before hand-rearing such as:

- Letting the parents rear the infant
- Try have a support parent if possible for the mother
- Fostering the infant to another mother
- Cross fostering the infant to a mother of another species
- Hand-rearing as a last resort

(TAFE Class 2010)

In saying this, from the author's point of few it is hard to do the first 4 points because of rejection of the infant. *Papio hamadryas* are fussy with their young and if the infant is not their own, they will reject the infant. Even if the mother undergoes a caesarian and does not have the newborn naturally, she will reject the infant (Scott Heffernan pers comm. May 2010). Also the infant is aware of their environment and probably wouldn't accept another species to rear it.

11.10 Weaning

As mentioned above in **section 10.14**, from conversations with Scott Heffernan from the National Baboon Colony 'depending how many young the female has had in the past she breastfeeds for 6 – 9 months.' This is the natural weaning age if the mother is rearing her infant.

If hand-rearing an infant *Papio hamadryas* this process is done earlier because introduction to the colony has to be done as early as possible. Above in **section 11.3** states that at 2-3 months of age, solids should be introduced into their diet, as well as still bottle feeding them milk (Scott Heffernan pers comm. May 2010). Solids of cereal (such as Farex), mashed up bread and softer fruits can be offered such as banana and these solids can be increased the older they get and more variety and substance can be offered (Scott Heffernan pers comm. May 2010).

Please see **APPENDIX 19** for information on Farex.

11.11 Rehabilitation and Release Procedures

Because this species is abundant in numbers (see **section 1.2 and 3.3**), this species is sometimes referred to as a crop pest in some areas in Africa, because they eat farmers crops. Although if going to release Hamadryas Baboon *Papio hamadryas* back into the wild after being rehabilitated it needs to satisfy a number of criteria (TAFE Class 2010):

- Be fit and healthy (physically and mentally)
- Be maintaining condition on natural foods
- Able to recognise its own species
- Be familiar with the social behaviour of its species (it should ideally be housed with members of its own species)
- Show appropriate levels of fear of humans and predators
- Show no evidence of being imprinted by humans

Because Hamadryas Baboon is native to Africa, it is vital that any rehabilitation and release programs be conducted in their natural environment and habitat (Kateferedayshete 2010).

One person that is heavily involved in conservation of the Hamadryas Baboon *Papio hamadryas* is Larissa Swedell Ph.D. Columbia University 2000. On her website of http://www.baboonsonline.org/swedell/ it states 'most broadly, my interest's center on the behavior, ecology, and evolution of nonhuman primates and what they can tell us about human biology, evolution, and behaviour. More specifically, I am interested in the social behaviour and ecology of papionin monkeys, especially baboons. My research so far has focused mainly on Hamadryas Baboons in Ethiopia, and I'm currently broadening my scope to include Chacma Baboons of the Western Cape Peninsula of South Africa. In the wake of increasing habitat destruction and fragmentation, with the concomitant threat to baboons and increase in baboon-human conflict, I am actively involved in conservation strategies to promote the value of baboons and improve their conservation status. I am currently directing my efforts towards the Save Awash National Park conservation organisation in Ethiopia (founded by Mathew Pines) and the Imfene Baboon Conservation and Education Initiative (co-founded with Julian Saunders).' (Baboons online 2010).

The Save Awash National Park organisation states 'Awash National Park (ANP) is the most important conservation area in the Ethiopian lowland. Home to a diverse array of savannah and scrubland plant and animal species and stunning volcanic landscape, ANP should play a major role in conserving Ethiopia's natural heritage and contributing to the social and economic wellbeing of the present and future generations of Ethiopians. Sadly, however, ANP faces some serious challenges and, if things continue unchecked, then the park's future looks grim. "Save Awash National Park" (SANP) is a not for profit organisation established to facilitate the conservation of ANP's natural heritage. SANP is working with park management to tackle the issues facing Awash National Park and the local pastoralist communities to ensure the long term survival, prosperity and health of both.' (Save Awash National Park 2010). Information is on the website on how to help out.

Fig 102: A map with a red arrow showing the Awash national park (Imfene 2010)

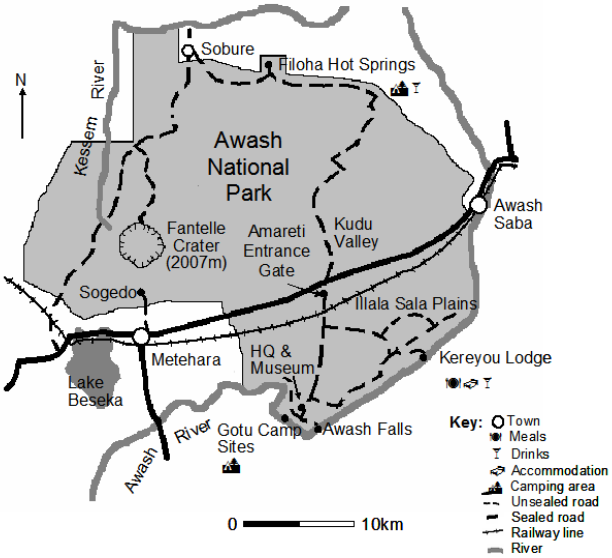


Fig 103: A map of the Awash national park (Imfene 2010)

For more information on rehabilitation and release please visit these websites:
http://www.kateferedayeshete.net/section178380_97885.html
http://www.baboonsonline.org/swedell/
http://www.baboonsonline.org/bru/personnel/larissa-swedell
http://www.imfene.org/
http://save-awash-national-park.com/

12 Acknowledgements

The biggest thank you ever to Scott Heffernan, Manager at The Australian National Baboon Colony, Royal Prince Alfred Hospital, NSW, Australia for all your time, help and input on my husbandry manual. Not only did you go out of your way to provide me with all the information I needed, you spent countless hours over many days and months, having numerous conversations with me to answer my all of my questions, for all aspects of this husbandry manual. Thank you for spending the time to find information that has been recorded and gathered internally at the Australian National Baboon Colony and supplying it to me. Also thank you for giving me your paper titled 'A Guide for Researchers, Animal Technicians and New Staff Members working with *Papio hamadryas* (Sacred Baboon) at the Australian National Baboon Colony', which is a work in progress, but it helped me with some information I did not have to ask you about and supplied me with some pictures I used in this husbandry manual. Also thank you for spending the time to proof read my manual and correct mistakes or wrong information and adding in information as well.

Penny Farrell, Veterinarian for the Australian National Baboon Colony, Royal Prince Alfred Hospital for answering questions and giving me information on the health of this species.

Jacki Salkeld, Brad Walker and Graeme Phipps, TAFE Teachers, Certificate III Captive Animals, TAFE NSW, Richmond Campus, NSW, Australia. Thank you to my teachers who taught me all my subjects to be able to complete this husbandry manual and for always giving encourangement. This husbandry manual has been a project and a half but very worthwhile.

Jo Carroll, Librarian at TAFE NSW Richmon Campus, Sydney, NSW, Australia for spending the time to sit down with me and go through my referencing.

Wade Standen, Keeper at Sydney Wildlife World, Sydney, Australia, for giving me the time to ask you as many questions as I could on my husbandry manual and how to go about things.

Tammy Etchells, Keeper/Veterinary Nurse at Taronga Wildlife Hospital, Taronga Conservation Society Australia, Mosman, NSW, Australia, for supplying me with information through email on housing and feeding on primates in general and for forwarding on my emails to people that could help me.

Clare Campbell Supervisor of Primates, Perth Zoo, W.A, Australia for your help via email on your diet for your Hamadryas Baboons and also plants to include in exhibits.

Emma Yengi, Keeper at Monarto Zoo, Australia for your help via email on your diet for your Hamadryas Baboons and also plants to include in exhibits.

Bec J, Primate Keeper at Melbourne Zoo, Vic, Australia for your help via email on your diet for your Hamadryas Baboons and also plants to include in exhibits.

13 References

Allaby, M., "Papio." A Dictionary of Zoology. 1999. Retrieved April 02, 2010 from Encyclopedia.com: http://www.encyclopedia.com/doc/1O8-Papio.html

Aplin, K., *Environmental enrichment and welfare implications for captive Hamadryas baboons*
http://vip.vetsci.usyd.edu.au/contentUpload/content_2611/Aplin.pdf [March 2010]

Alyawarra Ethnographic Archive WOODROW W. DENHAM, PH. D. 1990
Available from:
http://www1.aiatsis.gov.au/exhibitions/AlyaWeb/public/dir/03NHP/03NHPKSA/KSA346AbhaHmdMaleYawn.jpg [September 2009]

Animal Diversity. Available from:
http://animaldiversity.ummz.umich.edu/site/accounts/information/Papio_hamadryas.html
[September 2009]

Animal Health 2008. *Zoo Imports and Exports.* Available from:
http://animalhealth.com.au/shadomx/apps/fms/fmsdownload.cfm?file_uuid=5650A239-049B-F54B-21ED-C23D387A0C31&siteName=aahc [February 2010]

Anon. (1978) *Nutrient Requirements of Non-human Primates*, National Academy of Science, Washington DC

Answers. Available from:
http://www.answers.com/topic/baboon [November 2009]

ARAZPA Guidelines on Animal Transport 2005. Available from:
www.zooaquarium.org.au [November 2009]
http://www.google.com.au/url?sa=t&source=web&cd=1&ved=0CBgQFjAA&url=http%3A%2F%2Fwww.zooaquarium.org.au%2FArticleDocuments%2F34%2FARAZPA%2520General%2520Standards%2520.pdf.aspx&rct=j&q=ARAZPA+Guidelines+on+Animal+Transport+&ei=GToOTI2rBpDQcbP47YMN&usg=AFQjCNGVnfxymtDgJla5EHJSurCUZL3R8Q

ARAZPA
http://www.arazpa.org.au/

Australian Government. Department of the Environment, Water, Heritage and the Arts forms for importing/exporting animals. *Cooperative Conservation Program Guidelines.* Available from:
http://www.environment.gov.au/biodiversity/trade-use/sources/non-commercial/ccp/pubs/ccp-guidelines.pdf [January 2010]

Baboons online. Available from:
http://www.baboonsonline.org/swedell/ [March 2010]

Baby Centre. Available from:
http://www.babycenter.com.au/baby/health/thrush/#ixzz0m0w7nJcs [April 2010]

BBC website. Available from:
http://www.bbc.co.uk/nature/wildfacts/factfiles/228.shtml [November 2009]

Bergman. T. J., and Beehner, J. C. 2004. *Social System of a Hybrid Baboon Group (Papio anubis × P. hamadryas).* Springer. Available from:
http://www.ingentaconnect.com/content/klu/ijop/2004/00000025/00000006/00492100
[September 2009]

Botanical. Available from:
http://www.botanical.com/botanical/mgmh/n/nighde05.html [March 2010]

Boug, A., S. Biquand, V. Biquand-Guyot, and K. Kamal. 1994. The response of commensal hamadryas baboons to seasonal reduction in food provisioning. Rev. Ecol. (Terre et Vie) 49:307-319.

Britannica Online Encyclopaedia. Available from:
http://www.britannica.com/EBchecked/topic/2560/Acacia-senegal
http://www.britannica.com/EBchecked/topic/253146/hamadryas
[March 2010]

Buss, D, H., 1968. *Gross Composition and Variation of the Components of Baboon Milk during Natural Lactation*. Division of Biological Growth and Development, Southwest Foundation for Research and Education, San Antonio, Texas. Primate Milk in an Evolutionary Perspective, Michael Power - American College of Obstetricians & Gynecologists (2005)

CITIES
http://www.cites.org/

Comuzzie, A. G., S. A. Cole, L. Martin, K. D. Carey, M. C. Mahaney, J. Blangero, and J. L. VandeBerg. 2003. *The baboon as a nonhuman primate model for the study of genetics of obesity*. Obesity Research 11(1):75–80.

Department of Primary Industries
Policy on exhibiting Primates in New South Wales, 2000. *Exhibited Animals Protection Act. Policy approved by the Director- General of NSW Agriculture on 27 March 2000.* Available from:
http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0006/121569/primate-policy-welfare.pdf [January 2010]

Deleu, R., Veenhuisen, R. and Nelissen, M. 1994. *Evaluation of the mixed-species exhibit of African Elephants and Hamadryas Baboons in Safari Beekse Bergen*, The Netherlands
http://www.dpz.gwdg.de/pr/pr65/deleu.pdf

Dictionary Available at:
http://dictionary.reference.com/ [March 2010]

Easley SP, Coelho Jr. AM. 1991. *Is lipsmacking an indicator of social status in baboons?* Folia Primatol 56(4): 190-201.

Encyclopedia 2
http://encyclopedia2.thefreedictionary.com/baboon
S. C. Strum, *Almost Human* (1987).

Fleagle, J.G. 1988. *Primate Adaptation and Evolution.* New York: Academic Press.

Fraser, O. and Amy B. Plowman, A. B. 2007. *Function of Notification in Papio hamadryas***.** Springer Netherlands**.** Devon, UK
http://www.springerlink.com/content/jp1515332375t07/

Free Dictionary
http://www.thefreedictionary.com/Hamadryas+Baboon

Fort Zoo Enrichment Online
www.enrichmentonline.org

Graves, L. E., Hennessy, A., Sunderland, N., McKenzie, P., Cooper, W., Heffernan, S., Tomson, S., (2005) *The incidence of lymphoma in a captive-bred baboon (Papio hamadryas) colony*. Department of Renal Medicine. RPA, Sydney.

Groves, C., 2001. *Primate Taxonomy*. Smithsonian Institution Press, Washington, District of Columbia.

Heffernan, S., 2006. *A Guide for Researchers, Animal Technicians and New Staff Members working with Papio hamadryas (Sacred Baboon) at the Australian National Baboon Colony*. Royal Prince Alfred Hospital. Sydney

Hennessy. A., Phippard, A. F, Harewood, W. J, Horam, C. J, & Horvath, J.S. (1993) *Helminthic infestation complicated by intussusception in baboons (Papio hamadryas)*. Department of Renal Medicine, Royal Prince Alfred Hospital, Sydney, Australia
http://la.rsmjournals.com/cgi/reprint/28/3/270.pdf

HernÃ¡ndez-Lloreda, MarÃa Victoria; Colmenares, Fernando. 2005. *Mother-infant relationships in baboons (Papio hamadryas): Predictors of differences and discontinuities in developmental pathways.* Journal of Comparative Psychology. Vol 119(3), 311-324. American Psychological Association.

Honolulu Zoo
http://www.honoluluzoo.org/enrichment_recipes.htm
Hrdy, S., P. Whitten. 1987. *Patterning of sexual activity*. Pp. 370-384 in B. Smuts, D. Cheney, R. Seyfarth, R. Wrangham, T. Struhsaker, eds. Primate Societies. Chicago: The University of Chicago Press.

International Air Transport Association - Live Animals Regulations 27th Edition 2000 – Montreal Geneva. Available from Richmond TAFE NSW February 2010
Information on the Live Animals Regulations from:
http://www.iata.org/ps/publications/Pages/live-animals.aspx [8th June 2010]

Internal information from the Australian National Baboon Colony, Royal Prince Alfred Hospital (ANBC, 2009/2010)

IUCN Redlist Website
http://www.iucnredlist.org/search

Jackson, S.M. (2002) *Standardizing captive-management manuals: guidelines for terrestrial vertebrates* revised, in International Zoo Yearbook (2003) 38: 229-243, The Zoological Society of London, London.

Jolly, C. Y. 1993. Species, subspecies, and baboon systematics. In *Species, Species Concepts, and Primate Evolution,* edited by W. H. Kimbel and L. B. Martin. New York: Plenum Press.

Jones, M.L. 1968 *Longevity of primates in captivity. International Zoo Yearbook, 8, 183-192*

Judge, P.G., Griffaton, N.S., Fincke, A.M. 2006. *Conflict management by hamadryas baboons (Papio hamadryas hamadryas) during crowding: A tension-reduction strategy*. John Wiley & Sons, Inc.
http://www.faqs.org/abstracts/Psychology-and-mental-health/Conflict-management-by-hamadryas-baboons-Papio-hamadryas-hamadryas-during-crowding-A-tension-reducti.html

Kessel, A., & Brent , L., 2001. *The rehabilitation of captive baboons.* Journal of Medical Primatology, Volume 30, Number 2, April 2001 , pp. 71-80(10). Blackwell Publishing. Department of Laboratory Animal Medicine, Southwest Foundation for Biomedical Research, San Antonio, Texas Correspondence to Linda Brent, Ph.D., Southwest Foundation for Biomedical Research, P.O. Box 760549, San Antonio, TX
http://www.ingentaconnect.com/content/mksg/jmp/2001/00000030/00000002/art00001
07/06/2010

Kirkwood, J., Stathatos, K., 1992. *Biolody, rearing and care of young primates.* Oxford University Press, New York

Krauss, H. (2003). *Zoonoses: Infectious Disease Transmissible from Animal to Human*. ASMP Press. Washington DC
http://books.google.com.au/books?id=VS5bqBQ9RWoC&printsec=frontcover&dq=bacterial+diseases+in+papio+hamadryas&source=gbs_similarbooks_s&cad=1#v=snippet&q=primates&f=false

Kummer, H. 1968. *Social Organization of Hamadryas Baboons. A Field Study*. Basel and Chicago: Karger, and University Press.
http://animaldiversity.ummz.umich.edu/site/accounts/information/Papio_hamadryas.html

Merck Available from
http://www.merck.com/mmpe/sec21/ch319/ch319d.html [09/06/10]

Munson, L., Moresco, A., Calle, P. P., 2005. *Adverse Effects of Contraceptives.* The Johns Hopkins University Press. Baltimore
http://books.google.com.au/books?hl=en&lr=&id=ydFciujnWTcC&oi=fnd&pg=PA66&dq=contraception+in+papio+hamadryas&ots=1XGBy0JVh-&sig=Ub3xNobe0wK_0zhj9khON3n6LXA#v=onepage&q=contraception%20in%20papio%20hamadryas&f=false

Napier, J., P. Napier. 1985. *The natural history of the primates*. Cambridge, Massachusetts: The MIT Press.

National Baboon Colony 2009/2010 *Internal data and information and records.* Available from Australian National Baboon Colony [dates of information are variable but information obtained June 2009 – June 2010]

Newman, T. K., C. J. Jolly, and J. Rogers. 2004. *Mitochondrial phylogeny and systematics of baboons* (*Papio*). American Journal of Physical Anthropology 124(1):17–27.

Newsome, J. 1967. *Baboons. In the UFAW handbook on the care and management of laboratory animals (3rd edition).* pp. 709-719. Livingstone, Edinburgh & London

Nowak, R. 1999. *Walker's Mammals of the World, Sixth Edition*. Baltimore: The Johns Hopkins University Press.

NAP website
Nutrient Requirements of Nonhuman Primates: Second Revised Edition (2003) Board on Agriculture and Natural Resources (BANR)
http://www.nap.edu/openbook.php?record_id=9826&page=193#p200068c29960193001

National Library of Medicine
http://www.ncbi.nlm.nih.gov/pubmed/8544227
http://gateway.nlm.nih.gov/MeetingAbstracts/ma?f=102202311.html

New World Encyclopedia

http://www.newworldencyclopedia.org/entry/Baboon

Orville Lloyd Douglas Available at:
orvillelloyddouglas.wordpress.com/2009/01/ [10/06/10]

Palm & Cycad Societies of Florida, Inc.
http://www.plantapalm.com/vpe/photos/Species/hyphaene_thebaica.htm
Personal communication on numerous occasions with Scott Heffernan 2009 and 2010

Personal communication from email 16th March 2010
Clare Campbell Supervisor-Primates – Perth Zoo

Personal communication from email 12th March 2010
Emma Yengi – Monarto Zoo

Phillips-Conroy. J. E., Jolly. C. J. 2005. *Sexual dimorphism in two subspecies of Ethiopian baboons (Papio hamadryas) and their hybrids.* Rhode Island
http://www3.interscience.wiley.com/journal/110483274/abstract

Plant File Online
http://www.plantfileonline.net/VPB.php

Plowman, A. B., Jordan, N.R., Anderson, N., Condon, E. and Fraser. O. 2004. *Welfare implications of captive primate population management: behavioural and psycho-social effects of female-based contraception, oestrus and male removal in hamadryas baboons (Papio hamadryas).* Devon, U.K.
http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6T48-4DTBVK8-1&_user=10&_rdoc=1&_fmt=&_orig=search&_sort=d&_docanchor=&view=c&_searchStrId=1092380625&_rerunOrigin=scholar.google&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=425dde12ec0403b290732cecc7fca366

Popilskis, S. J and Kohn, D. F. (1997) *Anaesthesia and Analgesia in Nonhuman Primates*. Academic Press

Portugal, M. M , Asa, C. S. *Effects of chronic melengestrol acetate contraceptive treatment on perineal tumescence, body weight, and sociosexual behavior of hamadryas baboons (Papio hamadryas).* Missouri
http://www3.interscience.wiley.com/journal/110495198/abstract

Primate Info Net
Cawthon Lang KA. 2006 April 18. Primate Factsheets: Olive baboon (Papio anubis) Behaviour . <http://pin.primate.wisc.edu/factsheets/entry/olive_baboon/behav>. Accessed 2009 November 23.

Primate Info Net, 2002. "Primate Info Net" (On-line). Hamadryas Baboon (Papio hamadryas). Accessed July 14, 2003 at http://www.primate.wisc.edu/pin/factsheets/papio_hamadryas.html .

Purdue University
http://www.hort.purdue.edu/newcrop/duke_energy/Acacia_senegal.html#Uses

Pusey, A. E., and Packer, C. (1986). Dispersal and philopatry. In: Smuts, B. B., Seyfarth, R. M., Wrangham, R. W., and Struhsaker, T. T. (eds.),*Primate Societies*, University of Chicago Press, Chicago, pp. 250–266.

Ransom TW. 1981. Beach troop of the Gombe. East Brunswick (NJ): Assoc Univ Pr. 319

Reinhardt, V., Liss, C., and Stevens, C. 1995. *Restraint Methods of Laboratory Non-Human Primates: A Critical Review.* Animal Welfare Institute, Washington, DC, USA

Romich, J.A., 2008. *Understanding Zoonotic Diseases.* Canada: Thomson Delmar Learning

Schlabritz-Loutsevitch, N. E., Moore, C. M., Lopez-Alvarenga, J. C., Dunn, B. G., Dudley, D. & Hubbard, G. B. 2008. *The baboon model* (*Papio hamadryas*) *of fetal loss: maternal weight, age, reproductive history and pregnancy outcome.* University of Texas Health Science Centre. San Antonio, TX, USA
http://www.ncbi.nlm.nih.gov/pubmed/19017195

Shefferly, N. 2004. "Papio hamadryas" (On-line), Animal Diversity Web. Accessed November 16, 2009
at http://animaldiversity.ummz.umich.edu/site/accounts/information/Papio_hamadryas.html

Smuts BB. 1985. *Sex and friendship in baboons*. New York: Aldine de Gruyter. 303 p.

Springer Link
http://www.springerlink.com/content/n866n272811380q3/

Stammbach, E. 1987. Desert, forest, and montain baboons: Multilevel societies. Pp. 112-120 in B. Smuts, D. Cheney, R. Seyfarth, R. Wrangham, T. Struhsaker, eds. *Primate Societies*. Chicago: The University of Chicago Press.

Sugawara, K. 1982. *Sociological Conparison between Two Wild Groups of Anubis-Hamadryas Hybird Baboons.* Kyoto University
http://ci.nii.ac.jp/naid/110000066174/en

Sunderland, N., Heffernan, S., Thomson, S. & Hennessy, A. 2008. *Maternal parity affects neonatal survival rate in a colony of captive bred baboons (Papio hamadryas*). John Wiley and Sons A/S. Australia
http://www3.interscience.wiley.com/journal/120173863/abstract
http://www.ncbi.nlm.nih.gov/pubmed/18194221?itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVDocSum&ordinalpos=1

Swedell, L. **2002.** Affiliation among females in wild hamadryas baboons (*Papio hamadryas hamadryas*). *International Journal of Primatology*, 23/6: 1205-1225.

Swedell, L., Tesfaye, T. **2003.** *Infant mortality after takeovers in wild Ethiopian Hamadryas Baboons.* University of New York. New York
http://www3.interscience.wiley.com/journal/104546764/abstract

Swedell, L., and Schreier, A. **2008.***Use of palm trees as a sleeping site for hamadryas Baboons (Papio hamadryas hamadryas) in Ethiopia***.** John Wiley & Sons, Inc.
http://www.faqs.org/abstracts/Psychology-and-mental-health/Use-of-palm-trees-as-a-sleeping-site-for-hamadryas-Baboons-Papio-hamadryas-hamadryas-in-Ethiopia.html

Swedell, L., Hailemeskel, G., Schreier, A., **2008**, *Composition and Seasonality of Diet in Wild Hamadryas Baboons: Preliminary Findings from Filoha*, Folia Primatologica Vol: 79 Issue: 6 from page 476

The Primata
http://www.theprimata.com/papio_hamadryas.html

Tour Egypt
http://www.touregypt.net/featurestories/baboons.htm

Walters, R., R. Seyfarth. 1987. Conflict and cooperation. Pp. 306-317 in B. Smuts, D. Cheney, R. Seyfarth, R. Wrangham, T. Struhsaker, eds. *Primate Societies*. Chicago: The University of Chicago Press.

Walters, J. 1987. Transition to Adulthood. Pp. 358-369 in B. Smuts, D. Cheney, R. Seyfarth, R. Wrangham, T. Struhsaker, eds. *Primate Societies*. Chicago: The University of Chicago Press.

Wikipedia
http://en.wikipedia.org/wiki/Hepatitis_A
http://en.wikipedia.org/wiki/Hamadryas_Baboon

Wild Watch
http://www.wildwatch.com/living_library/plants-1/acacias-thorn-trees-of-africa

Williams, S. and Barker, I. (2001). *Infectious Diseases of Wild Animals 3rd Edition.* Blackwell Publishing. Iowa USA
http://books.google.com.au/books?id=I62ZO_-4cjwC&pg=PA218&lpg=PA218&dq=bacterial+diseases+in+papio+hamadryas&source=bl&ots=bHjv-7dKHE&sig=0JCx7KV_98f9UmNPQHarqfnt0lc&hl=en&ei=8dKoSr_XJ5vE6wOAn7XsBw&sa=X&oi=book_result&ct=result&resnum=3#v=onepage&q=&f=false

WILLIAMS-BLANGERO, S., VANDEBERG, J.L., BLANGERO, J., KONIGSBERG, L. and DYKE, B., (1990), *Genetic Differentiation Between Baboon Subspecies: Relevance for Biomedical Research.* Southwest Foundation for Biomedical Research, Sun Antonio, Texas

Wolfensohn, S. and Honess, P., 2005. *Handbook of Primate Husbandry and Welfare*. Oxford, UK: Blackwell Publishing Ltd

Wolfheim, J.H., Ed. 1983. *Primates of the World: Distribution, Abundance, and Conservation.* Seattle: University Washington Press.

World Agro Forestry Centre
www.worldagroforestry.org/af/treedb/AFTPDFS/Hyphaene_thebaica.pdf

Zinner, D., and Deschner, T. (2000). Sexual swellings in female hamadryas baboons after male take-overs: "Deceptive" swellings as a possible female counter-strategy against infanticide. *Am. J. Primatol*. **52**: 157–168.

World Weather
http://www.worldweather.org/042/c00154.htm

Zoom info
http://www.zoominfo.com/people/Kummer_Hans_39823133.aspx

Zoonoses 2009– University of Tasmania document – Edu Campus at TAFE NSW Richmond Campus

Zurovsky, Y., and A. Shkolnik. 1982. *Physiological adaptation of hamadryas baboon to the desert.* Isr. J. Zool. 31:61-62.

14 Bibliography

Altmann J. 1980. *Baboon mothers and infants.* Cambridge: Harvard University Press. 242 p.

Altmann J, Alberts S. 1987. *Body size and growth rates in a wild primate population*. Oecologia 72:15–20

American Journal of Physical Anthropology
http://biology.kenyon.edu/courses/biol241/baboon%20cladistics%20Newman%202004.pdf

Angela Meder. 1990. *Integration of hand-reared gorillas into breeding groups*. Zoo Biology Volume 9, Issue 2, Date: 1990, Pages: 157-164

Buss, D. H.: Voss, W. R. *Evaluation of four methods for estimating the milk yield of baboons*. JOURNAL OF NUTRITION 101:90-909, 1971

Chism, J. 2000. *Allocare Patterns among Cercopithecines.* Folia Primatologica, Evolution of Non-Maternal Care in Primates, Department of Biology, Winthrop University, Rocky Hill, S.C., USA

Cole, M.; Davison, D.; Eldridge, P.J.; Mehren, K.; Rapley, W.A. 1979 *Notes on the early hand-rearing of an orangutan and its subsequent reintroduction to the mother.* INTERNATIONAL ZOO YEARBOOK 19~263-264

Davenport, R.K.; Rogers, C.M. *Differential rearing of the chimpanzee. A project survey.* Pp. 337-360 in THE CHIMPANZEE, VOL. 3. G.H. Bourne, ed. Basel, Karger, 1970.

Diane K. Brockman, Mary S. Willis, William B. Karesh. 1987. *Management and husbandry of ruffed lemurs, Varecia variegata, at the San Diego Zoo. II. Reproduction, pregnancy, parturition, litter size, infant care, and reintroduction of hand-raised infants.* Zoo Biology Volume 6, Issue 4, Date: 1987, Pages: 349-363

Dietmar Zinner. 1999. *Relationship between feeding time and food intake in hamadryas baboons (Papio hamadryas) and the value of feeding time as predictor of food intake*. Zoo Biology. Volume 18, Issue 6, Date: 1999, Pages: 495-505

Goldsmith; J. Moor-Jankowski, cds. Bascl, Kargcr, 1972
Chorazyna, H. *Separation of baby monkeys from their mothers*, pp, 88-92 in MEDICAL PRIMATOLOGY 1972, PART I. E. 1.

Humphrey, L. T., Dirks, W., Dean, C., Jeffries, T. E., 2008. *Tracking Dietary Transitions in Weanling Baboons (Papio hamadryas anubis) Using Strontium/Calcium Ratios in*

Enamel. Departments of a Palaeontology and b Mineralogy, Natural History Museum, and Department of Anatomy and Cell Biology, University College London, London , and School of Dental Sciences, Newcastle University, Newcastle upon Tyne , UK

Jackson, S.M. (2002) *Standardizing captive-management manuals: guidelines for terrestrial vertebrates* revised, in International Zoo Yearbook (2003) 38: 229-243, The Zoological Society of London, London.

Jean-Claude Fabre, Berthille Pallaud, Jean-Claude Fady *An electrified enclosure of 650 m^2 designed for rearing baboons (Papio papio)* (p 61-67) Published Online: May 10 2005 9:00PM DOI: 10.1002/zoo.1430020107

Ken Kawata, Kay M. Elsen. 1984. *Growth and feeding relationships of a hand-reared lowland gorilla infant (Gorilla g gorilla)*. Zoo Biology Volume 3, Issue 2, Date: 1984, Pages: 151-157

Kurland JA, Gaulin SJC. 1987. *Comparability among measures of primate diets*. Primates 28:71–7.

Mehren, K.G. Rapley, W.A. *Reintroduction of a rejected orangutan infant to its mother* PROCEEDINGS AMERICAN ASSOCIATION ZOO VETERINARIANS, 1978

Mitochondrial Phylogeny and Systematics of Baboons (Papio) 124:17–27 (2004)
http://www.nyu.edu/gsas/dept/anthro/programs/csho/Content/Facultycvandinfo/Jolly/2004NystromEtAl.pdf
Dental Microwear in Anubis and Hybrid Baboons (Papio hamadryas, Sensu Lato) Living in Awash National Park, Ethiopia

Nicolson N. 1982. Weaning *and the development of independence in olive baboons.* Ph.D. Thesis. Harvard University, Cambridge, MA. Available from University Microfilms, Ann Arbor, MI: DA 8216201.

http://www.ivis.org/proceedings/eazwv/2002/parasitic/parasitic.pdf
(2002) *European Association of Zoo and Wildlife Veterinarians Parasitic Diseases*. Session May 8-12, 2002, Heidelberg, Germany.

http://www.springerlink.com/content/l3222nn164853u72/
Phillips-Conroy, J. E., Jolly, C. J., Nystrom, P. and Hemmalin, H. A., 2007. *Migration of male hamadryas baboons into anubis groups in the Awash National Park, Ethiopia*

P. L. O'Neill, M. A. Novak, S. J. Suomi. 1991. *Normalizing laboratory-reared rhesus macaque (Macaca mulatta) behavior with exposure to complex outdoor enclosures*. Zoo Biology Volume 10, Issue 3, Date: 1991, Pages: 237-245

http://books.google.com.au/books?hl=en&lr=&id=ydFciujnWTcC&oi=fnd&pg=PA119&dq=implanon+use+in+primates&ots=1XGBy0MZm2&sig=xds0TE5tGYQs9xGK_Z5AeWCZt0E#v=onepage&q=implanon%20use%20in%20primates&f=false

Porton, I. J., Dematteo, K. E., 2005. *Contraception in Non-Human Primates.*The Johns Hopkins University Press. Balitmore

Prancing Papio
http://theprancingpapio.blogspot.com/

Reinhardt V, Roberts A. 1997. *Effective feeding enrichment for non-human primates: a brief review*. Anim Welfare 6:265–72.

15 Glossary

Colostrum – a yellowish liquid, especially rich in immune factors, secreted by the mammary gland of female mammals a few days before and after the birth of their young.

Diurnal – active by day or belonging to the daytime

Pelage - The hair, fur, wool, or other soft covering of a mammal.

Perineum – The portion of the body in the pelvis occupied by urogenital passages and the rectum, bounded in front by the pubic arch, in the back by the coccyx, and laterally by part of the hipbone; The region between the scrotum and the anus in males, and between the posterior vulva junction and the anus in females.

Perineal swelling - This swelling only happens in female baboons when they are cycling. It shows their monthly oestrus cycle and for breeding their perineum swells up and when it is at its largest, this is when the male will mate with the female

Intussusception - A medical condition in which a part of the intestine has invaginated into another section of intestine, similar to the way in which the parts of a collapsible telescope slide into one another. This can often result in an obstruction.

16 Appendix

APPENDIX 1
Section 1.3

Import and export information

Application for a permit to export or import wildlife

APPENDIX 2

Section 4.7 and 5.1

ANNUAL CYCLE OF MAINTENACE FOR HAMARYAS BABOON

Papio hamadryas

	Daily	Weekly	Monthly	6 monthly	Yearly
January	1, 2, 3, 4, 5, 6	7, 8, 9, 10, 11, 12	13, 14, 15, 18	16	
February	1, 2, 3, 4, 5, 6	7, 8, 9, 10, 11, 12	13, 14, 15, 18		
March	1, 2, 3, 4, 5, 6	7, 8, 9, 10, 11, 12	13, 14, 15, 18		17
April	1, 2, 3, 4, 5, 6	7, 8, 9, 10, 11, 12	13, 14, 15, 18		
May	1, 2, 3, 4, 5, 6	7, 8, 9, 10, 11, 12	13, 14, 15, 18		
June	1, 2, 3, 4, 5, 6	7, 8, 9, 10, 11, 12	13, 14, 15, 18		
July	1, 2, 3, 4, 5, 6	7, 8, 9, 10, 11, 12	13, 14, 15, 18	16	
August	1, 2, 3, 4, 5, 6	7, 8, 9, 10, 11, 12	13, 14, 15, 18		
September	1, 2, 3, 4, 5, 6	7, 8, 9, 10, 11, 12	13, 14, 15, 18		
October	1, 2, 3, 4, 5, 6	7, 8, 9, 10, 11, 12	13, 14, 15, 18		
November	1, 2, 3, 4, 5, 6	7, 8, 9, 10, 11, 12	13, 14, 15, 18		
December	1, 2, 3, 4, 5, 6	7, 8, 9, 10, 11, 12	13, 14, 15, 18		

1. Clean water troughs/ponds and give fresh water. This can be done by emptying the water and letting it fill up again with fresh water or by scrubbing the water using a scourer and water. Please make sure you use gloves and a facemask when cleaning waters.
2. All faeces and urine should be removed from the enclosure. To do this, lock out the baboons and remove the faeces with a shovel/rake and hose down and scrub logs/branches. Please wear appropriate PPE of a face mask and gloves and a scrub top and closed in shoes.
3. Rake the substrate in the enclosure daily. To do this get a rake from the service tool area and rake the top of the substrate with faeces and urine in piles and sift if the substrate is sand and remove the gross contamination by a bin. Make sure appropriate PPE and also posture is used. Also make sure the baboons are locked out of the area you are cleaning
4. The night-house area hosed and faecal matter removed and not hosed down the drain. To do this hose all the faecal matter from the night-house walls and cages and hose the faeces into piles, which can be picked up and put into a bin with a bin liner and put into a big industrial bin

5. Water plants
6. Take night-house temperatures and record them for each day and month
7. The substrate should be turned over either using a shovel or high pressure water cleaner once a week to a month to remove faecal build up underneath the surface.
8. All pathways if getting faecal matter or dropped food scraps on should be hosed weekly and the waste removed. This includes any build up around raceways etc.
9. If the enclosure walls or door is glass or plastic of some kind, it should be cleaned once a week with F10 or glass cleaner sprayed onto some paper towel and then the glass/plastic cleaned with the moistened paper towel.
10. Pest control should be carried out with feral rats being the biggest pests which can carry diseases transmissible to baboons. These baits should be checked weekly and baits changed when needed.
11. If any plants are in the exhibit, they should be pruned monthly
12. Water troughs/ponds should be drained and scrubbed weekly to monthly.

13. Branches and rocks should be replaced when heavily soiled or mouldy.
14. The work area, pathways and night-house floors, walls and caging should be high pressure cleaned or scrubbed every month because of faecal build up and staining.
15. If the cages are filled with large pebbles, the cage perimeter pebbles should be pushed back off the cage. This can be done using a high pressure water cleaner.

16. Substrate totally replaced. This can be done by removing all of the enclosure furniture along with the baboons, temporarily housing the group/s and changing the substrate with all new substrate.

17. Routine testing of all individuals over 2 years of age. This includes chemically restraining each individual and doing a thorough physical examination. Please see section 8. This includes a Mantoux tuberculosis test
18. Routine worming of *P.hamadryas* should be done using injectable Doramectin or Ivomectin subcutaneously and the dosage is 0.03ml/kg. This regime can be increased to once a month in the colder months of winter as infestations can worsen at these times.

APPENDIX 3
Section 5.1

Spree MSDS Sheet for Spree Dishwashing Liquid

Available from:
http://victas.uca.org.au/main.php?pg=download&id=8589 [08/06/10]

Can be purchased from your local supermarket or corner store.

APPENDIX 4

Section 5.1

MSDS Sheet for F10 Disinfectant and Windex and supplier

Available from:
http://www.lomb.com.au/images/products/F10SC_MSDS_Dec_2003.pdf
http://victas.uca.org.au/main.php?pg=download&id=8576
[08/06/10]

F10 can be bought from ProVet:
http://provet.com.au/ContactProvet/tabid/99/Default.aspx

Australian Contacts

Provet QLD Pty Ltd
Ph: 07 3621 6000
Fax: 07 3621 6099

Provet North Queensland
Ph: 07 4729 3200
Fax: 07 4774 7270

Provet VMS Pty Ltd
Ph: 02 4955 4488
Fax: 02 4955 4555

Provet Victoria Pty Ltd
Ph: 03 9540 5700
Fax: 03 9540 5777

Provet SA Pty Ltd
Ph: 08 8154 5455
Fax: 08 8234 3672

Provet Riverina Pty Ltd
Ph: 02 6921 4799
Fax: 02 6921 9725

Provet WA Pty Ltd
Ph: 08 9421 8400
Fax: 08 9248 2989

Provet NSW Pty Ltd
Ph: 02 9899 5022
Fax: 02 9899 6931

Provet NT
Ph: 08 8947 3226
Fax: 08 8947 3227

Provet Tasmania
Ph: 03 6232 9000
Fax: 03 6248 5229

or Kennel Solutions:
http://kennelsolutions.com.au/index.php?option=com_content&Itemid=260&id=1&lang=en&task=view

Windex can be bought from your local supermarket or corner store

APPENDIX 5
Section 5.1

Racumin MSDS sheet and instructions

Available from:
http://agservaustralia.com/downloads/racumin%20racumin%208.pdf
[08/06/10]

Racumin is available to buy from:

Bayer Australia Limited, Animal Health, Queensland Office (07) 3240 4241

Bayer Environmental Science
391 – 393 Tooronga Road, East Hawthorn, Victoria, 3123, Australia
(03) 9248 6888

APPENDIX 6
Section 5.1

High Pressure Water Cleaner

Can be purchased from:

http://www.aussiepumps.com.au/high-pressure-water-cleaners/high-pressure-water-cleaners.html
7 Gladstone Road,
Castle Hill,
NSW 2154
PO Box 6164, BHBC NSW 1755
PH: (02) 8865 3500
Fax: (02) 9894 4240

http://www,sydneytools.com.au/shopexd.asp?id=11914&bc=no
Sydney Tools
429 New Canterbury Road
Dulwich Hill, NSW 2203
Ph: (02) 9569 6133
Fax: (02) 9569 6155
order@sydneytools.com.au

APPENDIX 7
Section 5.1

MSDS Sheet for Lemex, Animal House and Trigene plus Trigene dilution rates

Available from:
http://www.waiwhetu.co.nz/MSDS/QC-MSDS/LEMEX.pdf
http://www.glason.com.au/assets/products/cleaning/Air-tech_PETZ_AnimalHouse.pdf
http://www.delvetgroup.com.au/msds/Trigene_MSDS.pdf
http://www.medi-chem.com/FileLib/App_TrigLab_general.pdf
[08/06/10]

APPENDIX 8
Section 5.2 and 8.2.2

Family Tree for 'Bart'

Physical examination sheet (Routine testing) and baboon dental chart

APPENDIX 9
Section 6.2

Food supplies

Fruit and vegetables:
T&F All States Pty Ltd
7-9 George Young Street,
Regents Park NSW 2143
Ph: (02) 8594 7800
Fax: (02) 9516 1435
info@tandfallstates.com.au
www.tandfallstates.com.au

Bread:
Buttercup Bakeries Moorebank
Locked Bag 2222
North Ryde NSW 2113
Ph: 1300 225 464

Dried fruit and all nuts:
Harolka Food Worldwide
3-7 Highgate Street
Auburn NSW 2144
Ph: (02) 9737 9322
Fax: (02) 9737 8883
www.harkola.com.au
george@harkola.com.au

Pellets and seeds:
Milford produce
www.avigrain.com.au
Lot 4 Journeyman Close
Berkeley NSW
Ph: (02) 4389 8081

Gordon's Specialty Stock Feeds
3930 Rememberance Drive
Yanderra NSW 2574
Australia
(02) 4684 1216

Monkey Chow:

ZuPreem® Primate Diet Dry is a nutritionally complete diet designed to meet all the nutritional requirements of non-human primates, including the great apes. The diet contains adequate levels of protein and vitamin D3 to meet the needs of both New World and Old World primates.

- 100% complete and balanced nutrition
- Fed to primates in zoos for more than 25 years
- Highly palatable
- Contains stabilized form of Vitamin C
- Contains Vitamin D3
- Extrusion cooking enhances carbohydrate bioavailability
- Biscuit expands and maintains shape if soaked in liquid
- Formulated by veterinarians and nutritionists

http://www.zupreem.com/our-food/primates/primate-diet-dry

Primate Pellets:
Drover Down Under
30 Sir Henry's Parade
Faulconbridge, NSW, 2776
(02) 4751 1808
http://ddu.com.au/
[07/06/10]

APPENDIX 10
Section 6.4

Breeders Choice Cat Litter

Can buy from your supermarket such as Coles or Woolworths
Or
Provet:

Australian Contacts

Provet QLD Pty Ltd
Ph: 07 3621 6000
Fax: 07 3621 6099

Provet North Queensland
Ph: 07 4729 3200
Fax: 07 4774 7270

Provet VMS Pty Ltd
Ph: 02 4955 4488
Fax: 02 4955 4555

Provet Victoria Pty Ltd
Ph: 03 9540 5700
Fax: 03 9540 5777

Provet SA Pty Ltd
Ph: 08 8154 5455
Fax: 08 8234 3672

Provet Riverina Pty Ltd
Ph: 02 6921 4799
Fax: 02 6921 9725

Provet WA Pty Ltd
Ph: 08 9421 8400
Fax: 08 9248 2989
Provet NSW Pty Ltd
Ph: 02 9899 5022
Fax: 02 9899 6931

Provet NT
Ph: 08 8947 3226
Fax: 08 8947 3227

Provet Tasmania
Ph: 03 6232 9000
Fax: 03 6248 5229

Or
http://www.petalia.com.au/templates/prodsublist.cfm?group_no=2106 [08/06/10]

APPENDIX 11
Section 7.3

Distribution nets

Nationwide Netmakers Pty Ltd
Free call: 1800 451 747
Email: getanet@netmaker.com.au
http://www.netmaker.com.au/
http://pin.primate.wisc.edu/idp/idp/products

Lomir Inc.
Address: 99 East Main Street, Malone, New York 12953 UNITED STATES
Phone: 877-425-3604
Fax: 518-483-8195
Email: info@lomir.com
Website: http://www.lomir.com
Lomir is the world's largest manufacturer of animal jackets and infusion products. Included is the most comprehensive range of equipment for primates available in biomedical research including, but not confined to the following:
Intravenous infusion:
- swivels
- tethers
- tether end plates
- jackets
- jackets with pockets for ambulatory equipment

Restraint:
- jackets designed to be used in restraining devices such as chairs
- slings and covers to restrain non-human primates

Protection:
- range of products designed to protect the animal from interfering with surgical sites, sutures, etc.
- bonnets to protect the skull
- full body jacket (with pants) to protect the legs
- jackets with full sleeves

Lomir manufactures equipment for all primate species. Standard equipment is available for rhesus, cynomolgus, baboons, squirrel monkey, owl monkey, and marmosets. Jackets are also available in an extensive range of sizes and designs. Customers may take advantage of our made-to-measure service for animals, such as adult baboons or apes.

Lomir also manufactures a full range of handling equipment; gloves, and kevlar armguards and gloves all in sizes from small through X-large. New products are always in development, our newest a capture **net** for both New and Old World primates.

Visit our web site, or contact us for a print catalog, to discuss your specific requirements.

Primate Products, Inc. (Corporate HQ & Equipment Division)
Address: 1755 East Bayshore Road, Suite 28A, Redwood City, California 94603 UNITED STATES
Phone: 650-368-0663
Fax: 650-368-0665
Email: Nataliecolbert@primateproducts.com
Website: http://www.primateproducts.com
Primate Products, Inc. offers live primates, contract quarantine and state of the art caging and equipment. We supply purpose bred primates from foreign and domestic sources. Our product line includes Modular Caging, the Pole and Collar Handling System, Macaque and Baboon Restrainers, our patented Puzzle Feeders, Puzzle Toss', Mirrors, Transfer Boxes, Capture Nets, Handling Gloves, Enrichment and Diet Supplements and Virus Test Kits.

Primate Products, Inc. (Live Animal Division)
Address: 7780 NW 53rd Street, Miami, Florida 33166 UNITED STATES
Phone: 305-471-9557
Fax: 305-471-8983
Email: Donbradford@primateproducts.com
Website: http://www.primateproducts.com
Primate Products, Inc. offers live primates, contract quarantine in an AAALAC-accredited facility, and state of the art caging and equipment. We supply purpose bred primates from foreign and domestic sources. Our product line includes Modular Caging, the Pole and Collar Handling System, Macaque and Baboon Restrainers, our patented Puzzle Feeders, Puzzle Toss', Mirrors, Transfer Boxes, Capture Nets, Handling Gloves, Enrichment and Diet Supplements and Virus Test Kits.

APPENDIX 12
Section 7.6

International Air Transport Association (IATA) - Live Animals Regulations 27th Edition 2000

APPENDIX 13
Section 8.2.1

Dose Rate for Anaesthetic Combination of Ketamine and Domitor / Chemical Restraint and Anaesthetic Agents / Analgesics in Primates

Can be available from:

ProVet (see **APPENDIX 10** above)
http://www.provet.com.au/

Lyppard:
http://www.lyppard.com.au/
Melbourne (Head Office)
14 – 16 Fiveways Blvd
Keysborough
Victoria 3173
Phone: 03 8769 0500
Fax: 03 9798 5599

Sydney
Unit 1 / 4 Hudson Avenue
Castle Hill
New South Wales 2154
Phone: 02 9899 1500
Fax: 02 9899 2829

Townsville
12 Madden Street
Aitkenvale
Queensland 4814
Phone: 07 4779 7333
Fax: 07 4725 1195

Brisbane
86 Crockford Street
Northgate
Queensland 4013
Phone: 07 3260 8600
Fax: 07 3260 8660

Adelaide
28 Charles Road
Beverley
South Australia 5009
Phone: 08 8349 1000
Fax: 08 8349 1050

Perth
4 Gibberd Road
Balcatta
Western Australia 6021
Phone: 08 9240 1910
Fax: 08 9240 2013

APPENDIX 14
Section 8.2.2

Body scoring

APPENDIX 15

Section 9.2 Social Behaviour continued…

One Male Unit

In addition to the leader male, there may be a subordinate "follower" male. This "follower" is thought usually to be related to the leader in some fashion. (Kummer, 1968; Stammbach, 1987). Followers or groups of young males (bachelor groups) usually acquire harems by befriending sexually immature females, who the other males are not yet interested in, and so are met with little resistance. When the female becomes sexually mature and has her first cycle, this is when the male mates with her.

Bands

Bands of *P.hamadryas* appear to have an important function in allowing the baboons to compete for sleeping sites and for access to water holes. Male OMU leaders begin each day by "coordinating" with one another regarding the location of the specific watering hole at which the band will reunite at midday. A OMU leader will take several steps in the direction of a particular water hole. Other OMU leaders may signal "agreement" with the choice by taking a few steps in the same direction, or they may signal that they wish to visit a different water source by taking some steps in the direction of the other water hole. Members of the same clan tend to support one another in this debate. When a majority of OMU leaders agree, the baboons will begin their daily foraging march. The band will break up into separate clans or OMUs during the morning in order to make use of the sparse and patchy food resources. These sub-groups are out of visual and vocal communication most of the time, yet they manage to come together at the specified water hole at midday. Since other animals and other baboons may utilise the same water hole, it is important for Hamadryas Baboons to have adequate numbers of individuals present when they appear at the water source to secure access to the water, but also because of predators. A similar pattern of behaviour is expressed in the designation of sleeping sites for the night. (Stammbach, 1987)

Troops

Males appear, then, to associate with relatives throughout their lives. In this respect, Hamadryas Baboons differ from other members of the genus *Papio*. In other baboons, males transfer from their family groups into other troops, where they establish themselves in the male dominance hierarchy, and pursue their reproductive agendas appropriately. In *P.hamadryas*, although both males and females transfer to new social groups, or OMUs, the males maintain active bonds with their male relatives, remaining in their natural clans and usually their natural bands. These groups of related males are united against other groups of male relatives. (Kummer, 1968; Pusey and Packer, 1987; Stammbach, 1987)

In comparison, the other baboon species tend to form very loose groups and are not as structured as the Hamadryas society. For example, the Olive Baboons society consists of a loose association of animals mostly females, usually 20-50 in number with up to 5 adult males, that work together to lead and protect the group. However there is constant aggression and struggles for dominance to determine breeding rights to the majority of the females. (Heffernan, S. 2006)

It may be this close association of male relatives that has led to the unusual trend of male *P.hamadryas* to "respect" the social bonds between other males and their mates. Studies of male *P.hamadryas* in captivity suggest that if two males are placed into an enclosure with a strange female, they will compete aggressively for access to her, in much the same fashion as other baboons. However, if one of the males is allowed to view the other male with the female before he is placed into the enclosure with them, he will avoid the female, and will not instigate a fight with the resident male for access to the female. The honesty of the OMU as the basis of Hamadryas Baboon society, depends upon this "agreement" between males to respect the property access of their male relatives to certain females. (Stammbach, 1987)

In saying this, it is quite likely that female baboons retain close associations with their female relatives throughout their lives also. Female *P.hamadryas* prefer to affiliate themselves with OMUs in which past female connections already live in. It is not uncommon for females from the same family group to end up in the same OMU as adults. Such females are likely to be half-sisters or full sisters. Within the OMU, some females spend as much time with other females as they do with the OMU leader, a pattern which may be a product of female relatedness. The amount of time which females spend in proximity with one another or interacting socially with one another is greater in OMUs with more females. The relatedness between females in Hamadryas OMUs is higher than is seen in other species of primates in which females transfer into new groups. Although many of the interactions between female *P.hamadryas* are controlled by OMU leader males, the females still have some ability to associate with, and help their extended families. (Swedell, 2002)

Within a wild OMU, females do not display the consistent dominance relationships which are seen in other species of baboons. The only time females of this species are capable of these dominance relationships is if they are kept in captive groups of females. However, in wild groups, OMU leader males suppress the aggression between females that could lead to social hierarchy. (Kummer, 1968; Stammbach, 1987)

In spite of the lack of typical baboon dominance hierarchies, female *P.hamadryas* do exhibit social differences. Some females, called central females, spend more time in proximity with the OMU leader, have a stronger social bond with him, grooming him more and are more socially active. Females who spend less time in proximity with the OMU leader are called peripheral females. Peripheral females may incur greater risks of predation than central females. These females are often the first to enter a new foraging area, or first to attempt to use a water hole, and, as a result, are more likely to be surprised by a predator than central females. (Stammbach, 1987)

Perhaps because of this difference, females of an OMU compete amongst themselves to have stronger bonds with the OMU leader. This competition may play a role in "deceptive" sexual cycles exhibited by females when a new OMU leader takes over control of a social group. Females who are lactating may develop sexual swellings and exhibit oestrous behaviour immediately upon OMU takeover. These females do not become pregnant any sooner than they would have had the leadership of the OMU remained stable, however, copulations with the new leader male may place them higher in his favour. (Kummer, 1968; Stammbach, 1987; Zinner and Deschner, 2000)

An alternative explanation for these "deceptive" sexual cycles is that the females are preventing the new leader male from killing their infants. In primates, it is not uncommon for males to kill the dependent offspring of a female when they take over control of a harem unit (called infanticide). If the female can mimic this effect, making herself appear fertile even though she might not be, there is no reason for the male to kill her infant. (Zinner and Deschner, 2000)

Communication

A study written by Fraser, O. and Amy B. Plowman, A. B. in 2007 on the 'Function of Notification in Papio hamadryas' said that 'notification is a form of ritualised greeting behaviour performed by adult male Hamadryas Baboons (*Papio hamadryas*). Originally observed in the wild when harem leaders signalled the direction of travel to their followers on daily foraging marches, its true function is unknown. Notification involves the approach of an adult male baboon to another male, the presentation of his hindquarters, then retreat. Researchers have previously linked notification to aggression avoidance, settlement, and the dominance-subordination relationship between males. We observed instances of notification over 6 months among 8 adult males in a troop of 61 captive-bred Hamadryas Baboons at Paignton Zoo Environmental Park, Devon, UK. We compared observation sessions in which notification occurred with matched control periods. We classified different forms of notification according to the recipient's response: presenting, mounting, touching of the buttocks or genitals, or ignoring. Results suggest that different forms of notification may have different functions, including submission, alliance, and peacekeeping but not general greeting, recruitment, or appeasement.' (Fraser, O. 2007)

Section 9.5 Behavioural Problems

Studies done in regards to behavioural problems in result to *P. hamadryas* being housed individually say 'Eleven baboons who had been singly housed indoors for an average of 5 years were moved to outdoor social groups in an attempt to provide a more species-typical environment and reduce high levels of abnormal behaviour. Nine of the baboons were observed while in single housing and, over a 6-month period, while housed outdoors socially to document long-term changes in behaviour. Abnormal behaviour decreased significantly from an average of 14% of the observation time in the single cages to 3% in the sixth month of social housing. Cage manipulation and self-directed behaviours also significantly decreased, while social behaviour, enrichment-directed behaviour, and locomotion increased in social housing. Baboons that had been in long-term indoor single housing were able to reproduce and form stable social groups without injury. This study provides evidence that even behaviourally disturbed nonhuman

primates can be successfully rehabilitated to live in social groups.' (Kessel, A and Brent, L.)

Section 10.5 Occurrence of Hybrids continued…

Another paper written by Thore J. Bergman and Jacinta C. Beehner described 'the social organisation, mating system, and social structure of a group of hybrid baboons (*Papio Anubis* x *P. hamadryas*) in Ethiopia's Awash National Park. The group contained elements of both *hamadryas* and *anubis* societies. Overall, the group was a multi-male, multi-female group that lacked unity and frequently formed sub-groups. Sub-group formation was more strongly associated with predation risk than food availability. Although there were several *hamadryas*-like one-male units OMUs within the group, there was no evidence of a *hamadryas* multilevel society. Male and female members of OMUs were phenotypically more *hamadryas*-like than non-OMU individuals. The group contained substantial variation in the strength of inter and intra-sexual bonds: some females primarily groomed males while other females primarily groomed females, and the patterns were consistent with the OMU substructure. Despite some promiscuous mating, mating was biased towards the *hamadryas* condition for all group members. Additionally, rates of immigration and emigration were very low, and mean pair wise relatedness within the group is rising. For measures of intersexual bonding, all members of the group were intermediate between *anubis* and *hamadryas* individuals in less hybridised groups. The group was phenotypically and behaviorally more intermediate than it was in the 1970s (Sugawara, K. (1988). *Primates* 29: 429–448.) and the changes may indicate a relatively young and dynamic hybrid zone.' (Bergman. T. J, 2004)

APPENDIX 16
Section 9.7

Environmental Enrichment Calendar and blank behaviour observation sheet

APPENDIX 17
Section 10.12

Reproduction / Cycling Record

APPENDIX 18
Section 11.3 and 11.5

Hand-rearing information on Goliath and Wilfred

APPENDIX 19
Section 11.4

Lectade
http://www.petshopboyz.com.au/Downloads/0F9978AD-DCCE-4C15-925D-C97F3894B2DE-LECTADE_SACHETS_TNPDF.pdf [08/06/10]

Registered Name
Lectade Concentrate Oral Rehydration Therapy (referred to as Lectade Sachets in text)
Schedule
Not Scheduled

Lectade Solution can be used as the sole source of fluids during treatment.
The following doses of the prepared Lectade Solution are recommended as a guide:
LECTADE SACHETS
Oral Rehydration Therapy for Foals, Calves, Lambs, Pigs, Dogs & Cats

Active Constituents undiluted diluted as "Lectade Solution"
Glucose 44.61 g 22.30 g/L
Glycine 6.18 g 3.08 g/L
Citric Acid Monohydrate 0.48 g 0.26 g/L
Potassium Citrate 0.12 g 0.06 g/L
Potassium Phosphate Monobasic 4.08 g 2.04 g/L
Sodium chloride 8.58 g 4.28 g/L

Properties
Lectade Sachets when reconstituted as directed provide an oral rehydration therapy containing a balanced mixture of glucose, glycine and electrolytes with the added advantage of being a non-antibiotic oral supportive treatment.
Once diluted Lectade Solution is isotonic, ensuring glucose and glycine are actively absorbed by the intestinal tract, causing water and sodium to be absorbed simultaneously with these nutrients and resulting in a high degree of rehydration in scouring and dehydrated animals. Where specific disease control (i.e. antibiotic therapy) is indicated, it can be administered in conjunction with Lectade Solution.

Indications
- Diarrhoea
- Dehydration (simple or associated with diseases such as canine parvovirus and feline panleucopaenia)
- Post travelling stress and dehydration
- Post-surgical or disease convalescence
- Concomitant treatment of viral or bacterial scours

Directions for Use
For oral treatment only
Sections A and B must always be used together when preparing Lectade Solution

 Add the contents of section A and B of one Lectade Sachet to 2 litres of warm water, stir until dissolved.
 To make 500 mL of Lectade Solution: using a 5 mL medicine spoon add 1 level spoonful of section A and 3 heaped spoonfuls of section B to 500 mL warm water, stir until dissolved, store remainder of powder in a dry place
 Most dogs find Lectade Solution palatable and will drink it voluntarily. Palatability for cats is variable.
 Lectade Solution may also be administered orally via syringe
 Continue treatment for 1 to 2 days after the animal appears clinically recovered and is feeding normally.

Technical Notes

Directions for Use *(continued)*

Dogs

 Miniature - 125 mL, 2 to 3 times daily
 Medium - 500 mL, 2 to 3 times daily
 Small - 250 mL, 2 to 3 times daily
 Large - 750 mL, 2 to 3 times daily

Cats

 125 mL, 2 to 3 times daily

Foals

 1-2 L, 2 to 3 times daily
 Give by drenching bottle or stomach tube

Calves

 1 L/10 kg bodyweight daily, divided into 2 or more doses
 1.5 L/10 kg bodyweight daily initially if dehydration is severe, divided into 3 or more doses
 Scouring Calves: As soon as signs of scours are seen withdraw milk or milk replacer and feed the required dose of Lectade Solution for 2 days. For the next 2 days return to feeding milk at half the rate and, either separate to or mixed with, an equal amount of prepared Lectade Solution. Return to full milk feeding thereafter
 Bought-in or Stressed Calves: Feed 2 L of Lectade Solution instead of milk as the first feed on arrival. For the next feed use 1 L milk or milk replacer mixed with 1 L Lectade Solution. Return to full milk feeding thereafter. Adequate colostrum must be fed to calves within 48 hours of birth.

Pigs

 A litter of 1 week old piglets will consume approximately 2-3 L per day
 A weaner pig will consume approximately 1-2 L per day.
 Lectade solution should be made available for 4 days. If there has been some improvement after 4 days, but the scour has not cleared completely, treatment may be continued for up to 8 days in total.
 Suckling Piglets: Immediately scour symptoms show, fresh Lectade solution made up as directed should be made available, in a cube drinker or similar clean vessel, to the whole litter.
 Weaned Pigs: If these pigs are showing signs of scour, make fresh Lectade solution available in a suitable clean vessel, cube drinker, trough or drum with nipple drinker

Lambs

 150 mL of Lectade solution 3 times daily is a suitable dosage regimen
 Lectade solution made up as directed should be administered orally to scouring or dehydrated neonatal lambs by drenching bottle or stomach tube

Withholding Period

Nil

Presentation

12 x 64 g sachets per box

Storage

Lectade Solution may be stored in the fridge for 24 hours before discarding
Store sachets below 25°C (air conditioning) in a dry place

JUROX Pty Ltd ACN 000 932 230
85 Gardiners Rd
RUTHERFORD NSW 2320
AUSTRALIA
Phone: 02 4931 8200
Fax: 02 4931 8222
(Intl: Country 61 Area 2)
Customer Service: 1800 023 312

Can also be obtained through ProVet (see Appendix 10 above)

Vytrate

www.jurox.com.au/custom/sitetools/html/filedownload.cfm?productkey=176&filetype=technote [08/06/10]

Registered Name

Vy'Trate Calf and Pig Scour Treatment (referred to as Vy'trate Sachets in text)

Schedule

Not Scheduled

Active Constituents undiluted diluted as Vy'trate Solution

Glucose 44.61 g 22.30 g/L
Glycine 6.18 g 3.08 g/L
Citric acid 0.48 g 0.26 g/L
Potassium citrate BP 0.12 g 0.06 g/L
Potassium acid phosphate 4.08 g 2.04 g/L
Sodium chloride 8.58 g 4.28 g/L

Properties

Vy'trate Sachets when reconstituted as directed provide an oral rehydration therapy containing a balanced mixture of glucose, glycine and electrolytes with the added advantage of being a non-antibiotic oral supportive treatment.
Once diluted Vy'trate Solution is isotonic, ensuring glucose and glycine are actively absorbed by the intestinal tract, causing water and sodium to be absorbed simultaneously with these nutrients and resulting in a high degree of rehydration in scouring and

dehydrated animals. Where specific disease control (i.e. antibiotic therapy) is indicated, it can be administered in conjunction with Vy’trate Solution.

Indications

 Diarrhoea
 Dehydration (simple or associated with disease)
 Post travelling stress and dehydration
 Supportive treatment to viral or bacterial scours

Directions for Use

For oral treatment only

Sections 1 and 2 must always be used together when preparing Vy’trate Solution

 Add the contents of section 1 and 2 of one Vy’trate Sachet to 2 litres of warm water, stir until dissolved.
 Continue treatment for 1 to 2 days after the animal appears clinically recovered and is feeding normally.
 If blood is present in the faeces seek veterinary advice as soon as possible.

Vy’trate Solution can be used as the sole source of fluids during treatment.

The following doses of the prepared Vy’trate Solution are recommended as a guide:

Calves

 1 L/10 kg bodyweight daily, divided into 2 or more doses
 1.5 L/10 kg bodyweight daily initially if dehydration is severe, divided into 3 or more doses
 Scouring Calves: As soon as signs of scours are seen withdraw milk or milk replacer and feed the required dose of Vy’trate Solution for 2 days. For the next 2 days return to feeding milk at half the rate and, either separate to or mixed with, an equal amount of prepared Vy’trate Solution. Return to full milk feeding thereafter Vytrate Sachets & liquid, Various electrolyte ingredients Effective rehydration of scouring calves, pigs, dogs & cats. Isotonic fluid for rapid absorption Oral, non-antibiotic supportive treatment for replacement of electrolytes & lost fluids

Bought-in or Stressed Calves: Feed 2 L of Vy’trate Solution instead of milk as the first feed on arrival. For the next feed use 1 L milk or milk replacer mixed with or separate to 1 L Vy’trate Solution. Return to full milk feeding thereafter. Adequate colostrum must be fed to calves within 48 hours of birth.

Pigs

 A litter of 1 week old piglets will consume approximately 2-3 L per day
 A weaner pig will consume approximately 1-2 L per day.
 Vy’trate solution should be made available for 4 days. Replace with freshly made up Vy’trate Solution every 24 hours. If there has been some improvement after 4 days, but the scour has not cleared completely, treatment may be continued for up to 8 days in total.
 Suckling Piglets: Immediately scour symptoms show, fresh Vy’trate solution made up as directed should be made available, in a cube drinker or similar clean vessel, to the whole litter.
 Weaned Pigs: If these pigs are showing signs of scour, make fresh Vy’trate solution available in a suitable clean vessel, cube drinker, trough or drum with nipple drinker

Withholding Period

Nil

Presentation

12 x 64 g sachets per box

Storage
Vy'trate Solution may be stored in the fridge for 24 hours before discarding
Store sachets below 25°C (air conditioning) in a dry place

JUROX Pty Ltd ACN 000 932 230
85 Gardiners Rd
RUTHERFORD NSW 2320
AUSTRALIA
Phone: 02 4931 8200
Fax: 02 4931 8222
(Intl: Country 61 Area 2)
Customer Service: 1800 023 312

Farex baby food

Farex is a food for babies and infants made primarily from flour and enriched with vitamins. It was produced by the company Glaxo.

Available to buy from your local supermarket or chemist