Species-specific provisions for Non-Human Primates

Background information for the proposals presented by the Group of Experts on Non-Human Primates

PART B
SECTION B : SCIENTIFIC JUSTIFICATION

1 Introduction

Normal behavioural repertoire

The aim for captive primates should be for them to have the facility to carry out a wide range of normal behaviour providing it does not result in injury or distress to itself or another animal (Schapiro et. al. 1996). It is particularly important that the enclosure should enable the animals to adopt normal postures and a range of locomotor behaviour (Buchanan-Smith 1997, Home Office 1989, International Primatological Society 1993, Marriott et al. 1993, Offert et al. 1993, Poole 1991, Poole et al. 1994, Reinhardt 1997a, Snowdon and Savage 1989, Whitney and Wickings 1987). Test conditions lacking adequate environmental enrichment should be regarded as testing under abnormal conditions (Kessel and Brent, 1995a; Reinhardt et al. 1996), which in certain cases may lead to false conclusions from the results.

However, in captivity, non-human primates may perform abnormal behaviours, such as locomotor stereotypies, self-directed behaviour and even self-mutilation. Such behaviours are indicative of unsatisfactory environmental conditions according to Bayne et al. (1992), Broom and Johnson (1993). However, the presence of stereotypies may reflect past, not present, environments (Brent and Hughes 1997, Broom and Johnson 1993, Mason 1991a, Mason and Mendl 1993). The causes may be either a restricted social environment during development or early infant separation from the mother and the behaviour may be untreatable (Capitanio 1986, Mason and Berkson 1975, Novak and Drewson 1989, O'Neill 1989) or only eliminated with considerable effort (Kessel and Brent 1997). Cage height may also be a factor, as long-tailed macaques were found to exhibit less self-directed stereotypy in taller cages as compared with those in shorter ones (Watson and Shively, 1996). In a study of the influence of cage size and behaviour, pairs of common marmosets were found to show stereotypies and higher levels of aggression and startle responses in smaller cages (Kitchen and Martin, 1996). From this literature, it is apparent that three factors can induce abnormal behaviour in mammals, but that these act in combination, for primates they are single housing, small cages and lack of environmental complexity. Thus, minimum or even optimum cage size alone cannot be quantified scientifically.

From this literature, it can be concluded that the captive environment should provide non-human primates with an adequately complex social and physical environment. Cage dimensions should allow for sufficient structures to enable them to carry out a wide range of normal behaviour and exhibit a minimum of abnormal ones.

2 Health

Health:

Non-human primates are known to sometimes harbour viruses, bacteria, protozoa and other endoparasites that can be harmful or even fatal when transmitted to humans. Herpes B virus, Marburg virus and Mycobacterium tuberculosis are the three pathogens which have received the widest concern. (Hazards of handling simians, Laboratory Animal Handbooks 4, 1969). Additional agents, e.g. of the retrovirus group pose a health risk to other primates in a colony. Some diseases are endemic in certain areas in the wild population but not in others and may lead to severe outbreaks when transmitted to primates from areas that are free of the agent. Unfortunately the reservoir species for certain diseases are not always known and not all species show clinical symptoms after infection.

The use of purpose-bred animals has helped to minimise such health problems, and reputable breeders will supply a health certificate based on their health monitoring scheme. This may help shorten the compulsory quarantine period. The fact that infections may go unobserved for a long time necessitates a regular screening of the animals. Eradication of the disease is not always easy through treatment, but knowing the microbiological status of the animals will allow the necessary precautions to be taken to prevent transmission to other animals and the staff. Guidelines for health monitoring have been proposed by FELASA (1999).
Some diseases may be transmitted from humans to primates. Typical is tuberculosis for which most non-human primates are highly susceptible and cannot effectively be treated. Therefore, screening of the staff, and precautions with personnel with health problems is essential.

Rodents, birds and insects, and for animals in the source country, wild conspecifics may be a threat to the captive bred groups. Especially for groups in outdoor enclosures preventive measures against intrusion of possible disease vectors are essential.

The reason for scrupulous separation of animals from different geographical areas during transport and until the health status of the animals has been clarified is that transmission from some silent pathogens in reservoir species causing severe outbreaks of disease in animals from other geographical areas cannot be excluded (FELASA, 1997).

The following references cover the subject of health monitoring: FELASA (1997, 1999), OIE (1999a,b).

3 Housing and enrichment

3.1 Social housing

It has already been pointed out that being part of a compatible group provides a sense of security for the vast majority of non-human primates. It also provides opportunities for a whole range of species-specific social activities such as grooming, embracing, huddling, patting and kissing (Cheney et al, 1987, Jolly 1985). In most species, social bonds are forged and maintained by grooming which is therefore of paramount importance in maintaining social cohesion (Williams and Bernstein, 1995). In addition it has been demonstrated that grooming has a relaxing effect on the animal being groomed, lowering the heart rate (Boccia et al. 1989). Singly housed primates are particularly prone to show abnormal behaviour, whereas keeping them in groups reduces the incidence of this behaviour (in long tailed macaques Line et al. 1990, rhesus monkeys, Schapiro et al. 1996, squirrel monkeys, Spring et al. 1997, macaques and baboons, Woolley 1997). Isolation and prevention of contact with companions may also lead to altered physiological parameters e.g. elevated blood pressure in baboons (Coelho et al. 1991), altered cell mediated immune responses in rhesus monkeys (Schapiro et al. 1997).

Reinhardt et al. (1995a) pointed out that many of the reasons commonly given to justify single housing, such as difficulties in creating compatible pairs and aggression between cage mates are not supported by the evidence. Most Old World primates are put into groups as juveniles aged up to twelve months as this avoids most of the problems of incompatibility, but it is possible to form compatible groups of macaques well into adolescence. In some species such as vervets and rhesus monkeys there may be disruption in such groups as they approach maturity. However, Reinhardt et al. (1995a) and Lynch and Baker (1998) were successful in establishing adult macaques as long term compatible pairs. For this procedure to succeed, it is necessary to assess the attitudes of the animals to the prospective partners and to carefully monitor their behaviours after introduction. Reinhardt et al. (1995a) outlined a nine step partner evaluation and introduction technique. It is important, however, to bear in mind that placing two animals in a bare small cage can lead to conflict; an appropriately complex cage environment should also be provided (APHIS 1999).

For groups of maturing same sex monkeys, the proximity of members of the opposite sex in nearby cages can lead to intra-group aggression among previously amicable animals, especially males. Same sex grouped monkeys should therefore be well separated from enclosures containing members of the opposite sex.

To conclude, virtually all primates commonly used in laboratories are highly social and need to be kept with one or more compatible conspecifics, this provides them with a sense of security, companionship and opportunities for a wider range of normal behaviour. Their physiological condition also benefits.
Separation and weaning
Young monkeys have a long period of dependency on their mothers and natal group. During this period they learn about their environment under the mother’s protective vigilance, they also learn social and parenting skills from other group members.

Early separation results in extreme distress to the infant at the time, but it is now well established that it damages normal development and results in animals which are physiologically and immunologically abnormal, as adults. Nursery rearing, in the absence of adults, also commonly results in behavioural abnormalities, such as locomotor stereotypies and auto-aggression (Capitanio 1986, Marriner and Drickamer 1994). Even separation for as little as two weeks during the animal’s first year of life can have permanent adverse effects on the immune system of pig-tailed macaques (Laudenslager et al. 1990).

For most species, the best way to produce behaviourally and physiologically normal monkeys, suitable for breeding and long term study, is to ensure, wherever practicable, that they remain in the natal group for as long as possible, ideally for the first 18 months of their lives. Juveniles separated from their mothers for whatever reason should be reared in social, preferably well-organised groups.

3.2 Environmental complexity

Animals cannot be expected to carry out every natural behaviour in captivity but, excluding the extremes, behaviour seen in nature provides a useful guide (Veasey et. al. (1996), Rosenblum and Andrews 1995, McGrew 1981). Captive conditions should fit within the adaptive range of the species (Kaumanns 1997).

However the animals should be able, as in the wild to carry out a complex daily programme of activity. While it is seldom possible to provide the majority of features of the wild habitat in a laboratory, major attributes can be provided. In the wild, primates require a secure environment (provided by a familiar home range and their social group), a sufficient amount of appropriate complexity (to enable them to carry out a wide behavioural repertoire) and facilities to enable them to achieve objectives. Finally, as natural environments are not invariant, a level of novelty to which they can respond adaptively is necessary. If these features are incorporated into the captive environment, primates can lead a full and interesting life (Poole 1998).

A sense of security
Non-human primates show adaptive flight responses. They respond to ground predators by fleeing upwards into trees or cliffs and downwards to mid-level branches or to the ground to avoid aerial predators (Seyfarth and Cheney 1980). In addition, while social groups are cohesive, a certain amount of dispersion of individuals has been observed in both field and captive studies. There is general agreement among primatologists that enclosures for primates should enable them to fully utilise the vertical dimension (Abee 1985, Buchanan-Smith 1997, Dukelow and Asakawa 1987, International Primatological Society 1993, Maple and Perkins 1996, Olfert et al.1993, Poole et al.1994, Reinhardt et al.1996, Queyras et al.1997).

Their sense of security both from predators and also from rivals, depends on being able to reach a high point in their environment; dominant squirrel monkeys used the highest available perches (Williams et al,1988). Furthermore, long tailed macaques (Woodbeck and Reinhardt 1991), rhesus monkeys, (Watson and Shively 1996) marmosets and tamarins (Caine et. al. 1992; Prescott and Buchanan-Smith 2002; Ely et al. 1998; Keri and Rothe 1996; Buchanan-Smith et al. 2002) all show preferences for the upper part of their cages.
Hediger (1964) pointed out that a captive mammal’s liability to panic and hence its sense of security depends on the enclosure allowing for an adequate flight response. In the case of primates, this relates to the enclosure being of adequate height to allow adequate vertical movement; primates tend to move to a position where they can look down on the perceived threat.

A second, important, factor which provides the primate with a sense of security, is the presence of one or more social companions. Apart from orang utans and some prosimians, primates live in social groups. This enables them to detect predators more efficiently and escape from them or defend themselves against their smaller enemies. The most vulnerable time in the life of an adult wild primate is when it emigrates from one troop to another. Even when unwelcome, the isolated animal will attempt to attach itself to a group, for example, living on the periphery of an established social group, as in forest dwelling guenons, or joining bachelor troops, as in langurs and desert baboons. For the vast majority of primates, therefore, a social group is essential to ensure their security.

**Complexity**

A complex environment, which includes swings, perches and branches allows the animals to display a wide locomotor repertoire. Captive rhesus macaques were observed by Dunbar (1989) to walk, gallop, leap, climb, swim and hang from climbing structures. Long tailed macaques, rhesus monkeys and vervets are good swimmers. Leaping is a common mode of locomotion for arboreal species, such as callitrichids, squirrel monkeys and long tailed macaques. Observations in the wild show that squirrel monkeys can leap considerable distances when travelling from branch to branch (Fleagle et al. 1981) and long tailed macaques commonly make leaps of 2.2 m (Cant 1988). Enclosures should allow for leaping in these species. Space allowances for juveniles should be the same as adults of the species as the former require plenty of space for play (Goosen et al. 1984).

Play is a good indicator of welfare in the young as it is only carried out in a relaxed situation (Fagen 1993, O’Neill et al. 1990, Thompson, 1996, Pereira et al. 1989).

Tactile stimuli are also valuable (such as a soft substrate for foraging). Where primates need to be singly housed, fleece pads can be sprinkled with food items. Lam et al (1991) provided such fleece pads and found that stereotyped behaviour declined by 73%; after the food had been depleted, rhesus monkeys continued to use the fleece for grooming.

Opportunities to achieve objectives.

Primates need to be able to exert some control over their environment, both physical and social; this is essentially a need to be able to achieve objectives. As Sambrook and Buchanan-Smith (1997) have pointed out, this is an adaptive aspect of behaviour. It enables them to adjust to change, alter confronting stimuli, organise response strategies and apply their cognitive capacities (Rosenblum 1991, Neveu & Deputte 1996). It also reduces stress, as indicated by plasma cortisol levels, in a captive environment (Hanson et al. 1976). A primate’s ability to produce predictable environmental changes through its own actions enables it to be comfortable in a captive environment (Fragaszy and Adams-Curtis 1991).

Although puzzle feeders and foraging boxes (Meunier et al. 1989, Florence & Riondet 2000) are more effective in reducing stereotypic behaviour and increasing activity in rhesus monkeys, watching videos and manipulating video game joysticks, can also be beneficial (Platt and Novak, 1997).

**Novelty**

Some novelty should also be introduced at intervals (for example objects, which can include destructible materials) or minor changes in the conformation or arrangement of cage furniture (Sambrook and Buchanan-Smith 1997).

It can be concluded that primates require an environment which encourages them to carry out a daily complex programme of activity.
3.3 Enclosures - dimensions and flooring
As previously mentioned, primates’ ability to utilise three dimensions and the expression of complex social behaviour necessitates the use of cages and enclosures which have a vertical dimension sufficiently high for them to feel secure and control their social environment. Primates should be able to perch higher than a perceived threat and IPS (1993) recommends that this should be above human eye level. If the cages are to be of adequate height, two tier housing will be impractical as lower-row animals are forced to remain below human eye level (NRC/ILAR 1998). Two tier housing is also unsuitable because the animals in the lower cages are not only subject to poorer lighting conditions, which is unsatisfactory for a diurnal animal, but the stressful situation also increases unnecessary experimental variables (CCAC 1993, IPS 1993). Primates in lower tier cages are also less easily observed by the staff (Reinhardt 1997c, 1999). Visual barriers will help to prevent monkeys in social housing from being stressed by agonistic behaviour of other group members.

For various reasons, it may be necessary to separate an animal from a partner or group. In this situation, it is advantageous for housing to be provided within visual contact of the original cagemate(s) (Lynch 1998, Reinhardt et. al. 1995a).

The animals will spend much time foraging if a substrate is provided in which food can be scattered. The substrate, which must be clean and free from toxic residues, can take the form of straw, wood wool, wood chips, shredded paper, vegetation or soil (Westergaard and Munkenbeck-Fragaszy 1985, McKenzie et al. 1986). Chamove et al. (1982) found that the provision of a wood chip substrate with scattered food significantly reduced aggression in the majority of socially housed primates. Foraging can also be encouraged by the provision of browse (Shumaker 1995).

Cage inclusions should be sufficient to encourage a natural range of locomotor behaviour (walk, jump, climb, run) by providing, platforms, perches and climbing frames. Young primates also like to use mobile furniture, such as swings and ropes. A complex environment reduces both inactivity and aggression in social groups (Chamove et al. 1982, McKenzie et al. 1986, Chamove and Anderson 1989).

To conclude, the size of the enclosure/cage will depend not only on the size and number of animals, but also on the inclusion of adequate space for foraging facilities, high platforms or perches and opportunities to carry out a typical repertoire of locomotor and cognitive behaviour. Cages for experimental animals should also be in a single tier to allow for them to be of adequate height, to enable them to retreat from fear-inducing stimuli as they will be stressed if unable to reach an appropriate elevation (Burt and Plant 1990, King and Norwood 1989, Whitney and Wickings 1987)

To avoid the stresses associated with social isolation, unless absolutely essential, experimental animals should not be singly housed. Separation of an animal for experimental purposes can be achieved either by training or enticing the animal into a small subdivision of the cage, with or without further restraint.

3.4 Feeding
Scattered food will encourage foraging (Chamove et al. 1982), or where this is difficult puzzle feeders can be provided. Variations in dietary components can provide interest and environmental enrichment.

A varied diet, however, should not be provided if it is likely to influence experimental results (Coates 1999). However, many standard diets are available in different flavours and these can be used to provide variation.
3.5 Substrate
Except for disease eradication programmes, deep litter systems have been shown to be both hygienic and labour saving as Chamove et al. (1982) found that bacterial growth was inhibited in wood chip substrate and that it need only be swept out and removed once every 1-4 weeks. In outdoor enclosures the base may be natural vegetation, however, larger primates can root up grass and low herbs, leaving an unsatisfactory muddy substrate. This can be prevented by planting under wire mesh or, as is common practice in many zoos, covering the soil with a non-toxic bark chip substrate with rapidly growing shrubs planted at intervals.

3.6 Handling and training the animals
Staff/animal relations
From the standpoint of non-human primate welfare, the caregiver’s role is of prime importance. Good, friendly relations between familiar carers and monkeys reduce stress and also act as enjoyable stimulation for both staff and animals (Bayne et al. 1993).

In contrast, where keepers make no effort to socialise with the animals, because the animals cannot avoid them, any contact will be stressful (Heath 1989, Olfert et al. 1993, Van Vlissingen 1997.)

Training
Handling or anaesthetising primates is stressful and an increasing number of facilities are training animals to co-operate in many routine procedures, such as injections, blood sampling, urine collection, vaginal smears, oral drug administration and moving to another cage (UFAW 1992, Biological Council 1992, Reinhardt 1997d, Laule 1999). Training animals is not difficult and does not require specialist knowledge (see Pryor 1984) and most caregivers will have trained their monkeys to take treats from the hand. Positive reinforcement must always be used. It is but a short step to familiarise an animal with, say being touched by a needle, to getting it to accept an injection followed by a suitable reward (Reinhardt et al. 1995a, Laule 1999). It is even possible to train a macaque to willingly enter a restraint box and accept dosing through a stomach tube, a relatively unpleasant procedure (Jaeckel 1989). As primates are highly intelligent, training need not be time consuming and can save much time and stress to the animals and their caregivers in the long run. There will, of course, also be some individuals who may be difficult to train and some procedures which may be too aversive so that, for these situations, traditional methods will be unavoidable.

3.7 Training staff
As non-human primates require specialist care, it is essential that staff should receive special training covering the biology, husbandry, health, behavioural needs and psychological wellbeing and safety aspects of primatology. Special courses are usually available run by veterinary, laboratory animal science or technicians’ organisations or in university laboratory animal science or primatology departments. A useful document outlining the levels of expertise required to manage non-human primates was published by the International Primatological Society (1993) in a section entitled « IPS Code of Practice : 2 Levels of Training for Care Giving Staff ».

GENERAL READING
A continuously updated database of relevant publications, established can be found at the following web site http://www.animalwelfare.com/Lab_animals/biblio/enrich.htm. There is an excellent, well documented review in the American APHIS’ Final Report on Environmental Enhancement to Promote the Psychological Well-Being of NonHuman Primates : http://www.aphis.usda.gov/ac/eejuly15.html. Also the document from the Council of Europe – GT 123 (99) 9 « Report on workshop of the European Federation for Primatology » and « The Psychological well-being of nonhuman primates » published by the National Research Council in 1998 provide useful information.
The following are valuable for reference and general reading and information on species not considered specifically in the above guidelines (such as *Cebus* and *Aotus*):


**FURTHER RESEARCH WHICH WOULD BE OF VALUE**

The value of various forms of dietary variation and content (for example, access to medicinal herbs, and dietary effects (if any) on excess multiple births in marmosets, and on psychological well-being).

Further studies on the effects of weaning age and post-weaning rearing conditions on social skills, immune competence, physiology and breeding success.

Assessment of possible adverse auditory stimuli, in the typical laboratory environment.

The value of visual stimulation, including light quality, using choice experiments.

The correlation between group size, cage size enrichment, and group compatibility using behavioural and non-invasive physiological measures.

The influence of staff working in the animal unit during nocturnal animals’ rest periods.

**REFERENCES**


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Line S.W, K. N Morgan, H Markowitz, JA Roberts and M Ridell 1990, Behavioural reponses of female long-tailed macaques (M. fascicuaris) to pair formation. Laboratory Primate Newsletter. 29 1-5


Reinhardt, V. (1997c) Lighting conditions for laboratory monkeys: are they adequate? AWIC Newsletter 8 (2): 3-6


MARMOSETS (Callithrix) AND TAMARINS (Saguinus)

SECTION B: SCIENTIFIC JUSTIFICATION

2.2 Temperature

Background

The allowance for slightly higher temperature than 28 °C takes into account the Callitrichid ecological niches that are geographically distributed in tropical regions (Rylands; 1993, 1997). In experimental conditions, consideration should be given to the effect of environmental temperature on marmosets’ core temperature rhythm (Palkova et al., 1999; Petry et al., 1990).

2.3 Humidity

Background

Values above 70% RH will not impact upon the welfare of the animals for the ecological considerations mentioned above.

2.4 Lighting

Background

Marmosets and tamarins are day-light active species (Erkert, 1997) and the period of behavioural activity is 11-12 hours (Stevenson et al., 1988). In order to reduce experimental variation, illumination and intensity of light should be standardized (Wechselberger et al., 1994).

4.1 Social housing

Background

Marmosets and tamarins are highly social animals exhibiting a complex natural behaviour (Caine, 1993; Garber, 1993; Stevenson et al., 1976). The social structure is most often represented by an extended family group with a monogamous mating strategy (Anzenberger, 1992; Dunbar, 1995a; Epple, 1978; Evans et al., 1984). The suppression of subordinate female reproduction is due to hormonal and behavioural mechanisms (Abbott et al., 1993; Porter et al., 1997). In the laboratory conditions, the animals are commonly maintained in breeding pairs with one or more sets of twins (Hubrecht, 1997; Pryce et al., 1997; Tardif et al., 1993). When grouping same-sex animals the success is often unpredictable and may depend on the environment and individual temperament: twins or a parent with offspring are more likely to be compatible (Eckert, 2000). In general, social interactions should be carefully monitored to prevent the outbreak of aggressive behaviours within captive groups (Anzenberger, 1993; Sutcliffe et al., 1984). The infants are reared cooperatively by all family members (Achenbach et al., 1998; Bales et al., 2000; Dunbar, 1995b; Savage et al., 1996; Snowdon, 1996), thus enabling the juveniles to achieve adequate experience as future breeders (Johnson et al., 1986; Missler et al., 1992). However, in tamarins, the eldest set of twins may be rejected as a new offspring is generated.

4.2 Environmental complexity

Background

The natural environment of marmosets and tamarins incorporates features of complexity and unpredictability that stimulate the expression of a complete behavioural repertoire. One of the consequences of laboratory conditions is generally the reduction of space and the impoverishment of the social and physical environment that barely satisfies the behavioural requirements of the animals (Kerl et al., 1996; Kitchen et al., 1996; Schoenfeld, 1989). An environmental enrichment programme for laboratory marmosets and tamarins is unquestionably an essential component in the improvement of their well-being and has the advantage to incorporate natural and artificial elements that enhance either species-typical and potentially adaptive new behavioural patterns. In
the literature several studies describe various enrichment techniques and their impact on the animal welfare (Box et al., 1993; Buchanan-Smith, 1994,1996,1997; Dettling, 1997; Heath et al., 1993; Poole, 1990; Sambrook et al., 1997; Scott, 1991; Snowdon et al., 1989). The use of different materials and items for cage furniture in callitrichid primates has been proved beneficial to increase their behavioural repertoire, the control over the environment and their foraging propensities (Dettling, 1997; Forster, 1996; Hannaford, 1996; Harrison et al., 1988, 1994; Hosey, 1999, 1998; Kelly, 1993; McGrew, 1986; Roberts, 1999; Vitale et al. 1997).

4.3 Enclosures- dimensions and flooring

Background

Existing guidelines (European Council Directive, 1986; ILAR guidelines, 1996; Home Office Code of Practice, 1989,1995) provide diverse minimum requirements for cage dimensions of marmosets and tamarins, either for floor area or height. These variations are most probably due to the limited scientific data available on space needs of these species and to the diversity of common practices in various countries.

The present proposals take into account several factors such as: the arboreal nature of the animals, their locomotory patterns and flight reaction, the need for adequate space for social interactions and for the inclusion of enrichment devices. The minimum enclosure/cage sizes for experimental animals allow for sufficient enrichment, although the restriction of space should be limited only to the time required by the experimental procedure. It is more important to provide tamarins with a good volume of space than it is marmosets, if their wellbeing and breeding success are to be maximised, (Prescott and Buchanan-Smith, in press).

4.7 Cleaning

Background


REFERENCES – Marmosets and Tamarins part B


Bales K; Dietz J; Baker A; Miller K; Tardif SD (2000): Effects of allocare-givers on fitness of infants and parents in callitrichid primates. FOLIA PRIMATOLOGICA 71(1-2): 27-38.

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SQUIRREL MONKEYS (*Saimiri sciureus*)

SECTION B: SCIENTIFIC JUSTIFICATION

The recommendations are based on personal experience gained by the authors (H. Contamin, N. Herrrenschmidt, and H. Weber) during the past more than 10 years with squirrel monkeys in breeding and experimental colonies of the Pasteur Institute in Cayenne, French Guyana, the Primate Centre at Strasbourg, France, and Novartis Pharma Ltd., Basel, Switzerland. They include personal information obtained from G. Dubreuil, CNRS - Marseille, and M. Huber, formerly ROCHE, Basel. An overview on squirrel monkeys is published in the book of Rosenblum and Coe, (1985) and their care and management by Mendosa (1999).

Complementary comments on the chapters 1 to 6:

1. Introduction
   **Background**

   The taxonomic classification of the various species and subspecies has been undergoing changes throughout the years and has recently been subject to genetic analysis. For practical reasons it seems at present appropriate to differentiate between two subgroups only. In contrast to previous opinion animals of both subspecies can mate and produce viable offspring.

2.2. Temperature:
   **Background**

   The squirrel monkeys live in regions with warm climates of the Amazon area to cool climates of the mountain ranges of Peru and Bolivia. Though the species may tolerate a wide range of temperatures, within the habitat of individual colonies, temperatures are not usually subject to sudden substantial variations. Within the forest animals apparently seek the regions with most suitable temperatures in the canopy.

2.4. Lighting:
   **Background**

   Little is known about the minimal light requirements for squirrel monkeys except that they are daylight active and only feed when there is light. (Parker CE, 1966, Psychon. Sci, Vol. 6, 111-112). Based on current experience and best practice, light intensities of 400 lux and above seem to ensure healthy animals, normal behavior and reproduction. Provision of UV for up to 1 hour/day has proved useful in avoiding osteopathogenesis due to possible lack of vitamin D3 in the diet. Animals having access to outdoor enclosures may cater for their needs by moving to the exterior. However, in indoor enclosures, even with large windows, UV exposure is eliminated by the glass. When providing UV with UV lamps time limits and distance to the lamp must be controlled according to the instructions.

3. Health
   **Background**

   For the health monitoring of squirrel monkeys reference is made to the FELASA recommendation Health Monitoring of Non-human Primate Colonies (1999), *Laboratory Animals*, 33 (Suppl.1), S1:3 - S1:18.

4.1. Social housing
   **Background**

   Saimiriis usually live in groups of around 20 individuals, (Robinson and Janson 1987; Emmons and Freer 1990), and, therefore, groups of 5 and more animals, though they may sit together in small subgroups, are preferable to pair housing for any form of permanent housing. The minimal
enclosure sizes for less than 5 animals are only given for possible cases of incompatibility or if experiments of longer duration require smaller groups than 5.

With their long rearing period, female saimiris produce one offspring (rarely twins) every one to two years. Reproductive performance is rather low compared to macaques, though in stabilised colonies a 50% reproduction rate may be reached. Since, in nature, the leading male may change according to its (“fatty”) reproductive state, an appropriate exchange of males may be considered.

The authors are not aware of literature on the exact “imprinting” age of young squirrel monkeys, which may start soon after birth. However, the fact that animals leave their mothers at quite an early stage and are easily adopted by other females and that hand reared infants attach to their foster parents indicates that this takes place within the first six months of life. Nevertheless, if not necessary, weaning and separation from the parent colony should not take place before 6 months of age.

4.3. Enclosures – dimensions and flooring

Background

Although enclosure dimensions for group housing are based on enclosures for two animals, it is recommended - as mentioned for 4.1. to keep squirrel monkeys in larger groups. Fewer than 5 animals in a group should only be kept in cases of incompatibility or experimental requirements. Based on the dimensions given for each additional animal above 6 months of age 5 animals will require 5.5m² which is less than the 8m³ required by the Swiss Animal Protection Act but considered to be sufficient to provide structures and retreat possibilities. The linear space increase given for each additional animal is, therefore to be taken as guidance. Splitting a group may be preferable to simply adding additional space. Judgement should be based on the condition and behaviour of the colony.

The enclosure dimensions suggested for experimental individual or pair housing correspond with two of the present cages recommended by the Appendix A of ETS 123 for unlimited housing of saimiris and with the cages required by the Swiss Animal Welfare Act for temporary housing of monkeys. They are based on allometric measurements and would allow an animal to sit on or under a perch and walk and turn with ease. These cage dimensions are considered as acceptable for experimental conditions where larger enclosures would be contra-productive to animal welfare and/or for a limited time as justified by the experimental protocol.

4.4. Feeding

Background

Like some other South American monkeys, Squirrel Monkeys do not seem able to utilise D2 but rely on D3 which is synthesised in the skin under the influence of UV light. Since UV is absorbed by most types of glass it is recommended, for animals maintained indoors, to ensure a sufficient supply of vitamin D3 in the diet to avoid osteopathogenesis. The risk of vitamin D3 intoxication is low since South American species are known to be very tolerant to excessive vitamin D3. Most commercially available diets are absolutely adequate for feeding to Squirrel Monkeys and for providing sufficient Vitamin C and D3. Feeding meal-worms, crickets or other insects bears the risk of transmitting bacterial diseases.

4.8 Handling:

Background

Squirrel monkeys can be trained to come forward for titbits or drinks as rewards. They are also capable of learning how to solve tasks for reward. For catching for investigation or treatment, animals should be trained to enter gangways with trap cages or individual enclosures. Though animals can be trained to accomplish tasks, attention should be paid to appropriate recovery periods when subjected to experiments repeated at intervals. Task performance requires energy for concentration. Sessions of three to four hours duration seem to be well tolerated by
Squirrel Monkeys. However, single experimental sessions lasting longer should not be repeated more frequently than at weekly intervals and the monkeys should be under close veterinary supervision.

**GENERAL REFERENCES**


Lehner et al “Biological activities of vitamins D2 and D3 from growing Squirrel Monkeys” Laboratory Animal Care vol. 17, 433-493


MACAQUES AND VERVETS

SECTION B REFERENCES

Most of the relevant discussion regarding the basis for the species-specific provisions for Macaques and Vervets and literature has been surveyed in the Introduction, however the following additional references are of value:


Line SW, KN Morgan, H Markowitz, JA Roberts and M Ridell 1990, Behavioural responses of female long-tailed macaques (M. fascicularis) to pair formation. Laboratory Primate Newsletter. 29 1-5


Seiers JV, and PW de Lange, 1996, A mobile cage facilitates periodic social contact and exercise for singly caged adult vervet monkeys. Journal of Medical Primatology 25, 64-68.
SECTION B: EXPLANATORY PART AND REFERENCES

1. Introduction:
   Background

The species nomenclature is based on commonly accepted terms (Jolly C.E. 1993). Other names, occasionally to be found in some publications are not considered to be correct and may be due to the fact that hybridisation of species can occur.

3. Health:
   Background

Like all Old World species, baboons are very susceptible to tuberculosis and have to be protected from contamination through humans. They are also susceptible to the Ebola viruses and - if originating from certain African areas - may be carriers of yellow fever virus for which, however, vectors for transmission are missing in Europe. Simian immunodeficiency virus (SIV) could be of concern in transplantation studies and transmission to Asian species may induce clinical symptoms in the same.

4.1. Social housing/breeding
   Background

The proportion males to females and group sizes recommended for breeding groups are based on the average subgroup sizes observed in the wild and ensure adequate reproduction. However, other group sizes with a single male may also be acceptable. Since both species mentioned are not organised as harems, females may mate with different males. Therefore, if the genetic background is relevant, single male groups will be appropriate.

With about 4 months infants start walking on their own when the troop is on the move. Between the age of 8 to 14 months the infants begin to interact with other animals of the colony with increasing independence and, therefore, can be separated and integrated into peer groups with less stress. For animals that have to be separated from their mothers below the age of 8 months for veterinary reasons adoption by other adult females in stable colonies may be considered. This may be problematic with older infants, in which case housing with peers is recommended if the infant cannot be left in the group. Animals foreseen for breeding should be left in their maternal colony in order to acquire parental skills and complete social competence.

It is evident that for most experimental purposes and stock single sex groups will be formed. It is preferable to have groups of 4 and more animals in order to avoid bullying of individual animals. Since conflicts due to competition may occur when males and females are housed in the same room the sexes should be housed in separate rooms.

4.3. Enclosures - dimensions and flooring
   Background

The proposed dimensions are based on morphometric characteristics of growing and adult male baboons allowing them to sit upright on and under two perches and move at least 4 steps in one direction. For experimental purposes the dimensions required could also be provided with two or more interconnected modules with the minimal volume per animal. This would have the advantage of providing retreat if required or temporarily separating individuals.

Baboons have a growth spurt up to the age of 4-5 years. After 5 years size (but not body weight) does not increase much. Sexual maturity is attained between 4.5 (females) and 7 (males) years. In immature animals the time budget is dominated by play. From 4 years onward play regresses.
and conflicts may occur especially in confined conditions, thus requiring careful observation of the group. In such cases groups of three may not be ideal. Therefore, baboons older than 3 years may have to be kept in compatible pairs or preferably in larger same sex groups.

**Determination of age:** At the age of 4 years both male and female baboons have attained a weight of approximately 9 kg. Since, however, weight may differ more than size, depending on nutritional conditions during development, other criteria may be more helpful in determining the age of animals for which the birth date is not known. In baboons the testicles of males drop between the age of two to three years. Dentition/tooth eruption may also be helpful in as much as at the age of 3 years the first two secondary incisivi as well as most premolars and molars have erupted. The canines in males erupt between 3 and 4 years of age.

**Indoor/Outdoor enclosures** In most European regions it is necessary to ensure that all animals have access to an indoor enclosure with the recommended minimal space allowances to accommodate all the animals of a group should detrimental weather conditions force to prevent them from moving to an additionally provided outdoor enclosure. In some parts of Europe it is entirely possible to provide the minimum space allowance by an outdoor enclosure. Nevertheless, under such circumstances additional accommodation must be provided to allow shelter from inclement weather, shade from the sun and overnight sleeping quarters. The size of such sheltered or indoor areas should be large enough to accommodate all of the animals harmoniously for their resting periods.

4.8. **Handling**

**Background**

Young baboons are often easier to handle than macaques or vervets. With adult male baboons, though they too may be trained to come forward for the minor manipulations mentioned in section A safety precautions for personnel may be necessary in view of their strength and large canines.

**SELECTED REFERENCES:**


