Washington National Primate Research Center
Plan for Environmental Enhancement to Promote the Psychological Well-Being of Nonhuman Primates
Version of November 9, 2015

In accordance with the Animal Welfare Act (AWA)[1] each animal facility that houses nonhuman primates must have a Plan for Environmental Enhancement to Promote the Psychological Well-Being of Nonhuman Primates. The primary goal of this plan at the WaNPRC is to not only be in compliance with the AWA regarding environmental enrichment, but to provide best practices to comply with all animal welfare regulations and promote the psychological well-being (PWB) of nonhuman primates (NHPs). This expanded plan includes the following key components: social housing program, exemptions from social housing, nonsocial environmental enrichment, detection and treatment of atypical and abnormal behaviors, habituation, animal training, restraint, and personnel training. This plan has been developed by the Division of Primate Resources (DPR) at the WaNPRC along with the Attending Veterinarian and the Institutional Animal Care and Use Committee (IACUC) at the University of Washington (UW). It pertains to all nonhuman primates housed at the University of Washington, the WaNPRC Western Avenue vivaria in Seattle, WA and the Arizona Breeding Colony in Mesa, AZ. This plan is in accord with currently accepted professional standards as cited in professional journals and reference guides, and as directed by the Attending Veterinarian of the UW. Throughout this document, the term 'Attending Veterinarian' includes any veterinarian to whom the Attending Veterinarian of the University of Washington has delegated authority to perform professional judgments required by the plan.

A. Exemptions from the Environmental Enhancement (EE) Program

Although no animals can be exempted from the Environmental Enrichment Program some individuals may be exempted from participating in part of the program. There are two types of exemptions: veterinary and scientific. Animals can be exempted by the Attending Veterinarian because of health or condition, or in consideration of their well-being. These exemptions will be noted in the animal's records. Scientific exemptions from any portion of the EE Program must be approved by the Institutional Animal Care and Use Committee (IACUC). These exemptions must be requested/described using the IACUC's Environmental Enhancement Checksheet form. The form must be submitted by the PI with the IACUC protocol and approved by the IACUC before exemptions are implemented. All protocols involving use of NHPs must contain a completed Environmental Enhancement Checksheet even if exemptions are not requested. The WaNPRC will use the most recently approved Environmental Enhancement Checksheet to determine whether exemptions are to be allowed on a protocol. The IACUC protocol form has a specific item for requesting the use of restraint, and any restraint must be justified by the PI using the item of the form. The IACUC and WaNPRC will use this item of the form to determine whether restraint is to be allowed.

B. Special Considerations

Animal Welfare Regulations require special consideration regarding environmental enhancement to be provided to several classifications of animals.

(1) Infants and young juveniles;

(2) Those that show signs of being in psychological distress through behavior or appearance;

(3) Those used in research for which the Committee-approved protocol requires restricted activity;

(4) Individually housed nonhuman primates that are unable to see and hear nonhuman primates of their own or compatible species.

Special consideration of infants and young juveniles are outlined in WaNPRC SOP0739 (Standard Operating Procedure for the Environmental Enrichment (EE) of Infant and Juvenile Nonhuman Primates. Environmental Enrichment for animals who are singly housed, showing signs of psychological distress or are part of a research protocol that requires restricted activity are outlined in WaNPRC SOP 0712 (Extra Enrichment for Nonhuman Primates). In practice the WaNPRC strives to never have cases where NHPs are unable to see and hear nonhuman primates of their own or compatible species. If special circumstances require that animals be housed in this condition for a short period of time they would receive extra enrichment as outlined in SOP 0712.

C. Social Grouping

Animal welfare regulations, guidelines, and published research studies concur that social housing of nonhuman primates improves their psychological well-being[1-16]. The presence of chronic psychological distress adversely impacts animal welfare and may result in inaccurate research data, increasing the numbers of animals required for biomedical research. Nonhuman primates used in biomedical research at the WaNPRC can be socially housed without compromising the validity of these studies. However, some experiments require that NHP not be socialized, and scientific exemptions from social housing may be granted by the IACUC. The WaNPRC has adopted the best practices that all NHPs that are non-exempt from social housing should be housed socially and that the staff will ensure compliance with the spirit of the guidelines. The DPR staff does not consider cage size or the lack of caging reasons to singly house an animal. This plan is in accordance with currently accepted professional standards as cited in professional journals and reference guides, and as directed by the Attending Veterinarian of the UW.

The importance of social housing has been emphasized in the Guide for The Care and Use of Laboratory Animals[9]. In the wild, all species of NHPs housed at the WaNPRC typically live in social groups. In these groups they form intricate relationships, and they spend a great deal of time engaged in social behaviors. In captivity, social contact provides the opportunity for animals to express these species-typical behaviors including social grooming and play. It should be noted that in a captive setting, some species-typical behaviors which occur in the wild should be managed so as to minimize their expression (e.g., aggression), or restricted to certain individuals (e.g., mating).

It is the policy of the WaNPRC that all NHPs not exempt from social contact be housed socially. The definition of social housing used in this document is two or more animals housed in the same space; including more than one animal housed in a compound or large cage or in run-through connected cages. The veterinary and BMS staff meet monthly to ensure that the SOPs for socialization are up-to-date, and to discuss strategies for socialization.

Compatibility of social partners will be ascertained by Psychological Well-being Coordinator at each facility who will implement the WaNPRC Socialization Procedure for Singly-Housed Monkeys (SOP 0720). Continued compatibility will be assessed by the Psychological Well-being Coordinator during Zones and Colony monitoring- and by daily observations by other DPR

staff during routine monitoring. Incompatibility will be reported to the Psychological Well-being Coordinator. Animals who have been previously compatible may be deemed incompatible and require new social partners as outlined in the Exemption from Social Housing (SOP 0916). Animals that are incompatible with three social partners due to prolonged and severe aggression on their part can be permanently exempted from social housing by the Attending Veterinarian (see permanent veterinary exemption below). Whenever possible, social pairs/groups will be kept together when moved within the WaNPRC and/or assigned to projects.

Allowable Exemptions from the Social Housing Program

Exemptions from social housing may be granted for scientific and/or veterinary reasons. Exemptions for scientific reasons must be for the shortest period possible given the research protocol and can only be obtained through justification and approval by the University of Washington Institutional Animal Care and Use Committee (IACUC). All research exemptions are reviewed by veterinary, behavior staff, and the IACUC prior to the start of a project and then on a yearly basis.

Permanent or temporary veterinary exemptions can be authorized by the Attending Veterinarian for reasons such as extreme age, recent or impending birth, debilitation, disease, serious injury, severe and prolonged aggression, etc. Temporary veterinary exemptions are reviewed by the Attending Veterinarian every 30 days and permanent exemptions are reviewed at least quarterly Veterinary exemptions from social housing must be noted in the animal's clinical record. A complete description of social housing exemptions is contained in the Exemptions from Social Housing (SOP 0916).

The Animal Welfare Act regulations state: "The environment enhancement plan must include specific provisions to address the social needs of nonhuman primates of species known to exist in social groups in nature. Such specific provisions must be in accordance with currently accepted professional standards, as cited in appropriate professional journals or reference guides, and as directed by the attending veterinarian."[1] In review of the professional literature, it is noted that the intra-group male to female ratio in pigtailed macaques is about 1:5.5 to 1:8[43].As implied by the skewed sex ratio, most males live as peripherals or solitaries (though not, apparently, in all-male bands). The proximate mechanism for this 'shedding' of males from groups in pigtails involves displays and antagonism by the group-living adult males toward adolescent and other adult males" [17]. Attempted introductions of large adult male (>15 kg) pigtails (*Macaca nemestrina*) to full social contact has resulted in overt aggression and/or injury. Therefore, these animal may be exempted from full-contact socialization (with the exception of breeding males), and alternative strategies will be employed, including protected contact with other males, protected contact with females, or full contact with females following sterilization of the male or female in the pair.

Animals who must be exempted from social housing will receive extra nonsocial environmental enrichment as outlined in SOP 0712. Whenever possible, singly housed animals will also receive a periodic rotation through large exercise cages or will be allowed intermittent or protected social contact[18-20]. The Psychological Well-being Coordinator will be responsible for scheduling rotations through activity cages and assuring that extra enrichment is being distributed.

D. Nonsocial Environmental Enrichment

A variety of items can be used to provide environmental enrichment for nonhuman primates[21-29]. The environment of each caged monkey is enriched with a perch and a manipulable object (i.e., toy). Perches are positioned at an appropriate height to allow the animal to attain an upright posture while sitting on the perch. The monkeys receive toys, which are rotated every two weeks (when the cages are cleaned and changed). Novel toys are continually substituted as they are purchased. Animal care technicians are responsible for ensuring each caged NHP has a toy at all times. Every cage also has at least one foraging device, usually in the form of a puzzle ball or spool that is provisioned at least weekly by the animal husbandry staff.

Animals that are housed in compounds will be provided with perches and/or large play structures for climbing and perching. All compounds contain items to allow animals to avoid conspecifics. Animals are also provided with a substrate on the floor of the compound. This provides a medium through which they may forage. Animals in the compounds also receive at least one toy for every two animals.

All animals will be given daily enrichment in the form of treats and/or foraging or other non-food enrichment. Composition and disbursement of this enrichment is governed by the Standard Operating Procedure for Food Treat and Foraging Enrichment (SOP 0712). The Psychological Well-being Coordinator is responsible for ordering these enrichment items and the animal technicians are responsible for disbursement. These enrichment items are composed of a wide variety of dry goods and produce, frozen items that add to novelty and increase consumption time, and other items (i.e. paper, egg cartons, etc.) that the animals can manipulate. Foraging items are food or drink enrichment that require extra manipulation and prolong consumption time, thus providing mental stimulation. Video and auditory enrichment is also provided through use of music and TVs.

Documentation of daily enrichment and extra enrichment provided will be recorded by animal technicians on Enrichment Calendars which are posted outside every animal room. This documentation will be scanned and retained by Psychological Well-being Coordinators for a period of six years. An exemption of Nonsocial Environmental Enrichment may be granted by the IACUC for researchers whose animals receive daily treats in conjunction with tasks associated with their research protocols. When this exemption is granted, it is the responsibility of research staff to document enrichment for each research animal and be able to provide these documents for inspection by regulating agencies. Where allowed, animals who cannot receive food treats will be given other allowable forms of enrichment (i.e. paper, egg cartons, etc.).

E. Detection and Treatment of Atypical and Abnormal Behaviors

All personnel working with the animals will be trained to identify and report any animal that expresses atypical and/or abnormal behaviors to the Behavior Case Manager. In addition, all animals at the WaNPRC will be monitored by the Psychological Well-being Coordinators through Zones monitoring (conducted twice yearly) and by Colony Monitoring (conducted by-weekly) for detection of atypical/abnormal behaviors. During Zones monitoring, animals will also be scored for the presence and extent of alopecia (SOP 0713: Alopecia Scoring). If an animal is reported as having an abnormal or atypical behavior, the Behavior Case Manager will review the case, conduct a cage side assessment and where necessary, collect quantitative behavioral data, and devise a treatment plan. Treatments may involve requests to other DPR staff for socialization, movement to another room or within the room, providing extra space in the form of

activity cages or extra space via modular caging, extra enrichment or training. For cases requiring medication, the pharmaceutic treatment plan is devised by consultation with a DPR veterinarian. Post treatment data will be collected to assess the efficacy of treatment and behavior modification strategies. Detailed descriptions of behaviors of concern and treatment procedures are described in the WaNPRC Behavioral Referral and Treatment Process (SOP 0715).

F. Animal Training Program

The Animal Training Program (ATP) at the University of Washington National Primate Research Center was established to help promote the well-being and safety of the nonhuman primates, reduce the need for chemical restraint, and enhance the safety of staff. The trainer uses operant conditioning techniques to train NHPs to voluntarily participate in research, clinical, husbandry, and environmental enhancement (socialization) procedures. In addition to the beneficial voluntary participation of different procedures, animal training enhances enrichment programs by offering mental stimulation, expanded behavioral repertoires, and increased physical activity[30-39]. Training requests are submitted via an online form that is available to all personnel within the WaNPRC.

G. Habituation

Relocation can affect both psychological well-being and research results[40-42]. Wherever possible, animals will be habituated to a new housing environment for one week prior to the occurrence of any new research procedures. This allows them time to acclimate to the potentially stressful new environment. This policy is further outlined in the WaNPRC Acclimation (SOP 0702).

H. Restraint

If physical restraint must be used it should be for the shortest period necessary. Restraint devices should not be used simply as a convenience and alternatives to restraint should be considered. The use of restraint devices, including chairing, must be justified and approved by the IACUC. Animals that will be placed in restraint devices should receive positive reinforcement training to adapt to the equipment and personnel. Animals who fail to adapt should be removed from the study. Personnel who are involved in the study should be trained regarding the purpose of the restraint and its duration.

For minor non-painful procedures which are performed frequently, short term restraint may be less stressful than repeated sedation. In these situations restraint devices such as a table top restraint device (TTRD) or procedure cages may be utilized. Animals will be acclimated to the restraint device through positive reinforcement methods.

I. Personnel Training

All personnel who will be entering an animal housing or testing room will receive training by behavior management personnel. Training will include all aspects of the Environmental Enhancement plan, the purpose of environmental enrichment in behavioral management, appropriate interaction with the NHPs, how to identify and report abnormal or atypical behaviors, and the behavioral ecology of the species housed at the WaNPRC. Basic training will take

place during general orientation and more detailed training on abnormal behaviors will be provided subsequently.

REFERENCES

1. USDA/APHIS. Animal Welfare Regulations. *CFR 9, Chapter 1, Part 3, Subpart D, Section 3.81.* (2010).
2. Bayne, K.A., Dexter, S.L. & Suomi, S.J. A preliminary survey of the incidence of abnormal behavior in rhesus monkeys (Macaca mulatta) relative to housing condition. *Lab Anim (NY)* **21**, 38-46 (1992).
3. Bellanca, R.U. & Crockett, C.M. Factors predicting increased incidence of abnormal behavior in male pigtailed macaques. *Am J Primatol* **58**, 57-69 (2002).
4. Crockett, C.M., Bowers, C.L., Bowden, D.M. & Sackett, G.P. Sex differences in compatibility of pair-housed adult longtailed macaques. *Am J Primatol* **32**, 73-94 (1994).
5. DiVincenti, L., Jr. & Wyatt, J.D. Pair housing of macaques in research facilities: a science-based review of benefits and risks. *J Am Assoc Lab Anim Sci* **50**, 856-63 (2011).
6. Doyle, L.A., Baker, K.C. & Cox, L.D. Physiological and behavioral effects of social introduction on adult male rhesus macaques. *Am J Primatol* **70**, 542-50 (2008).
7. Gilbert, M.H. & Baker, K.C. Social buffering in adult male rhesus macaques (Macaca mulatta): Effects of stressful events in single vs. pair housing. *Journal of Medical Primatology* **40**, 71-8 (2011).
8. Gust, D.A., Gordon, T.P., Brodie, A.R. & McClure, H.M. Effect of a preferred companion in modulating stress in adult female rhesus monkeys. *Physiol Behav* **55**, 681-4 (1994).
9. National Research Council (U.S.). Committee for the Update of the Guide for the Care and Use of Laboratory Animals. & Institute for Laboratory Animal Research (U.S.). *Guide for the Care and Use of Laboratory Animals*, xxv, 220 p. (National Academies Press, Washington, D.C., 2011).
10. Novak, M.A. & Suomi, S.J. Social interaction in nonhuman primates: an underlying theme for primate research. *Lab Anim Sci* **41**, 308-14 (1991).
11. Reinhardt, V. Social enrichment for laboratory primates: a critical review. . *Prim. News* **29**, 7-11 (1990).
12. Reinhardt, V. Avoid aggression during and after pair formation of adult rhesus macaques. *Lab. Primate Newsletter* **31**, 10 (1992).
13. Reinhardt, V. Refining the traditional housing and handling of laboratory rhesus macaques improves scientific methodology. *Prim. Rep.* **49**, 93-113 (1997).
14. Reinhardt, V. Pairing Macaca mulatta and Macaca arctoides of both sexes. . *Lab. Primate Newsletter* **37**, 2 (1998).
15. Schapiro, S.J. Effects of social manipulations and environmental enrichment on behavior and cell-mediated immune responses in rhesus macaques. *Pharmacology Biochemistry and Behavior* **73**, 271-278 (2002).
16. Seelig, D. A tail of two monkeys: social housing for nonhuman primates in the research laboratory setting. *J Appl Anim Welf Sci* **10**, 21-30 (2007).
17. Fa, J.E. & Lindburg, D.G. *Evolution and Ecology of Macaque Societies*, (Cambridge University Press, 1996).
18. Baker, K.C. et al. Benefits of isosexual pairing of rhesus macaques (Macaca mulatta) vary with sex and are limited by protected contact but not by frequent separation. *Am J Primatol* **70**, 44-44 (2008).
19. Baker, K.C. et al. Pair housing for female longtailed and rhesus macaques in the laboratory: behavior in protected contact versus full contact. *J Appl Anim Welf Sci* **15**, 126-43 (2012).

20. Lee, G.H., Thom, J.P., Chu, K.L. & Crockett, C.M. Comparing the relative benefits of grooming-contact and full-contact pairing for laboratory-housed adult female Macaca fascicularis. *Appl Anim Behav Sci* **137**, 157-165 (2012).
21. Baker, K. Enrichment and primate centers: closing the gap between research and practice. *J Appl Anim Welf Sci* **10**, 49-54 (2007).
22. Baker, K.C., Weed, J.L., Crockett, C.M. & Bloomsmith, M.A. Survey of environmental enhancement programs for laboratory primates. *Am J Primatol* **69**, 377-94 (2007).
23. Crockett, C.M., Bellanca, R.U., Heffernan, K.S., Ronan, D.A. & Bonn, W.F. Puzzle ball foraging device for laboratory monkeys. . *Lab. Primate Newsletter* **40**, 4-7 (2001).
24. Crockett, C.M., Bielitzki, J., Carey, A. & Velez, A. Kong toys as enrichment devices for singly-caged macaques. . *Lab. Primate Newsletter* **28**, 21-2 (1989).
25. Heath, S., Shimoji, M., Tumanguil, J. & Crockett, C.M. Peanut puzzle solvers quickly demonstrate aptitude. . *Lab. Primate Newsletter* **31**, 12-3 (1992).
26. Lee, G.H., Yi, M.J. & Crockett, C.M. Assessing video presentation as enrichment for captive male pigtailed macaques (Macaca nemestrina). . *Lab. Primate Newsletter* **50**, 7-9 (2011).
27. Lloyd, C.R., Lee, G.H. & Crockett, C.M. Puzzle-ball foraging by laboratory monkeys improves with experience. *Lab. Primate Newsletter* **44**, 1-3 (2005).
28. Lutz, C.K. & Novak, M.A. Environmental enrichment for nonhuman primates: theory and application. *ILAR J* **46**, 178-91 (2005).
29. Runeson, E.P., Lee, G.H., Crockett, C.M. & Bellanca, R.U. Evaluating paint rollers as an intervention for alopecia in monkeys in the laboratory (Macaca nemestrina). *J Appl Anim Welf Sci* **14**, 138-49 (2011).
30. Baker, K.C. et al. Positive reinforcement training moderates only high levels of abnormal behavior in singly housed rhesus macaques. *J. Appl. Anim. Welf. Sci.* **12**, 236-252 (2009).
31. Baker, K.C., Bloomsmith, M.A., Neu, K., Griffis, C. & Maloney, M. Positive reinforcement training as enrichment for singly housed rhesus macaques (Macaca mulatta). *Animal Welfare* **19**, 307-313 (2010).
32. Bayne, K.A., Dexter, S.L. & Strange, G.M. The effects of food treat provisioning and human interaction on the behavioral well-being of rhesus monkeys (Macaca mulatta). *Contemp Top Lab Anim Sci* **32**, 6-9 (1993).
33. Bloomsmith, M.A., Laule, G.E., Alford, P.L. & Thurston, R.H. Using training to moderate chimpanzee aggression during feeding. *Zoo Biol.* **13**, 557-566 (1994).
34. Buchanan-Smith, H.M. The benefits of positive reinforcement training and its effects on human non-human animal interactions. *Proceedings of the Fifth Annual Symposium on Zoo Research.* , 21-6 (2003).
35. Laule, G. & Whittaker, M. Enhancing nonhuman primate care and welfare through the use of positive reinforcement training. *J Appl Anim Welf Sci* **10**, 31-8 (2007).
36. Laule, G.E., Bloomsmith, M.A. & Schapiro, S.J. The use of positive reinforcement training techniques to enhance the care, management, and welfare of primates in the laboratory. . *J. Appl. Anim. Welf. Sci.* **6**, 163-73 (2003).
37. O'Brien, J.K., Heffernan, S., Thomson, P.C. & McGreevy, P.D. Effect of positive reinforcement training on physiological and behavioural stress responses in the hamadryas baboon (Papio hamadryas). *Animal Welfare* **17**, 125-138 (2008).
38. Coleman, K. & Maier, A. The use of positive reinforcement training to reduce stereotypic behavior in rhesus macaques. *J. Appl. Beh. Sci.* **124**, 142-8 (2010).
39. Baker, K.C. Benefits of positive human interaction for socially housed chimpanzees. *Anim. Welfare* **13**, 239-45 (2004).

40. Capitanio, J.P. & Lerche, N.W. Social separation, housing relocation, and survival in simian AIDS: A retrospective analysis. *Psychosomatic Medicine* **60**, 235-244 (1998).
41. Crockett, C.M., Shimoji, M. & Bowden, D.M. Behavior, appetite, and urinary cortisol responses by adult female pigtailed macaques to cage size, cage level, room change, and ketamine sedation. *Am J Primatol* **52**, 63-80 (2000).
42. Davenport, M.D., Lutz, C.K., Tiefenbacher, S., Novak, M.A. & Meyer, J.S. A rhesus monkey model of self-injury: effects of relocation stress on behavior and neuroendocrine function. *Biol Psychiatry* **63**, 990-6 (2008).
43. Caldecott, J.O. 1986. An ecological and behavioural study of the pig-tailed macaque. In: Szalay F.S., editor. Contributions to primatology, Vol. 21. Basel (Switzerland): Karger. 259 p.