

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



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I. INTRODUCTION

In accordance with the Animal Welfare Act of 1970, and as amended in 1991, this document presents the Environmental Enhancement Plan used at the Southwest National Primate Research Center (SNPRC), at the Southwest Foundation for Biomedical Research (SFBR) to promote the psychological well-being of its nonhuman primates. As required by the Animal Welfare Act, 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 is home to almost 5000 nonhuman primates, with over 90% living in social groups. One hundred and seventy two chimpanzees (*Pan troglodytes*) are housed mainly in indoor/outdoor enclosures. Approximately 3,000 baboons (*Papio hamadryas* sp.) live in a variety of housing arrangements including two 6-acre corrals, large, outdoor group enclosures with sheltered areas, and indoor caging. Approximately 475 rhesus macaques (*Macaca mulatta*) live mostly in small groups in indoor/outdoor enclosures or indoor cages. Cynomolgus macaques (*Macaca fascicularis*) number over 800 and live in large groups in indoor/outdoor enclosures. Marmosets (approximately 275) and tamarins (approximately 20) are housed indoors in family groups or singly.

II. PROGRAM PURPOSE

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, possibly self-injurious behavior (i.e., self-biting), and other aberrant self-directed and appetitive disorders.

The enrichment program is built upon accumulated knowledge of the natural history of each species housed at the SNPRC. This knowledge is integral to the development of appropriate, species-relevant enrichment plans. Details of the natural history of the common species at the SNPRC are provided below.

III. NATURAL HISTORY

A. Chimpanzees (*Pan troglodytes*)

Chimpanzees are the great ape that is most closely related to humans. They are found in equatorial Africa in habitats ranging from woodland savanna and grassland to tropical rainforest. They are an endangered species in the wild, and are considered threatened in captivity. Although chimpanzees are mainly quadrupedal knuckle-walkers, they also spend time in suspensory postures and brachiating. Males may weigh 60 kg in the wild (over 100 kg in captivity) and females may weigh between 30 and 47 kg. Chimpanzees are omnivorous and their diet includes mainly fruits, leaves and flowers, but they also hunt small mammals, including monkeys. They use tools to obtain termites (termite fishing) and ants (ant dipping) from nests. Overall, chimpanzees spend 43-62% of their time feeding and foraging.

In the wild, chimpanzees live in large home ranges ranging from 1200-7800 hectares where they may travel up to 4 km in a day. Chimpanzees have a fission-fusion social organization, and females spend much time alone or with offspring. Males, in contrast, travel, forage, and rest with other males. Group sizes range from 5-100 individuals. Chimpanzees live in male-bonded groups that have a recognizable dominance hierarchy, with females usually emigrating permanently or temporarily during mating. Chimpanzee mating is often promiscuous, with one female mating with several males in succession. However, they sometimes do form temporary consortships and a male and female may travel together during estrus and mate exclusively during that time.

Chimpanzees can live to be 60 years old. Mothers and offspring have close, sometimes lifelong relationships, with infants being weaned at about 4 years of age. Their interbirth interval is about 60 months. First birth occurs at about 14.5 years of age after a 240-day gestation. Sexual maturity is reached at age 11 for females and age 13 for males. Chimpanzees are known for their advanced cognitive abilities, including self-recognition, the ability to make and use tools, social maneuvering, and deception.

Ideal housing and enrichment -- Chimpanzees and other great apes are extremely agile and strong, so housing must be very sturdy. Large indoor/outdoor enclosures are best, and allow mixed-age and mixed-sex groups to be formed. Because chimpanzees live in dynamic social groups, social housing (i.e., in groups of three or more) is the most important form of enrichment. Chimpanzees are very curious and manipulative, and novelty in the environment is important. Durable objects and toys are used, but should be rotated because the animals may habituate to them quickly. Feeding devices and puzzles are popular. Cognitive tasks, such as tool-using tasks, are necessary to provide mental stimulation. In addition, training chimpanzees for routine husbandry and other tasks also provides mental stimulation, promotes positive human interaction, and gives these highly intelligent and strong animals some amount of control over their environment.

B. Baboons (*Papio hamadryas* sp.)

Baboons are found in many areas of Africa. They are among the largest and most terrestrial of the Cercopithecines. There are five types of baboons: olive, yellow, hamadryas, chacma, and red (or Guinea). Baboons are quadrupedal, and their forelimbs and hindlimbs are approximately the same size. While most baboons live in dry savanna woodlands, they can also be found in a variety of other habitat types from dry highlands, to savanna scrub, and even rainforest. Although primarily terrestrial when traveling, baboons spend a lot of time feeding, climbing, and perching in trees and on rock faces. They are agile climbers.

Baboons are sexually dimorphic, with males being much larger than females. Male weight across the five subspecies ranges from 18 to 30 kg, whereas females weigh between 10 and 15 kg. Males have long canine teeth. Baboons are omnivorous, eating mainly roots, tubers, grasses, seeds and fruits, and are opportunistic hunters. They have large home ranges of up to 4000 hectares and travel long distances each day.

Olive (*Papio hamadryas anubis*) and yellow (*Papio h. cynocephalus*) baboons are found throughout equatorial Africa and are typically called savannah baboons. Olive baboon females weigh, on average, 15 kg, and males nearly 30 kg. Yellow baboons are slightly smaller, with females weighing about 12.5 kg and males 25 kg. Olive baboons can be distinguished from yellow baboons by their dark (brown-black) faces, brownish-green hair, and larger body sizes. Both subspecies form multi-male/multi-female groups ranging in size from 20-200. Females are permanent members of the group, which has a matrilineal organization. Both females and males have distinct dominance hierarchies. Males emigrate from their natal group after about 4 years. Females reach sexual maturity at 4.5 years, and males reach sexual maturity at 5.5 years. Infants are born after a 180-day gestation and the interbirth interval is 18 to 34 months. Female baboons have an estrus cycle of roughly 34 days, which is marked by vivid anogenital swellings. Olive and yellow baboons usually live for 30 to 45 years.

Hamadryas (*Papio h. hamadryas*) baboons are found in the highlands of Ethiopia. Hamadryas are the smallest of the five subspecies of baboons, but they are still highly sexually dimorphic. Males have silvery white hair, kinky “capes”, and bright red rumps. This, along with a pink face, is a distinguishing characteristic of the hamadryas. Hamadryas baboons have complex multi-level societies. The most basic unit is a one-male unit. Females are bonded to a particular male, and the male herds the females with threats, aggression, and neck bites. Up to four of these groups may come together to form a clan of (usually) related males. Several clans may converge to form bands, and many bands come together each night on a cliff face to sleep, forming a troop. Female hamadryas baboons reach sexual maturity at age 4.5 and often have their first infant at 6 years of age after a 170-day gestation. The interbirth interval is 22 months. Hamadryas baboons may live 36 years.

Chacma (*Papio h. ursinus*) baboons are indigenous to southern Africa, living on the grasslands and in acacia scrub and semi-desert habitat. Chacma baboons can be distinguished from other baboons by the white hair on their face under their eyes and a curly flip of hair at the nape of the neck. Like the olive and yellow species, female chacmas form the core of their multi-male/multi-female social groups, which are based on matriline. Group sizes are smaller than other *Papio* subspecies, ranging from 20 to 50 individuals. Female chacma baboons reach sexual maturity at 3 years of age, and have their first infant at nearly 4 years of age. They have a 187-day gestation and an interbirth interval of 18 to 24 months. Male chacmas reach sexual maturity at 5 years. This subspecies of baboon may live 45 years.

Red or Guinea (*Papio h. papio*) baboons are found in a restricted area of West Africa in the countries of Senegal, Mauritania, Guinea, and Sierra Leone. Red baboons can be distinguished from other subspecies by their very dark faces and red hair. Like their eastern counterparts, this subspecies has a multi-level society in which small subgroups of one male and several females forage separately during the day, but many of these regroup at night to sleep. Like hamadryas baboon males, male Guinea baboons herd females with neck bites as well as grooming. Not much is known about the Guinea baboon’s life history patterns. Gestation lasts 184 days and their interbirth interval is 14 months. This species may live 40 years.

Ideal enrichment and housing -- Baboons can be successfully housed in variety of captive conditions, from indoor cages to large outdoor semi-free ranging enclosures. Sturdy cages are

required due to the destructive habits of baboons. They have very strong teeth and jaws and often destroy objects by chewing. Enrichment items must be sturdy or they will be destroyed quickly. Baboons are agile climbers and can often be found perching high above the enclosure floor; physical enrichment that allows for use of vertical space is important. In addition, the dominance interactions that occur in baboon social groups require the ability for subordinates to remove themselves from the presence of dominant animals. Physical enrichment such as hanging barrels, hiding spaces, and perching spaces at varied strata all function to minimize aggression and injury. Finally, baboons can be trained to cooperate during a variety of management procedures.

C. Macaques (*Macaca* sp.)

Of the 16 species of macaque, 15 are found in Asia, and one in Africa. Macaques live in more climates and habitats than any other primate except humans, from temperate regions of Japan to Morocco. Macaques are so behaviorally and ecologically flexible that a single species can successfully live in different habitat types including rainforest, mangrove forest, and cultivated areas. The flexibility in habitat choice they exhibit has caused many species of macaques to come into contact with humans and become agricultural pests. Macaques are quadrupeds that spend much of their time in trees but they also spend a significant portion of their time on the ground. For the three species we currently house at SNPRC, the rhesus macaque (*Macaca mulatta*), the cynomolgus, or crab-eating, macaque (*Macaca fascicularis*), and the pig-tailed macaque (*Macaca nemestrina*) home range sizes range from 1 to 800 hectares. Each species covers a large distance during the day. Although macaques are mainly frugivores, they also eat seeds, other plant parts, and small invertebrates such as insects or crabs. All three species of macaque live in large (10 to 100) multi-male, multi-female social groups. Females remain in the group and form the core of the social group, while males emigrate to join new social groups. Female social relationships are structured around matriline and there are distinct dominance hierarchies for both male and female macaques. Macaques are the most common species for biomedical research. They are also carriers of Herpes B, a virus that poses no serious threat to the animal, but is fatal in over 70% of the cases in humans that contracted the virus. Herpes B is passed to humans through bites, scratches, and splashes, and initially causes flu like symptoms that can progress to more serious neurologic problems and death.

Cynomolgus (*Macaca fascicularis*) macaques are from southern Indochina, Burma, Indonesia, the Philippines, and Nicobar Islands. They are very tolerant of humans, often found near or in populated areas. Cynomolgus macaques are sexually dimorphic, with females weighing between 2.5 and 5.5 kg and males weighing 4.5 to 8.5 kg. They can be distinguished from other macaques by a smaller, more gracile body, and a pointed ridge of hair running along the sagittal crest. Males have a mustache and cheek whiskers and females have a beard. Cynomolgus macaques are primarily frugivorous, but also eat seeds, leaves, insects, frogs, and crabs. They swim well and jump into water from trees. Sexual maturity is attained at 4.5 years for both males and females. Females most often give birth to their first infant at this time after a gestation of roughly 165 days. Sexual maturity and age at first birth may occur earlier, especially in captivity. The interbirth interval for this species is roughly one year. Cynomolgus macaques may live for about 32 years. Male cynomolgus macaques migrate from their natal group into another multi-male/multi-female group. Although there is a dominance hierarchy for males and

females, this hierarchy is less marked than in other macaque species. Group size ranges from 10 to 50 animals, but groups may get even larger. Individuals often split into subgroups.

Rhesus (*Macaca mulatta*) macaques live from Afghanistan and India to Thailand and Southern China. Rhesus monkeys are one of the more terrestrial macaques, but they do spend a large portion of the time in trees. Female rhesus macaques may weigh 4.5 to 8 kg and males weigh 5.5 to 11 kg. Rhesus macaques can be distinguished from other macaques based on their relatively naked and very pink face (which turns reddish when females are in estrus) and relatively short hair on top of their head. In addition to fruits, leaves, and insects, they eat grass, clover, roots, bark, resin, and human food. Rhesus monkeys reach sexual maturity at roughly 4 years of age. Females often give birth to their first infant at 5.5 years of age after a 164-day gestation period. The interbirth interval is 1 to 2 years in rhesus monkeys. They may live to 30 years. Rhesus monkey groups tend to be large multi-male, multi-female groups of 10 to 50 animals, but can be larger, especially in areas of high human density. Adult males tolerate juveniles until they are about 4 years of age, at which point the juveniles transfer from their natal group. Strong linear dominance hierarchies exist in rhesus macaque social groups. Female relationships are based on matriline relationships and higher ranking individuals tend to get better quality food. The recipient of a display of dominance or aggression will often redirect it onto a more subordinate individual. Rhesus macaques are the most common primate used in biomedical research.

Pigtailed (*Macaca nemestrina*) macaques inhabit Southeast Asia from Burma to the Malay Peninsula and Sumatra. They are primarily arboreal and inhabit forests, but spend about 10% of their time on the ground. As with other macaques, pig-tails are sexually dimorphic with females ranging from 4.5 to 10.5 kg and males from 6 to 14.5 kg. They can be distinguished from other macaques based on their short, thinly-furred, curly tail and the dark crown of hair on their head. Pigtailed macaques primarily eat fruit and seeds. Female pigtailed macaques reach sexual maturity at roughly 3 years of age and give birth to their first infant one year later after a 171-day gestation. The interbirth interval for this species is 1 to 2 years and their lifespan is about 26 years. This species of macaque tends to live in smaller, less variable multi-male multi-female groups of 15 to 20 individuals. Like most other macaque species, pigtail males emigrate and there are strong dominance hierarchies for males, females, and female matriline.

Ideal enrichment and housing -- Housing should be sturdy because macaques, like other Old World monkeys, can be very destructive. Macaques should be housed in mixed-sex groups, but can be housed in single-sex groups or pairs. Care must be taken when managing both group- and individually-housed macaques because of their dominance relationships. For example, if there is a room of singly housed rhesus monkeys, those individuals have established dominance relationships, and any moves or changes within the room must be completed with the established order in mind. Perching areas allow use of the preferred upper areas of the cage or enclosure and should be high enough so animal tails do not touch the ground. Macaques are very curious and manipulative. Novel objects are useful, and the monkeys can work puzzles and operate a joystick to perform computer video tasks. Feeding and foraging devices are popular and help to increase foraging time. Cynomolgus macaques in particular are fond of water for swimming; tubs of water are good enrichment options for these animals.

D. Marmosets (*Callithrix* sp.) and Tamarins (*Saguinus* sp.)

Marmosets and Tamarins are found in the northern, central, eastern, and Amazonian regions of South America, including modern-day Brazil, Peru, Colombia, and Panama. These New World monkeys make up the Family Callitrichidae and are found in mountain and valley regions and in forests.

Marmosets and tamarins are among the smallest primates, with body weights as little as 125 g (Pygmy marmoset, *Callithrix pygmaea*), but more commonly fall in the range of 200 to 600 g. Marmosets and tamarins have very sparsely furred or naked faces, but they tend to have elaborate and colorful pelage. The tails of these primates are not prehensile, but are used in balancing while climbing, leaping, and reaching. Marmosets and tamarins are considered quadrupeds; they often run along branches, but they also do a significant amount of vertical clinging and leaping. These primates are distinct from other New World monkeys in having claws of compressed nail on most digits other than the great toe. The claws function to help marmosets and tamarins hang on large tree trunks while feeding in an orthograde posture.

Marmosets and tamarins are entirely arboreal and gain their nourishment primarily through fruits. Nectars, flowers, saps, gums, and small animals such as frogs, lizards, insects, and spiders augment their diet. Marmosets have procumbent incisors, which aid in exudate feeding. Tamarins are more robust and have longer canine teeth. A majority of the species of marmosets and tamarins spend between 25 and 30% of their time foraging. Each species is highly adapted to and dependent upon the edible resources found in their specific area.

Marmosets and tamarins are very social animals, and live in family groups ranging from 4 to 15 members. Marmoset groups tend to be larger (9 individuals), on average, than tamarin groups (5 individuals). As a rule, each family is very territorial, and defends a home range of 10 to 40 hectares. These primates are extremely active, and roam about one-third of their territory daily, traveling up to 2 km in one day. Marmosets and tamarins protect their territories from each other by calling, chasing, displaying, and posturing. Territories are scent-marked with musk, recognized by the inhabiting family, produced by chest and suprapubic glands. Marmosets and tamarins are diurnal. The mating patterns of these Callitrichids are monogamy or polyandry (one female-multimale). Females produce one to three young annually after a gestation period of about 145 days, although twins are most common. Young are raised communally and are weaned at 2 months. Older siblings often remain in their natal group and serve as “helpers at the nest”. Only the dominant female in the group will reproduce, and other adult females are reproductively suppressed. It has been hypothesized that this suppression is a result of pheromones. Therefore, scent appears to be a way of communication other than just boundary marking. Facial expressions and chattering are primary ways of communication, as well as posturing and fur bristling.

Common marmosets (*Callithrix jacchus*) are found in Brazil. Common marmosets are arboreal and can be found in scrub forests, swamps, and tree plantations. They can be distinguished from other Callitrichids by their large white ear tufts and dark, ringed tail. Common marmosets usually weigh about 250 to 350 g and live up to 12 years. They are omnivorous, eating fruit, gums, and animal prey. They reach sexual maturity at 1 year for females and slightly later for males. Age at first birth is roughly 2 years for this species after a gestation of 148 days. Their interbirth interval is 5 months. Common marmosets live in groups of 4 to 15 in the wild with various group compositions. They are territorial and only the dominant female in each group

reproduces. Allomaternal and paternal care is common in marmosets. Both sexes eventually disperse to establish their own breeding group after a prolonged period in their natal group. Mustached tamarins (*Sanguinus mystax*) can be found in primary and secondary forests and swamps in Brazil and Peru. They can be distinguished from other Callitrichids by their mostly black and dark-brown bodies and white mustache surrounding their nose and mouth. Mustached tamarins usually weigh 500 to 650 g and eat fruit, insects, and exudates. Sexual maturity is attained by female mustached tamarins at 15 to 17 months of age. Males attain sexual maturity a bit later. Their gestation is 140 to 150 days. These primates usually live 12 to 20 years. They live in multi-male, multi-female groups of up to 16 individuals, but are usually smaller than marmoset groups, with 5 members on average.

Ideal enrichment and housing -- The recommended housing for marmosets and tamarins are male-female pairs or small family groups. Non-related adults of the same sex should not be housed together because intense aggression will result, especially between unrelated females. Large cages with branches and other climbing substrates, especially vertical substrates, promote well-being and allow the callitrichids to scent mark, assume normal postures, and locomote (climbing, running, and jumping). Their well-being is improved if their cage is tall enough that it allows access to vertical space at or above personnel level and is provided with a nest box. They have advanced cognitive abilities and long memories, developing strong likes and dislikes of personnel. Enrichment involved with searching for food items encourages activity, and simple objects placed in the cage elicit exploratory behaviors. Marmosets and tamarins tend to be highly vigilant and are frequently neophobic in captivity. These are important factors in determining the best means for enrichment.

IV. PROGRAM OBJECTIVES

To achieve the primary goals of encouraging species-typical behavior and decreasing abnormal behavior in nonhuman primates, the Behavioral Services staff uses the following strategies:

- Promoting proper infant socialization and development
- Working toward social housing of animals whenever possible
- Monitoring animal behavior and enrichment delivery via the Behavioral Intervention Program (Section IV.C.1.), the Single Housing Report (Section IV.C.3), Enrichment Check Sheets (Section VI.B.), and requested observations (Section IV.C.4)
- Training staff on behavioral issues via workshops on primate behavior (Section IV.C.2.)
- Providing a nonhuman primate positive reinforcement training program for enrichment, behavioral modification, husbandry, and research purposes (Section IV.C.6.)
- Maintaining enrichment standards, developing and testing enrichment methods and devices, and conducting behavioral research (Sections IV. D. and VII. A.)

These strategies can be divided into four focal categories: infant development, social interactions, behavior monitoring and management, and environmental enrichment. Behavioral Services considers these main areas when evaluating and updating its program.

A. 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 (Brent et al., 1989; Davenport, 1979; Davenport and Rogers, 1970; Harlow and Harlow, 1965; Suomi et al., 1971). More recent studies have in fact shown that altered early rearing environments have long-lasting behavioral (Capitanio et al., 1986), cognitive (Brent et al., 1995), and physiological (Coe et al., 1989; Higley et al., 1991) effects. Therefore, rearing by the mother in species-typical groupings is recommended so that the infant develops appropriate behavioral and locomotor skills. In this way, an infant develops appropriate attachment behaviors, learns how to interact socially with the mother and other individuals in the group, and has access to peers and a complex environment.

The SNPRC maintains breeding colonies of baboons, cynomolgus macaques, rhesus macaques, and marmosets. Unless otherwise removed due to sickness, neglect, or 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 are commonly weaned at approximately 12 months and baboon infants at 9 months. 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 adult female “nanny” 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. However, in some rare cases, infants are removed due to illness or injury, an incompetent mother who puts her infant at risk, or 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.

B. Social Interactions

Social housing is recommended for naturally socially-living nonhuman primates by the Animal Welfare Act. Social housing is necessary for the appropriate development of species-typical behavior and communication patterns (Mason, 1991). 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. The benefits of social housing include the opportunity for the expression of species-typical social behavior, including maternal behavior and sexual behavior. Social housing is known to have a positive effect on nonhuman primate behavior and health, while single housing has measurable negative consequences (Brent et al., 1989; Lutz et al., 2003). Forming social groups of nonhuman primates is not without risks. Aggression to strange animals is common in many primate species, and wounding may occur. However, most group formations of chimpanzees and pair formations of macaques have successful outcomes (Brent et al., 1997; Reinhardt et al., 1995). These benefits of social housing often outweigh the risks. Additional benefits of social housing can include a reduction in abnormal behavior such as self-injurious behavior, regurgitation, and

locomotor and other stereotypies. These abnormal behaviors can create clinical conditions that may invalidate study results.

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 compatible social groups. Chimpanzees are generally housed in groups of 2 to 5 individuals, while monkeys can be housed in groups of 15 to 40 individuals (with corral-housed baboons in groups of several hundred). Individual primates may be singly housed while recovering from an illness or injury, when taking part in an Institutional Animal Care and Use Committee (IACUC) approved research project, prior to shipment to another facility, or during quarantine upon arriving at this facility. Even individuals on research projects may be paired for the purposes of social enrichment when not restricted by research protocol and when the individuals are compatible. 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 V.A).

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 described below depending on age, sex, and use.

1. Chimpanzees

Group housing -- Most chimpanzees are housed in compatible social groups of two or more animals in indoor/outdoor runs. Currently, each group housed in Building 7 is in an indoor/outdoor run with access to a large, enriched playground area for one week every 4 to 6 weeks. The indoor/outdoor animal area comprises 5089 sq. ft. and the playgrounds encompass 9000 sq. ft. Thirty six chimpanzees currently occupy Building 7. Building 23 (Quarantine) has nine 5 ft. x 25 ft. and five 10 ft. x 25 ft. indoor/outdoor runs, totaling 2375 sq. ft. of animal space. Eight chimpanzees in pairs or small groups currently occupy this space. Buildings 431 to 444 are also indoor/outdoor housing and are referred to as the “condos” and “hotels”. There are nine “condos,” each having 220 sq. ft. of floor space, and five “hotels” with two cages each of 490 sq. ft. of floor space. These two types of housing comprise 8990 sq. ft. of animal space and are currently occupied by 47 chimpanzees. The recently built Primadome facility provides the SNPRC with additional space in the form of three central indoor enclosures each connected to four large, individual geodesic dome cages. At present, 43 chimpanzees occupy these domes, which have been outfitted with extensive physical enrichment to promote species-typical locomotor patterns. Finally, a few chimpanzees in “huts” (indoor housing, most with outdoor runs) are paired or housed individually (see below).

Single cage housing -- Chimpanzees may be housed individually in Buildings 413 to 422 (the “huts”) and 445 while on research protocols requiring such housing or when recovering from an illness or injury. Whenever possible, though, individuals are socialized in compatible pairs. Some chimpanzees have restricted physical contact, but are not completely socially isolated (Section V.B.). Buildings 413 to 422 and Building 445 currently house 33 chimpanzees. Combined, they provide animals with 7228 sq. ft. of space. All huts housing chimpanzees and all but two bays in Building 445 have outdoor runs to provide the animals housed there with

indoor-outdoor access as well as easy means of pairing chimpanzees. These runs each have a floor surface area of 90 sq. ft. and are 15 ft. tall. Every effort is made to not house chimpanzees continuously indoors for more than 6 months unless specific approval has been obtained from the IACUC.

2. Baboons

Breeding colony corrals -- A large population of baboons is housed in two 6-acre, open-air corrals for breeding and holding purposes (Buildings 100 and 105). The corral environment, housing up to 600 animals, provides opportunities for baboons of a wide age range to participate in complex social interactions.

Group housing -- Large outdoor cages of varying sizes (300 to 1000 sq. ft.) are used for large group housing of baboons [Buildings 102 (1000 sq. ft.), 103 (500 sq. ft.), 104 (600 sq. ft.), 106 (323 sq. ft.)]. Adult baboons and offspring are placed in compatible social groups of 10 to 30 animals. Most breeding groups have a single male to assure proper identity of paternity. Juvenile baboons maintained in gang cages are placed in compatible social groups with at least one adult female baboon per group to serve as a role model.

Single cage housing -- Baboons are housed indoors in single cages if required by approved research protocols (Buildings 2, 4, 6, 10) or for clinical management purposes (Building 8). Singly caged baboons have visual, auditory, and/or olfactory contact with conspecifics unless clinical circumstances require isolation (e.g., positive tuberculosis test). When possible, tactile contact for grooming purposes is maintained.

Swing space -- Some juvenile baboons are housed in groups of up to 10 to 12 in Building 114. Large runs (120 sq. ft.) are located in a covered building with partial walls and open sides that allow cross-ventilation and a view outside. The juvenile baboons are provided with both physical and nutritional enrichment.

3. Macaques

Large group housing -- The SNPRC manages a large breeding colony of cynomolgus macaques (*Macaca fascicularis*) for the Southwest Foundation for Biomedical Research. These monkeys are housed in spacious, indoor/outdoor runs, outfitted with perches and swings, in groups of approximately 20 individuals. Breeding groups are composed of one male with up to 15 females and their offspring. All-male and juvenile groups are also maintained.

Small group housing -- A large, specific pathogen free breeding colony of rhesus macaques is housed on site at the SNPRC. These animals are held in 176-sq. ft. indoor/outdoor cages containing appropriate physical enrichment. Most groups consist of one male, several females, and their offspring. Young bachelor, juvenile, and weanling groups may also be maintained. Sometimes groups of breeder females are also held as a group until an appropriate sire can be found.

Single cage housing -- Macaques are placed in single cages (Buildings 1, 6, 10, 23, huts 409-412) if required by approved research protocols or for clinical management purposes. Singly

housed macaques in these areas have visual, auditory, and/or olfactory contact with conspecifics unless clinical circumstances require social isolation (e.g., positive viral infection). Those housed in adjacent cages may be able to groom through the open wire mesh. In the breeding colony, some macaques are maintained singly in clinic areas due to viral status or until a proper breeding configuration can be formed. Some caging units (huts 409-412) do allow for pair housing when possible.

4. Marmosets and Tamarins

Group housing -- Marmosets are typically housed in social groups. If they are not to breed, they are kept with same-sex siblings when possible. 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. A similar protocol is used for tamarins.

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

5. Other Monkeys

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

C. Behavior Monitoring and Management

Behavioral Services closely monitors the disposition of both 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 behavior problems. As a result, the Behavioral Services staff has also developed a training program to help caretakers and veterinary staff members to accurately identify behavior problems that they may see when attending to the animals and relay that information back to Behavioral Services staff. Below, an outline of each of the programs is provided.

1. Behavioral Intervention Program

Animals that exhibit abnormal behaviors are evaluated by the Behavioral Intervention Program (BIP). Care and veterinary staff members are trained in the identification of abnormal behaviors, the operation of the BIP, and how environmental enrichment plays a role in the prevention of abnormal behaviors via a series of workshops on primate behavior (Section IV.C.2.). Following training through these workshops, departmental staff members can report animals observed with abnormal behaviors using a reporting program integrated into the Computerized Animal Management Program (CAMP).

By 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 requirements for 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. Detailed behavioral observations are conducted before, during, and after any intervention is applied to gauge its effect.

A database for the Behavioral Intervention Program has been developed that includes information on individuals reported for abnormal behaviors or suspicion of such behaviors. It is updated and maintained by a member of the Behavioral Services staff. Any behavioral data collected (baseline or follow-up) and intervention methods applied are also recorded in this database. This information is valuable when investigators choose animals for studies because many of the animals treated in the BIP program react poorly to single caging or other stressful procedures. In addition, these data are used to assess environmental and management factors that contribute to the development of abnormal behavior. These data will ultimately be integrated into the new behavioral component of the CAMP database and managed there.

2. Primate Behavior, Training, and Enrichment Workshop Series

A 7-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. The first four parts of the course focus individually on ecology, reproduction, and normal behaviors of chimpanzees, baboons, macaques, and marmosets/ tamarins. Part five of the course focuses on types of abnormal behaviors, their development, and the use of the BIP to report such behaviors. The final two parts of the course discuss the concept of positive reinforcement training and its use in behavioral management, and the different types of enrichment and their uses.

A Powerpoint presentation has also been developed that briefly summarizes each section of the 7-part training course. Newly hired care and veterinary staff members can 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.

3. Single Housing Report

Individuals housed in single cage areas are evaluated quarterly. Each animal is observed by a member of the Behavioral Services staff to assess behavioral disposition and to ensure the quality of the care and management of each individual. In addition to conducting behavioral observations with a special emphasis on abnormal behaviors, the Behavioral Services staff member also 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 BIP manager. A copy of the Single Housing Report is also provided to the animal care supervisors, the veterinarians, and the IACUC, and concerns are discussed.

4. Requested Behavioral 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. If excessive aggression is directed toward the animal or if it appears to be under any undue stress, the area supervisor and attending veterinarian are contacted, and recommendations for changes in housing are made. Observations can also be requested upon formation of large social groups of baboons or macaques to watch for any excessive aggression or wounding.

5. 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, or collecting and analyzing behavioral data.

6. Behavioral Training Program

A formal Behavioral Training Program has been implemented at the SNPRC. In August of 2004, a behaviorist with primate training experience was hired to establish this program. At present, the trainer handles roughly 5 to 10 cases each month addressing a variety of concerns. In some instances, other Behavioral Services staff members assist in training. A training request form is currently used by area supervisors to request training of individuals or groups of animals for clinical, husbandry, research, or behavioral modification purposes. Monthly status reports are generated to keep all relevant staff informed of progress. Staff members are also encouraged to shadow the trainer to get hands-on experience with positive reinforcement training. Once behaviors are reliably trained, the members of the behavior staff transfer responsibility of maintenance for those behaviors to the veterinary technical and care staff that will be working most extensively with those animals.

D. Environmental Enrichment

In addition to an emphasis on social housing, creating a complex environment for nonhuman primates can significantly encourage species-typical behaviors and reduce boredom and stress that may result in abnormal behaviors. Numerous studies have found significant differences in behavior when nonhuman primates are provided with specific environmental enrichment devices (Bloomsmith et al., 1991; Schapiro et al., 1991), usually resulting in an increase in species-typical behavior and an improvement in well-being. Key concepts to environmental enrichment are novelty, complexity, and control. Novel, or new, objects, foods, and other items increase attention and use. However, novelty may quickly wear off for stationary enrichment objects, and rotation of objects is useful to maintain higher levels of use (Crockett et al., 1989; Pruettz and Bloomsmith, 1992). The properties of an enrichment object greatly influence the attention primates give to it. More complex objects often have a longer latency to habituation (Tripp, 1985; Weld et al., 1991; Wilson, 1982). Providing a more responsive environment through appropriate enrichment can increase the captive primate's well-being. Items which can be

moved, manipulated, changed, and used to cause a desired effect can provide a level of control (Sambrook and Buchanan-Smith, 1997). In addition, interactions that allow them some choice or control over the outcome have positive effects on behavior (Bayne et al., 1994; Laule, 1992; Markowitz and Line, 1989) because providing choices is a way to allow animals to exert control. Many animals readily “work” for food rewards by completing some task, even when food is readily available. Offering nonhuman primates choices in their daily lives enhances their ability to control the environment. For example, constructing areas where individuals can hide from conspecifics offers a subordinate individual the ability to avoid others. Similarly, offering a number of manipulable items also provides choices.

At the SNPRC, nonhuman primates take part in an extensive environmental enrichment program which includes the provision of varied food items, manipulable objects, climbing and resting structures, interaction with conspecifics, and varied sensory input. Enrichment techniques are chosen to address the needs of the animals, to allow species-typical activity and development, and to reduce abnormal behavior. No individual is exempt from all aspects of the enrichment program. Of specific priority for environmental enrichment are indoor-housed, singly caged nonhuman primates and all chimpanzees. These individuals are regularly provided with enrichment that requires extended periods of time for processing or use, promotes cognitive challenges, and provides novelty.

Enrichment techniques fall under the following categories: physical, nutritional, sensory, social, and occupational (Bloomsmith et al., 1991). For a detailed description of the construction and implementation of the enrichment devices used at the SNPRC, see the Enrichment Device Manual at http://www.sfbr.org/pdf/Manual_07-26-06.pdf.

1. Physical Enrichment

Physical enrichment includes additions to and variety in the physical environment of the animal. These items promote species-typical manual manipulation and locomotor patterns, and also provide visual barriers for privacy. They can include both **manipulable enrichment** such as plastic balls and rubber chew toys, as well as **structural enrichment** such as perches and climbing structures.

a. Manipulable Enrichment

Manipulable objects (all species) -- Durable manipulable objects such as plastic balls (Horseman’s Pride, Inc.), cone shaped rubber toys (The Kong Co., Lakewood, CO; PetEdge, Topsfield, MA), Nylabones, and plaque attackers (Nylabone Products, Neptune, NJ), are available to all chimpanzees, baboons, and macaques. Smaller toys (e.g., stainless steel rattles and rattles made of PVC and bolted washers) 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.

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. (See also sensory enrichment)

b. Structural Enrichment

Climbing structures (all species) -- Concrete culverts, wood and metal structures, suspended ladders, and telephone poles have been placed in the large outdoor housing areas, such as the chimpanzee playground, the chimpanzee Primadomes, the baboon corrals, and baboon gang cages. Smaller structures are available to the cynomolgus macaques and juvenile monkeys. These structures provide shade, hiding areas, resting areas, and facilitate some locomotion patterns. Marmosets have complex cages with various climbing structures. In addition, their cages are constructed of mesh surfaces, which promote vertical clinging and leaping.

Nest boxes (marmosets and tamarins) -- All marmosets and tamarins 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) -- Pipes are available in most group housing areas for perching and swinging. Platforms, benches, or other perches are available in all chimpanzee enclosures, baboon enclosures, and macaque housing. Hanging barrels and milk crates have been added for locomotion, play, hiding, and resting. Swinging tires and large ropes have also been suspended in some chimpanzee areas such as the “hotels”, the playgrounds, and the Primadomes. Natural wooden perches are available for marmosets and tamarins to encourage space use as well as gnawing and scent-marking. Perches or benches are available to most singly housed nonhuman primates.

Playgrounds (chimpanzees) -- The chimpanzee playground consists of three contiguous outdoor enclosures measuring 40 ft. x 75 ft. each. It is 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, ropes, tires, and barrels) to provide shade, climbing and resting areas, privacy, and a means to use the vertical space. The chimpanzees from Building 7 are rotated into the playground for one week’s access every 4 to 6 weeks.

Primadomes (chimpanzees) -- Like the playgrounds, the Primadomes are large outdoor areas that have a variety of physical enrichment. These 32-ft. diameter geodesic domes have perches at three levels for resting, perching, and to provide shade, a ladder, as well as a large number of poles set at various angles to promote climbing and other locomotor patterns. Two such horizontal poles have ropes hanging at regular intervals to allow the chimpanzees to brachiate. All these structures are made of treated wood. Furthermore, the Primadomes also have concrete culverts for hiding spaces and shade, as well as tire swings and a large, 4-inch nylon rope that spans the height of the dome.

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

2. Nutritional Enrichment

Nutritional enrichment includes fruit, grain, or novel food items, approved by veterinary staff, presented in a variety of ways that increase the diversity of the animals' diets.

Grain mixes (all species) -- Different grains and cereals, including corn, sunflower seeds, Cheerios, and peanuts in the shell are spread throughout the larger enclosures (indoor/outdoor runs, group housing areas) to stimulate foraging activity 2 to 5 days per week. For chimpanzee areas with a wire floor, such as individual housing, the grains are presented in a PVC foraging device. This device is half of a PVC tube and is placed horizontally on the outside of the enclosure. Manual manipulation is required to retrieve grains or other enrichment placed in the foraging device.

Whole fruit and vegetables (all species) -- A variety of fruit and vegetables processed as little as possible is provided to primates on a regular basis, provided that their diet is not restricted due to health concerns or IACUC approved study restrictions. 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 unique shapes or varying sized pieces to increase its novelty and prevent the animal from becoming bored.

Novel food items (all species) -- 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. All of these items are approved by the veterinary staff prior to use.

3. 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 (all species) -- For added auditory variety, radios are available in most holding and research areas, and they can be used for several hours a day. Either individual radios are used in the bays, or radios are operated from a central location and transmitted into the animal areas (such as Buildings 6 and 8).

Televisions (chimpanzees and macaques) -- Televisions are provided to the indoor chimpanzee research areas and some macaque areas (buildings 409-412, 6, and the BSL3) to add auditory and visual stimulation. The televisions can be operated by the carestaff and remain on for several hours each 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.

Mirrors (all species) -- 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 (all species) -- 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.

4. Social Enrichment

Social enrichment includes both conspecific social interaction as well as positive human interaction. The former promotes species-typical behavior that is required for successful mating and infant-rearing. In addition, it forces animals to respond to novel stimuli in the form of the actions of the other animals. The latter promotes a more positive environment for the animals and an easier working environment for humans.

Conspecific interaction (all species) -- The majority of primates at the SNPRC are housed in social groups that allow for free physical interaction. The groups may consist of large multi-male/ multi-female groups, single male harem groups, same-sex groups, and juvenile groups sometimes with an adult serving as a role model or “nanny.” Indoor-housed primates are paired whenever possible, given research, housing, and temperament constraints. Singly housed individuals have auditory and visual contact with conspecifics unless otherwise necessitated by clinical circumstances. In addition, cages may be placed next to each other so that singly housed monkeys can physically interact and/or groom one another.

Human interaction (all species) -- Positive human interaction is important to develop rapport and good relations with the primates, especially those being handled frequently. Chimpanzees are visited at least twice weekly by the enrichment technician, who plays games and interacts with them as well as provides them with feeding enrichment and occupational enrichment (Section IV.D.6.).

5. 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) -- Paper such as toilet tissue is occasionally provided to chimpanzees to encourage nesting behavior.

Drawing and painting materials (chimpanzees) -- Certain individuals adept at drawing and painting are given crayons or paint brushes and paper for drawing.

Feeder devices (baboons, macaques, chimpanzees) -- A number of feeding devices are available for singly caged primates, 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. They are provided on a rotating schedule every week for most singly housed monkeys, and more often for those showing signs of distress or abnormal behavior if deemed to be effective strategy by the BIP.

Pipe feeders and termite mounds (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. Two pipefeeders are provided to most groups of animals to prevent possible aggressive monopolization of the device. Termite mounds consist of a 55-gallon plastic barrel with different size and positioned holes cut into it, with a shallow container filled with a sticky substance such as oatmeal placed in the bottom. Again, sticks are provided so that the animals can fashion a tool which they can insert into the holes and dip into containers holding the food items. Termite mounds are large enough to allow several chimpanzees to forage at the same time.

Positive reinforcement training (all species) -- Whenever possible, positive reinforcement is used to shape a primate's behavior. Animals are rewarded for performing desired behaviors, building a more positive relationship with the caregiver and providing goal directed, enriching activity. Training for chimpanzees is an especially integral component of their management due to their high cognitive ability and impressive strength. Training is considered worthwhile because it minimizes environmental stressors on the animal being trained and reduces time and labor for care staff.

6. Daily Enrichment Program for Chimpanzees

A variety of enrichment items are provided to all chimpanzees five times per week. Items are selected from four major categories: social interactions with the technician, novel foods, puzzles, and sensory enrichment. A behavioral staff member administers the program with some assistance from the care staff. A monthly schedule of enrichment is generated and includes enrichment such as: cereal, drawing, playing chase, frozen fruits and vegetables, food puzzles, and picture books. Records are kept on an enrichment check sheet for each chimpanzee housing area. Each month, these records are returned to the enrichment staff.

V. SPECIAL CONSIDERATIONS

A. Mobility-Restricting Research

Research that limits an animal's mobility and activity is not routinely conducted by the SFBR. Instead, 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 using a specially designed tubular restraint device, but the animals are habituated and trained to tolerate it beforehand.

B. 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 assessed quarterly (Section IV.C.3.) and are provided with additional enrichment (Section V.D). 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 -- Pairing or small group housing is attempted if allowable for the research project. However, a primate on an approved active research protocol may not be able to be housed with another animal on the same protocol 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.

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.

C. 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 feeding enrichment techniques.

VI. RECORD KEEPING

A. Animal Records Database

The SNPRC maintains an extensive database 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. The SNPRC is currently constructing a behavioral component of the database, so staff members throughout the facility may also access behavioral management information on individual animals. This information will also be used for enrichment purposes as well as to provide information vital to program management. Currently, there is a program in place which allows staff to electronically report any instances of abnormal behavior that they observe. A series of questions is asked to gather details regarding the form and appearance of the behavior. This information is stored in the CAMP database and can be retrieved and reviewed at any time.

B. Enrichment Distribution Records

Records on environmental enrichment provided to the primates are kept for the different primates in each area. Specific enrichment forms are used to record enrichment delivery by individual bay, building, or area. Those items recorded on the enrichment check sheets include the chimpanzee daily enrichment program and both occupational and nutritional enrichment for the other monkeys. The individual who distributed the enrichment is required to initial and date the records. These records are collected, analyzed monthly, evaluated and summarized quarterly, and stored 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. Social Group Formation Records

All introductions of chimpanzees are observed and recorded by the behavioral staff. 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). Observations are conducted for a minimum of 10 minutes. Longer or additional observations are scheduled 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.

Pairing records are also collected and maintained for macaque monkeys. Behavioral data are collected throughout the pairing process and records are kept on aggressive and social behavior, proximity, and final outcome of the pairing attempt.

D. Behavioral Management Records

Records are also kept on any observations requested for management of an individual animal or group of animals (Section IV.C.4.). For example, individuals who exhibit signs of social incompatibility may be observed following a request from an area supervisor. Results of such observations are provided to the animal care and veterinary services staff, along with any recommended changes in housing.

E. Individual Behavior Records

1. Chimpanzee Information Database

All chimpanzees have a file with information on rearing history, abnormal behavior, maternal behavior, and any other pertinent data. Behavioral observations are also scheduled for once a week on chimpanzees that are singly housed to evaluate behavioral changes and disposition. The data are collected and concerns are discussed with chimpanzee care staff.

2. Behavioral Intervention Program Database

All species -- As part of the Behavioral Intervention Program (Section IV.C.1.), 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. Each report is evaluated on an individual basis. Handling of individual cases may involve baseline data collection, intervention methods to decrease severe or chronic abnormal behaviors, and follow-up data collection. Records for each case reported to the Behavioral Intervention Program are kept in a database managed by a member of the Behavioral Services staff.

3. Single Housing Report Database

All primates that have been singly housed for three or more months are observed during the quarterly single housing report (Section IV.C.3). 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 Single Housing Report include the animal's disposition, coat condition, available manipulable enrichment, visual access to conspecifics, and any additional concerns.

VII. PROGRAM ASSESSMENT

A. Research

Behavioral Services is committed to the 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:

Bourgeois SR, Vazquez M, Brasky K. 2007. Combination therapy reduces self-injurious behavior in a chimpanzee (*Pan troglodytes*): A case report. *JAAWS* 10:123-140.

Cox LD, Glover EJ, Pecotte JK. 2006. Social interactions, dominance rank, and frequency of wounding in a captive baboon colony (*Papio hamadryas* sp.). *American Journal of Primatology* 68(Suppl 1):78.

Durcik AM, Glover EJ, Grassi C. 2006. Effectiveness of four types of feeders as enrichment devices for singly-housed rhesus macaques (*Macaca mulatta*). *International Journal of Primatology* 27(Suppl 1): Abstract #277.

Glover EJ, Cox LD, Pecotte JK. 2006. Differences in social behavior of male and female baboons (*Papio hamadryas* sp.) housed in same-sex groups. *American Journal of Primatology* 68(Suppl 1): 124-125.

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Novak, MA, Davenport MD, **Lutz CK**, Meyer JS. 2007. A functional view of abnormal behavior in rhesus monkeys (*Macaca mulatta*). *American Journal of Primatology* 69, Supplement 1:116.

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Wooding S, Bufe B, Grassi C, Howard MT, Stone AC, **Vazquez M**, Dunn DM, Meyerhof W, Weiss RB, Bamshad MJ. 2006. Independent evolution of bitter-taste sensitivity in humans and chimpanzees. *Nature* 440:930-934.

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. The committee meets monthly to discuss progress on behavior issues and ways to implement improvements. The committee reviews the Environmental Enhancement Plan, which is then sent to the IACUC for final approval. Recommendations on staffing and resource needs are discussed by the committee and shared with the IACUC during the Semi-Annual Review.

C. Behavioral Services Staff Meetings

The Behavioral Services staff has weekly meetings to discuss upcoming events and the progress of the program. Items and techniques that are useful, as well as those that are not, are discussed. Information obtained from the animal care staff and veterinary technicians on animal use and practical issues (ease of cleaning, durability, etc.) are shared. Observations on individual animals are discussed, especially those needing additional attention due to housing condition or behavior.

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