THE ENVIRONMENTAL ENRICHMENT PLAN FOR SPECIES OTHER THAN NONHUMAN PRIMATES AT THE UNIVERSITY OF MARYLAND BALTIMORE (UMB)

Revised September 2021

Table of Contents

This enrichment plan has been written to address concerns and standards surrounding captive animal enrichment. This plan was written according to suggestions in The Guide for the Care and Use of Laboratory Animals, 8th Edition, NRC, National Academy Press, 2011, Animal Welfare Regulations (9CFR Part 3.81).

Statement of Goals

A. Goals of the facility

1. Research: Our goal is to assist in research excellence through quality care of our animals both physiologically and psychologically. We provide psychological well-being and opportunities for species-typical activity to ensure that aberrant behaviors are not exacerbated by protocols and to attempt to prohibit the development of these behaviors. We provide remediation to afflicted animals with all the tools available to us.

2. Breeding: Reproductive success of animals is a sign of psychological health and a goal in itself. Housing breeding pairs provides social companionship.

B. Goals of the Enrichment Program

The primary goal of the program is to provide for the psychological well-being in conjunction with the physiological health of all research animals at UMB. This is accomplished through understanding the natural habitats and social structures of the species with which we work and applying critical elements toward their living conditions. These critical elements include: social needs, housing structure, foraging opportunities, manipulanda and use of all five senses. They will be applied to the following specific goals.

1. *Opportunities for expressing a broad range of species-typical behaviors* such as posture, foraging, sleeping, feeding diversity, grooming, vocalization, etc., are a primary goal of the program. The individual animal's rearing history, age, previous experience, normal wild-type behavior, nature of the research and type of housing will be considered when determining what is typical behavior.

2. *Cognitive stimulation* may be provided through the use of foraging, manipulable objects or toys, companions, or cage furniture.

3. *Decreasing stereotypies* (which are manifestations of the stress and boredom that animals may experience in captivity) may be accomplished through direct visual, olfactory and auditory contact with conspecifics and interaction with human caregivers when experimental goals dictate

individual housing situations. Medical intervention is only necessary in the event that aberrant behaviors are adding to physiological stress, weight loss or physical trauma. Encouraging cognitive stimulation with objects that retain the animal's interest limits boredom and frustration.

4. *Predictable routine procedures and events* are more necessary in animals with limited control over their environment. All of their needs such as food and diversion are from exogenous sources. Disruption of routine is likely to result in anxiety and frustration in animals already limited in choices related to fulfilling basic needs.

5. *Species typical behavior is a sign of well-being* and it is encouraged by providing cage space that meets or exceeds all applicable regulations. Socially housed animals can express social behaviors through direct contact. Foraging behaviors are encouraged as previously described. Breeding animals can express mating behaviors.

6. *Opportunities for animals to alter their environment* provide enrichment through self-initiated activity. This may include the use of bedding substrate or foraging opportunities that require animals to "work" for food.

7. *Training personnel* lends opportunity for a positive interface with the animals. Trained caregivers are less likely to negatively impact animals in daily maintenance and the animals have more predictable and less dangerous behavior.

Mice, Rats and Hamsters

- Mice, rats and hamsters are routinely housed in cages with corn cob substrate.
    - Mice will be provided with additional nesting material during cage changes.
        - Partial old nests will be transferred to the new cage at the bi-weekly cage change provided they are not excessively soiled and additional new nesting material will be added to the new cage.
- In general, these rodents gnaw at their food which causes small bits of food to fall to their bedding, providing foraging opportunities.
- Housing items and species-specific manipulanda may be provided for specific investigators if space allows.
- VR personnel (husbandry and vet tech) as well as approved research personnel may provide time for human interaction as enrichment.
- Mice, rats and hamsters are socially housed, with up to 5 adults per cage for hamsters and up to 3 adult rats per cage, however, when identified by VR veterinary staff as exhibiting aggressive behavior, or for medical or experimental reasons, animals may be singly housed with additional inanimate enrichment (*e.g., nesting materials, housing, or exploratory manipulanda*). When this is the case, the singly housed animal is identified

with a cage card which describes the reason for single housing. This single housing is not considered an exemption to the Guide but is approved under this policy as a focused activity for the well-being of the animal.
    - Additional inanimate enrichment will be checked daily and changed or added at a minimum every two weeks.
    - Mice are socially housed in compliance with the UMB Policy on Cage Population Densities for Rodents.
- Consultation with the Principal Investigator (PI) is necessary prior to modifying the existing care or interaction with research animals, to prevent any untoward effects upon the research outcomes.

Guinea Pigs

- Guinea pigs are routinely housed in cages with virgin pulp bedding which allows for burrowing, nesting and hiding behaviors.
- Guinea pigs are provided with a variety of chew toys/manipulanda, and foraging treats such as NutraBlocks.
    - Chew Toys are checked daily and are changed at a minimum every two weeks
    - Foraging Treats are provided and/or checked daily
- VR personnel (husbandry and vet tech) as well as approved research personnel may provide time for human interaction as enrichment.
- Guinea pigs are socially housed with a maximum of 5 adults per cage.
- Guinea pigs may be socially housed in either breeding groups or in single-sex groups.
- Single housing may sometimes be necessary for scientific, medical, or behavioral reasons. Single housing may also occur when a single animal of a given sex is present in a litter at weaning or through planned or unplanned attrition in a cage during an experiment. When this is the case the singly housed animal is identified with a cage card which describes the reason for single housing. These animals are still housed where they will have olfactory and auditory contact with other guinea pigs and are provided with additional inanimate enrichment.
- Consultation with the PI is necessary prior to modifying the existing care or interaction with research animals, to prevent any untoward effects upon the research outcomes.

Rabbits

- Rabbits are housed socially whenever experimental parameters and individual animal temperament allows.
- To promote foraging behavior, rabbits receive timothy hay cubes and a variety of vegetables.
- To promote increased activity rabbits are provided bunny blocks and inside cage toys/manipulanda for gnawing.
    - Chew Toys are checked daily and are changed at a minimum every two weeks
    - Foraging Treats are provided and/or checked daily
- Rabbits may be groomed by VR staff or approved research staff to provide human interaction and reduce fur ingestion.

- Rabbits are socially housed, however, when identified by VR veterinary staff as exhibiting aggressive behavior, or for medical or experimental reasons, may be singly housed with additional inanimate enrichment (e.g., nesting materials, housing, or exploratory manipulanda). When this is the case the singly housed animal is identified with a cage card which describes the reason for single housing. These animals are still housed where they will have olfactory and auditory contact with other rabbits. This single housing is not considered an exemption to The Guide but is approved under this policy as a focused activity for the well-being of the animal.
- Consultation with the PI is necessary prior to modifying the existing care or interaction with research animals, to prevent any untoward effects upon the research outcomes.

Ferrets

- Ferrets are housed socially whenever experimental parameters and individual animal temperament allows.
- To promote increased activity ferrets are provided a variety of inside cage toys/manipulanda for gnawing.
    - Chew Toys are checked daily and are changed at a minimum every two weeks
    - Foraging Treats are provided and/or checked daily
- Ferrets may be handled by VR staff or approved research staff to provide human interaction.
- Ferrets are socially housed, however, when identified by VR veterinary staff as exhibiting aggressive behavior, or for medical or experimental reasons, may be singly housed with additional inanimate enrichment (e.g. nesting materials, housing, or exploratory manipulanda). When this is the case the singly housed animal is identified with a cage card which describes the reason for single housing. These animals are still housed where they will have olfactory and auditory contact with other ferrets. This single housing is not considered an exemption to The Guide but is approved under this policy as a focused activity for the well-being of the animal.
- Consultation with the PI is necessary prior to modifying the existing care or interaction with research animals, to prevent any untoward effects upon the research outcomes.

Swine and Sheep

- Swine and sheep are housed in solid floor pens with pine shavings. These pens are large enough to allow for free movement and the pine shavings allow foraging/grazing behavior. When enclosure, animal size, experimental parameters and individual animal temperament allow swine and sheep to be housed socially. When animals cannot be socially housed, every attempt is made to house them so that they have direct visual, olfactory, and auditory contact with other animals. The singly housed animal is identified with a cage card which describes the reason for single housing.
- Animals are permitted to roam outside their housing pens during daily cage cleaning and socially interact with other animals through the safety of the chain link doors
- VR personnel (husbandry and vet tech) as well as approved research personnel may provide time for human interaction as enrichment.

- Each pen is provided with an inside cage toy/manipulanda for increased activity.
    - Toys are checked daily and are changed at a minimum weekly
- Swine and sheep are provided a variety of fruits and vegetables five days per week to promote foraging/grazing behavior.
- Sheep receive loose mixed grass hay daily to promote foraging/grazing behavior as well as to supplement their diet.
- Consultation with the PI is necessary prior to modifying the existing care or interaction with research animals, to prevent any untoward effects upon the research outcomes.

Dogs

- Dogs are housed in solid floor pens with pine shavings. These pens are large enough to allow for free movement and the pine shavings allow foraging behavior. When enclosure, animal size, experimental parameters and individual animal temperament allow dogs to be housed socially. When animals cannot be socially housed, every attempt is made to house them so that they have direct visual, olfactory, and auditory contact with other animals. When this is the case the singly housed animal is identified with a cage card which describes the reason for single housing. These animals are provided with additional inanimate enrichment.
- Dogs are permitted to roam outside their housing pens and socially interact with other dogs as long as temperament allows. In the event a dog's temperament does not allow, that said animal is allowed to roam outside his run during normal cage cleaning and interact with other dogs through the chain link fence.
- VR personnel (husbandry and vet tech) as well as approved research personnel may provide additional time for human interaction as enrichment.
- Each dog is provided with an inside cage toy/manipulanda for increased activity as well as a dental bone for teeth hygiene.
    - Toys are checked daily and are changed at a minimum every two weeks
- Dogs are provided additional food enrichment.
    - Food enrichment is provided for daily
- Consultation with the PI is necessary prior to modifying the existing care or interaction with research animals, to prevent any untoward effects upon the research outcomes.

Xenopus and Zebrafish

- Xenopus are group-housed in tanks of up to 6 for 16-liter tank and up to 10 per 23-liter tank. They can be singly housed for medical, experimental or behavioral reasons.
- In addition to social housing Xenopus are provided either lily pads or tubes in the enclosure for hiding.
    - Lilly pads and tubes are checked daily
- Zebrafish are housed in groups at a density of 5 animals per liter.
- As well as being group-housed, Zebrafish are provided brine shrimp as food enrichment twice per day to promote hunting behavior.
    - Brine shrimp is provided Monday-Friday

Other Species with the exception of Nonhuman Primates

- Enrichment needs of other species of animals, not mentioned above, will be researched prior to arrival. An enrichment program will be designed to ensure (when appropriate) animals are properly housed in social pairs/groups and provided adequate species-specific enrichment to promote species-typical behaviors.

REFERENCES

Armstrong KR, Clark TR, Peterson MR. 1998. Use of corn-husk nesting material to reduce aggression in caged mice. Contemp Top Lab Anim Sci 37:64-66.

Augustsson H, Lindberg L, Hoglund AU, Dahlborn K. 2002. Human-animal interactions and animal welfare in conventionally and pen-housed rats. Lab Anim 36:271-281.

Barnett SA. 1965. Adaptation of mice to cold. Biol Rev 40**:**5-51.

Barnett SA. 1973. Maternal processes in the cold-adaptation of mice. Biol Rev 48:477-508.

Baumans V. 1997. Environmental enrichment: Practical applications. In: Van Zutphen LFM, Balls M, eds. Animal Alternatives, Welfare and Ethics. Elsevier. p 187-197.

Baumans V. 2005. Environmental enrichment for laboratory rodents and rabbits: Requirements of rodents, rabbits, and research. ILAR J 46:162-170.

Bayne KA. 2002. Development of the human-research animal bond and its impact on animal wellbeing. ILAR J 43:4-9.

Bayne KA. 2005. Potential for unintended consequences of environmental enrichment for laboratory animals and research results. ILAR J 46:129-139.

Becker BA, Christenson RK, Ford JJ, Nienaber JA, DeShazer JA, Hahn GL. 1989. Adrenal and behavioral responses of swine restricted to varying degrees of mobility. Physiol Behav 45:1171-1176.

Bergmann P, Militzer K, Büttner D. 1994. Environmental enrichment and aggressive behaviour: influence on body weight and body fat in male inbred HLG mice. J Exp Anim Sci 37:59-78.

Blom HJM, Van Tintelen G, Van V. 1996. Preferences of mice and rats for types of bedding material. Lab Anim 30:234-244.

Bly JE, Quiniou SM, Clem LW. 1997. Environmental effects on fish immune mechanisms. Dev Biol Stand 90:33-43.Borski R, Hodson RG. 2003. Fish research and the institutional animal care and use
committee. ILAR J 44:286-294.

Carfagnini AG, Rodd FH, Jeffers KB, Bruce AEE. 2009. The effects of habitat complexity on aggression and fecundity in zebrafish (*Danio rerio*). Environ Biol Fish 86:403-409.

Cherry JA. 1987. The effect of photoperiod on development of sexual behavior and fertility in golden hamsters. Physiol Behav 39:521-526.

Chmiel DJ, Noonan M. 1996. Preference of laboratory rats for potentially enriching stimulus objects. Lab Anim 30:97-101.

Comfortable quarters for sheep in research institutions. 2002. Reinhardt V. In: Comfortable Quarters for Laboratory Animals, 9th ed. Washington: Animal Welfare Institute. p 83-88.

Eskola S, Lauhikari M, Voipio HM, Laitinen M, Nevalainen T. 1999. Environmental enrichment may alter the number of rats needed to achieve statistical significance. Scand J Lab Anim Sci 26:134-144.

Fullerton PM, Gilliatt RW. 1967. Pressure neuropathy in the hind foot of the guinea pig. J Neurol Neurosurg Psychiat 30:18-25.

Garner JP. 2005. Stereotypies and other abnormal repetitive behaviors: Potential impact on validity, reliability, and replicability of scientific outcomes. ILAR J 46:106-117.

Germán Andrés Vásquez Niño. April 2009. Housing and environmental enrichment of ferrets (Mustela putorius Furo). Universiteit GentFaculteit DiergeneeskundeAdvanced Course in Ethology and Animal Welfare

Gordon CJ. 2004. Effect of cage bedding on temperature regulation and metabolism of group-housed female mice. Comp Med 54:63-68.

Gordon CJ, Becker P, Ali JS. 1998. Behavioral thermoregulatory responses of single- and group-housed mice. Physiol Behav 65:255-262.

Green SL. 2009. The Laboratory *Xenopus* sp. (Laboratory Animal Pocket Reference). Boca Raton FL: CRC Press.

Haemisch A, Voss T, Gärtner K. 1994 Effects of environmental enrichment on aggressive behaviour, dominance hierarchies and endocrine states in male DBA/2J mice. Physiol Behav 56:1041-1048.Hubrecht RC. 1993. A comparison of social and environmental enrichment methods for laboratory housed dogs. Appl Anim Behav Sci 37: 345-361.

Lupo C, Fontani G, Girolami L, Lodi L, Muscettola M. 2000. Immune and endocrine aspects of physical and social environmental variations in groups of male rabbits in seminatural conditions. Ethol Ecol Evol 12:281-289.

Olsson IA, Dahlborn, K. 2002. Improving housing conditions for laboratory mice: A review of environmental enrichment.. Lab Anim 36:243-270.

Spence R, Gerlach G, Lawrence C, Smith C. 2008. The behavior and ecology of the zebrafish, *Danio rerio*. Biol Rev 83:13-34.