



Insectivorous Bat Care Standards

This set of standards includes bats in

Family: *Various*

Genus: *Various*

Common names: Mouse-eared bats, plain-nosed bats, free-tailed bats

There are over 1,000 recognized species of bats (order Chiroptera) worldwide. They are greatly diversified both in habitat and in feeding strategies. Bats feed on insects, fruits, plant parts such as leaves and flowers, nectar, pollen, fish, smaller vertebrates and blood. Approximately 70% of all species of bats are specialized insectivores. There are several hundred various species of insectivorous bats, the most common insect eating bats held in captivity belong to the *Vespertilionidae* and *Mollossidae* family and are the primary focus of these standards.

All bats require proper flight for their long term well-being. They must be provided with sufficient space in an appropriate environment to ensure their physical and psychological needs are met. Because of these species' specialized needs and diet, Sanctuaries shall be prepared to meet all their husbandry requirements. The following standards are minimal and every effort shall be made to exceed them.

I. Housing requirements

Insectivorous bats are usually opportunistic roosters, roosting in tree hollows, caves, tree foliage and manmade structures. Roosting colonies can vary and sometimes can be many hundreds of individuals.

a. Enclosure requirements

- i. Enclosures should be designed with soft-sided materials, free of sharp edges as these bats are prone to wing tip injuries.
- ii. Enclosure shape may be variable; square, rectangular, L-shaped or hexagonal.
- iii. Enclosure design should promote continuous flight, such as a center structure or cage furniture to impede cross flight.
- iv. Design of enclosures using solid walls must allow for sufficient sunlight and air flow throughout the enclosure.
- v. Ceiling and enclosure sides should provide polyethylene or cloth mesh no greater than 1 cm to allow bats to grasp, hang and climb. Wire mesh is too harsh of a roosting material for these delicate bats.
- vi. Roosting areas such as vaults, concave hollows or synthetic crevice, cave structures should have roughened surfaces to facilitate roosting.
- vii. If the enclosure is exposed to a fair amount of sunlight, it is necessary to provide multiple darkened areas within the enclosure allowing the bats to rest during the day.

- viii. Multiple visual barriers should be implemented in the form of enclosure decorations such as plants, partitions or roosting boxes to reduce social structure stress within the group.
- ix. Sanctuary must also provide alternative housing for sick or injured individuals while in close proximity to the social group.

b. Dimensions

- i. Enclosure should be of adequate size to promote allow for continuous free flight and hovering. For a group up to twenty individuals (20) the minimum enclosure size should be a minimum of 12 times the wingspan of the largest bat, squared. For each addition of 10 animals, total enclosure space should be increased by 15%.
- ii. Take into consideration food presentation and roosting structures in enclosure design, insuring that structures do not reduce total flight space.
- iii. Cage height should be at a height where caretakers can perform visual inspections of individuals and easily access bats from ceiling, typically ranging from 6.5 feet to 7.5 feet.

c. Outdoor enclosures

- i. Outdoor enclosures must be double contained (cage within a cage) for optimum safety of the bats and to prevent escapes.
- ii. Outer structure of the enclosure should be structurally sound and/or have safeguards to be secure from predators such as snakes and raccoons.
- iii. In the event of inclement weather, inadequate temperature control (too cold) or extreme weather (high winds) an enclosed shelter must be provided and utilized for the bats safety.
- iv. Enclosed shelters (indoor day/night rooms) for groups housed outdoors can be used.
 - a. Bats should have free choice access to structure at all times.
 - b. In situations such as weather or temperature that bats must be locked within the shelter, this shall only be for short-term confinement and not comprise the primary housing.

i. Containment

- i. Barriers shall prevent direct contact between bats and the public if allowed in the Sanctuary.
- ii. Enclosures must be inspected on a regular basis to ensure caging /mesh are in good condition and able to prevent escapes.

ii. Substrate

i. Outdoor enclosures

- 1. All outdoor enclosures will have a natural substrate consistent with the site.
- 2. The substrate surfaces can be made of natural substances (e.g. soil, sand, grass) that provide good drainage.
- 3. Hard surface items naturally occurring like rocks should be removed from enclosure.

ii. Indoor enclosures

- 1. All indoor enclosures should have a padded or soft textured floor to prevent injuries to downed bats. Concrete floors should be covered with a non-porous cushioned surface designed to withstand daily cleaning.
- 2. Standing water in indoor floor areas can be a drowning hazard and become a breeding ground for bacteria. Floors shall therefore be impervious to water, be quick to dry, and sloped to a drain if necessary.

iii. Enclosure doors

- i. It is recommended that there be a double door system installed, as these bats are very quick and highly maneuverable flyers. Double doors are a key element of facility design to prevent escape.
- ii. Doors must be designed to allow caregiver view of enclosures while opening doors.
- iii. Doors must have safety mechanisms to insure they can be “locked” for both human and animal safety.

iv. Shelter

Most insect eating bats prefer to roost in the concealed, confined crevice type roosting areas but can also be found roosting from the top of the cage, amongst foliage or in roosting structures. Most insectivorous bats are colonial and may cluster in large groups. Females of some species may segregate into maternity colonies.

- i. A sufficient number of roosting structures to accommodate all animals simultaneously should be provided.
- ii. Roosting structures, such as wicker baskets, boxes, pouches, fleece, natural or artificial vegetation or artificial cave like structures, provide both day roosting habitat and night roosting habitats. Bats should have access to both types of roosting structures at all times.
- iii. Bats that are crevice dwelling in nature should be provided sufficient artificial crevices in the form of fabric pouches and cloths, fleece, or foam objects that provide roosting areas to hide either inside or behind.
- iv. Roosting areas should be constructed from non-treated wood. All four sides as well as the top on front of the roost box should be grooved or be lined with a polyethylene mesh to provide an area for bats to easily grasp and hold. It is necessary to have a long landing platform that extends to the floor for bats to climb back inside the roost if grounded while flying.
- v. Shelters can be created through natural and artificial means within outdoor and indoor enclosures.
- vi. Roosting areas must provide dry space during wet weather and provide protection from wind.

v. Enclosure furniture

1. Accessories to provide bats a more natural environment should be utilized. Various types of foliage ranging from artificial flowers, vines, leaves and plants can be used.
2. Plantings, potted trees or plantings or natural cuttings and branches may also be used.
 - a. All plant materials in an enclosure will be evaluated for potential toxicity, including leaves, buds, seeds, fruit, bark and flowers.
 - b. Avoid using plants that contain thorns.

vi. Sanitation

- i. Care must be taken to minimize exposure of animals in adjacent spaces to overspray, disinfectants or waste materials.
- ii. Outdoor enclosures shall be cleaned daily and feces raked and removed to avoid unsanitary or unsafe conditions.
- iii. Daily removal of uneaten food
 1. Is an important element of pest control and disease prevention
 2. Enables care givers to monitor changes in food consumption.
 3. Minimizes risk for consumption of spoiled food items.

vii. Daily removal of animal waste

- i. Is an important element of pest control and disease prevention

- ii. Enables caregivers to monitor animal health
- iii. Enables caregivers to collect fecal samples in a timely manner.
- iv. Soiled bedding material and substrate are removed and replaced with fresh materials daily.
- v. Damaged and soiled enrichment items are removed daily.
- vi. Disinfection and Sanitizing
 - 1. All surfaces including walls, floors, ceiling, cage mesh and caregiver work areas must be sanitized regularly.
 - 2. Staff must follow proper disinfecting procedures when moving between enclosures.
 - 3. Disinfectants used in outdoor areas must not accumulate in soil and pose hazards to enclosure occupants or to the environment.
 - 4. Disinfectants used in indoor areas must be rotated on a regular basis.
 - 5. Disinfectants must be evaluated for hazards to both staff and animals.
 - 6. Food containers are sanitized daily.
 - 7. Water containers are sanitized daily.
- vii. Local, county, state laws regarding proper waste removal are observed.
- viii. A pest control regimen that is not harmful to the bats (such as bait) shall be in place to prevent infestation. Ants and cockroaches are the most common pest found in enclosures and around insect-eating bats.

II. Temperature, Humidity, Ventilation, Lighting

a. Temperature

Insect eating bats live in a variety of climates, ranging from warm and humid to cooler temperatures and in various elevations. These neo-tropical to temperate animals do best in temperatures ranging from 68° - 77° F (20° – 25° C).

b. Humidity

Humidity is of greater concern during winter months in indoor enclosures when forced air heat may be in use. A humidity range of 50-60% is generally adequate.

c. Ventilation
Enclosures should be well ventilated with a recommended 6 – 10 air exchanges per hour with a minimum of 25% fresh air exchange.

d. Lighting

i. Indoor enclosures

- 1. Natural lighting is optimal and can be obtained from skylights, windows, roll up doors or other means. Supplemental lighting composed of fluorescent or full spectrum lighting can be used during day cycles. Nocturnal lighting must have blue filters to prevent interference with light cycles. A dimming system must be used to prevent the shock of immediate bright light/ complete darkness.

ii. Outdoor enclosures

- 1. While not necessarily required, consideration should be given to supplemental lighting or power sources for use in outdoor areas in event of emergencies.

- 1. Bats adapt well to a daylight period ranging from 10 – 14 hours. An equal photoperiod of 12 hours is ideal for insectivorous bats.

- 2. An artificially shortened day length period can adversely impact food consumption and other natural behaviors.

III. Nutrition

Insectivorous bats have specialized dietary requirements. They feed solely on insects and some arachnids. Even though these bats are adapted to this diet, some species also will feed on human formulated diets in captivity.

a. Basic Requirements

- i. High quality and nutritionally correct food shall be provided in sufficient quantities to maintain animal health and appropriate weight.
- ii. Insect eating bats must have access to food 24 hours a day.
- iii. iii. Consumption of diets, including browse and enrichment items, should be monitored closely.
- iv. Browse can be used to provide enrichment activities for the bats but should not be considered as a daily food source.
- v. There should always be uneaten food remaining in feeders to ensure all bats are getting enough food.

b. Diet Composition

i. Insect Diet

1. The main staple of insectivorous bats in captivity is the larvae of the darkling beetle *Tenebrio molitor*: the mealworm. Crickets, dipteran larvae, “superworms” and “meadow plankton” have all been used as supplemental nutrition to the mealworm diet.
2. Mealworms must be fortified prior to feeding for optimal nutrition.
3. Mealworms must be alive, clean and removed from all substrate medium prior to feeding.

ii. Supplementation

1. Vitamin supplementation is required for insect eating bats in captivity. The following supplements should be sprinkled on top of each 2 cups of mealworms:

1/16 teaspoon CoQ 10 powder
1 scoop powdered cranberry
2 teaspoons of Missing Link vitamin supplement vegetarian formulation OR
2 teaspoons canine Vionate vitamin supplement (alternating nights)

iii. Complete Soft Food Diet

Due to various reasons: invalidity, age, tooth loss, fear, etc., some insect-eating bats in captivity are not able to consume a diet of whole insects. These bats require a processed diet that is soft enough for them to consume.

1. Soft Food Composition

- a. 1 ½ cups frozen mealworms and ½ cup water blended together and refrozen into 1 cup portions
- b. When ready for use, mix the following:
 - i. 1 cup frozen mealworm mixture from above, thawed
 - ii. 1 tablespoon water
 - iii. 2 tablespoons of human vegetable or fruit baby food ((such as bland flavors like sweet potato, corn, squash, carrots, peas, apple, pear)
 - iv. Supplements

1/16 teaspoon CoQ 10 powder
2 scoops powdered cranberry

2 teaspoons of Missing Link vitamin supplement vegetarian formulation

2 teaspoons canine Vionate vitamin supplement

½ teaspoon canine Liquid Oral Care water additive

½ teaspoon organic flax seed oil

c. Water

- i. Fresh clean water must be available at all times.
- ii. Water should be presented in small shallow dishes placed on the floor of large enclosures or on ledges around the perimeter of the enclosure at a height of approximately one head to toe length of the bat from the ceiling. When various sizes of insectivorous bats are housed together, height of dish placement from the ceiling should also vary. Water can also be placed on shelves attached to the walls of the flight cage. Shelves should be large enough to allow bats to walk onto the shelf and drink from a horizontal position.
- iii. Drowning is a factor to consider when presenting water for small bats. Items like glass beads or marbles in a shallow dish can prevent drowning.

d. Treats or “Enrichment” Food items

- i. Novel insects may be offered as enrichment valued items.
- ii. Enrichment items shall be offered periodically so bats do not feed solely on enrichment items.
- iii. Enrichment items should never be relied on as a part of the daily diet.

e. Food presentation

Presentation of the diet is as important as the diet itself. It is important to take into consideration when choosing a feeding style or item whether or not it will be accommodating and easily used by insectivorous bats.

- i. Dishes should be deep enough to allow the bottom of the bottom of the dish to be completely covered with ample supply of mealworms, preventing mealworm escape as well as shallow enough to allow bats to climb in and out of dish.
- ii. Dishes should be placed against a surface on which the bat can easily cling, allowing the bat to crawl down and feed from dish while still remaining upside down. This can be accomplished by either hanging dishes on enclosure sides or placing dishes on shelves or platforms attached to the flight cage wall.
- iii. Do not place dishes under common roost areas to prevent soiling of food with urine and feces.
- iv. When changing feeding presentation, do so with additional insects to ensure all bats have found enough food sources. Lesser used items can then be removed after the transition period.
- v. Place feeders in several different areas of the enclosure to reduce competition for food.
- vi. Place some feeders in very open, easily accessible areas for older, less maneuverable bats.
- vii. Food should never be offered from the floor of the enclosure at any time.

f. Feeding schedule

- i. Bats should be fed at the end of the light cycle to minimize spoilage of diet prior to feeding.
- ii. Feeders should be removed at the beginning of the light cycle to prevent ingestion of spoiled food.
- iii. Fresh diet should be offered at all times. During the bats resting period, a few feeders containing fresh diet (not diet left from the night before) should be distributed throughout the enclosure.

g. Diet increases or decreases

- i. Adjustments made to an already formulated and nutritionally balanced diet must be made to the entire diet to insure continued nutritional balance.

- ii. Considerations for diet increase include weight and condition of all animals in the group, overall food consumption, activity level of the group, feeding competition and other medical or behavioral considerations.
 - iii. Considerations for diet decrease include weight and condition of all animals in the group, overall food consumption, activity level of the group, feeding competition and other medical or behavioral considerations.
 - iv. Diet increases or decreases must be made in modest increments with animal response to the change assessed for a minimum period before additional changes are made.
 - v. Underweight individuals experiencing health or behavioral problems may be separated into smaller groups (never solitary) for supplemental feeding as needed to avoid undesirable weight gain in conspecifics.
- h. Food handling protocols
- i. Feeders should be thoroughly washed with soap, rinsed very well and air dried before reuse.
 - ii. Feeders and mixing utensils should be bleached once weekly and left to thoroughly dry to prevent bacterial growth.
 - iii. Food storage protocols
 - iv. Follow expiration dates of perishable items very closely.
- j. Mealworms
- 1. To prevent larvae from maturing into pupae and subsequently into adult beetles, mealworms should be stored in a clean, dry refrigerator.
 - 2. Mealworms must be stored at room temperature for 2 days prior to feeding to insure proper “gut loading”.
- ii. Prepared soft food diet
- 1. Once prepared, diets can be stored for 3 days when refrigerated. May be kept in freezer for up to 30 days.
 - 2. Oldest stock must be used first.

IV. Social, Psychological, Physical and Behavioral Well-Being

a. Social Housing and Management

- a. Bats are highly social animals.
- b. Bats should not be housed as single animals.
- c. When possible, breeding should not be permitted.
- d. Sex ratios of 3 males to 12 females are recommended if it is necessary to house mixed sex groups. This number can vary greatly depending on species.
- e. Females of most insectivorous bats will segregate into maternity colonies.

ii. Solitary housing

- 1. Never house social bats individually. Even in situations when it is necessary to remove a bat from the main colony, a few additional bats can be housed with the convalescing or quarantining bat. This must be temporary and reserved for situations including but not limited to:
 - a. Quarantine
 - b. Medical assessment
 - c. Medical care

iii. Introductions of unfamiliar individuals

1. The introduction or removal of female insectivorous bats tend to create no problem within existing colonies.
2. The introduction of male insectivorous bats into existing colonies may result in initial bickering and fighting as the group's social structure is challenged or altered and occupation of territories are attempted.
3. The removal of male insectivorous bats from colonies makes no impact unless the male is of high ranking in the social order. Then there will be aggression amongst males until a new hierarchy is established.
4. Close observation must be made by staff for several hours after the introduction of any bat into an established colony.

iv. Coexistence with other species

1. There is currently no documentation in regards to housing insectivorous bats with other species, therefore, is not recommended.

v. Caregiver Relationships

1. Insect eating bats do not form relationships with caregivers, but do become accustomed to the daily routine of feeding and cleaning of the enclosure. Any changes in caregivers must be done gradually to prevent stress.

V. Handling and Restraint

- a. Insect eating bats can be caught with a finely meshed insect or aquarium net.
- b. Avoid capturing of bats against any rigid wall of the enclosure.
- c. Never pull a bat from its roosting area. Instead, carefully unhook their toenails from mesh or perches that the bat may be roosting on to prevent injury or loss of toes/toenails.
- d. Most insectivorous bats are very delicate and do not require the use of heavy thick gloves. Instead, gloves that are soft and thin, such as goat skin or nitrile are recommended. Never remove a bat by force that bites a glove. This can cause injury to their jaws or teeth. Blow quick forceful puffs of air on the face's face until it lets go.
- e. Never squeeze or hold bats too tightly. Instead, gently hold the bats in your cupped hand to prevent injuries.

Never hold bats by the wing tips, always fold the wings in their natural position close to the bat's body.

VI. Crating and Transport

- a. IATA standards should be followed for all shipments of bats.
 - i. Bats can be shipped communally.
 - ii. Mothers with nursing infants should not be shipped.
 - iii. Mesh should be attached to all sides, including ceiling to allow for proper roosting behavior in transit.
 - iv. The bottom of the transport container should be covered with a pillow or foam pad.
 - v. Consideration should be given to bats that are crevice dwelling in habit and appropriate pouches and/or roosting cloths should be provided.
 - vi. Bats should have access to food and water prior to shipping.
 - vii. Bats should not remain in shipping container for more than 15 hours.

VII. Record Keeping

- a. Detailed individual or colony records are necessary for good husbandry, management and veterinary care. Additionally, some records and programs are required by federal regulations.

Records that are recommended and/or required include but are not limited to:

- i. Individual animal records showing origin, age, species, gender etc.
- ii. Individual veterinary record
- iii. Reproductive history
- iv. Current diet and record of diet changes
- v. Group food consumption and preferred food items
- vi. Daily enrichment
- vii. Group deaths, including neo-natal deaths, stillborns and aborted fetuses should be recorded.

VIII. Staff Safety

- a. All sanctuary personnel directly involved with animal care should be vaccinated against rabies and have periodic titer evaluations.
- b. Sanctuaries shall have an emergency response protocol, and shall be able to demonstrate readiness to respond to an emergency situation, such as an escape or natural disaster involving evacuation.

IX. Veterinary Care

- a. All sanctuaries shall adhere to USDA APHIS requirements.
- b. Services of a licensed veterinarian with experience in exotic, zoo or wildlife mammal medicine shall be available and be on call at all times to deal with routine health evaluation and treatment and medical emergencies.
- c. All bats shall be visually inspected on a daily basis. A general assessment shall be made and any unusual activities shall be recorded in the daily log at each inspection. Specifically, logs shall include observations such as condition of urine and feces, eating and drinking patterns, administration of medications (if any), and general condition and behavior of the group.
- d. A veterinarian or trained veterinary technician shall perform fecal examinations to look for parasites and other problems at least twice a year. Results shall be recorded.
- e. All sanctuaries shall have the ability to capture animals to address medical concerns or allow veterinary procedures to occur.
- f. The most common injuries seen in insectivorous bats in captivity are wing fractures with the humerus being the most commonly effected bone as well as bite wounds from territorial squabbles
- g. Advanced periodontal disease is the most common condition requiring veterinary medical attention in insectivorous bats.
- h. All deceased bats should be necropsied and the results recorded.

- i. No vaccinations are recommended for bats, although extra-label use of the rabies 3 year vaccine has been used to vaccinate bats with apparent success.

Frugivorous Bat Care Standards

Version 1.0 September 1, 2010

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This set of standards includes bats in

Family: *Pteripodidae*, *Phyllostomidae* Genus: Various

Common names: Various, collectively called fruit bats

There are about 1,000 recognized species of bats (order Chiroptera) worldwide. They are greatly diversified both in habitat and in feeding strategies. Bats feed on insects, fruits, plant parts such as leaves and flowers, nectar, pollen, fish, smaller vertebrates and blood. There are approximately 250 species of frugivorous bats found in the Americas, Africa, Asia, and Oceania. All bats that eat fruit with the exception of those belonging to the genus *Pteropus* are the primary focus of these standards.

All bats require proper flight for their long term well-being. They must be provided with sufficient space in an appropriate environment to ensure their physical and psychological needs are met. Because of these species' specialized needs and diet, Sanctuaries shall be prepared to meet all their husbandry requirements. The following standards are minimal and every effort shall be made to exceed them.

I. Housing requirements

Fruit eating bats can have variable roosting requirements and habits. Some roost in colonial groups, some roost in groups, though do not cluster and some roost solitarily. Some use structures such as tree hollows, caves, tree foliage and man-made structures. Some roost in trees in groups. Roosting colonies can vary in number.

a. Enclosure requirements

- i. Enclosures should be designed free of sharp edges to prevent wing tears and wing tip injuries.
- ii. Enclosure surfaces should be non-porous and non-abrasive.
- iii. Some small fruit bats can squeeze through incredibly small spaces. Doors and enclosure joints must be constructed carefully. Vents must also be covered to prevent escape.
- iv. Enclosures must be able to withstand a great deal of hosing and/or cleaning.
- v. Enclosure shape may be variable; square, rectangular, L-shaped or hexagonal.
- vi. Enclosure design should promote continuous flight, such as a center structure or cage furniture to impede cross flight, keeping in mind that some fruit bats are low flyers.
- vii. Design of enclosures using solid walls must allow for sufficient sunlight and air flow throughout the enclosure.
- viii. Ceiling and enclosure sides should be no greater than ¼ inch to allow bats to grasp, hang and climb.
- ix. Polyethylene or vinyl coated wire mesh may be used for ceiling and enclosure sides.

- x. Galvanized wire mesh should not be used as it can cause zinc toxicity in bats. xi. Roosting areas such as vaults, concave hollows or synthetic cave structures should have roughened surfaces to facilitate roosting.
- xii. Roosting areas should be offered at various elevations within the enclosure.
- xiii. If the enclosure is exposed to a fair amount of sunlight, it is necessary to provide multiple darkened areas within the enclosure allowing the bats to rest during the day.
- xiv. Multiple visual barriers should be implemented in the form of enclosure decorations such as plants, partitions or roosting boxes to reduce social structure stress within the group, to allow for the establishment of multiple territories and for bachelor groups to form.
- xv. Sanctuary must also provide alternative housing for sick or injured individuals while in close proximity to the social group.

b. Dimensions

- i. Enclosure should be of adequate size to promote allow for continuous free flight. For a group up to twenty individuals (20) the minimum enclosure size should be a minimum of 12 times the wingspan of the largest bat, squared. For each addition of 10 animals, total enclosure space should be increased by 15%.
- ii. Take into consideration food presentation and roosting structures in enclosure design insuring that structures do not reduce total flight space.
- iii. Cage height should be at a height where caretakers can perform visual inspections of individuals and easily access bats from ceiling, typically ranging from 6.5 feet to 7.5 feet. c. Outdoor enclosures
 - i. It is recommended that outdoor enclosures be double contained (cage within a cage) for optimum safety of the bats and to prevent escapes. ii. Outer structure of the enclosure should be structurally sound and/or have safeguards to be secure from predators such as snakes and raccoons.
 - iii. In the event of inclement weather, inadequate temperature control (too cold) or extreme weather (hurricane, tornado) an enclosed shelter must be provided and utilized for the bats safety.
 - iv. If bats are housed outdoors for part of the year and housed indoors for the rest of the year, ideally the two structures should be connected allowing for stress-free movement (hands free) transition from one enclosure to the other.
 - v. Enclosed shelters (indoor day/night rooms) for groups housed outdoors can be used.
 - 1. Bats should have free choice access to structure at all times.
 - 2. In situations such as weather or temperature that bats must be locked within the shelter, this shall only be for short-term confinement and not comprise the primary housing.

d. Containment:

- i. Barriers shall prevent direct contact between bats and the public if allowed in the Sanctuary.
- ii. Enclosures that be inspected on a regular basis to ensure caging /mesh are in good condition and able to prevent escapes.

e. Substrate

i. Outdoor enclosures

- 1. All outdoor enclosures will have a natural substrate consistent with the site.
- 2. The substrate surfaces can be made of natural substances (e.g. soil, sand, grass) that provide good drainage.
- 3. Hard surface items naturally occurring like rocks should be removed from enclosure.

ii. Indoor enclosures

1. All indoor enclosures should have a padded or soft textured floor to prevent injuries to downed bats. Concrete floors should be covered with a non-porous cushioned surface designed to withstand daily cleaning.
2. Standing water in indoor floor areas can be a drowning hazard and become a breeding ground for bacteria. Floors shall therefore be impervious to water, be quick to dry, and sloped to a drain if necessary.

f. Enclosure doors

- i. It is recommended that there be a double door system installed, as these bats are very quick and highly maneuverable flyers. Double doors are a key element of facility design to prevent escape.
- ii. Doors must be designed to allow caregiver view of enclosures while opening doors.
- iii. Doors must have safety mechanisms to insure they can be 'locked' for both human and animal safety.

g. Shelter

Since roosting habits and reproductive strategies vary greatly among frugivorous bats, a wide variety of roosting options should be offered, especially when housing mixed species groups. Some bats may prefer to roost in the open, from the top of the cage or in roosting structures. Most Phyllostomid fruit bats are colonial to some degree and females of some species may segregate into maternity colonies.

- i. A sufficient number of roosting structures to accommodate all animals simultaneously will be provided in all enclosures.
- ii. Roosting structures, such as wicker basket, boxes, natural or artificial vegetation or artificial cave like structures, provide both day roosting habitat and night roosting habitats. Bats should have access to both types of roosting structures at all times. iii. Roosting boxes should be constructed from non-treated wood. All four sides as well as the top on front of the roost box should be grooved or be lined with a polyethylene mesh to provide an area for bats to easily grasp and hold. It is necessary to have a long landing platform on these boxes that are meshed or grooved as well.
- iv. Shelters can be created through natural and artificial means within outdoor and indoor enclosures.
- v. Roosting areas must provide dry space during wet weather and provide protection from wind.

h. Enclosure furniture

1. Accessories to provide bats a more natural environment should be utilized. Various types of foliage ranging from artificial flowers, vines, leaves and plants can be used.
2. Plantings, potted trees or plantings or natural cuttings and branches may also be used.
 - a. All plant materials in an enclosure will be evaluated for potential toxicity, including leaves, buds, seeds, fruit, bark and flowers.
 - b. Avoid plants that contain thorns.
 - c. Fruit bats will feed on certain leaves and flowers of several plants available for horticulture.
3. Climbing apparatus should be offered in the form of ropes, swings, ladders, vines or natural or artificial tree climbs.
 - a. Ropes and swings promote static flight which is common especially in juvenile individuals.

- b. Ropes should be at a minimum height of 1 ½ times the length of the longest animal to prevent touching or hitting the enclosure floor.
 - i. Sanitation
- i. Care must be taken to minimize exposure of animals in adjacent spaces to over spray, disinfectants or waste materials.
 - ii. Outdoor enclosures shall be cleaned daily and feces raked and removed to avoid unsanitary or unsafe conditions.
 - iii. Daily removal of uneaten food
 - 1. Is an important element of pest control and disease prevention
 - 2. Enables care givers to monitor changes in food consumption.
 - 3. Minimizes risk for consumption of spoiled food items.
 - iv. Daily removal of animal waste
 - 1. Is an important element of pest control and disease prevention.
 - 2. Enables caregivers to monitor animal health.
 - 3. Enables caregivers to collect fecal samples in a timely manner.
 - v. Soiled bedding material and substrate are removed and replaced with fresh materials daily.
 - vi. Damaged and soiled enrichment items are removed daily.
 - vii. Disinfection and Sanitizing
 - 1. All surfaces including walls, floors, ceiling, cage mesh and caregiver work areas must be sanitized regularly to the extent possible.
 - 2. Staff must follow proper disinfecting procedures when moving between enclosures.
 - 3. Disinfectants used in outdoor areas must not accumulate in soil and pose hazards to enclosure occupants or to the environment.
 - 4. Disinfectants used in indoor areas must be rotated on a regular basis.
 - 5. Disinfectants must be evaluated for hazards to both staff and animals.
 - 6. Food containers are sanitized daily.
 - 7. Water containers are sanitized daily.
 - viii. Local, county, state laws regarding proper waste removal are observed.
 - ix. A pest control regimen that is not harmful to the bats (such as bait) shall be in place to prevent infestation. Ants, fruit flies, cockroaches and rats are the most common pest found in enclosures and around fruit bats.

II. Temperature, Humidity, Ventilation, Lighting

a. Temperature

Fruit bats live in a variety of climates, ranging from tropical to sub-tropical, where it is warm and humid, to cooler temperatures in higher elevations. These tropical animals do best in temperatures ranging from 70° - 90° F (21° – 32° C).

- 1. Supplemental heat should be offered when temperatures fall below 70° F (21° C).
- 2. Fruit bats can not withstand temperatures below 50° F (10° C)

Humidity is of greater concern during winter months in indoor enclosures when forced air heat may be in use. A humidity range of 60-90% is generally adequate.

c. Ventilation

Enclosures should be well ventilated with a recommended 6 – 10 air exchanges per hour with a minimum of 25% fresh air exchange.

d. Lighting

i. Indoor enclosures

1. Natural lighting is optimal and can be obtained from skylights, windows, roll up doors or other means. Supplemental lighting composed of fluorescent or full spectrum lighting can be used during day cycles. Nocturnal lighting must have blue filters to prevent interference with light cycles. A dimming system must be used to prevent the shock of immediate bright light/ complete darkness.
2. Fruit bats can see most colors, including red.

ii. Outdoor enclosures

1. While not necessarily required, consideration should be given to supplemental lighting or power sources for use in outdoor areas in event of emergencies.
1. Fruit bats adapt well to a daylight period ranging from 10 – 14 hours.
2. An artificially shortened day length period can adversely impact food consumption and other natural behaviors.

III. Nutrition

Frugivorous bats have specialized dietary requirements. They primarily feed on fruits on trees, vines and shrubbery in the wild. They also will consume flowers, nectar, pollen, plant parts and occasionally incidental insects.

a. Basic Requirements

- i. High quality and nutritionally correct food shall be provided in sufficient quantities to maintain animal health and appropriate weight.
- ii. Consumption of diets, including browse and enrichment items, should be monitored closely.
- iii. Browse can be used to provide enrichment activities for the bats but should not be considered as a daily food source.
- iv. There should always be uneaten food remaining in feeders to ensure all bats are getting enough food.

b. Diet Composition

i. Fresh manually prepared diet

Captive diets are comprised of a mix of fruits, vegetables, juices and supplements.

- a. Various forms of diets are available, however, sanctuaries should strive to be as close as possible to the following ratios:

Apple	36%
Pear	7%
Banana	14%
Grapes	10%
Melons (cantaloupe, honey dew)	12%
Carrot or Sweet Potato	9%
Leafy Greens (kale, spinach etc)	6%
Supplements	6%

should be well mixed prior to feeding.

- c. For smaller phyllostomid bats, the apple ratio can be reduced and replace with an increase of melon.

- ii. Supplements for frugivorous bats in captivity include
 - a. Well balanced vitamin supplement
 - i. Vitamin a and e are extremely important to bats.
 - b. Calcium supplement
 - i. Insure source is free of contaminants such as fluoride or heavy metals.
 - c. Commercially prepared fruit bat supplement are available.
- iii. Commercial diets
 - 1. Commercially processed fruits such as canned fruits have been used for the feeding of fruit eating bats.
 - a. Commercially processed foods should not comprise the majority of the diet, nor fed to bats in entirety.
 - b. All syrups and sugars should be rinsed off fruit prior to use.
- iv. Juice
 - a. For smaller frugivorous bats, juices may be offered in addition to fruit.
 - b. Most often supplements are mixed into juice to make a slurry for the bats.
 - c. Juices should be 100% juice, not a fruit juice beverage.
- c. Water
 - i. Fresh clean water must be available at all times. ii. Water should be presented in small shallow dishes placed on ledges or hanging cups around the perimeter of the enclosure at a height of approximately one head to toe length of the bat from the ceiling. When various sizes of frugivorous bats are housed together, height of dish placement from the ceiling should also vary. If large water dishes are used in order to accommodate multiple species, mesh ladders should be attached to the wall or ceiling and extend inside the water bowl as a safety precaution for insure smaller bats.
- d. Browse (fresh plant or produce material)
 - i. Freshly cut plant material, produce such as vegetables and fruit wedges or flowers should be offered daily to enhance natural feeding behaviors.
 - ii. All caregivers must be trained to identify safe non-toxic plant species appropriate to feed bats. iii. Bats held in outdoor cages may crawl down the side of the enclosure in search of grass forage.
- e. Treats or 'Enrichment' Food items
 - i. Novel fruits, vegetables, flowers, juices, natural jams or preserves may be offered as enrichment valued items. Items can be dispersed to encourage foraging behaviors.
 - ii. Enrichment items shall be offered periodically so bats to not feed solely on enrichment items. iii. Enrichment items should never be relied on as a part of the daily diet.
 - iv.
- f. Food presentation

It is important to take into consideration when choosing a feeding style or item whether or not it will be accommodating and easily accessed by fruit eating bats.

 - i. Bowls, coop cups or non-toxic dishes may be used to offer fruit.
 - 1. Food must be at a height to allow bats to hang over dishes to access fruit. Food stations can be suspended from ceiling in baskets or offered along the sides of the structure.

2. If feeding stations are in a confined area, several dishes should be offered to reduce competition for food.
 3. A few dishes should be a few feet lower to the main level of dishes to insure that submissive individuals can escape and can avoid more dominant individuals guarding dishes while maintaining access to food.
 4. Stainless steel dishes are durable and easiest to sanitize.
- ii. Open topped feeders or shallow dishes in baskets may be used when offering nectar or juices.
 1. Drowning is a factor to consider when presenting food for small bats. Items like glass beads or marbles in a shallow dish can prevent drowning.
 - iii. When changing feeding presentation, do so with additional fruit to ensure all bats have found enough food sources. Lesser used items can then be removed after the transition period.
 - iv. Place feeders in several different areas of the enclosure to reduce competition for food.
 - v. Place some feeders in very open, easily accessible areas for older, less maneuverable bats.
 - vi. Fruits can be also offered on metal skewers, tree branches or from suspended dishes.
 - vii. Food should never be offered from the floor of the enclosure at any time.
 - g. Feeding schedule
 - i. Fruit mixtures and juices will ferment when left out overnight, especially in warm climates.
 1. Bats should be fed at the end of the light cycle to minimize spoilage of diet prior to feeding.
 2. Feeders should be removed at the beginning of the light cycle to prevent ingestion.
 3. Additional feedings may be necessary when housing large colonies of frugivorous bats to insure all individuals are provided will sufficient access to food.
 - h. Diet increases or decreases
 - i. Adjustments made to an already formulated and nutritionally balanced diet must be made to the entire diet to insure continued nutritional balance.
 - ii. Considerations for diet increase include weight and condition of all animals in the group, overall food consumption, activity level of the group, feeding competition and other medical or behavioral considerations.
 - iii. Considerations for diet decrease include weight and condition of all animals in the group, overall food consumption, activity level of the group, feeding competition and other medical or behavioral considerations.
 - iv. Diet increases or decreases must be made in modest increments with animal response to the change assessed for a minimum period before additional changes are made.
 - v. Underweight individuals experiencing health or behavioral problems may be separated into smaller groups (never solitarily) for supplemental feeding as needed to avoid undesirable weight gain in conspecifics.
 - i. Food handling protocols
 - i. Feeders and dishes should be thoroughly washed with soap, rinsed very well and air dried before reuse.
 - ii. Feeders, dishes and mixing utensils should be bleached once weekly and left to thoroughly dry to prevent bacterial growth.
 - j. Food storage protocols
 - i. Follow expiration dates of perishable items very closely.

ii. Produce

1. Must be stored in a clean, dry refrigerator.
 2. Order in increments that can be used prior to spoilage.
- iii. Frozen
1. Even though the bats prefer fresh fruit, thawed frozen fruit can be offered.

IV. Social, Psychological, Physical and Behavioral Well-Being

a. Social Housing and Management

- a. Bats are highly social animals.
- b. Bats should not be housed as single animals.
- c. When possible, single sex groups are recommended and breeding should not be permitted.
- d. Sex ratios of 2 males to 6-8 females are generally recommended if it is necessary to house mixed sex groups.
- e. Females of some fruit bats will segregate into maternity colonies.
- f. Inter or intra-specific aggression is rarely noted in situations such as food or harem guarding.

ii. Solitary housing

1. Never house social bats individually. Even in situations when it is necessary to remove a bat from the main colony, a few additional bats can be housed with the convalescing or quarantining bat. This must be temporary and reserved for situations including but not limited to:
 - a. Quarantine
 - b. Medical assessment
 - c. Medical care

iii. Introductions of unfamiliar individuals

1. The introduction or removal of female fruit bats tend to create no problem within existing colonies.
2. The introduction of male fruit bats into existing colonies may result in initial bickering and fighting as the group's social structure is challenged or altered and occupation of territories are attempted.
3. The removal of male fruit bats from colonies makes no impact unless the male is of high ranking in the social order. Then there will be aggression amongst males until a new hierarchy is established.
4. Close observation must be made by staff for several hours after the introduction of any bat into an established colony.

iv. Coexistence with other species

1. Frugivorous bats have been housed with other frugivorous and nectarivorous bats without any apparent problems.
2. Fruit bats have been housed with mixed taxa with no apparent problems.

v. Caregiver Relationships

1. Though some frugivorous bats do exhibit some preferences among handlers, the bats do not form relationships with caregivers. They do become accustomed to the daily routine of feeding and cleaning of the enclosure and sometimes will seek out the caretaker for food.

V. Handling and Restraint

- a. Fruit bats can be caught with a finely meshed insect, aquarium net or finely meshed fishing net.
- b. Avoid capturing of bats against any rigid wall of the enclosure.
- c. Never pull a bat from its roosting area. Instead, gently unhook their toenails from any wire, mesh or perches that the bat may be roosting on to prevent injury or loss of toes/toenails.
- d. Most fruit bats are smaller and do not require heavy thick gloves. Goat skin gloves are soft, thin and flexible if necessary. For larger bats, heavier, thick leather gloves may be necessary. If a bat bites a glove, never remove the bat by force. This can cause injury to their jaws or teeth. Blow quick forceful puffs of air on the face's face until it lets go.
- e. Never squeeze or hold bats too tightly. Holding the bats in your cupped hand or wrapped in a towel will prevent injuries to the bats.
- f. Never hold bats by the wing tips during restraint and always fold the wings in their natural position close to the body.

VI. Crating and Transport

- a. IATA standards should be followed for all shipments of bats.
 - i. Bats can be shipped communally.
 - ii. Mothers with nursing infants should not be shipped.
 - iii. Mesh should be attached to all sides, including ceiling to allow for proper roosting behavior in transit.
 - iv. The floor of the carrier should be padded with a pillow or foam pad.
 - v. Bats should have access to food and water prior to shipping.
 - vi. Bats should not remain in shipping container for more than 15 hours.

VII. Record Keeping

- a. Detailed individual or colony records are necessary for good husbandry, management and veterinary care. Additionally, some records and programs are required by federal regulations.

Records that are recommended and/or required include but are not limited to:

- i. Individual animal records showing origin, age, species, gender etc.
- ii. Individual veterinary record
- iii. Reproductive history
- iv. Current diet and record of diet changes
- v. Group food consumption and preferred food items
- vi. Daily enrichment
- vii. Group deaths, including neo-natal deaths, stillborns and aborted fetuses should be recorded.

VIII. Staff Safety

- a. All sanctuary personnel directly involved with animal care should be vaccinated against rabies and have periodic titer evaluations.
- b. Staff should wear leather gloves when handling larger bats to prevent bites.
- c. Sanctuaries shall have an emergency response protocol, and shall be able to demonstrate readiness to respond to an emergency situation, such as an escape or natural disaster involving evacuation.

IX. Veterinary Care

- a. All sanctuaries shall adhere to USDA APHIS requirements.
- b. Services of a licensed veterinarian with experience in exotic, zoo or wildlife mammal medicine shall be available and be on call at all times to deal with routine health evaluation and treatment and medical emergencies.
- c. All bats shall be visually inspected on a daily basis. A general assessment shall be made and any unusual activities shall be recorded in the daily log at each inspection. Specifically, logs shall include observations such as condition of urine and feces, eating and drinking patterns, administration of medications (if any), and general condition and behavior of the group.
- d. A veterinarian or trained veterinary technician shall perform fecal examinations to look for parasites and other problems at least twice a year. Results shall be recorded.
- e. All sanctuaries shall have the ability to capture animals to address medical concerns or allow veterinary procedures to occur.
- f. Thumb and nail injuries, wing tears, lip abrasions, dry skin and feet, and fractures are the most common injuries seen in frugivorous feeding bats in captivity.
- g. All deceased bats should be necropsied and the results recorded.
- h. No vaccinations are recommended for bats, although extra-label use of the rabies 3 year vaccine has been used to vaccinate bats with apparent success.

Nectarivorous Bat Care Standards

Version 1.0 September 1, 2010

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This set of standards includes bats in

Family: *Pteripodidae*, *Phyllostomidae*

Genus: *Various*

Common names: Flower bats, Nectar bats, Long tongued bats, Long nosed bats, Dawn bats

There are about 1,000 recognized species of bats (order Chiroptera) worldwide. They are greatly diversified both in habitat and in feeding strategies. Bats feed on insects, fruits, plant parts such as leaves and flowers, nectar, pollen fish, smaller vertebrates and blood. Approximately 60 species of bats are specialized nectarivores. Even though a dozen nectar feeding bats belong to the family *Pteripodidae*, the most common nectarivorous bats held in captivity belong to the *Phyllostomidae* family and are the primary focus of these standards.

All bats require proper flight for their long term well-being. They must be provided with sufficient space in an appropriate environment to ensure their physical and psychological needs are met. Because of these species' specialized needs and diet, Sanctuaries shall be prepared to meet all their husbandry requirements. The following standards are minimal and every effort shall be made to exceed them.

I. Housing requirements

Nectar feeding bats are usually opportunistic roosters, roosting in tree hollows, caves, tree foliage and manmade structures. Roosting colonies can vary and sometimes can be many hundreds of individuals. a. Enclosure requirements

- i. Enclosures should be designed with soft-sided materials, free of sharp edges as these bats are prone to wing tip injuries.
- ii. Enclosure shape may be variable; square, rectangular, L-shaped or hexagonal.
- iii. Enclosure design should promote continuous flight, such as a center structure or cage furniture to impede cross flight. iv. Design of enclosures using solid walls must allow for sufficient sunlight and air flow throughout the enclosure.
- v. Ceiling and enclosure sides should provide polyethylene or cloth mesh no greater than 1 cm to allow bats to grasp, hang and climb. Wire mesh is too harsh of a roosting material for these delicate bats.
- vi. Roosting areas such as vaults, concave hollows or synthetic cave structures should have roughened surfaces to facilitate roosting.
- vii. If the enclosure is exposed to a fair amount of sunlight, it is necessary to provide multiple dark areas within the enclosure allowing the bats to rest during the day.
- viii. Multiple visual barriers should be implemented in the form of enclosure decorations such as plants, partitions or roosting boxes to reduce social structure stress within the group.
- ix. Sanctuary must also provide alternative housing for sick or injured individuals while in close proximity to the social group.

b. Dimensions

- i. Enclosure should be of adequate size to promote allow for continuous free flight and hovering. For a group up to twenty individuals (20) the minimum enclosure size should be a minimum of 12 times the wingspan of the largest bat, squared. For each addition of 10 animals, total enclosure space should be increased by 15%.
- ii. Take into consideration food presentation and roosting structures in enclosure design insuring that structures do not reduce total flight space.
- iii. Cage height should be at a height where caretakers can perform visual inspections of individuals and easily access bats from ceiling, typically ranging from 6.5 feet to 7.5 feet.

c. Outdoor enclosures

- iv. It is recommended that outdoor enclosures be double contained (cage within a cage) for optimum safety of the bats and to prevent escapes. ii. Outer structure of the enclosure should be structurally sound and/or have safeguards to be secure from predators such as snakes and raccoons.

- v. In the event of inclement weather, inadequate temperature control (too cold) or extreme weather (hurricane, tornado) an enclosed shelter must be provided and utilized for the bats safety.
- vi. If bats are housed outdoors for part of the year and housed indoors for the rest of the year, ideally the two structures should be connected allowing for stress-free movement (hands free) transition from one enclosure to the other.
- vii. Enclosed shelters (indoor day/night rooms) for groups housed outdoors can be used.
 - 1. Bats should have free choice access to structure at all times.
 - 2. In situations such as weather or temperature that bats must be locked within the shelter, this shall only be for short-term confinement and not comprise the primary housing.
- d. Containment:
 - i. Barriers shall prevent direct contact between bats and the public if allowed in the Sanctuary.
 - ii. Enclosures that be inspected on a regular basis to ensure caging /mesh are in good condition and able to prevent escapes.
- e. Substrate
 - i. Outdoor enclosures
 - 1. All outdoor enclosures will have a natural substrate consistent with the site.
 - 2. The substrate surfaces can be made of natural substances (e.g. soil, sand, grass) that provide good drainage.
 - 3. Hard surface items naturally occurring like rocks should be removed from enclosure.
 - ii. Indoor enclosures
 - 1. All indoor enclosures should have a padded or soft textured floor to prevent injuries to downed bats. Concrete floors should be covered with a non-porous cushioned surface designed to withstand daily cleaning.
 - 2. Standing water in indoor floor areas can be a drowning hazard and become a breeding ground for bacteria. Floors shall therefore be impervious to water, be quick to dry, and sloped to a drain.
- f. Enclosure doors
 - i. It is recommended that there be a double door system installed, as these bats are very quick and highly maneuverable flyers. Double doors are a key element of facility design to prevent escape. ii. Doors must be designed to allow caregiver view of enclosures while opening doors.
 - ii. Doors must have safety mechanisms to insure they can be 'locked' for both human and animal safety.
- g. Shelter

Nectar feeding bats prefer to roost in the open, from the top of the cage or in roosting structures. Most nectarivorous bats are colonial, however, do not cluster in groups. Females of some species may segregate into maternity colonies.

 - i. A sufficient number of roosting structures to accommodate all animals simultaneously will be provided in all enclosures.
 - ii. Roosting structures, such as wicker basket, boxes, natural or artificial vegetation or artificial cave like structures, provide both day roosting habitat and night roosting habitats. Bats should have access to both types of roosting structures at all times. iii. Roosting boxes should be constructed from non-treated

wood. All four sides as well as the top on front of the roost box should be grooved or be lined with a polyethylene mesh

to provide an area for bats to easily grasp and hold. It is necessary to have a long landing platform on these boxes that are meshed or grooved as well.

- iv. Shelters can be created through natural and artificial means within outdoor and indoor enclosures.
- v. Roosting areas must provide dry space during wet weather and provide protection from wind.

h. Enclosure furniture

- 1. Accessories to provide bats a more natural environment should be utilized. Various types of foliage ranging from artificial flowers, vines, leaves and plants can be used.
- 2. Plantings, potted trees or plantings or natural cuttings and branches may also be used.
 - a. All plant materials in an enclosure will be evaluated for potential toxicity, including leaves, buds, seeds, fruit, bark and flowers.
 - b. Nectar feeding bats like to feed on certain flowers of several plants available for horticulture. Species include but are not limited to: Satin

Leaf (*Chrysphyllum oliviforme*), Firebush (*Hamelia patens*), Astrocaryum (*Astrocaryum alatum*), Zebra plant (*Aphelandra tetragona*), Calathea (*Calathea cro-talifolia*) Goldfish plant (*Columnea spp.*), Spiral Ginger (*Costus spiralis*) and trees belonging to the genus *Inga*.

i. Sanitation

- i. Care must be taken to minimize exposure of animals in adjacent spaces to over spray, disinfectants or waste materials.
- ii. Outdoor enclosures shall be cleaned daily and feces raked and removed to avoid unsanitary or unsafe conditions.

iii. Daily removal of uneaten food

- 1. Is an important element of pest control and disease prevention
- 2. Enables care givers to monitor changes in food consumption.
- 3. Minimizes risk for consumption of spoiled food items.

iv. Daily removal of animal waste

- 1. Is an important element of pest control and disease prevention
- 2. Enables caregivers to monitor animal health
- 3. Enables caregivers to collect fecal samples in a timely manner.

- v. Soiled bedding material and substrate are removed and replaced with fresh materials daily.

- vi. Damaged and soiled enrichment items are removed daily.

vii. Disinfection and Sanitizing

- 1. All surfaces including walls, floors, ceiling, cage mesh and caregiver work areas must be sanitized regularly to the extent possible.
- 2. Staff must follow proper disinfecting procedures when moving between enclosures.
- 3. Disinfectants used in outdoor areas must not accumulate in soil and pose hazards to enclosure occupants or to the environment.
- 4. Disinfectants used in indoor areas must be rotated on a regular basis.
- 5. Disinfectants must be evaluated for hazards to both staff and animals.

6. Food containers are sanitized daily.
7. Water containers are sanitized daily.
- viii. Local, county, state laws regarding proper waste removal are observed.
- ix. A pest control regimen that is not harmful to the bats (such as bait) shall be in place to prevent infestation. Ants and cockroaches are the most common pest found in enclosures and around nectar feeding bats.

II. Temperature, Humidity, Ventilation, Lighting

a. Temperature

Nectar eating bats live in a variety of climates, ranging from warm and humid to cooler temperatures in higher elevations. These neo-tropical animals do best in temperatures ranging from 70° - 85° F (21° - 29° C).

b. Humidity

Humidity is of greater concern during winter months in indoor enclosures when forced air heat may be in use. A humidity range of 75-85% is generally adequate.

c. Ventilation
Enclosures should be well ventilated with a recommended 6 – 10 air exchanges per hour with a minimum of 25% fresh air exchange.

d. Lighting

i. Indoor enclosures

1. Natural lighting is optimal and can be obtained from skylights, windows, roll up doors or other means. Supplemental lighting composed of fluorescent or full spectrum lighting can be used during day cycles. Nocturnal lighting must have blue filters to prevent interference with light cycles. A dimming system must be used to prevent the shock of immediate bright light/ complete darkness.

ii. Outdoor enclosures

1. While not necessarily required, consideration should be given to supplemental lighting or power sources for use in outdoor areas in event of emergencies.
- e. Photoperiod
 1. Nectar feeding bats adapt well to a daylight period ranging from 10 – 14 hours.
 2. An artificially shortened day length period can adversely impact food consumption and other natural behaviors.

III. Nutrition

Nectarivorous bats have specialized dietary requirements. They primarily feed on nectar and pollen of night blooming plants. They rely on pollen as a primary source of protein. Even though these bats are adapted to this diet, some species also will consume fresh fruit and insects.

a. Basic Requirements

- i. High quality and nutritionally correct food shall be provided in sufficient quantities to maintain animal health and appropriate weight.
- ii. Nectar feeding bats must have access to food 24 hours a day.
- iii. Diet should follow a ratio of 70-75% nectar to 25-30% fresh fruit.
- iv. Consumption of diets, including browse and enrichment items, should be monitored closely.
- v. Browse can be used to provide enrichment activities for the bats but should not be considered as a daily food source.

- vi. There should always be uneaten food remaining in feeders to ensure all bats are getting enough food.
- b. Nectar Composition
 - i. Fresh manually prepared diet
 - 1. Nectar solutions should be comprised of 85-90% unsweetened, 100% fruit juice, preferably organic in origin.
 - 2. The remainder of the solution is comprised of protein/fats additives in the following ratios: corn or flax seed oil-1.5%; finely ground high protein monkey chow-1.5%; Nektar Plus, a commercial nectar supplement- 5%; sucrose or fructose powder-1%; human baby mixed cereal powder 1%.
 - 3. Mixed ingredients should be well blended together prior to feeding.
 - ii. Commercial diet
 - 1. There are commercial diets for hummingbird and lorikeets that have been used for the feeding of nectar feeding bats, including Roudybush brand products.
- c. Fresh fruits
 - i. Only very soft fruits can be eaten by nectar feeding bats. ii. The most common sources of fruits for nectar feeding bats in captivity are ripe bananas (75%) and melon (cantaloupe, honeydew, watermelon) (25%).
- d. Water
 - i. Fresh clean water must be available at all times. ii. Water should be presented in small shallow dishes placed on the floor of large enclosures or preferably on ledges around the perimeter of the enclosure at a height of approximately one head to toe length of the bat from the ceiling. When various sizes of nectarivorous bats are housed together, height of dish placement from the ceiling should also vary.
- e. Browse (fresh plant or produce material)
 - i. Freshly cut plant material, such as leaf lettuce or flowers should be offered daily to enhance natural feeding behaviors.
 - ii. All caregivers must be trained to identify safe non-toxic plant species appropriate to feed bats.
- f. Treats or 'Enrichment' Food items
 - i. Novel fruits, juices, natural jams or preserves may be offered as enrichment valued items. Items can be dispersed to encourage forage behaviors.
 - ii. Enrichment items shall be offered periodically so bats to not feed solely on enrichment items.
 - iii. Enrichment items should never be relied on as a part of the daily diet.

g. Food presentation

Presentation of the diet is as important as the diet itself. It is important to take into consideration when choosing a feeding style or item whether or not it will be accommodating and easily used by nectar feeding bats.

- i. Hummingbird or Oriole feeders may be used. Feeders should be suspended from the ceiling of the enclosure.
 - 1. Feeders must be free of bee guards or obstructions around the openings.
 - 2. Openings must be very close to nectar source within the feeder to ensure that bats can reach the nectar with their tongue.
- ii. Glass or plastic tube bottom delivery feeders may be used.

- iii. Open topped feeders or shallow dishes in baskets may be used.
 - 1. Drowning is a factor to consider when presenting food for small bats. Items like glass beads or marbles in a shallow dish can prevent drowning.
 - iv. When changing feeding presentation, do so when additional nectar to ensure all bats have found enough food sources. Lesser used items can then be removed after the transition period.
 - v. Place feeders in several different areas of the enclosure to reduce competition for food.
 - vi. Place some feeders in very open, easily accessible areas for older, less maneuverable bats.
 - vii. Fruits can be offered on metal skewers, tree branches or from suspended dishes.
 - viii. Food should never be offered from the floor of the enclosure at any time.
- h. Feeding schedule
- i. Nectar diets will sour when left out overnight, especially in warm climates.
 - 1. Bats should be feed at the end of the light cycle to minimize spoilage of diet prior to feeding.
 - 2. Feeders should be removed at the beginning of the light cycle to prevent ingestion.
 - ii. Fresh diet should be offered at all times. During the bats resting period, a few feeders containing fresh diet (not diet left from the night before) should be distributed throughout the enclosure.
- i. Diet increases or decreases
- i. Adjustments made to an already formulated and nutritionally balanced diet must be made to the entire diet to insure continued nutritional balance.
 - ii. Considerations for diet increase include weight and condition of all animals in the group, overall food consumption, activity level of the group, feeding competition and other medical or behavioral considerations.
 - iii. Considerations for diet decrease include weight and condition of all animals in the group, overall food consumption, activity level of the group, feeding competition and other medical or behavioral considerations.
 - iv. Diet increases or decreases must be made in modest increments with animal response to the change assessed for a minimum period before additional changes are made.
 - v. Underweight individuals experiencing health or behavioral problems may be separated into smaller groups (never solitarily) for supplemental feeding as needed to avoid undesirable weight gain in conspecifics.
- j. Food handling protocols
- i. Nectar feeders should be thoroughly washed with soap, rinsed very well and air dried before reuse.
 - ii. Feeders and nectar mixing utensils should be bleached once weekly and left to thoroughly dry to prevent bacterial growth.
- k. Food storage protocols
- i. Follow expiration dates of perishable items very closely.
 - ii. Prepared nectar solution
 - 1. Once prepared, diets can be stored for 3 days when refrigerated.
 - 2. Oldest stock must be used first.
 - iii. Produce
 - 1. Must be stored in a clean, dry refrigerator.
 - 2. Order in increments that can be used prior to spoilage.

iv. Frozen

1. Even though the bats prefer fresh fruit, thawed frozen fruit can be offered.

IV. Social, Psychological, Physical and Behavioral Well-Being

a. Social Housing and Management

- a. Bats are highly social animals.
- b. Bats should not be housed as single animals.
- c. When possible, single sex groups are recommended and breeding should not be permitted.
- d. Sex ratios of 3 males to 12 females are recommended if it is necessary to house mixed sex groups.
- e. Females of most nectar feeding bats will segregate into maternity colonies.
- f. Inter or intra-specific aggression is very rarely noted in nectarivorous bats.

ii. Solitary housing

1. It is not recommended to house social bats individually. Even in situations when it is necessary to remove a bat from the main colony, a few additional bats can be housed with the convalescing or quarantining bat. This must be temporary and reserved for situations including but not limited to:
 - a. Quarantine
 - b. Medical assessment
 - c. Medical care

iii. Introductions of unfamiliar individuals

1. The introduction or removal of individuals appears to create no problem within existing colonies.

iv. Coexistence with other species

1. Nectar feeding bats have been housed with smaller frugivorous bats without any apparent problems.

v. Caregiver Relationships

1. Nectar bats do not form relationships with caregivers, but do become accustomed to the daily routine of feeding and cleaning of the enclosure.

V. Handling and Restraint

- a. Nectar feeding bats can be caught with a finely meshed insect or aquarium net.
- b. Avoid capturing of bats against any rigid wall of the enclosure.
- c. Never pull a bat from its roosting area. Gently unhook their toenails from any wire, mesh or perches that the bat may be roosting on to prevent injury or loss of toes/toenails.
- d. Most nectar bats are very delicate and not requiring heavy thick gloves. Goat skin gloves are soft, thin and flexible if necessary. If these small bats bite a glove, never remove the bat by force. This can cause injury to their jaws or teeth. Blow quick forceful puffs of air on the face's face until they let go.
- e. Never squeeze or hold bats too tightly. Holding the bats in your cupped hand will prevent injuries to the bats.

- f. Never hold bats by the wing tips during restraint and always fold the wings in their natural position close to the body.

VI. Crating and Transport

- a. IATA standards should be followed for all shipments of bats.
 - i. Bats can be shipped communally.
 - ii. Mothers with nursing infants should not be shipped.
 - iii. Mesh should be attached to all sides, including ceiling to allow for proper roosting behavior in transit.
 - iv. Container floor should be covered with a pillow or foam pad.
 - v. Bats should have access to food and water prior to shipping.
 - vi. Bats should not remain in shipping container for more than 15 hours.

VII. Record Keeping

- a. Detailed individual or colony records are necessary for good husbandry, management and veterinary care. Additionally, some records and programs are required by federal regulations.

Records that are recommended and/or required include but are not limited to:

- i. Individual animal records showing origin, age, species, gender etc.
- ii. Individual veterinary record
- iii. Reproductive history
- iv. Current diet and record of diet changes
- v. Group food consumption and preferred food items
- vi. Daily enrichment
- vii. Group deaths, including neo-natal deaths, stillborns and aborted fetuses should be recorded.

VIII. Staff Safety

- a. All sanctuary personnel directly involved with animal care should be vaccinated against rabies and have periodic titer evaluations.
- b. Sanctuaries shall have an emergency response protocol, and shall be able to demonstrate readiness to respond to an emergency situation, such as an escape or natural disaster involving evacuation.

IX. Veterinary Care

- a. All sanctuaries shall adhere to USDA APHIS requirements.
- b. Services of a licensed veterinarian with experience in exotic, zoo or wildlife mammal medicine shall be available and be on call at all times to deal with routine health evaluation and treatment and medical emergencies.
- c. All bats shall be visually inspected on a daily basis. A general assessment shall be made and any unusual activities shall be recorded in the daily log at each inspection. Specifically, logs shall include observations such as condition of urine and feces, eating and drinking patterns, administration of medications (if any), and general condition and behavior of the group.
- d. A veterinarian or trained veterinary technician shall perform fecal examinations to look for parasites and other problems at least twice a year. Results shall be recorded.

- e. All sanctuaries shall have the ability to capture animals to address medical concerns or allow veterinary procedures to occur.
- f. Wing fractures are the most common injury seen in nectar feeding bats in captivity with the humerus being the most commonly effected bone.
- g. All deceased bats should be necropsied and recorded.
- h. No vaccinations are recommended for bats, although extra-label use of the rabies 3 year vaccine has been used to vaccinate bats with apparent success.

Old World Frugivorous Bat Care Standards

Version 1.0 September 1, 2010

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This set of standards includes bats in

Family: *Pteripodidae*

Genus: *Pteropus*

Common names: Various, collectively called flying foxes

There are about 1,000 recognized species of bats (order Chiroptera) worldwide. They are greatly diversified both in habitat and in feeding strategies. Bats feed on insects, fruits, plant parts such as leaves and flowers, nectar, pollen fish, smaller vertebrates and blood. There are approximately 60 species of frugivorous bats belonging to the genus *Pteropus* found in the Africa, Asia, and Oceania. These bats are the primary focus of these standards.

All bats require proper flight for their long term well-being. They must be provided with sufficient space in an appropriate environment to ensure their physical and psychological needs are met. Because of these species' specialized needs and diet, Sanctuaries shall be prepared to meet all their husbandry requirements. The following standards are minimal and every effort shall be made to exceed them.

All bats belonging to the genus *Pteropus* are deemed “injurious wildlife” by the United States Fish and Wildlife Service and require additional licensure in order to be held in captivity.

I. Housing requirements

Flying foxes can have variable roosting requirements and habits. Some roost in colonial groups, some roost in groups, though do not cluster and some roost solitarily. Most flying foxes roost in the tops of trees, in the open in tree foliage however, some small flying foxes may use caves, structures and vegetation. Roosting colonies can vary in number.

a. Enclosure requirements

- i. All bats belonging to the genus *Pteropus* are subject to USFWS Title Code 50 as well as United States Code Title 7 (Animal Welfare Act). Specifically pertaining to enclosures, *Pteropus* are required to be maintained in a double-contained enclosure (cage within a cage) at all times.

- ii. There should be a minimum of 2 inches between inner containment and outer containment to prevent bats thumbs and toes from getting caught.
- iii. Enclosures should be designed free of sharp edges to prevent wing tears and wing tip injuries.
- iv. Enclosure surfaces should be non-porous and non-abrasive.
- v. Some bats can squeeze through incredibly small spaces. Doors and enclosure joints must be constructed carefully. Vents must also be covered to prevent escape. vi. Enclosures must be able to withstand a great deal of hosing and/or cleaning. vii. Enclosure shape may be variable; square, rectangular, L-shaped or hexagonal.
- viii. Enclosure design should promote continuous flight, such as a center structure or cage furniture to impede cross flight, keeping in mind that some fruit bats are low flyers.
- ix. Design of enclosures using solid walls must allow for sufficient sunlight and air flow throughout the enclosure.
- x. Ceiling and enclosure sides should be no greater than ½ inch to allow bats to grasp, hang and climb.
- xi. Polyethylene or vinyl coated wire mesh may be used for ceiling and enclosure sides.
- xii. Galvanized wire mesh should not be used as it can cause zinc toxicity in bats. xiii. Roosting areas such as synthetic tree limbs or roosting structures should have roughened surfaces to facilitate roosting.
- xiv. Roosting areas should be offered at various elevations within the enclosure. xv. If the enclosure is exposed to a fair amount of sunlight, it is necessary to provide multiple darken areas within the enclosure allowing the bats to rest during the day.
- xvi. Multiple visual barriers should be implemented in the form of enclosure decorations such as plants, partitions or roosting boxes to reduce social structure stress within the group, to allow for the establishment of multiple territories and for bachelor groups to form.
- xvii. Sanctuary must also provide alternative housing for sick or injured individuals while in close proximity to the social group.

b. Dimensions

- i. Enclosure should be of adequate size to promote allow for continuous free flight. For a group up to twenty individuals (20) the minimum enclosure size should be a minimum of 12 times the wingspan of the largest bat, squared. For each addition of 10 animals, total enclosure space should be increased by 15%.
- ii. Take into consideration food presentation and roosting structures in enclosure design insuring that structures do not reduce total flight space.
- iii. Cage height should be at a height where caretakers can perform visual inspections of individuals and easily access bats from ceiling, typically ranging from 6.5 feet to 7.5 feet. c. Outdoor enclosures
 - i. Outdoor enclosures must be double contained (cage within a cage) for optimum safety of the bats and to prevent escapes.
 - ii. Outer structure of the enclosure should be structurally sound and/or have safeguards to be secure from predators such as snakes and raccoons.
 - iii. In the event of inclement weather, inadequate temperature control (too cold) or extreme weather (hurricane, tornado) an enclosed shelter must be provided and utilized for the bats safety.
 - iv. If bats are housed outdoors for part of the year and housed indoors for the rest of the year, ideally the two structures should be connected allowing for stress-free movement (hands free) transition from one enclosure to the other.
 - v. Enclosed shelters (indoor day/night rooms) for groups housed outdoors can be used.

1. Bats should have free choice access to structure at all times.
 2. In situations such as weather or temperature that bats must be locked within the shelter, this shall only be for short-term confinement and not comprise the primary housing.
- d. Containment:
- i. Barriers shall prevent direct contact between bats and the public if allowed in the Sanctuary.
 - ii. Enclosures that be inspected on a regular basis to ensure caging /mesh are in good condition and able to prevent escapes.
- e. Substrate
- i. Outdoor enclosures
 1. All outdoor enclosures will have a natural substrate consistent with the site.
 2. The substrate surfaces can be made of natural substances (e.g. soil, sand, grass) that provide good drainage.
 3. Hard surface items naturally occurring like rocks should be removed from enclosure.
 - ii. Indoor enclosures
 1. All indoor enclosures should have a padded or soft textured floor to prevent injuries to downed bats. Concrete floors should be covered with a non-porous cushioned surface designed to withstand daily cleaning.
 2. Standing water in indoor floor areas can be a drowning hazard and become a breeding ground for bacteria. Floors shall therefore be impervious to water, be quick to dry, and sloped to a drain if necessary.
- f. Enclosure doors
- i. A double door system must be installed per statues of the USFWS. Double doors are a key element of facility design to prevent escape.
 - ii. Doors must be designed to allow caregiver view of enclosures while opening doors.
 - iii. Doors must have safety mechanisms to insure they can be „locked“ for both human and animal safety.
- g. Shelter
- Since roosting habits and reproductive strategies vary greatly among frugivorous bats, a wide variety of roosting options should be offered, especially when housing missed species groups. Some bats may prefer to roost in the open, from the top of the cage or in roosting structures. Most flying foxes are colonial to some degree and females of some species may segregate into maternity colonies.
- i. A sufficient number of roosting structures to accommodate all animals simultaneously will be provided in all enclosures.
 - ii. Roosting structures, such as wicker baskets, boxes, natural or artificial vegetation or artificial cave like structures, provide both day roosting habitat and night roosting habitats. Bats should have access to both types of roosting structures at all times.
 - iii. Roosting boxes should be constructed from non-treated wood. All four sides as well as the top on front of the roost box should be grooved or be lined with a polyethylene mesh to provide an area for bats to easily grasp and hold. It is necessary to have a long landing platform on these boxes that are meshed or grooved as well.
 - iv. Shelters can be created through natural and artificial means within outdoor and indoor enclosures.
 - v. Roosting areas must provide dry space during wet weather and provide protection from wind.
- h. Enclosure furniture

1. Accessories to provide bats a more natural environment should be utilized. Various types of foliage ranging from artificial flowers, vines, leaves and plants can be used.
 2. Plantings, potted trees or plantings or natural cuttings and branches may also be used.
 - a. All plant materials in an enclosure will be evaluated for potential toxicity, including leaves, buds, seeds, fruit, bark and flowers.
 - b. Avoid plants that contain thorns.
 - c. Fruit bats will feed on certain leaves and flowers of several plants available for horticulture.
 3. Climbing apparatus should be offered in the form of ropes, swings, ladders, vines or natural or artificial tree climbs.
 - a. Ropes and swings promote static flight which is common especially in juvenile individuals.
 - b. Ropes should be at a minimum height of 1 ½ times the length of the longest animal to prevent touching or hitting the enclosure floor.
 - i. Sanitation
- i. Care must be taken to minimize exposure of animals in adjacent spaces to over spray, disinfectants or waste materials.
 - ii. Outdoor enclosures shall be cleaned daily and feces raked and removed to avoid unsanitary or unsafe conditions.
 - iii. Daily removal of uneaten food
 1. Is an important element of pest control and disease prevention
 2. Enables care givers to monitor changes in food consumption.
 3. Minimizes risk for consumption of spoiled food items. iv. Daily removal of animal waste
 1. Is an important element of pest control and disease prevention
 2. Enables caregivers to monitor animal health
 3. Enables caregivers to collect fecal samples in a timely manner.
 - v. Soiled bedding material and substrate are removed and replaced with fresh materials daily.
 - vi. Damaged and soiled enrichment items are removed daily.
 - vii. Disinfection and Sanitizing
 1. All surfaces including walls, floors, ceiling, cage mesh and caregiver work areas must be sanitized regularly to the extent possible.
 2. Staff must follow proper disinfecting procedures when moving between enclosures.
 3. Disinfectants used in outdoor areas must not accumulate in soil and pose hazards to enclosure occupants or to the environment.
 4. Disinfectants used in indoor areas must be rotated on a regular basis.
 5. Disinfectants must be evaluated for hazards to both staff and animals.
 6. Food containers are sanitized daily.
 7. Water containers are sanitized daily.
 - viii. Local, county, state laws regarding proper waste removal are observed. ix. A pest control regimen that is not harmful to the bats (such as bait) shall be in place to prevent infestation. Ants, fruit flies, cockroaches and rats are the most common pest found in enclosures and around fruit bats.

II. Temperature, Humidity, Ventilation, Lighting

a. Temperature

Flying foxes live in a variety of climates, ranging from tropical to sub-tropical, where it is warm and humid, to cooler temperatures in higher elevations. These tropical animals do best in temperatures ranging from 70° - 90° F (21° – 32° C).

1. Supplemental heat should be offered when temperatures fall below 70° F (21° C).
2. Flying foxes cannot withstand temperatures below 50° F (10° C).

Humidity is of greater concern during winter months in indoor enclosures when forced air heat may be in use. A humidity range of 60-90% is generally adequate.

Ventilation
Enclosures should be well ventilated with a recommended 6 – 10 air exchanges per hour with a minimum of 25% fresh air exchange.

d. Lighting

i. Indoor enclosures

1. Natural lighting is optimal and can be obtained from skylights, windows, roll up doors or other means. Supplemental lighting composed of fluorescent or full spectrum lighting can be used during day cycles. Nocturnal lighting must have blue filters to prevent interference with light cycles. A dimming system must be used to prevent the shock of immediate bright light/complete darkness.
2. Fruit bats can see most colors, including red.

ii. Outdoor enclosures

1. While not necessarily required, consideration should be given to supplemental lighting or power sources for use in outdoor areas in event of emergencies.
1. Flying foxes adapt well to a daylight period ranging from 10 – 14 hours.
2. An artificially shortened day length period can adversely impact food consumption and other natural behaviors.

III. Nutrition

Frugivorous bats have specialized dietary requirements. They primarily feed on fruits on trees, vines and shrubbery in the wild. They also will consume flowers, nectar, pollen, plant parts and occasionally incidental insects.

a. Basic Requirements

- i. High quality and nutritionally correct food shall be provided in sufficient quantities to maintain animal health and appropriate weight.
- ii. Consumption of diets, including browse and enrichment items, should be monitored closely.
- iii. Browse can be used to provide enrichment activities for the bats but should not be considered as a daily food source.
- iv. There should always be uneaten food remaining in feeders to ensure all bats are getting enough food.

b. Diet Composition

- i. Fresh manually prepared diet

Captive diets are comprised of a mix of fruits, vegetables, juices and supplements.

a. Various forms of diets are available, however, sanctuaries should strive to be as close as possible to the following ratios:

Apple	36%
Pear	7%
Banana	14%
Grapes	10%
Melons (cantaloupe, honey dew)	12%
Carrot or Sweet Potato	9%
Leafy Greens (kale, spinach etc)	6%
Supplements	6%

b. Ingredients should be well mixed prior to feeding.

c. For bats, the apple ratio can be reduced and replace with an increase of melon.

ii. Supplements for frugivorous bats in captivity include

a. Well balanced vitamin supplement

i. Vitamin a and e are extremely important to bats.

b. Calcium supplement

i. Insure source is free of contaminants such as fluoride or heavy metals.

c. Commercially prepared fruit bat supplement are available.

iii. Commercial diets

1. Commercially processed fruits such as canned fruits have been used for the feeding of fruit eating bats.

a. Commercially processed foods should not comprise the majority of the diet, nor fed to bats in entirety.

b. All syrups and sugars should be rinsed off fruit prior to use.

iv. Juice

a. For smaller frugivorous bats, juices may be offered in addition to fruit.

b. Most often supplements are mixed into juice to make a slurry for the bats.

c. Juices should be 100% juice, not a fruit juice beverage.

c. Water

i. Fresh clean water must be available at all times. ii. Water should be presented in small shallow dishes placed on ledges or hanging cups around the perimeter of the enclosure at a height of approximately one head to toe length of the bat from the ceiling. When various sizes of frugivorous bats are housed together, height of dish placement from the ceiling should also vary.

d. Browse (fresh plant or produce material)

i. Freshly cut plant material, produce such as vegetables and fruit wedges or flowers should be offered daily to enhance natural feeding behaviors.

ii. All caregivers must be trained to identify safe non-toxic plant species appropriate to feed bats. iii. Bats held in outdoor cages may crawl down the side of the enclosure in search of grass forage.

e. Treats or „Enrichment“ Food items

i. Novel fruits, vegetables, flowers, juices, natural jams or preserves may be offered as enrichment valued items. Items can be dispersed to encourage foraging behaviors.

ii. Enrichment items shall be offered periodically so bats to not feed solely on enrichment items.

iii. Enrichment items should never be relied on as a part of the daily diet.

f. Food presentation

It is important to take into consideration when choosing a feeding style or item whether or not it will be accommodating and easily accessed by fruit eating bats.

i. Bowls, coop cups or non-toxic dishes may be used to offer fruit.

1. Food must be at a height to allow bats to hang over dishes to access fruit. Food stations can be suspended from ceiling in baskets or offered along the sides of the structure.
2. If feeding stations are in a confined area, several dishes should be offered to reduce competition for food.
3. A few dishes should be a few feet lower to the main level of dishes to insure that submissive individuals can escape and can avoid more dominate individuals guarding dishes while maintaining access to food.
4. Stainless steel dishes are durable and easiest to sanitize.

ii. Open topped feeders or shallow dishes in baskets may be used when offering nectar or juices.

1. Drowning is a factor to consider when presenting food for small bats. Items like glass beads or marbles in a shallow dish can prevent drowning.

iii. When changing feeding presentation, do so with additional fruit to ensure all bats have found enough food sources. Lesser used items can then be removed after the transition period.

iv. Place feeders in several different areas of the enclosure to reduce competition for food.

v. Place some feeders in very open, easily accessible areas for older, less maneuverable bats.

vi. Fruits can be also offered on metal skewers, tree branches or from suspended dishes.

vii. Food should never be offered from the floor of the enclosure at any time. g. Feeding schedule

i. Fruit mixtures and juices will ferment when left out overnight, especially in warm climates.

1. Bats should be feed at the end of the light cycle to minimize spoilage of diet prior to feeding.
2. Feeders should be removed at the beginning of the light cycle to prevent ingestion.
3. Additional feedings may be necessary when housing large colonies of frugivorous bats to insure all individuals are provided will sufficient access to food.

h. Diet increases or decreases

i. Adjustments made to an already formulated and nutritionally balanced diet must be made to the entire diet to insure continued nutritional balance.

- ii. Considerations for diet increase include weight and condition of all animals in the group, overall food consumption, activity level of the group, feeding competition and other medical or behavioral considerations.
- iii. Considerations for diet decrease include weight and condition of all animals in the group, overall food consumption, activity level of the group, feeding competition and other medical or behavioral considerations.
- iv. Diet increases or decreases must be made in modest increments with animal response to the change assessed for a minimum period before additional changes are made.
- v. Underweight individuals experiencing health or behavioral problems may be separated into smaller groups (never solitarily) for supplemental feeding as needed to avoid undesirable weight gain in conspecifics.

- i. Food handling protocols
 - i. Feeders and dishes should be thoroughly washed with soap, rinsed very well and air dried before reuse.
 - ii. Feeders, dishes and mixing utensils should be bleached once weekly and left to thoroughly dry to prevent bacterial growth.
- j. Food storage protocols
 - i. Follow expiration dates of perishable items very closely.
 - ii. Produce
 - 1. Must be stored in a clean, dry refrigerator.
 - 2. Order in increments that can be used prior to spoilage.
 - iii. Frozen
 - 1. Even though the bats prefer fresh fruit, thawed frozen fruit can be offered.

IV. Social, Psychological, Physical and Behavioral Well-Being

- a. Social Housing and Management
 - a. Bats are highly social animals.
 - b. Bats should not be housed as single animals.
 - c. When possible, single sex groups are recommended and breeding should not be permitted.
 - d. Sex ratios of 2 males to 6-8 females are generally recommended if it is necessary to house mixed sex groups.
 - e. Females of some fruit bats will segregate into maternity colonies.
 - f. Inter or intra-specific aggression is rarely noted in situations such as food or harem guarding.
- ii. Solitary housing
 - 1. Never house social bats individually. Even in situations when it is necessary to remove a bat from the main colony, a few additional bats can be housed with the convalescing or quarantining bat. This must be temporary and reserved for situations including but not limited to:
 - a. Quarantine
 - b. Medical assessment
 - c. Medical care
- iii. Introductions of unfamiliar individuals
 - 1. The introduction or removal of flying foxes tend to create no problem within existing colonies.
 - 2. The introduction of male flying foxes into existing colonies may result in initial bickering and fighting as the group's social structure is challenged or altered and occupation of territories are attempted.
 - 3. The removal of male flying foxes from colonies makes no impact unless the male is of high ranking in the social order. Then there will be aggression amongst males until a new hierarchy is established.
 - 4. Close observation must be made by staff for several hours after the introduction of any bat into an established colony.
- iv. Coexistence with other species

1. Frugivorous bats have been housed with other frugivorous and nectarivorous bats without any apparent problems.
2. Fruit bats have been housed with mixed taxa with no apparent problems.

v. Caregiver Relationships

1. Though some frugivorous bats do exhibit some preferences among handlers, the bats do not form relationships with caregivers. They do become accustomed to the daily routine of feeding and cleaning of the enclosure and sometimes will seek out the caretaker for food.

V. Handling and Restraint

- a. Flying foxes can be caught with a finely meshed insect, aquarium net or finely meshed fishing net.
- b. Avoid capturing of bats against any rigid wall of the enclosure.
- c. Never pull a bat from its roosting area. Gently unhook their toenails from any wire, mesh or perches that the bat may be roosting on to prevent injury or loss of toes/toenails.
- d. Flying foxes have very strong jaws. Heavier, thick leather gloves may be necessary. If a bat bites a glove, never remove the bat by force. This can cause injury to their jaws or teeth. Blow quick forceful puffs of air on the face's face until they let go.
- e. Never squeeze or hold bats too tightly. Holding the bats in your cupped hand or wrapped in a towel will prevent injuries to the bats.
- f. Never hold bats by the wing tips during restraint and always fold the wings naturally close to the body.

VI. Crating and Transport

- a. IATA standards should be followed for all shipments of bats.
 - i. Bats can be shipped communally.
 - ii. Mothers with nursing infants should not be shipped.
 - iii. Mesh should be attached to all sides, including ceiling to allow for proper roosting behavior in transit.
 - iv. Floor of the container should be padded with a pillow or foam pad.
 - v. Bats should have access to food and water prior to shipping.
 - vi. Bats should not remain in shipping container for more than 15 hours.
- b. Standards listed in USFWS Title Code 50 FCR Part 13 and Part 16 as well as United States Code Title 7, Chapter 54, Section 2143 must be followed
 - i. Animals must be maintained in a double enclosed container at all times.

VII. Record Keeping

- a. Detailed individual or colony records are necessary for good husbandry, management and veterinary care. Additionally, some records and programs are required by federal regulations.

Records that are recommended and/or required include but are not limited to:

- i. Individual animal records showing origin, age, species, gender etc.
- ii. Individual veterinary record
- iii. Reproductive history
- iv. Current diet and record of diet changes

- v. Group food consumption and preferred food items
- vi. Daily enrichment
- vii. Group deaths, including neo-natal deaths, stillborns and aborted fetuses should be recorded.

VIII. Staff Safety

- a. All sanctuary personnel directly involved with animal care should be vaccinated against rabies and have periodic titer evaluations.
- b. Staff should wear heavy leather gloves when handling larger bats to prevent bites.
- c. Sanctuaries shall have an emergency response protocol, and shall be able to demonstrate readiness to respond to an emergency situation, such as an escape or natural disaster involving evacuation.

IX. Veterinary Care

- a. All sanctuaries shall adhere to USDA APHIS requirements.
- b. Services of a licensed veterinarian with experience in exotic, zoo or wildlife mammal medicine shall be available and be on call at all times to deal with routine health evaluation and treatment and medical emergencies.
- c. All bats shall be visually inspected on a daily basis. A general assessment shall be made and any unusual activities shall be recorded in the daily log at each inspection. Specifically, logs shall include observations such as condition of urine and feces, eating and drinking patterns, administration of medications (if any), and general condition and behavior of the group.
- d. A veterinarian or trained veterinary technician shall perform fecal examinations to look for parasites and other problems at least twice a year. Results shall be recorded.
- e. All sanctuaries shall have the ability to capture animals to address medical concerns or allow veterinary procedures to occur.
- f. Thumb and nail injuries, wing tears, lip abrasions, dry skin and feet, and fractures are the most common injuries seen in frugivorous feeding bats in captivity.
- g. All deceased bats should be necropsied and results recorded.
- h. No vaccinations are recommended for bats. Extra-label use of the rabies 3 year vaccine has been used to vaccinate bats with apparent success.

Sanguinivorous (Vampire) Bat Care Standards

Version 1.0 September 1, 2010

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This set of standards includes bats in

Family: *Phyllostomidae*

Genus: *Desmodus rotundus*, *Diaemus youngii*, *Diphylla ecaudata*

Common names: Common vampire bat, White-winged vampire bat and Hairy-legged vampire bat

There are about 1,000 recognized species of bats (order Chiroptera) worldwide. They are greatly diversified both in habitat and in feeding strategies. Bats feed on insects, fruits, plant parts such as leaves and flowers, nectar, pollen fish, smaller vertebrates and blood. Three species of bats are specialized sanguinivores. The most common vampire bat held in captivity is the Common vampire bat, *Desmodus rotundus* and is the primary focus of these standards.

All bats require proper flight for their long term well-being. They must be provided with sufficient space in an appropriate environment to ensure their physical and psychological needs are met. In addition to flight, vampire bats feature an elongated thumb enabling them to climb vertical walls, crawl on “all fours” and jumping in virtually in any direction. Because of this species' specialized needs and diet, Sanctuaries shall be prepared to meet all their husbandry requirements.

The following standards are minimal and every effort shall be made to exceed them.

I. Housing requirements

Suitable roosting sites are very important to vampire bats. They can be found roosting in tree hollows, humid caves, old mineshafts, abandoned wells and man-made structures. Roosting preference and colony size may vary. Vampire bats may roost alone, in small groups or in very large colonies of many hundreds of individuals.

a. Enclosure requirements

- i. Enclosures should be designed free of sharp edges to prevent wing tears and wing tip injuries.
- ii. Enclosure surfaces should be non-porous and non-abrasive since these bats readily use their thumbs for locomotion.
- iii. During enclosure design, keep in mind that vampire bats will hang from horizontal and vertical surfaces with preference to surfaces that allow for contact with forearms.
- iv. Vampire bats can squeeze through incredibly small spaces. Doors and enclosure joints must be constructed carefully. Vents must also be covered to prevent escape.
- v. Enclosures must be able to withstand a great deal of hosing and/or cleaning.
- vi. Enclosure shape may be variable; square, rectangular, L-shaped or hexagonal.
- vii. Enclosure design should promote continuous flight, such as a center structure or cage furniture to impede cross flight, keeping in mind that vampire bats are low flyers.
- viii. Design of enclosures using solid walls must allow for sufficient sunlight and air flow throughout the enclosure.
- ix. Ceiling and enclosure sides should be no greater than ¼ inch to allow bats to grasp, hang and climb.
- x. Polyethylene or vinyl coated wire mesh may be used for ceiling and enclosure sides.
- xi. Galvanized wire mesh should not be used as it causes zinc toxicity in vampire bats.
- xii. Roosting areas such as vaults, concave hollows or synthetic cave structures should have roughened surfaces to facilitate roosting.
- xiii. Roosting areas should be offered at various elevations within the enclosure.
- xiv. If the enclosure is exposed to a fair amount of sunlight, it is necessary to provide multiple darken areas within the enclosure allowing the bats to rest during the day.
- xv. Multiple visual barriers should be implemented in the form of enclosure decorations such as plants, partitions or roosting boxes to reduce social structure stress within the group, to allow for the establishment of multiple territories and for bachelor groups to form.

- xvi. Sanctuary must also provide alternative housing for sick or injured individuals while in close proximity to the social group.

b. Dimensions

- i. Enclosure should be of adequate size to promote allow for continuous free flight and terrestrial movement. For a group up to twenty individuals (20) the minimum enclosure size should be a minimum of 12 times the wingspan of the largest bat, squared. For each addition of 10 animals, total enclosure space should be increased by 15%.
- ii. Take into consideration food presentation and roosting structures in enclosure design insuring that structures do not reduce total flight space.
- iii. Cage height should be at a height where caretakers can perform visual inspections of individuals and easily access bats from ceiling, typically ranging from 6.5 feet to 7.5 feet. c. Outdoor enclosures

Due to the sensitivity of these bats to temperature, it is recommended that vampire bats be housed indoors when possible.

- i. It is recommended that outdoor enclosures be double contained (cage within a cage) for optimum safety of the bats and to prevent escapes. ii. Outer structure of the enclosure should be structurally sound and/or have safeguards to be secure from predators such as snakes and raccoons.

- iii. In the event of inclement weather, inadequate temperature control or extreme weather

(hurricane, tornado) an enclosed shelter must be provided and utilized for the bats safety. iv. If bats are housed outdoors for part of the year and housed indoors for the rest of the year, ideally the two structures should be connected allowing for stress-free movement (hands free) transition from one enclosure to the other.

d. Containment:

- i. Barriers shall prevent direct contact between bats and the public if allowed in the Sanctuary.
- ii. Enclosures that be inspected on a regular basis to ensure caging /mesh are in good condition and able to prevent escapes.

e. Substrate

- i. Various substrates have been used to aid in cleaning the enclosure. ii. Ensure that substrates are not abrasive and do not adhere to the bats. iii. Non-colored newsprint paper provides the easiest substrate to clean and will not adhere to the bats.

1. Outdoor enclosures

- a. All outdoor enclosures will have a natural substrate consistent with the site.
- b. The substrate surfaces can be made of natural substances (e.g. soil, sand, grass) that provide good drainage.
- c. Hard surface items naturally occurring like rocks should be removed from enclosure.

2. Indoor enclosures

- a. All indoor enclosures should have a padded or soft textured floor to prevent injuries to downed bats. Concrete floors should be covered with a non-porous cushioned surface designed to withstand daily cleaning.
- b. Standing water in indoor floor areas can be a drowning hazard and become a breeding ground for bacteria. Floors shall therefore be impervious to water, be quick to dry, and sloped to a drain. f. Enclosure doors

- i. It is recommended that there be a double door system installed, as these bats are very quick and highly maneuverable flyers. Double doors are a key element of facility design to prevent escape. ii. Doors must be

designed to allow caregiver view of enclosures while opening doors, as these bats are very adept at hopping and very quick movers.

iii. Doors must have safety mechanisms to insure they can be „locked“ for both human and animal safety.

g. Shelter

As previously stated, suitable roosting structures are of utmost importance to vampire bats.

- i. A sufficient number of roosting structures to accommodate all animals simultaneously will be provided in all enclosures.
- ii. A greater number of roosting structures must be provided to vampire bats to ensure that displaced males have areas to retreat preventing inter-male aggression.
- iii. Regardless of the type of roosting structures offered, vampire bats will congregate in the highest area of the enclosure as possible.
 1. Ensure light fixtures are not the highest point of the enclosure, as vampire bats have been known to utilize fixtures as a roost.
- iv. Vampire bats seem to prefer cave-like or dome-like roosting structures that can be made of hardware cloth and plaster of Paris.
 1. Hardware cloth that is ¼ inch in size should be used and molded into a dome
 2. Plaster of Paris is applied to wire mesh frame.
 3. Grooves or pebbles are incorporated into plaster of Paris before it dries to provide a suitable roosting surface.
 4. Once dry, the structure should be sealed with water-based polyurethane finish.
- v. Roosting structures may be constructed out of materials such as laminated plastic or nontreated sealed wood boxes. These materials are the easiest to clean, as vampire excrement is very sticky and tar like.
- vi. Roosting boxes must be roughed or meshed. All four sides as well as the top on front of the roost box should be grooved or be lined with a polyethylene mesh to provide an area for bats to easily grasp and hold. It is necessary to have a long landing platform on these boxes that are meshed or grooved as well.
- vii. Roosting structures should provide both day roosting habitat and night roosting habitats.

Bats should have access to both types of roosting structures at all times.
- viii. Natural or artificial vegetation may be used however must be removable or replaceable for cleaning. ix. Shelters can be created through natural and artificial means within outdoor and indoor enclosures.
- x. Roosting areas must provide dry space during wet weather and provide protection from wind.

h. Enclosure furniture

1. Accessories to provide bats a more natural environment should be utilized. Various types of foliage ranging from artificial flowers, vines, leaves and plants can be used.
2. Plantings, potted trees or plantings or natural cuttings and branches may also be used.
3. All materials in an enclosure will be evaluated for potential toxicity, including leaves, buds, seeds, fruit, bark and flowers.
4. Avoid plants that contain thorns.

i. Sanitation

- i. Care must be taken to minimize exposure of animals in adjacent spaces to over spray, disinfectants or waste materials.

- ii. Outdoor enclosures shall be cleaned daily and feces raked and removed to avoid unsanitary or unsafe conditions.
- iii. Daily removal of uneaten food
 - 1. Is an important element of pest control and disease prevention
 - 2. Enables care givers to monitor changes in food consumption.
 - 3. Minimizes risk for consumption of spoiled food items.
- iv. Daily removal of animal waste
 - 1. Is an important element of pest control and disease prevention
 - 2. Enables caregivers to monitor animal health
 - 3. Enables caregivers to collect fecal samples in a timely manner.
- v. Soiled bedding material and substrate are removed and replaced with fresh materials daily.
- vi. Damaged and soiled enrichment items are removed daily.
- vii. Disinfection and Sanitizing
 - 1. Vampire bat excrement is very sticky and often requires scrubbing. All surfaces including walls, floors, ceiling, cage mesh and caregiver work areas must be sanitized regularly to the extent possible.
 - 2. Staff must follow proper disinfecting procedures when moving between enclosures.
 - 3. Disinfectants used in outdoor areas must not accumulate in soil and pose hazards to enclosure occupants or to the environment.
 - 4. Disinfectants used in indoor areas must be rotated on a regular basis.
 - 5. Disinfectants must be evaluated for hazards to both staff and animals.
 - 6. Food containers are sanitized daily.
 - 7. Water containers are sanitized daily.
- viii. Local, county, state laws regarding proper waste removal are observed.
- ix. A pest control regimen that is not harmful to the bats shall be in place to prevent infestation. Cockroaches are the most common pest found in enclosures and around vampire bats.

II. Temperature, Humidity, Ventilation, Lighting

a. Temperature

Vampire bats are tropical and sub-tropical bats and cannot withstand low temperatures for an extended period of time and also do poorly in excessive temperatures.

- i. These tropical animals do best in temperatures ranging from 65° - 85° F (18° – 29° C).
- ii. When ambient temperatures fall below 50° F (10° C), vampire bats have difficulty maintaining normal body temperatures.
- iii. Due to high metabolism and a poor ability to cool themselves, temperatures above 85° F (29° C) must be avoided.
- iv. A temperature gradient with the enclosure will ensure that all bats will have thermal preferences met.

b. Humidity

- i. Humidity is of greater concern during winter months in indoor enclosures when forced air heat may be in use.

- ii. A humidity range of 40-60% is generally adequate. iii. Vampire bats can tolerate a wider range of temperatures if humidity levels are maintained high enough.
- c. Ventilation
 - Enclosures should be well ventilated with a recommended 6 – 10 air exchanges per hour with a minimum of 25% fresh air exchange.
- d. Lighting
 - i. Indoor enclosures
 - 1. Natural lighting is optimal and can be obtained from skylights, windows, roll up doors or other means. Supplemental lighting composed of fluorescent or full spectrum lighting can be used during day cycles. Nocturnal lighting must have blue filters to prevent interference with light cycles. A dimming system must be used to prevent the shock of immediate bright light/complete darkness.
 - ii. Outdoor enclosures
 - 1. While not necessarily required, consideration should be given to supplemental lighting or power sources for use in outdoor areas in event of emergencies. e. Photoperiod
 - 1. Vampire bats adapt well to a daylight period ranging from 10 – 14 hours.
 - 2. An artificially shortened day length period can adversely impact food consumption and other natural behaviors

III. Nutrition

Vampire bats have very specialized dietary requirements. They are obligatory blood feeders. They have specialized digestive tracts and cannot accept solid food of any type. Therefore, they are unable to utilize coagulated blood.

- a. Basic Requirements
 - i. Vampire bats have high metabolisms and can only go 48-72 hours without food before they die of starvation. Sanctuaries must have a reliable source of fresh blood, provided in sufficient quantities to maintain animal health and appropriate weight.
 - ii. Cattle blood is the preferred diet by vampire bats. iii. Vampire bats must have access to food 24 hours a day. iv. Diet should be anticoagulated by means of chemical anticoagulation or manual defibrillation.
 - 1. Chemical anticoagulation is preferred as defibrillation results in altering factors within the blood necessary for the vampire bats welfare.
 - v. Consumption of diets, including enrichment items, should be monitored closely.
 - vi. There should always be uneaten food remaining in feeders to ensure all bats are getting enough food.
 - vii. Follow all applicable laws as many states have regulations regarding the distribution of blood.
- b. Blood Preparation
 - i. Blood must be collected from animal in a manner that does not cause contamination.
 - ii. Blood must immediately be prepared upon collection to prevent coagulation.
 - 1. Chemical coagulation
 - a. For each gallon of blood, add
 - i. Dextrose 12.5 grams
 - ii. Citric acid 4 grams
 - iii. Sodium citrate 11 grams
 - b. Mix very well
- c. Water

- i. Fresh clean water must be available at all times.
 - ii. Water should be presented in small shallow dishes or the same type of feeders that offer the blood meal placed low in the enclosures.
 - iii. If flowing water or small ponds are offered as a water source, the depth must not exceed 3-5 mm to prevent drowning.
- d. Enrichment Food items
 - i. Novel blood may be offered as enrichment valued items. Species of blood that have been used include swine, equine, sheep, chicken, elephant, camel and human.
 - ii. Enrichment items shall be offered periodically so bats to not feed solely on enrichment items.
 - iii. Enrichment items should never be relied on as a part of the daily diet.
- e. Food presentation
 - i. A variety of feeders may be used. Glass or plastic tube bottom delivery feeders, ice cube trays and Petri dishes may be used.
 - ii. Vampire bats prefer to eat low to the ground.
 - iii. Feeders that can accommodate more than one animal at a time will reduce aggression. iv. Place feeders in several different areas of the enclosure to reduce competition for food.
 - v. Place some feeders in very open, easily accessible areas for older, less maneuverable bats.
- f. Feeding schedule
 - i. Bats should be feed at the end of the light cycle to minimize spoilage of diet prior to feeding. ii. Feeders should be removed at the beginning of the light cycle to prevent ingestion of spoiled food.
 - iii. Fresh diet should be offered at all times. During the bats resting period, a few feeders containing fresh diet (not diet left from the night before) should be distributed throughout the enclosure.
 - iv. In large colonies, a twice daily feeding schedule may be necessary.
- g. Diet increases or decreases
 - i. Start with a guideline of 20 ml of blood per bat per day. Adjust accordingly. ii. Adjustments made to an already formulated and nutritionally balanced diet must be made to the entire diet to insure continued nutritional balance.
 - iii. Considerations for diet increase include weight and condition of all animals in the group, overall food consumption, activity level of the group, feeding competition and other medical or behavioral considerations
 - iv. Considerations for diet decrease include weight and condition of all animals in the group, overall food consumption, activity level of the group, feeding competition and other medical or behavioral considerations.
 - v. Diet increases or decreases must be made in modest increments with animal response to the change assessed for a minimum period before additional changes are made. vi. Underweight individuals experiencing health or behavioral problems may be separated into smaller groups (never solitarily) for supplemental feeding as needed to avoid undesirable weight gain in conspecifics.
- h. Food handling protocols
 - i. Feeders should be thoroughly washed with soap, rinsed very well and air dried before reuse.
 - ii. Feeders and utensils should be bleached once weekly and left to thoroughly dry to prevent bacterial growth.
 - i. Food storage protocols

- i. Fresh blood can be stored in refrigerator for no more than 14 days (7 days preferable)
- ii. Frozen blood can be stored in freezer for no more than 6 months (30 days preferable)
 - a. Frozen blood deteriorates rapidly upon thawing and must be used upon thawing.
 - b. Frozen blood is often kept as an emergency in the event where facilities are unable to obtain fresh blood.
- iii. Oldest stock must be used first.

IV. Social, Psychological, Physical and Behavioral Well-Being

a. Social Housing and Management

Vampire bats are highly social and will form colonies and bachelor groups. Females will segregate into maternity colonies, guarded by one dominant male.

- a. Bats are highly social animals.
 - b. Bats should not be housed as single animals.
 - c. Preferred sex ratios of 1 adult male to 8-20 females and young are recommended.
 - d. Problems such as decreased reproduction, increased inter-male aggression, increased infant and juvenile mortality may occur when housing too many males to females in overcrowded conditions.
 - e. Bachelor males will roost together in a separate roost close to the main colony, often trying to challenge the dominant male.
 - f. In groups contain one male, castration is recommended to prevent breeding.
 - g. Single sex groups are another method of population control.
 - h. The higher the number of bats, the more groups will form. Ensure that there is enough space and suitable roost to prevent overcrowding.
- ii. Solitary housing
 - 1. Never house social bats individually. Given the complex hierarchy structure of vampire bats, it is recommended only to remove bats when absolutely necessary, minimizing the separation time. Even in situations when it is necessarily to remove a bat from the main colony, a few additional bats can be housed with the convalescing or quarantining bat. This must be temporary and reserved for situations including but not limited to:
 - a. Quarantine
 - b. Medical assessment
 - c. Medical care
 - iii. Food sharing and social structure

Vampire bats are very unique in the animal kingdom in that individuals will adopt orphans and care for unrelated young, elderly or convalescing bats. Since survival in the wild is dictated by the availability of food, vampire bats will regurgitate blood meals to colony members. This behavior in vampire bats is called food sharing.

- 1. Food sharing is considered a normal and common behavior in captivity. It is most common amongst females.
- 2. Vampire bats spend approximately 5% of their day grooming and licking another. This is common necessary behavior for the well-being of the group.
- 3. Observation of many individuals food sharing to one individual may indicate illness in the bat receiving the donated meals.