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 by 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 behavior management and 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, enrichment manipulation, and feeding in a captive setting. In addition, the program seeks to prevent or reduce the occurrence of abnormal behaviors including stereotypic 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 well-being in nonhuman primates (NHPs), 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 behavior-related issues via workshops on primate behavior and providing research support
- Monitoring animal behavior, housing, social groups, and enrichment delivery
- Providing nonhuman primates with positive reinforcement training for enrichment, behavior modification, husbandry, clinical, and research purposes
- Conducting behavior research

II. ENVIRONMENTAL ENRICHMENT

Environmental enrichment allows species-typical activity and development, reduces abnormal behavior, and promotes well-being (Bloomsmith et al., 1991; Schapiro et al., 1991). Enrichment techniques fall under the following general and overlapping categories: physical, nutritional, sensory, social, and occupational (Bloomsmith 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, foraging devices, 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 long-term indoor housed monkeys, those housed both individually or in pairs, 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 418 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 primates. Additional toys (e.g., stainless steel rattles, novel toys) are attached to the enclosures 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 (all species) -- 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.

Minimum manipulable enrichment requirements -- Per SOP 418, baboon and macaque group enclosures should have at least 4 manipulable objects per cage. Chimpanzee group cages should have 2 large balls (10”), 1 medium ball (6”), and 3 chew toys. Indoor-housed monkeys, unless otherwise specified below, should have one toy for each monkey in the enclosure plus one extra (the “N+1 rule”). 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 and wood or metal structures have been placed in the large outdoor housing areas such as the chimpanzee Primadomes, the playgrounds (Bldg 7), the baboon corral, the Animal Care Complex (ACC), and other group enclosures. These structures provide opportunities for animals to climb and perch. In addition, caging in most areas is constructed of chain link or steel mesh which allows for climbing, 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, suspended ladders, or other perches are available in all chimpanzee, baboon, and macaque housing. Hanging barrels 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 unless removed for animal safety.

Playgrounds (baboon) -- The baboon playgrounds consist of three contiguous outdoor enclosures measuring 40 ft. x 75 ft. each. They are constructed of chain link walls, a barred roof for brachiation, and grassy 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.

Animal Care Complex (ACC, macaques and baboons) – ACC enclosures consist of climate-controlled indoor areas (349-777 ft^2) and associated field cages (2952-5472 ft^2). The field cages are partially comprised of natural ground (earth, grass, and/or natural vegetation) and include culverts, playground equipment, and other perching, climbing, and/or shade structures.

Primadomes (chimpanzees) -- Like the playgrounds and ACC, the Primadomes are large earthen or grass-covered outdoor areas, connected to indoor space, that have a variety of physical enrichment. These 32-ft. diameter geodesic domes have platforms 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 rope.

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.

Balconies or porches, and tunnels (various monkey species) -- Balconies are extensions that can be attached to the front of compatible indoor 4-pack cages (see SOP 423). They 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. Marmoset housing has similar attachments available. Tunnels are cage extensions that attach to the front of compatible indoor 4-pack cages. They connect the top and bottom tiers of caging allowing more space, vertical movement, wider view of the room, and more opportunities for social options including group housing indoors.

B. Nutritional Enrichment

Nutritional enrichment includes produce, grain, and other rare 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 418 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, 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 devices or a foraging trough. Manual manipulation is required to retrieve grains or other enrichment placed in these devices.

Fruits and vegetables -- A variety of produce 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 novel produce (e.g., pumpkin or watermelon), dried fruit, graham crackers, granola bars, and snack mixes.

Minimum food enrichment requirements -- All monkeys require food enrichment a minimum of 5 days per week. Chimpanzees receive up to four servings of produce per day to supplement their diet and grain or forage mix three times 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. Volume is kept at a reasonable level. Radios can be played for one to eight hours per day, but they are turned off at the end of the day.

White Noise Machines – For further auditory variety, white noise machines can be used in place of a radio and adjusted to play ambient nature sounds including but not limited to rainfall, ocean waves, flowing water, and bird calls. Volume is kept at a reasonable level and can be played for one to eight hours per day, but they are turned off at the end of the day.

Televisions -- To add auditory and visual stimulation, televisions are mounted in some indoor monkey areas and available mounted on push carts for others. 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 cartoons 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.

Novel scents -- For additional sensory enrichment, novel scents (e.g., extracts and essential oils) can be dabbed on a piece of paper or tissue and distributed. Special devices used to hold these have been constructed to hang on caging. Some rubber chew toys are also coated in extracts

such as vanilla or peppermint. Extracts can also be rubbed onto mirrors, rattles, or PVC tubes or used in aromatherapy diffuser.

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) -- Wood wool, blankets, or paper such as toilet tissue can be provided to chimpanzees to encourage nesting behavior.

Bedding (all species) – wood shavings, straw, hay, or other bedding material may be placed on the floor of an enclosure or on attached trays or in attached buckets, to encourage natural foraging behavior. Placing small food objects under and within the bedding, such as sunflower seeds, peanuts, raisins, and cereal, will especially encourage long bouts of search. Drain covers are available or can be specially made to prevent clogging. Periodic spot cleaning and replacement of bedding can be instituted for long-term deployment.

Drawing and painting materials (all species) -- Chimpanzees can be given an opportunity to draw or paint by providing them with crayons or paint and paper. Macaques, baboons and other NHPs can be given similar opportunities with the drawing or painting utensil affixed to the enclosure with a small chain.

Feeder devices (all species) -- 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 weekly rotating schedule, 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 pipe feeders are provided to groups of animals to prevent possible aggressive monopolization of the device.

Tablets and other electronic devices (all species) – computer tablets and electronic games can be affixed to NHP enclosures for voluntary usage. Visual and/or auditory feedback is provided by the device when the animal interacts with it.

Cognitive testing (all species) – The presentation of cognitive tasks is an excellent way to engage primates, and at the same time learn more about them. Platforms may include testing trays, automated computer testing devices, mechanical puzzles, and naturalistic problems set up in or near enclosures. Topics include attention, memory, reactions to novelty, social cognition, and

many others. Can be applied in any housing situation, and individual animals participate if they so choose. This is an ideal way to combine environmental enhancement and basic research.

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. For example, chimpanzees are trained to present for sedation, which is much safer, more accurate, and less stressful than darting, and chute training in baboons and macaques facilitates husbandry. Training provides a sense of control and predictability for the animals, minimizes environmental stressors, and reduces time and labor for 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, and usually does, outweigh the risks (Logan and Sayers 2024).

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 in indoor/outdoor enclosures. The Primadome facility provides four central indoor enclosures each connected to a large, individual geodesic dome cage. 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 will have visual and grooming contact with conspecifics when possible

2. Baboons

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

Group housing -- Large outdoor enclosures of varying sizes (~ 300 to > 3000 sq. ft.) are used for group housing of baboons, each with associated sheltered or indoor area. Adult baboons and offspring are typically placed in compatible social groups of 5 to 20 animals, though pairs and small groups do occur. Breeding groups typically consist of one male and approximately 8 to 10 females and their offspring. Juvenile baboons maintained in group cages are placed in compatible social groups often with an older adult baboon to serve as a role model. Larger groups can be accommodated in field enclosures, such as the playgrounds and ACC.

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 enclosures, outfitted with perches and hanging barrels, in groups that can range in size up to approximately 12 individuals in standard housing and 50 or more in the field enclosures of the ACC. Breeding groups are composed of one male with up to 10 females and their offspring in standard enclosures. The ACC can accommodate multiple male, multiple female breeding groups of much larger sizes. 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 small groups, 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. Vasectomized males are an option 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.

Pair housing -- Same-sex siblings can be housed in pairs or trios depending on the reason for and timing of the need to move them out of their natal group, but long-term stability of this situation is uncertain. Brothers may be more tolerant of each other, but it is unknown for how long. Sisters will generally become aggressive with each other. Same-sex mature juvenile or adult individuals who did not mature in the same social group are considered high-risk for aggression and injury and are generally not housed together. Unfamiliar females can be paired using a juvenile female with an older adult female (Majolo et al, 2003).

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, vervets). They are socially housed whenever possible, but the housing situation will depend on the needs of both the species and the research protocol. These species also receive environmental enrichment in the form of toys and feeding devices and positive reinforcement training, whenever necessary or beneficial.

6. Human interaction

Positive human interaction is important to develop rapport and good relations with the primates, especially those being handled frequently. Indoor caged Old World monkeys benefit from daily interactions with care staff during which enrichment is distributed. An enrichment specialist also visits some indoor caged Old World monkeys approximately four times per week. Chimpanzees are visited daily by the training and enrichment specialists, who interact with them and provide nutritional, sensory, and/or 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, pathogen control, 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 behavior patterns. Infant macaques and baboons are generally weaned at approximately 9 months of age or later. Under special circumstances such as generation of specific pathogen free or "test negative" animals for certain pathogens, artificial weaning may occur at age 6 months or later. 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 and macaque peer groups, if available, one or more older adult is placed with the infants and juveniles to serve as a role model and attachment figure. In field enclosures such as the ACC, infants may stay in their natal groups longer on average, or even indefinitely (e.g., the formation of matrilines as in macaques and most baboon varieties in the wild). For marmosets, infants remain in the natal group to mature until the group size (8 to 10 maximum) or sibling-sibling aggression requires removal of some individuals.

The SNPRC makes every attempt to rear all infants in their natal group until weaning, as applicable. 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 the rare instances that require hand-rearing, those 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

A 9-part course has been developed to assist with training the animal care and veterinary staff to recognize different aspects of primate behavior, and to facilitate their understanding of the various behavioral management and enrichment programs. The entire series is offered over the course of each year, and all staff members who work with or near nonhuman primates are required to attend each of the classes at least once. The first four parts of the course focus individually on ecology, reproduction, and normal behaviors of chimpanzees, baboons, macaques, and marmosets/New World monkeys. The remaining five classes cover: 1) abnormal behaviors, their development, and how to report these behaviors; 2) positive reinforcement-based training and its use in behavioral management; 3) environmental enrichment: types, uses, and benefits; 4) processes and research involved in the pairing of monkeys; and 5) physiology of psychology, a primer on chemical associations with behavior and its relation to primate management.

Two Powerpoint presentations have also been developed that highlight key aspects of many of the presentations, one on species-typical behavior and ecology and the other on abnormal behavior and enrichment. Newly hired staff members review the presentations as part of initial training as an introduction to primate behavior prior to their working with the animals.

B. Research

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 behavior data. Members of the Behavioral Services staff conduct independent research and collaborate with investigators in a wide range of areas.

C. New Hire Behavioral Training

Behavioral Services staff have developed training aimed at educating staff on how to appropriately interact with the nonhuman primates, respond to aggression, apply positive reinforcement training during common husbandry procedures, and to understand why nonhuman primate psychological health is important. Ultimately, this training stresses how we manage NHPs to maintain a psychologically healthy nonhuman primate model. This training is required for all new employees that will be working directly with nonhuman primates.

New chimpanzee staff (new hires or new to area) undergo extensive training to learn behavior modification skills that promote and maintain safety in all interactions with chimpanzees. Training sessions are scheduled 1-2 times/week and focus on teaching staff to recognize precursors to aggression, and how to employ specific skills and techniques that effectively decrease arousal and reinforce alternative calm, relaxed behavior. This training provides new employees with the opportunity to observe and practice behavior modification techniques that help to minimize the risk of injury during feeding and interaction. These training sessions teach introductory, foundation skills that form the basis for more advanced training skills, including cooperative feeding and shift training. Depending on prior experience, staff are required to complete a minimum of 3 training sessions to be signed off as reliably trained on each skillset.

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

The default housing of NHPs at SNPRC is social, as outlined in IACUC Policy Number 03.01. 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. In addition, an additional IACUC-appointed Subcommittee meets monthly to go over the Single Housing Report. This Subcommittee reports issues and offers recommendations for improvements to the IACUC at large.

B. Quarterly Behavioral Assessments (QBAs)

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 along with 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 QBA report is provided to the IACUC.

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 staff, 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 at least monthly on all of the chimpanzees. These observations include information on the animals' behavior and cage usage, and serve as a baseline should changes or issues arise. In the event that a chimpanzee needs to be singly housed, behavior 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, behavioral, clinical, or seasonal (Novak and Meyer, 2009) and can be an indicator of physical or psychological well-being. Behavioral Services works in conjunction with the veterinary staff to assess alopecia and address it when necessary. All care, behavioral, and veterinary staff 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 staff may 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 via PRT increases choice and control and enhances psychological well-being. Training requests may be submitted by staff 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 shifting and chute transfer training, along with cooperative feeding, presentation for sedation, and various research-specific training tasks.

Care and technical staff also receive training on the science of operant conditioning and are taught how to modify behavior through shaping and reinforcement of desired behavior. They learn how to motivate animals to cooperate with routine husbandry procedures by pairing behavioral choices (e.g., shifting into holding areas, enclosures, chutes and transfer cages) with desirable outcomes. For example, the animals learn that if they come inside and allow the door to close that they will receive a food reward or enjoyable activity. The Behavioral Training program works to integrate clinical, care, and technical staff into the training process with the ultimate goal of transferring responsibility and maintenance of the trained behavior to the staff working most extensively with those animals.

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 or later. 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. Juvenile macaques and baboons 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 Behavioral Services staff. Those animals showing signs of psychological distress through behavior or appearance are brought to the attention of the veterinary and behavioral staff. 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 macaques using a chair or procedure cage, but the exposure is brief, and the animals are habituated to tolerate it beforehand. Other protocols utilize implantable chips that record physiological state without impeding movement.

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 (i.e., climbing, swinging, brachiating). The height of the animal enclosures (Primadomes and associated indoor spaces) 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 outdoor enclosures on an ad-libitum basis, excepting specific clinical or husbandry circumstances. This space is furnished with physical enrichment, including tall climbing structures, 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, though 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. Other restrictions may occur for animals on research protocols, and any research exemptions must be approved by the IACUC.

VII. RECORD KEEPING

A. Animal Records Database

The SNPRC maintains an extensive database (CAMP-Computerized Animal Management Program 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 and social partner 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. Information included in the behavioral component includes any abnormal behavior for which an animal has been reported, the number of times each behavior has been reported, and the last time each behavior was reported. Information on pairing is also contained within electronic procedure notes.

B. Enrichment Distribution Records

Records on environmental enrichment provided to the primates are kept in each area. Nutritional enrichment like produce, grains, and novel food items are recorded along with puzzle feeder devices, physical enrichment like mirrors and rattles, sensory enrichment like television or scents, and any training interactions. 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. As noted, this report is provided to the IACUC.

D. Social Group Formation Records

Social group formations of chimpanzees, baboons, and macaques are observed and recorded by the Behavioral Services staff. Ad libitum observations recording behavior, directionality of interactions, and pertinent environmental variables are typically conducted for a minimum of 10 to 15 minutes. Longer or additional observations are conducted as needed. 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, veterinarian, or care or technical staff person. 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 monthly 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 CAMP database record, and a quarterly status report is maintained for active cases. A summary of interventions along with their outcomes is also kept for a convenient record of successful intervention strategies.

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, 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 conditions of the nonhuman primates at the SNPRC. This is coupled with a keen commitment towards advancing our knowledge of primate natural history in all its guises. In following with this, the Behavioral Services staff is involved in current research studying primate behavior and management, as well as other related research topics. Some recent publications include:

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Menzel, CR, and Sayers, K. 2022. The natural history of primate spatial cognition: an organismic perspective. In Bennett Schwartz and Michael Beran (Editors): *Primate Cognitive Studies*. Cambridge: Cambridge University Press, pp. 188-237.

Sayers, K. 2022. Ecology of *Semnopithecus*. In: Cyril R. Grueter, Julie Techroeb, and Ikki Matsuda (Editors): *Colobine Monkeys: Natural History, Behaviour and Ecological Diversity*. Cambridge: Cambridge University Press, pp. 186-198.

Clay AW, Ross SR, Lambeth S, Vazquez M, Breaux S, Pietsch R, Fultz A, Lammey M, Jacobson SL, Perlman JE, Bloomsmith MA. 2023. Chimpanzees (*Pan troglodytes*) in U.S. Zoos, Sanctuaries, and Research Facilities: A Survey-Based Comparison of Species-Typical Behaviors. *Animals* (Basel) 13(2):251.

Haertel AJ, Beisner BA, Buehler MS, Capuano S, Carrol KE, Church T, Cohen JK, Crane MM, Dutton JW, Falkenstein KP, Gill L, Hopper LM, Hotchkiss CE, Lee GH, Malinowski CM, Mendoza E, Sayers K, Scorpio D, Stockinger D, Taylor J. 2023. The impact of housing on birth outcomes in breeding macaque groups across multiple research centers**.** *American Journal of Primatology* 85: e23554.

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Sayers, K, and Ross, CN. 2024. Adaptive memory, primates, and human evolution. In Michael Toglia, Henry Otgaar, Jeanette Altarriba, and William Blake Erickson (Editors): *Interdisciplinary Perspectives in Understanding Adaptive Memory*: Oxford University Press, pp. 169-215.

B. Primate Behavior Interest Group (PBIG)

The Primate Behavior Interest Group (PBIG) is devoted to continuing education on primate behavioral, ecological, and evolutionary topics, and continual refinement of our management processes through knowledge of natural history. This interest group includes supervisors,

veterinarians, Behavioral Services staff members, and is open to any interested person from the institution. It meets quarterly to discuss current and historic literature, progress on behavior issues, and ways to refine management at our center

C. Pair/Group Formation Meetings

Behavioral Services and pertinent staff members including care and technical staff meet regularly to discuss the status of singly housed macaques and plans for future pairing introductions. Similarly, a committee that addresses chimpanzee socialization, management needs, and concerns meets approximately once a month or as needed. 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 behavior management issues is shared, and new ideas related to the program 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 seven National Primate Research Centers and additional affiliated institutions. 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. Behavioral Services staff are also involved in sub-committees involving topics such as abnormal behavior management, pairing and socialization, enrichment, animal training, and compassion fatigue and resilience.

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