Social and Environmental Enhancement for Non-primate Research Animals

371.1 Prologue

371.1.1 In order to enhance animal wellbeing, minimize animal stress, promote consistency and fulfill regulatory obligations, the IACUC has a standing policy for minimum (or “required”) enrichment standards, specifically defining housing conditions and socialization opportunities, for all species used in research at Emory University with the exception of nonhuman primates (addressed separately, see: http://www.iacuc.emory.edu/documents/ee_nhp.pdf).

371.2 Introduction

371.2.1 The environment may influence the validity, reliability and replicability of experiments by introducing abnormal animals into studies, increasing variability within the population, and altering the number and type of individual animals between laboratories, respectively.¹ In the context of the research animal, the environment consists of both physical attributes (e.g., lighting, temperature, cage design and complexity) as well as the nature of social interactions. In the proper care and use of research animals, the availability or suitability of enrichment must be considered in the provision of the environment and specifically with opportunities to exhibit species-typical behaviors and activity.²

371.2.2 When animals are unable to perform species typical behaviors and control their environment, unintended stress results and may proceed to adversely affect physiology and distress manifested as abnormal behaviors, both maladaptive and malfunctional.¹ Altered physiology and abnormal behaviors in a population are similarly potentially confounding to science because they are usually expressed inconsistently across the spectrum of the group.¹ Their expression varies by genetic background and developmental experience and may be difficult to mitigate with aging.¹ As such, successful enrichments reduce or prevent the occurrence of physiological dysfunction and malfunctional and maladaptive behaviors through appropriately lifelong (e.g., from development onward) social and environmental enrichment.¹,³

371.2.3 An important enrichment caveat is that social, environmental, dietary and other supplementations intended for improvement of animal well-being may alter important aspects of an animal’s physiology and development in ways not easily predictable based on what is already known.⁴⁵ Enrichment is a research variable that must be sensibly managed and must be biologically relevant.¹⁶ In essence, enrichment enables “good welfare” to equal “good science”.

371.2.4 In most cases, principles of training (e.g., operant conditioning or classical conditioning) may be employed to elicit voluntary cooperation with procedures. Habituating animals to routine husbandry, veterinary or experimental procedures is encouraged as it may assist the animal to better cope with a captive environment by reducing stress associated with those procedures. The type and duration of habituation or training needed will be determined by the individual species as well as by the complexity or frequency of the procedure.⁵
371.2.5 The social and environmental enrichments prescribed in this document have been demonstrated to promote animal wellbeing while enabling valid research. The IACUC assumes that investigators have sufficient knowledge of the species used and their model systems to take into account their associated needs and to scientifically justify any exceptions or enhancements from the minimum.

371.3 Abbreviations and Definitions

371.3.1 “Animal” – for purposes of the default enrichment program, “animal” is defined as to comprise all vertebrate species used in research at Emory University with the exception of nonhuman primates covered by a separate policy and program.


371.3.3 Social Animals – Animals are considered to be social if during the adult stages of ontogeny they are found in groups of two or more individuals under natural ecological conditions. All plans for socialization should take into account the needs and natural history of the species at hand.

371.3.4 Enrichment – Animal management principles that attempt to enhance the quality of care by identifying and providing the environmental stimuli necessary for psychological and physiological wellbeing meets the definition of “enrichment”. Effective enrichment is based on the species’ natural history and activity budgets, encourage beneficial species-specific behaviors, and are driven by specific goals (e.g., increase foraging behavior, decrease aggression, etc.).

371.4 General Principles

371.4.1 Social animals will be housed in compatible pairs or groups, rather than individually, provided such housing is not contraindicated by the protocol in question and does not pose undue risk to the animals in question. When individuals of social species are housed in a solitary arrangement, auditory, visual and/or olfactory contact to compatible individuals must be provided.

371.4.2 The structural habitat will include objects that increase opportunities for the expression of species-typical postures and activities that enhance the animals’ well-being.

371.4.3 When social animals must be housed alone, other forms of enrichment must be provided to compensate for the absence of other animals unless scientifically contraindicated.

371.4.4 Exemptions from some or all of the requirements of the enrichment program for scientific reasons must be documented in the protocol and specifically approved by the IACUC.

371.4.5 Qualified institutional veterinarians have the authority to exempt specific animals from inclusion in the enrichment program for reasons related to health, condition or well-being. The exemption and rationale must be documented in a medical record. For Act Species, veterinarians are obligated to review the status of the exemption at least every 30 days and renew it or void it accordingly (AWAR §3.8(d), §3.81(e)).
371.4.6 This program will be revised with the addition of new species to the census or in the case where significant new information emerges or approaches to enrichment come to be the norm.

371.5 Default Enrichment Program Description by Species

371.5.1 Aquatics (Hagfish, Lamprey, Zebrafish)

- **Minimum Requirements**: Zebrafish must be housed at densities that promote normal feeding and other behaviors and minimize aggression. For Hagfish a retreat space, either a darkened tank or sand in which to burrow, must be provided. The lamprey larval form requires sand in which to burrow and sustenance to filter feed. The pre-spawning adult form is parasitic and requires fish to feed. Post-spawning lampreys do not feed.

- **Additional Recommendations**: Sea lamprey and hagfish may be found as individuals or in groups in the wild – wherever a suitable habitat is found. Group housing is recommended, but not required. In the wild, zebrafish are found amid dense plant foliage, and also have been shown to prefer structure in captivity. The provision of structure is recommended, in low-density housing and breeding tanks, but not required.

371.5.2 Birds (Passeriformes):

- **Minimum Requirements**: Individuals of social species must be housed in appropriate group sizes with compatible individuals. A shelter (e.g., shelves or nest/roost boxes) must be provided to allow birds to nest and roost (Association of Avian Veterinarians 1999) and obtain refuge from aggression. Additional perches that allow for proper footing and minimization of foot trauma must be provided to allow Passeriformes the option to stay above the ground. Space within the enclosure must allow for exercise (i.e. flapping of wings) and the ability to express a range of natural behaviors.

- **Additional Recommendations**: Housing birds in pens or aviaries versus cages is suggested as it provides more space for flight. Nesting material in the form of hay, shredded paper or other appropriate material should be provided for species that construct nests. A water (or sand) bath should be available at least weekly to promote bathing activity. As foraging and feeding are two of the most common behaviors of birds, the complexity of food acquisition should be manipulated (scattering seed on floor, placing produce between mesh, hanging feeders from ceiling, providing feed in nature form such as millet sprays) and selections of food varied to satisfy these needs. For birds in social housing, multiple food portions should be presented to reduce hoarding by dominant individuals. Grit should be provided when appropriate. Human interaction is encouraged and training birds to perform tasks by hand-feeding improves habituation to people.

371.5.3 Galliforme Chicks:

- **Minimum Requirements**: Recently-hatched chicks and those up to 250 grams body weight (ca. 2-3 weeks of age) must be housed in brooders with a space requirement of 0.25 square feet per chick. Substrate must be used to help the chicks maintain body temperature. Food and water must be provided in low profile linear troughs for ease of access and also to encourage foraging behavior. Any chicks remaining past 1.5 kg must be transferred to cages or pens with perches, litter and dust bath with a minimum of 1 square foot per bird.
371.5.4 Guinea Pigs:

- **Minimum Requirements:** Group-housing of compatible individuals is the standard housing option. Shelter must be provided and must provide sufficient canopy to accommodate each individual in the enclosure. PVC tubes, transparent red huts or other approved structures can be used to meet this requirement. Hay and approved produce must be placed in the enclosure or present in devices approved for guinea pigs to promote foraging behaviors and increase diversity of food items. Hay and/or produce must be given on a daily basis as a nutritional supplement to the regular diet to decrease risk of alopecia.

- **Additional Recommendations:** If permissible, human contact with guinea pigs (social- and single-housing) is recommended and contributes to positive social interactions.

371.5.5 Hamster:

- **Minimum Requirements:** Social housing is not required. Hamsters may be cohabitated if a stable group or pairing is established at a young age (The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents). Nesting female hamsters, together with her litter, must be housed without other hamsters (The UFAW Handbook on the Care and Management of Laboratory and Other Research Animals, Eighth edition). Enrichment must include nesting material(s) and at least one other enrichment option.

- **Additional Recommendations:** Other enrichment options include: shelters, tubes, lofts/platforms; gnawing devices (nylon chewing blocks/bones, aspen blocks, manzanita wood sticks); novel food and foraging opportunities (seeds, seed hulls, cereal, treats, vegetables); feed on the cage floor to allow normal caching behavior; positive human-animal interaction and training.

371.5.6 Mice:

- **Minimum Requirements:** Mice must be group or pair housed unless otherwise approved by the IACUC. However, the following exceptions may apply; (1) Adult male mice which are either unfamiliar or have been separated from stable social housing must be housed individually or with female mice for breeding; a male mouse, used as a stud for a few days, may be returned safely to the group if the cage has not been changed; (2) Mice may be held in cages as single pregnant females to prevent cage mate trauma or overcrowding in the case of harem or trio breeding; and (3) the occasional finding of singly-housed mice because of the death of all others in the cohort or removal of cage mates at scheduled experimental time points. Minimum enrichment for socially housed mice: nesting materials in addition to the regular bedding. Minimum enrichment for individually housed mice: extra nesting materials or shelter in addition to regular bedding and regular nesting materials. Options for nesting materials include nestlet pads, shredded paper or other approved nesting materials.

- **Additional Requirements:** Other enrichment options for mice include: shelters, tubes, lofts/platforms; gnawing devices (nylon chewing blocks/bones, aspen blocks, manzanita wood sticks), foraging opportunities with laboratory grade diets and running wheels.
371.5.7 Rabbits:

- **Minimal Requirements:** Rabbits that are compatible must be socially housed in pairs or groups. Singly housed rabbits must be provided with the ability for visual, auditory and olfactory association with conspecifics. Manipulanda such as toys must be provided. Food enrichment in addition to pelleted diet is required.

- **Additional Recommendations:** Enrichment devices should be rotated to ensure novelty, and elevated shelves should be provided to provide an area for resting. Huts or boxes should be provided as a means for visual retreat in social housing situations. Handling and positive social interaction with animal care staff is encouraged. Rabbits housed in isolation should be provided mirrors, additional enrichment devices and additional positive human interaction.

371.5.8 Rats:

- **Minimal Requirements:** Rats must be socially housed. In the cases where rats must be housed singly for approved research purposes, where there may be incompatibility (such as in the case of sexually-mature, unfamiliar males), in the case of pregnant females, or where cohort attrition results in non-social housing, additional environmental enrichment meeting the needs of retreat space and burrowing must be provided. The occasional finding of singly-housed rats because of the death of cage mates or removal of cage mates at scheduled experimental time points is allowable. Providing harborage for rats is the most practical and best environmental enrichment that can be provided. Tunnels, sections of PVC pipe, some type of nesting material or shelters best serve this purpose. The minimum enrichment for an individually housed rat is to provide shelter and/or nesting material in addition to regular bedding. The quantity of the nesting material must be enough to cover the entire individual. When supplemented with nesting material, rats prefer long-fiber materials such as crinkled paper over nesting materials such as compressed cotton square.

- **Additional Recommendations:** As rats are highly adaptable and readily acclimate to human handling and research procedures, acclimation and handling programs may be beneficial and should be considered. Some research procedures may qualify as positive human animal interaction. Other enrichment options for rats that scientists may elect and that must be disclosed in the protocol include increasing cage complexity by using lofts/platforms; gnawing devices (nylon chewing blocks/bones, aspen blocks, manzanita wood sticks), foraging opportunities with laboratory grade diets, and positive human-animal interaction and training.

371.5.9 Sheep:

- **Minimum Requirements:** Sheep must be socially housed in stable, compatible pairs or small groups. If sheep are individually housed for approved research purposes, position them in such a way that they can see at least one other conspecific, because visual isolation is stressful for sheep. If other sheep are unavailable, a mirror may alleviate isolation stress. However, because sheep appear to treat their own reflection as a strange individual, a mirror may cause social stress. Careful monitoring and adjustments of mirror placement are necessary. Where there is likelihood of a single sheep remaining on census at a single site, experimental plans must account for the timely use of the remaining animal. Sheep are particularly susceptible to isolation stress and those not coping with social isolation
will be subject to IACUC endpoints including veterinary interventions (e.g., tranquilization) or euthanasia.

- **Additional Recommendations**: Species-appropriate bedding such as straw or wood shavings is recommended and should be provided to enclosures when possible. Sheep should be provided a diet high in roughage, to allow species-typical feeding and rumination, and to reduce the likelihood of abnormal behaviors. An undesirable behavior called wool biting may develop in sheep confined indoors for prolonged periods due to a paucity of roughage or other environmental stimulation. Strategies used to prevent or decrease this behavior include access to outdoor pastures, hanging chains from above the surface of the pen or adding objects to the pen (e.g., basketballs, plastic bottles, or chewing bars), playing music and altering the diet. Stressful research manipulations (e.g., venipuncture, drug application) should be accomplished within the presence of a familiar conspecific. Care personnel should habituate animals that are subjected to experimentation or any new, stressful or fear-inducing situations. Emphasizing positive reinforcement training techniques to encourage voluntary cooperation during common procedures such as blood collection and injection have been described in other ungulates and are recommended techniques for sheep whenever possible.

371.5.10 Swine:

- **Minimum Requirements**: Animals must be housed socially with compatible cage mates in suitable size runs or pens that allow them to turn around and move freely (unless justified, clinical, or in the case of a single animal which would receive special considerations). Within each enclosure, a toy or device must be provided to stimulate foraging.

- **Additional Recommendations**: The use of visual barriers and separate feeding stations may help ameliorate aggression should that arise, as well as opportunities that encourage rooting, scratching and wallowing could be provided through the use of substrates (i.e. wood chips, wheat straw, or hay) and/or a scratching post or brush. Acclimation and training to any research equipment is encouraged and can be readily achieved by using food rewards.

371.5.11 Voles:

- **Minimal Requirements**: Voles must be housed in social groups with males closely monitored for fighting. However, retired male breeders can be housed individually since they may be incompatible with other males. To maintain pheromone cues, part of the old nesting material must be transferred to the new cage at cage change. The housing requirement for space should minimally meet the “Guide” space requirements for hamsters. Minimum enrichment for socially housed voles: nesting material in the form of hay, straw, paper products such as crinkled paper or nestlets must be provided to fulfill burrowing needs in addition to the regular bedding. For voles that are individually housed, chewing devices (nylon chewing blocks/bones, aspen blocks, manzanita wood sticks) must be provided in addition to regular enrichment.

- **Additional Recommendations**: As additional shelter, tunnels, such as a PVC pipe section, can be used. Other enrichment options for voles: foraging opportunities with laboratory grade diets or hay (Timothy cubes).
371.5.12 Xenopus laevis:

- **Minimum Requirements:** Adult *Xenopus laevis* must be housed in tanks with a population density not exceeding one per 2 liters tank water volume and as otherwise stipulated by facility SOP. With respect to the latter, water treatment, circulation and quality may stipulate that greater volumes be accorded per head. For frogs housed with direct exposure to room light, refuges or retreats must also be provided in the form of pipes, flower pots, floating lily pads, or submerged plastic boxes unless the environment is already sufficiently dark. For tanks with young froglets who are typically weaker swimmers, small, floating balls must be placed in the tanks to provide structure to which froglets can cling to so that they can “hang” and rest at the surface.46

- **Additional Recommendations:** Although typically found solitary in the wild, African clawed frogs are often found socially housed in captivity. Maintaining *Xenopus* with familiar frogs in established, long-term housing cohorts is an advisable practice whenever possible.46 An increase in aggression may be observed if the stocking density is too high or there is no refuge cover available for lower ranking animals.47 Other enrichment may be used as a form of refuge, which may include: rocks, foam pieces, larger rocks, tiles, cups, and other plants.46

371.6 REFERENCES


24. (Pawlowicz et al., 2010)

25. (Coviello-McLaughlin et al., 1997)


371.6.2 Additional References


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