

**NONHUMAN PRIMATE
ENVIRONMENTAL ENHANCEMENT PLAN
OF
THE SOUTHWEST NATIONAL PRIMATE RESEARCH CENTER
Texas Biomedical Research Institute
San Antonio, Texas**



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I. INTRODUCTION

In accordance with the Animal Welfare Act, this document presents the Environmental Enhancement Plan used at the Southwest National Primate Research Center (SNPRC) at the Texas Biomedical Research Institute to promote the psychological well-being of its nonhuman primates. The procedures presented herein have been developed to address the psychological needs of each species of primate at the SNPRC and to provide enrichment to their physical environment.

The SNPRC employs a dedicated Behavioral Services staff to manage its multi-faceted environmental enrichment program. The main goal of this program is to provide an environment that encourages the expression of species-typical behaviors, such as appropriate social interactions, locomotion, manipulation, and feeding, in a captive setting. In addition, the program seeks to prevent or reduce the occurrence of abnormal behaviors, including stereotypical locomotion, potentially self-injurious behavior (e.g., self-biting), and other aberrant self-directed and appetitive disorders.

To encourage species-typical behavior and promote psychological wellbeing in nonhuman primates, the Behavioral Services staff uses the following strategies:

- Providing environmental enrichment, maintaining enrichment standards, and developing and testing enrichment methods and devices
- Social housing of animals
- Promoting proper infant socialization and development
- Training staff on behavioral issues via workshops on primate behavior and providing research support
- Monitoring animal behavior, housing, social groups, and enrichment delivery
- Providing nonhuman primate positive reinforcement training for enrichment, behavioral modification, husbandry, and research purposes
- Conducting behavioral research

II. ENVIRONMENTAL ENRICHMENT

Environmental enrichment addresses the needs of the animals, allows species-typical activity and development, reduces abnormal behavior, and promotes wellbeing (Bloomsmithe et al., 1991; Schapiro et al., 1991). Enrichment techniques fall under the following categories: physical, nutritional, sensory, social, and occupational (Bloomsmithe et al., 1991). At the SNPRC, nonhuman primates take part in an extensive environmental enrichment program which includes the provisioning of varied food items, manipulable objects, climbing and resting structures, interaction with conspecifics, and varied sensory input. No individual is exempt from all aspects of the enrichment program. Of specific priority for environmental enrichment are singly housed and caged indoor-housed monkeys and all chimpanzees. These individuals are regularly provided with enrichment that requires processing time, promotes cognitive challenges, and/or provides novelty.

A. Physical Enrichment

Physical enrichment promotes species-typical manual manipulation, perching, and locomotor patterns, and also provides visual barriers for privacy. It can include both manipulable enrichment such as plastic balls and rubber chew toys, as well as structural enrichment such as perches and climbing structures. For a detailed description of the construction and implementation of the enrichment devices used at the SNPRC, see SOP 409 and the Enrichment Device Manual at: <https://snprc.org/wp-content/uploads/2016/06/enrichment-device-manual.pdf>

1. Manipulable Enrichment

Manipulable objects (all species) -- Durable manipulable objects such as plastic balls or rubber toys are available to all chimpanzees, baboons, and macaques. Additional toys (e.g., stainless steel rattles or chew toys) are attached to the enclosure with short chains to provide opportunities for manipulation without the possibility of them being washed down the drain. In the rare cases where infants are hand-reared, they are provided with baby toys (plastic blocks, balls, etc.) and stuffed animals for manipulation. Marmosets are provided with PVC tubes and/or smaller toys.

Mirrors (baboons, macaques, chimpanzees) -- Plastic or stainless steel mirrors can be attached to the outside of some cages or hung from chains. Chimpanzees usually recognize themselves in the mirror and use it for grooming and self-inspection. Other species may handle the mirror and use it to watch areas otherwise out of view (See also sensory enrichment).

Minimum manipulable enrichment requirements—Baboon and macaque gang cages should have at least 2 balls and 2 rubber chew toys per cage. Chimpanzee group cages should have 2 large balls, 1 medium ball, and 3 chew toys. Singly housed monkeys should have at least one toy of appropriate size for that species. Singly housed chimpanzees should have 1 large ball, 1 medium ball, and 1 chew toy. Marmosets should have a PVC tube and/or small toys.

2. Structural Enrichment

Climbing structures (all species) – Structural enrichment such as concrete culverts, wood and metal structures, suspended ladders, and/or telephone poles have been placed in the large outdoor housing areas, such as the chimpanzee playground, the chimpanzee Primadomes, the baboon corral, and baboon gang cages. These structures provide shade, hiding areas, resting areas, and facilitate locomotion patterns. Marmoset cages have wood branches and PVC tubes for climbing. In addition, their cages are constructed of mesh surfaces, which promote vertical clinging and leaping.

Nest boxes (marmosets) -- All marmosets are provided with opaque nest boxes that allow them to escape exposure to other animals and humans. These nest boxes provide space for sleeping similar to that used in the wild.

Perches and swings (all species) – Horizontal pipes are available in most group housing areas for perching. Platforms, benches, or other perches are available in all chimpanzee, baboon, and macaque housing. Hanging barrels and milk crates have been added for locomotion, play, hiding, and resting. Swinging tires, fire hose, and large ropes have also been suspended in some

chimpanzee areas. Natural wooden perches are available for marmosets to encourage space use as well as gnawing and scent-marking. Perches or benches are available to indoor caged nonhuman primates.

Playgrounds (chimpanzees) -- The chimpanzee playgrounds consists of three contiguous outdoor enclosures measuring 40 ft. x 75 ft. each. They are constructed of chain link walls, a bar roof for brachiation, and grass ground covering. In addition, numerous structures are placed in the area (such as culverts, swings, tires, and barrels) to provide shade, climbing and resting areas, privacy, and a means to use the vertical space.

Primadomes (chimpanzees) -- Like the playgrounds, the Primadomes are large grass-covered outdoor areas that have a variety of physical enrichment. These 32-ft. diameter geodesic domes have perches at multiple levels for resting, perching, and to provide shade. They also contain a ladder, as well as a large number of poles set at various angles to promote climbing and other locomotor patterns. Furthermore, the Primadomes also have concrete culverts for hiding spaces and shade, as well as tire swings and a long fire hose.

Visual barriers (all species) -- Marmoset cages have partial visual screens and nest boxes to provide visual barriers, an important environmental feature for territorial species. Chimpanzee, baboon, and macaque enclosures and cages have built in solid partitions and/or hanging barrels that serve the same function.

Porches or balconies (macaques) -- Porches are extensions attached to the front of indoor macaque cages. Porches provide additional space, give the animals a wider view of the room, provide an additional perch, and allow the animals to better see their neighbors (see SOP 423).

B. Nutritional Enrichment

Nutritional enrichment includes fruit, grain, or novel food items approved by veterinarians and presented in a variety of ways that increase the diversity of the animals' diets. These items are provided as long as the animal's diet is not restricted due to health concerns or Institutional Animal Care and Use Committee (IACUC)-approved study restrictions. For a detailed description of the food enrichment provided at SNPRC, see SOP 482 and the Enrichment Cookbook at <https://snprc.org/wp-content/uploads/2016/06/enrichment-cookbook.pdf>. Check sheets are filled out whenever enrichment is provided to an animal or group of animals. These sheets are collected each month and maintained by the Behavioral staff (Section VII.B.).

Grain mixes -- Different grains and cereals, including corn, sunflower seeds, cereals, and peanuts in the shell, are spread throughout the larger enclosures (indoor/outdoor runs, group housing areas) to stimulate foraging activity. In some cases, the grains can be presented in a PVC foraging trough or a foraging board. Manual manipulation is required to retrieve grains or other enrichment placed in these devices.

Fruit and vegetables -- A variety of fruits and vegetables is provided to primates on a regular basis. Whole pieces of fruit or vegetables with peels still intact encourage the same sort of manipulation and processing prior to consumption that a primate would have to exhibit in the

wild. Produce can also be cut up into smaller pieces with a food chopper to be broadcast into group enclosures as well as frozen in the summer months.

Novel food items -- A diverse assortment of novel food items is supplied by the Behavioral Services staff to increase the variety of the animals' diets. These items can include types of special seasonal fruits (e.g., pumpkin and watermelon) and berries, yogurt, sugar-free popsicles, and snack mixes.

Minimum food enrichment requirements—All monkeys require food enrichment a minimum of 5 days per week. Chimpanzees require up to four servings of fruit and/or vegetables per day and grain or forage mix 3x per week.

C. Sensory Enrichment

Sensory enrichment includes items that promote auditory, visual, olfactory, and tactile stimulation. This can include television, music or species-relevant soundtracks, or novel scents.

Radios -- For added auditory variety, radios are available in most holding and research areas. Either individual radios are used in the bays, or radios are operated from a central location and transmitted into the animal areas (such as building 8). Volume is kept at a reasonable level, never more than 85 db. Radios can be played for one to eight hours per day, but they are turned off at the end of the day.

Televisions -- Televisions are provided to the chimpanzees and some indoor macaque and baboon areas to add auditory and visual stimulation. The televisions can be operated by the care staffs and remain on for one to eight hours each day, but are turned off at the end of the day. Some televisions have DVD players that can play children's videos or nature programs. Television and videos may also be provided to other primate species that are housed indoors for longer durations. Volume is kept at a reasonable level, never more than 85 db.

Mirrors -- Although small mirrors can be attached to the cage and handled and manipulated (see also manipulable enrichment), larger stainless steel or plastic mirrors can also be mounted on the wall across from the cage. This allows animals to view neighbors that they normally may not be able to see.

Novel scents -- For additional sensory enrichment, novel scents (e.g. scented oils) can be dabbed on a piece of paper or tissue and given to the chimpanzees. Some rubber chew toys given to baboons and macaques are coated in extracts such as vanilla or peppermint. Extracts can also be rubbed onto mirrors, rattles, or PVC tubes.

D. Occupational Enrichment

Occupational enrichment includes feeder devices to stimulate problem-solving, motor skills, and coordination. Also included is positive reinforcement training to provide animals with a way to occupy their time, to reinforce positive human interactions, and to minimize the stress of handling and other routine procedures on both animals and humans.

Nesting material (chimpanzees) – Excelsior or paper such as toilet tissue can be provided to chimpanzees to encourage nesting behavior.

Drawing and painting materials (chimpanzees) – The chimpanzees are given an opportunity to draw and paint. They are given crayons or paint and paper for drawing.

Feeder devices (baboons, macaques, chimpanzees) -- A number of feeding devices are available including PVC puzzle feeders, cup feeders, banana feeders, fleece boards, Kong™ feeders, and puzzle balls. They are usually filled with grain, treats, or sticky substances (e.g., peanut butter) and hung on the outside of the primate's cage. For most indoor caged monkeys, they are provided on a rotating schedule every week, and more often for those showing signs of distress or abnormal behavior if deemed to be effective strategy by the Behavioral Intervention Program.

Pipe feeders (chimpanzees) -- These feeding devices are designed to simulate termite fishing or ant dipping as reported for wild chimpanzees. Pipe feeders consist of a PVC tube filled with sticky or semi-liquid food items that is then attached to the cage. The chimpanzees must insert a straw or stick into the tube to retrieve the food. Multiple pipefeeders are provided to groups of animals to prevent possible aggressive monopolization of the device.

Positive reinforcement training (all species) -- Whenever possible, positive reinforcement is used to shape a primate's behavior and encourage cooperation in routine husbandry, clinical, and/or research procedures. Animals are rewarded for performing desired behaviors, which builds a more positive relationship with the caregiver and provides goal-directed, enriching activities. Training for chimpanzees is an especially integral component of their management due to their high cognitive ability and impressive strength. For example, chimpanzees are trained to present for sedation, which is much safer, more accurate, and less stressful than darting. Training provides a sense of control and predictability for the animals, minimizes environmental stressors, and reduces time and labor for care staff.

E. Social Enrichment

Social housing is recommended for naturally socially-living nonhuman primates by the Animal Welfare Act. A social partner is perhaps the most important and basic environmental variable (Bramblett, 1989), because it provides constantly changing stimuli and challenges the animal's social and cognitive functioning. Social housing is known to have a positive effect on nonhuman primate behavior and health, while single housing has measurable negative consequences (Lutz et al., 2003; Rommeck et al., 2009). Although forming social groups of nonhuman primates is not without risks, the benefits of social housing can outweigh the risks.

All nonhuman primate species housed at the SNPRC live in social groups in the wild. The standard practice at this facility is to house nonhuman primates in pairs or compatible social groups. Individual primates may be exempted from social housing while recovering from an illness or injury, when taking part in an IACUC- approved research project, prior to shipment to another facility, during quarantine upon arriving at this facility, or due to behavioral incompatibility. All singly housed primates have auditory, visual, and/or olfactory contact with conspecifics. This policy may require that a cagemate be brought into the single housing area so

that individuals may have visual and auditory contact with conspecifics. There may be exceptions to this policy under certain conditions (Section VI.E.).

Described below are the social housing options for each nonhuman primate group at the SNPRC. Each species may be housed in a number of different housing configurations depending on age, sex, and need.

1. Chimpanzees

Group housing -- The chimpanzees are housed in compatible pairs or social groups of three to five animals in indoor/outdoor enclosures. Each pair or group in building 7 has access to a large, enriched playground area. The Primadome facility provides additional space in the form of three central indoor enclosures each connected to four large, individual geodesic dome cages. Up to five chimpanzees can be housed in each dome, which has been outfitted with extensive physical enrichment and elevated chutes connecting the domes to promote species-typical locomotor patterns.

Single cage housing -- Standard housing for chimpanzees is in pairs or social groups. However, some chimpanzees may need to be temporarily individually housed when being socialized with new partners or when recovering from an illness or injury. When singly housed, chimpanzees have restricted physical contact, but they have visual and tactile contact with conspecifics.

2. Baboons

Corral -- A population of baboons is housed in a 6-acre, open-air corral. The corral environment can house up to 500 baboons and provides opportunities for the animals to participate in complex social interactions.

Group housing -- Large outdoor cages of varying sizes (300 to 1000 sq. ft.) are used for group housing of baboons. Adult baboons and offspring are placed in compatible social groups of 5 to 20 animals. Breeding groups typically consist of one male and approximately 8-10 females and their offspring. Juvenile baboons maintained in gang cages are placed in compatible social groups often with an older adult baboon to serve as a role model.

Single cage housing -- Baboons are housed indoors in single cages if required by IACUC-approved research protocols or for clinical management purposes. Singly caged baboons have visual, auditory, and olfactory contact with conspecifics unless clinical circumstances require isolation.

3. Macaques

Group housing -- Rhesus macaques are housed in spacious, indoor/outdoor runs, outfitted with perches and hanging barrels, in groups that can range in size up to approximately 12 individuals. Breeding groups are composed of one male with up to 10 females and their offspring. Young bachelor, juvenile, and weanling groups may also be maintained. Sometimes adult females are also held as a group until an appropriate sire can be found or until they are placed on an IACUC-approved research project.

Pair or trio housing -- Macaques housed in cages indoors are socially housed as standard practice, either as pairs or trios, depending on compatibility.

Single cage housing -- Macaques may be placed in single cages if required by IACUC-approved research protocols or for clinical management purposes. Singly housed macaques in these areas have visual, auditory, and olfactory contact with conspecifics unless clinical circumstances require social isolation. In some cases, they may be provided with tactile contact via grooming/contact bars. In the breeding colony, some macaques may be temporarily housed singly in clinic areas due to viral status or until a proper breeding configuration can be formed.

4. Marmosets

Group housing – Marmosets are typically group-housed in family units. If they are not to breed, they are kept with same-sex siblings when possible. Some males may be vasectomized to allow for non-breeding male/female pairs. Same-sex individuals who did not mature in the same social group are generally incompatible for pair or small group housing because high levels of aggression may result.

Single cage housing – Marmosets that cannot be compatibly housed with others or are on IACUC-approved research protocols requiring single housing are housed individually. All have auditory, olfactory, and visual contact with other conspecifics unless clinical circumstances require social isolation.

5. Other Monkey Species

Other species of nonhuman primates may be maintained at the SNPRC (e.g., squirrel monkeys, capuchins, tamarins). They are socially housed whenever possible, but the housing situation will depend on the needs of both the species and the research protocol.

6. Human interaction

Positive human interaction is important to develop rapport and good relations with the primates, especially those being handled frequently. Indoor caged monkeys are visited approximately 4-5x per week by an enrichment specialist. Chimpanzees are visited weekly by the training specialist and 4-5x per week by the enrichment specialist, who plays games and interacts with them as well as provides them with feeding, sensory, and occupational enrichment.

III. INFANT DEVELOPMENT

A great deal of research has shown that an unstimulating or restrictive early rearing environment has negative consequences on the behavior and physiology of nonhuman primates (Coe et al., 1989; Davenport, 1979; Harlow and Harlow, 1965; Suomi et al., 1971). Behaviorally, nursery-reared monkeys are more likely to exhibit higher levels of abnormal behavior such as clasping, digit sucking, rocking, repetitive movements, and self-biting in comparison to mother-reared (Bellanca and Crockett, 2002; Conti et al., 2012; Gottlieb et al., 2013; Lutz et al., 2007; Rommeck et al., 2009) and they also have deficits in social competence (Winslow et al., 2003).

Therefore, rearing by the mother in species-typical groupings is recommended so that the infant develops appropriate behavioral and social skills.

The SNPRC maintains breeding colonies of baboons, rhesus macaques, and marmosets. Unless otherwise removed due to sickness, neglect, or IACUC-approved research purposes, all infants remain with their mother in her social group after birth and until nutritional weaning to ensure adequate time and opportunity for the acquisition of normal social and nonsocial behavior patterns. Infant macaques and baboons are commonly weaned at approximately 9 months of age. Weanlings are placed in peer groups following separation from their mother. Efforts are made to wean several infants from the group at the same time so that they have familiar peers. In the baboon peer groups, if one is available, an older adult is placed with the infants and juveniles to serve as a role model and attachment figure. For marmosets, infants remain in the natal group to mature until the group size (8 to 10 maximum) requires removal of some individuals.

The SNPRC makes every attempt to rear all infants in their natal group until weaning. In some cases when a mother is incompetent, cross-fostering is used to ensure that the infant can be raised in a social group. However, in some rare cases, infants need to be removed due to illness, injury, or IACUC-approved research purposes, requiring hand rearing. Hand-reared infants are given every opportunity to visually and vocally interact with conspecifics, and they are placed with same-age peers as soon as possible.

IV. STAFF TRAINING AND RESEARCH CONSULTATION

A. Primate Behavior, Training, and Enrichment Workshop Series

An 8-part course has been developed to assist with training the care- and veterinary staffs to recognize different aspects of primate behavior and to facilitate their understanding of the various behavioral management and enrichment programs. All staff members who work with or near awake nonhuman primates are required to attend these classes. The first four parts of the course focus individually on ecology, reproduction, and normal behaviors of chimpanzees, baboons, macaques, and marmosets. The remaining four classes cover: 1) Identifying and reporting alopecia; 2) Abnormal behaviors, their development, and how to report these behaviors; 3) Positive reinforcement training and its use in behavioral management; and 4) Environmental enrichment: types, uses, and benefits.

A Powerpoint presentation has also been developed that briefly summarizes each section of the 8-part training course. Newly hired care- and veterinary- staff members review the presentation for an introduction to primate behavior prior to their working with the animals. It also gives contact information for the Behavioral Services staff should they have any questions or concerns.

B. Research Component Consultation

The Behavioral Services staff is available to offer advice and consultation on behavior-related issues of research projects. This can include recommending appropriate research subjects based on behavior, developing sections of research proposals with behavior components, training animals for research-related behaviors, or collecting and analyzing behavioral data.

V. BEHAVIOR MONITORING AND MANAGEMENT

Behavioral Services closely monitors the disposition of group- and singly housed animals. This is accomplished through a variety of programs intended to comprehensively document the behavior of the animals, any behavioral abnormalities they may exhibit, and the steps taken to remedy them. Given the number of animals housed at the SNPRC, the animal care and veterinary staffs are integral in the identification of animals exhibiting behavioral problems.

A. Single Housing Report

A monthly Single Housing Report is generated that lists all of the animals that are currently singly housed, the duration of their single housing, and the reason for their single housing status. This report is reviewed by the Attending Veterinarian and the IACUC.

B. Quarterly Behavioral Assessments

Animals that are singly housed for more than 30 days are evaluated quarterly. Each animal's behavior, with a special emphasis on abnormal behavior, is observed and assessed by a member of the Behavioral Services staff. The Behavioral Services staff member also notes the animal's coat condition and checks to make sure the singly housed individuals have at least visual and auditory contact with conspecifics and a minimum number of enrichment items. Animals exhibiting abnormal behavior during the observation are reported to the Behavioral Intervention Program (Section V.C.) via the abnormal behavior notification component on the Computerized Animal Management Program (CAMP). A copy of the Quarterly Assessment Report is provided to the Environmental Enrichment Committee and IACUC members for review.

C. Behavioral Intervention Program

Animals that exhibit abnormal behaviors are evaluated through the Behavioral Intervention Program (BIP). Care, behavioral, and veterinary staff members are trained in the identification of abnormal behaviors and report animals observed exhibiting abnormal behavior via the behavior notification component integrated into CAMP. Working with the veterinary and animal care staffs, the Behavioral Services staff evaluates the severity and possible cause of the abnormal behavior(s) and recommends possible interventions to correct or improve the behavioral condition in a manner consistent with the promotion of psychological well-being of nonhuman primates. Intervention methods can include the application of specific enrichment, changes in housing or husbandry, pharmaceutical treatments, or training relevant to the condition.

D. Chimpanzee Observations

Routine 15-minute observations are conducted approximately four times per year on all of the chimpanzees. These observations include information on the animals' behavior, cage usage, and hair coat quality, and serve as a baseline should changes or issues arise. In the event that a chimpanzee needs to be singly housed, behavioral observations are conducted weekly to evaluate behavioral changes and disposition. This information is maintained in the animals' records and any concerns are discussed with the chimpanzee supervisor and veterinarians.

E. Alopecia Assessment

Alopecia can occur as the result of a variety of issues, both behavioral and clinical (Novak and Meyer, 2009), and can be an indicator of physical or psychological wellbeing. Behavioral Services works in conjunction with the veterinary staffs to assess alopecia and address it when necessary. All care, behavioral, and veterinary staffs are involved with monitoring alopecia. If hair loss affects more than 50% of the animal's hair coat in the absence of hair pulling, it is reported to the veterinary staff for clinical evaluation. (Those observed to pull out their own hair are reported directly to the BIP for assessment.) If no clinical cause is established, the veterinary staffs can request a behavioral assessment. If a behavioral or environmental cause is determined, an appropriate intervention is recommended and conducted. Additional monitoring can also be conducted to rule out seasonal molting (see SOP 462).

F. Social Housing Observations

On occasion, when animals are introduced back into their social groups following treatment in the clinic or upon release from a study, Behavioral Services is called upon to conduct observations to ensure that the animal in question is able to make a smooth transition back into its group. Similarly, introductions of adult monkeys to new social groups are monitored by either a Behavioral Services staff member or a colony manager to ensure compatibility. Behavioral Services also plans and conducts chimpanzee socializations. If aggression occurs in existing pairs or social groups, Behavioral Services staff conduct observations to help identify the problem. If excessive aggression or wounding occurs, the colony manager, supervisor, clinical staff, and/or veterinarian are contacted, and recommendations for changes in housing are made.

G. Behavioral Training Program

The Behavioral Training Program maximizes positive reinforcement training (PRT) in the routine care and management of all primate species. Training requests may be submitted by area supervisors or veterinarians to request training of individuals or groups of animals for clinical, husbandry, research, or behavioral modification purposes. Examples of training cases for the chimpanzees include present for sedation, alert sample collection, exercise for overweight or geriatric animals, and shifting. Monkey training cases typically include chute training, target training, cooperative feeding, as well as various research-specific training tasks. Quarterly status reports are generated to keep all relevant staff informed of progress. Other staff members are also trained on positive reinforcement training techniques. Once behaviors are reliably trained, the Behavioral Training Program transfers responsibility of maintenance for those behaviors to the clinical and/or care staff that will be working most extensively with those animals. For example, animal care staffs receive training on how to shift their animals for routine husbandry purposes. Training via PRT increases choice and control, and enhances psychological wellbeing.

VI. SPECIAL CONSIDERATIONS

A. Infants and Young Juveniles

The SNPRC aims to encourage the development and maintenance of species-typical social behavior through the exposure of infants and juveniles to adults and/or peers. In order to do this, infants are left with their mothers in social groups until nutritional weaning. Infants are only removed from their mothers early if indicated by health concerns of the mother or infant, or by IACUC-approved research protocols. When possible, infants are placed with surrogate mothers for care. Young juveniles are maintained in peer groups, sometimes with an older adult added to the cage as a role model.

B. Individuals Showing Signs of Psychological Distress

All nonhuman primates are monitored daily by animal care, veterinary, and/or enrichment staffs. Those animals showing signs of psychological distress through behavior or appearance are brought to the attention of the veterinary and behavioral staffs. An assessment is conducted and an intervention is recommended, if warranted. Behavioral observations may be conducted to assess the effectiveness of the intervention.

C. Mobility-Restricting Research

Research that limits an animal's mobility and activity is not routinely conducted at SNPRC. In some instances, a tethering system that allows continuous physiological monitoring in primates without the need for physical restraint is used. The only restriction with a tether is that animals cannot have perches in their cages because equipment may become entangled on them. Some research procedures have been conducted on marmosets using a specially designed tubular restraint device, and on macaque monkeys using a chair or procedure cage, but the exposure is brief, and the animals are habituated and trained to tolerate it beforehand.

D. Great Apes Weighing More Than 110 lbs (50kg)

Chimpanzees are housed in cages or enclosures which allow adequate space for the display of regular locomotor patterns (climbing, swinging, brachiating). The height of the animal enclosures is such that normal stretching and jumping movements are not impeded. Large resting benches are also available in all enclosures. All chimpanzees have access to additional outdoor enclosures on an ad-libitum basis. This added space is furnished with structural enrichment and allows for additional opportunities for regular locomotor patterns.

E. Exemptions from Social Housing

Nonhuman primates may be housed singly under specific circumstances. Most situations requiring single caging are of a short-term nature (less than 30 days). Singly housed individuals are reviewed by the Attending Veterinarian monthly (Section V.A.) and those singly housed over 30 days are assessed by a Behavioral staff member quarterly (Section V.B.). Single housing may be approved for the following reasons:

Experimental reasons -- A primate on an approved active research protocol cannot be housed with another animal because of the experimental design or its infectious status in relation to other animals. This exemption must be approved by the IACUC.

Incompatibility – A primate may not be able to be housed with another animal due to behavioral incompatibility as determined by high levels of aggression or submission, weight loss due to monopolization of food, or evidence of physical injury to either animal. Attempts will be made to find compatible partners, however there may be some cases in which this is not possible.

Health -- A primate may be temporarily singly caged due to severe illness or injury.

Quarantine -- A primate may be singly caged after arrival at the facility for quarantine purposes. Individuals awaiting shipment to another facility may also be held in single cages for short periods of time.

F. Exemptions from Environmental Enrichment

No animals are exempted from the Environmental Enrichment Program. However, some individuals may be restricted from participating in part of the program. For example, an injury may require that a primate not use climbing structures and special diets may restrict the use of certain nutritional enrichment items.

VII. RECORD KEEPING

A. Animal Records Database

The SNPRC maintains an extensive database (CAMP and TAC- Total Animal Care) with information on each animal's history. Included in the database is information on acquisition and disposition, age, sex, weight, clinical and research information, and location history. Behavioral Services has developed a behavioral component of the database, so staff members throughout the facility may access summarized behavioral information on individual animals.

B. Enrichment Distribution Records

Records on environmental enrichment provided to the primates are kept in each area. Specific enrichment forms are used to record enrichment delivery by individual bay, building, or area. The individual who distributed the enrichment is required to initial and date the records. These records are collected and evaluated monthly, summarized quarterly, and maintained by the Behavioral Services staff. If certain areas do not meet the set enrichment goals for each month, the supervisors of the specific area are informed and actions necessary to attain those goals are discussed.

C. Quarterly Behavioral Assessment Database

All primates that have been singly housed for 30 days or more are observed during the Quarterly Behavioral Assessments (Section V.B.). A record of the collected behavioral data is maintained, and animals exhibiting abnormal behavior are reported to the Behavioral Intervention Program.

Additional records maintained for the Quarterly Behavioral Assessments include the animal's coat condition, available manipulable enrichment, visual access to conspecifics, and any additional concerns. This report is provided to the Environmental Enrichment Committee and IACUC members for review.

D. Social Group Formation Records

Social group formations of chimpanzees, baboons, and macaques are observed and recorded by the Behavioral staff. Observations are typically conducted for a minimum of 10 minutes. Longer or additional observations are conducted as needed. Data are collected during this time, noting the type and directionality of the behaviors observed. This information is summarized and recorded into a computer records database. These records have served as the basis for predicting the outcome of introduction events and for evaluating the past behavior of an individual during an introduction (Brent et al., 1997).

E. Behavioral Management Records

Records are also kept on any observations conducted for management of an individual animal or group of animals. For example, individuals who exhibit signs of social incompatibility may be observed following a request from an area supervisor, colony manager, or veterinarian. Results of such observations are maintained electronically and are provided to the appropriate staff, along with any recommended changes in housing.

F. Chimpanzee Information Database

All chimpanzees have a file with information on rearing history, abnormal behavior, maternal behavior, and any other pertinent data. This information includes behavioral data collected quarterly on all individuals (Section V.D.). Detailed information is also maintained on animal training, including training progress and preferences.

G. Behavioral Intervention Program Database

As part of the Behavioral Intervention Program (Section V.C.) detailed behavioral records are collected on individuals showing signs of stress or abnormal behavior. Individual animals are reported to the behavior staff using the abnormal behavior reporting component of the CAMP database. Records for each case reported to the Behavioral Intervention Program are kept in a database managed by a member of the Behavioral Services staff. This information is valuable when investigators choose animals for studies because many of the animals treated in the BIP program may react poorly to single caging or other stressful procedures. A summary of behavioral information is located on the Behavior tab of the animal's database record and a quarterly status report is presented to the Enrichment Committee meeting for review.

H. Pairing Database

A database containing information from macaque pairings is maintained by a Behavioral Services staff member. Information included in this database comprises general information on each of the pair, results of temperament testing, the schedule and procedures of the pairing

process, the length of time the animals were housed together, whether the pairing was a success, and whether any injuries occurred during pairing.

VIII. PROGRAM ASSESSMENT

A. Research

Behavioral Services is committed to developing, setting, and implementing standards for the care and welfare of nonhuman primates. Part of this commitment involves assessing the effectiveness of management strategies and enrichment methods at improving captive conditions of the nonhuman primates at the SNPRC. In following with this, the Behavioral Services staff is involved in current research studying behavior and environmental enrichment, as well as other related research topics. Recent publications include:

- Baker KC, Bloomsmith MA, Coleman K, Crockett CM, Worlein J, **Lutz CK**, Mc Cowan B, Pierre P, Weed J. 2017. The Behavioral Management Consortium- A partnership for promoting consensus and best practices. In: Schapiro SJ (ed.). Handbook of Primate Behavioral Management. CRC Press: New York. Pp. 9-23.
- Bloomsmith MA, Clay AW, Lambeth SP, **Lutz CK**, Breaux SD, Lammey ML, Franklin AN, Neu KA, Perlman JE, Reamer LA, Mareno MC, Schapiro SJ, **Vazquez M**, **Bourgeois SR**. 2019. Survey of behavioral indices of welfare in research chimpanzees (*Pan troglodytes*) in the United States. JAALAS 58:160-177.
- Coleman K, **Lutz CK**, Worlein JM, Gottlieb DH, Peterson E, Lee GH, Robertson ND, Rosenberg K, Menard MT, Novak MA. 2017. The correlation between alopecia and temperament in rhesus macaques (*Macaca mulatta*) at four primate facilities. American Journal of Primatology 79:e22504.
- Hamel AF, **Lutz CK**, Coleman K, Worlein JM, Peterson EJ, Rosenberg KL, Novak MA, Meyer JS. 2017. Responses to the human intruder test are related to hair cortisol phenotype and sex in rhesus macaques (*Macaca mulatta*). American Journal of Primatology 79:e22526.
- Lutz CK, Nevill CH. 2017. Behavioral Management of *Papio* spp. In: Schapiro SJ (ed.). Handbook of Primate Behavioral Management. CRC Press: New York. Pp. 367-383.
- Lutz CK. 2018. A cross-species comparison of abnormal behavior in three species of singly-housed Old World monkeys. Applied Animal Behaviour Science. 199:52-58.
- Lutz CK, Brown T. 2018. Assessing porches as enrichment for singly-housed cynomolgus macaques (*Macaca fascicularis*). JAALAS 57:134-137.
- Lutz CK, Menard MT, Rosenberg K, Meyer JS, Novak MA. 2019. Alopecia in rhesus macaques (*Macaca mulatta*): Association with pregnancy and chronic stress. Journal of Medical Primatology 48:251-256.
- Novak MA, Menard MT, El-Mallah SN, Rosenberg K, **Lutz CK**, Worlein J, Coleman K, Meyer JS. 2017. Assessing significant (>30%) alopecia as a possible biomarker for stress in captive rhesus monkeys (*Macaca mulatta*). American Journal of Primatology 79:e22547.

B. Environmental Enrichment Committee

The effectiveness of the enrichment program and its assessment strategies is evaluated by the Environmental Enrichment Committee at the SNPRC. This committee consists of supervisors, veterinarians, and Behavioral Services staff members. The committee meets monthly to discuss progress on behavior issues and ways to implement improvements. Quarterly Enrichment, BIP, Behavioral Assessment, and Training reports are distributed and discussed at these meetings. The committee reviews the Environmental Enhancement Plan, which is then sent to the IACUC for final approval.

C. Pair/Group Formation Meetings

A pairing meeting consisting of Behavioral Services, veterinary, and supervisory staff members is held every two weeks to discuss the status of all singly housed macaques and to plan future pairing introductions. Similarly, a committee that addresses chimpanzee socialization meets approximately once a month or as needed. The current goal is to increase the size and complexity of chimpanzee social groups. Weekly meetings are also held to discuss macaque and baboon releases and socializations. These meetings may also include discussions of behavioral concerns and animal training.

D. Behavioral Services Staff Meetings

The Behavioral Services staff has weekly meetings to discuss upcoming events and program updates. Information on animal or enrichment issues are shared, and new ideas for behavioral management are discussed.

E. Behavioral Management Consortium

The Behavioral Services Director is a member of the Behavioral Management Consortium, whose membership includes the behavioral directors of all eight National Primate Research Centers. This group conducts monthly webinars and meets annually. Behavioral issues are discussed and research collaborations are developed. Among the Consortium's goals is to standardize best practices across the centers.

IX. REFERENCES

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