ASSOCIATION OF ZOOS & AQUARIUMS

VIVERRID
(*Viverridae*)
CARE MANUAL

CREATED BY THE
AZA Small Carnivore Taxon Advisory Group
IN ASSOCIATION WITH THE
AZA Animal Welfare Committee

Viverrids (Viverridae) Care Manual

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Table of Contents

Introduction

Preamble

Association of Zoos & Aquariums (AZA) accredited institutions are required to comply with all relevant local, state, and federal wildlife laws and regulations in addition to all AZA accreditation standards.

AZA accreditation standards, relevant to the topics discussed in this manual, are highlighted in boxes such as this throughout the document (Appendix A).

AZA accreditation standards are continuously being raised or added. Staff from AZA-accredited institutions are required to know and comply with all AZA accreditation standards, including those most recently listed on the AZA website (www.aza.org) which might not be included in this manual.

Taxonomic Classification

Table 1: Taxonomic classification for Viverridae.

Classification	Taxonomy	Additional information
Kingdom	Animalia	
Phylum	Chordata	
Class	Mammalia	
Order	Carnivora	
Suborder	Feliformia	
Family	Viverridae	
Subfamily	Hemigalinae	Owston's civet (Owston's palm civet)
	Paradoxurinae	Binturong
	Prionodontinae	Banded and spotted linsangs
	Viverrinae	Civets, genets, linsangs

Genus, Species, and Status

Table 2: Genus, species, and status information for Viverridae recommended for management by the SCTAG (AZA SCTAG RCP 2009).

Genus	Species	Common Name	USA Status	IUCN Status	AZA Status
Arctictis	*binturong*	Binturong	Not Listed	Vulnerable	PMP
Chrotogale	*owstoni*	Owston's civet (Owston's palm civet)	Not Listed	Vulnerable	Species of Interest

General Information

The information contained within this Animal Care Manual (ACM) provides a compilation of animal care and management knowledge that has been gained from recognized species experts, including AZA Taxon Advisory Groups (TAGs), Species Survival Plan® Programs (SSPs), biologists, veterinarians, nutritionists, reproduction physiologists, behaviorists and researchers. They are based on the most current science, practices, and technologies used in animal care and management and are valuable resources that enhance animal welfare by providing information about the basic requirements needed and best practices known for caring for *ex situ* viverrid populations. This ACM is considered a living document that is updated as new information becomes available and at a minimum of every five years.

Information presented is intended solely for the education and training of zoo and aquarium personnel at AZA-accredited institutions. Recommendations included in the ACM are not exclusive management approaches, diets, medical treatments, or procedures, and may require adaptation to meet the specific needs of individual animals and particular circumstances in each institution. Statements presented throughout the body of the manuals do not represent specific AZA accreditation standards of care unless specifically identified as such in clearly marked sidebar boxes. AZA-accredited institutions which care for viverrids must comply with all relevant local, state, and federal wildlife laws and regulations; AZA accreditation standards that are more stringent than these laws and regulations must be met (AZA

AZA Accreditation Standard

(1.1.1) The institution must comply with all relevant local, state, and federal wildlife laws and regulations. It is understood that, in some cases, AZA accreditation standards are more stringent than existing laws and regulations. In these cases the AZA standard must be met.

Accreditation Standard 1.1.1).
The ultimate goal of this ACM is to facilitate excellent viverrid management and care, which will ensure superior viverrid welfare at AZA-accredited institutions. Ultimately, success in our viverrid management and care will allow AZA-accredited institutions to contribute to viverrid conservation, and ensure that viverrids are in our future for generations to come.

Regulatory Agencies: All state and federal regulations should be followed regarding the care and transportation of these species. Institutional Registrars and curators should consult these fish and wildlife agencies annually for any changes in pertinent regulations.

Taxon Specific Terminology: No taxa specific terminology is habitually found in the literature; typically young are referred to as "young" or "offspring," females as "females" and males as "males." It may be that some professionals refer to young as "kits," "kittens" or "cubs;" within this document we use kit for young.

List of Species (Many of these species are represented by small numbers in AZA institutions.)**:** The Viverridae family is divided into four subfamilies, Hemigalinae, Paradoxurinae, Prionodontinae, and Viverrinae, covering 35 species (ITIS 13 July 2009).

- The Hemigalinae includes four genera and four species of palm civet: Owston's civet (C*hrotogale owstoni*), otter civet (*Cynogale bennettii*), Hose's palm civet (*Diplogale hosei*) and the banded palm civet (*Hemigalus derbyanus*).
- The Paradoxurinae includes five genera and seven species: Binturong (*Arctictis binturong*), small-toothed palm civet (*Arctogalidia trivirgata*), Sulawesi palm civet (*Macrogalidia musschenbroekii*), masked palm civet (*Paguma larvata*) and three *Paradoxurus* species, the Asian palm civet (*P. hermaphrodites*), Jerdon's palm civet (*P. jerdoni*), and the golden palm civet (*P. zeylonensis*).
- The Prionodontinae includes two *Prionodon* linsang species: the banded and spotted linsangs (*P. linsang* and *P. pardicolor* respectively).
- The Viverrinae includes five genera and 22 species: African civet (*Civettictis civetta*); fourteen genet species, Abyssinian genet (*Genetta abysssinica*), Angolan genet (*G. angolensis*), Bourlon's genet (*G. bourloni*), Crested Servaline genet (*G. cristata*), common or small-spotted genet (*G. genetta*), Johnston's genet (*G. johnstoni*), panther or rusty-spotted genet (*G. maculate*), Pardine genet (*G. pardina*), aquatic genet (*G. piscivora*), king genet (*G. poensis*), servaline genet (*G. servalina*), Haussa genet (*G. thierryi*), Cape or large spotted genet (*G. tigrina*), giant forest or giant genet (*G. victoriae*); two linsang species of the genus *Poiana*, Leighton's linsang (*P. leightoni*) and the African linsang (*P. richardsonii*); four civet species of the genus *Viverra,* the Malabar or Malabar large-spotted civet (*V. civettina*), large spotted civet (*V. megaspila*), Malayan civet (*V. tangalunga*), and large Indian civet (*V. zibetha*). Last in this subfamily is the small Indian civet (*Viverricula indica*).

See Appendix F for Species Status listing.

Taxonomic Note: The classification of the Malagasy carnivores has been debated since their discovery. These species had been placed in several different families, including *Viverridae*, *Herpestidae*, and the fossa at one time was placed with the *Felidae* and *Eupleres*. At the time of its discovery, it was classified as an insectivore rather than a carnivore (Lioncrusher's domain: lioncrusher.com/family.asp?family=Eupleridae). All of the Malagasy carnivores have now been placed in the family Eupleridae and split into two subfamilies: *Euplerinae*, which includes the fossa, falanouc, and Malagasy civet; and *Galidiinae*, which includes the other five Malagasy carnivores. Based on new research from Wilson & Reeder (2005) and Gaubert et al. (2005), molecular and morphological evidence supports that these species are more closely related to each other than either group. These species are covered in the Mongoose and Fossa care manual.

Introduction: This family of 15 recent genera and 35 species is found in southwestern Europe, southern Asia, the East Indies, and Africa. Certain genera have been introduced to areas in which the family does not naturally occur (Nowak 1999).

Viverrids are characteristically small and medium-sized carnivores. Head and body length ranges from 350–950 mm (13.8-37.4 in), tail length 130–900 mm (5.1-35.4 in), and the adult weight range is 0.6–20 kg (1.3-44.1 lb) (Nowak 1999). There are various striped, spotted, and uniform color patterns. In some

genera the tail is banded or ringed. The body is generally long and sinewy, with short legs and typically a long, bushy tail (Nowak 1999).

One genus, *Arctictis* (binturong), has a truly prehensile tail. The binturong's head is elongated and the muzzle is pointed; the feet each have five toes. The claws may be partially sheathed but are never fully retracted; when climbing on solid surfaces the claw digs in automatically, when swiping out with their feet they cannot extend the claws (M.Stinner, personal communication).

Most viverrids have scent glands in the anal region that secrete a nauseous-smelling fluid as a defensive measure. Rubbed on various objects, the secretion of the scent glands is recognized by other individuals of the same species, and is probably used as a means of communication (Nowak 1999).

Viverrids are essentially forest inhabitants, but they also live in dense brush and thick grass. They are either diurnal or nocturnal, and shelter in any convenient retreat, usually a hole in a tree, a tangle of vines, ground cover, a cave, a crevice, or a burrow. A few species dig their own burrows. Those species that have adapted to living near man may be found under house rafters or in drain pipes (Nowak 1999). Sight, hearing, and smell are all considered to be acute (Nowak 1999).

Many genera are agile and extremely graceful in their movements. A number of species are skillful climbers; some apparently spend most of their lives in trees (e.g., binturong). Some genera take to water readily, especially during extremely hot weather (e.g., binturong), and swim well; two species, aquatic genet and otter civet, are semi-aquatic (Nowak 1999).

Viverrids may fight when cornered. They seek their prey in trees and on the ground either by stalking or by pouncing from a hiding place. They eat small vertebrates and various invertebrates, and occasionally consume vegetable matter such as fruit, bulbs, and nuts. Carrion is taken by some species. Viverrids are solitary or live in pairs or groups. Breeding may occur seasonally or throughout the year (Nowak 1999).

While there are a few individuals of other viverrid species held in North American zoological institutions, the AZA Small Carnivore TAG has designated the following species of Viverridae to be managed under the AZA Taxon Advisory Group 2009 Regional Collection Plan. These are: binturong (*Arctictis binturong*), a PMP, and Owston's civet (*Chrotogale owstoni*), listed as a species of interest. The following guidelines are designed specifically with these species in mind but provide some information on related or other species that were included in earlier RCPs and may still be held in some institutions.

The table below (Table 3) gives generalized information on each species. Social system codes indicate how they have been kept in zoos and aquariums, where available, or what is known of their social system in the wild. Arboreal/Terrestrial indicates where they spend most of their time, species listed as both (B) are those that are considered terrestrial but are known to climb well. A "W" indicates species that swim well or appear to enjoy water features in their exhibit. Species are listed as Carnivorous if they predominantly eat animal protein, however, they may eat some vegetation as well; an Omnivorous listing indicates those species that are known to eat vegetative matter regularly. Species are listed as C/O if they lean more towards carnivorous habits but are known to regularly eat fruit, etc. Nocturnal (N), Diurnal (D), or Crepuscular (C) codes indicate their typical, peak activity periods (Nowak 1999; Green 2001).

Table 3: Summary of biological attributes of wild and *ex situ* populations of viverrids

Species	Head-Body Length	Social system (S-solitary, P-pair, G-group)	Arboreal/ Terrestrial	Carnivore/ Omnivore	Noct/Diurnal/ Crepuscular
Binturong	**61–96.5 cm (24-38 in)**	**S, P, G**	**A, W**	**O/C**	**N,C,D**
Owston's civet	**56–72 cm (22-28.4 in)**	**S, P**	**B**	**C/O**	**N, C**
African civet	67–95 cm (26.4-37.4 in)	S	T, W	O	N
Otter civet	57.5–67.5 cm (22.6-26.6 in)	?	T, W	C	N?
Genet sp.	42–58 cm (16.5-22.8 in)	S, P	B	C	N
Banded palm civet	41–62 cm (16.1-24.4 in)	S, P?	B	C	N
Masked palm civet sp.	43–71 cm (16.9-28 in)	S, P?	A	O/C	N

Civet	50.8–76.2 cm (20-30 in)	S	A	C	N
Banded linsang	31–45 cm (12.2-17.7 in)	S, P?	A	C	N
African linsang	38.4 cm (15.1 in)	P,G	T	O	N
Large Indian civet	58.5–95 cm (23-37.4 in)	S	T	C/O	N

Chapter 1. Ambient Environment

1.1 Temperature and Humidity

Animal collections within AZA-accredited institutions must be protected from weather detrimental to their health (AZA Accreditation Standard 1.5.7). Viverrids not normally exposed to cold weather/water temperatures should be provided heated enclosures/pool water. Likewise, protection from excessive cold weather/water temperatures should be provided to those viverrids normally living in warmer climates/water temperatures.

AZA institutions with exhibits which rely on climate control must have critical life-support systems for the animal collection and emergency backup systems available, while all mechanical equipment should be included in a documented preventative maintenance program. Special equipment should be maintained under a maintenance agreement or records should indicate that staff members are trained to conduct specified maintenance (AZA Accreditation Standard 10.2.1).

AZA Accreditation Standard

(1.5.7) The animal collection must be protected from weather detrimental to their health.

AZA Accreditation Standard

(10.2.1) Critical life-support systems for the animal collection, including but not limited to plumbing, heating, cooling, aeration, and filtration, must be equipped with a warning mechanism, and emergency backup systems must be available. All mechanical equipment should be under a preventative maintenance program as evidenced through a record-keeping system. Special equipment should be maintained under a maintenance agreement, or a training record should show that staff members are trained for specified maintenance of special equipment.

Temperature: Viverrids originate in warm climates and generally prefer temperatures between 20-25 ºC (68-78 ºF). When kept outdoors during warm summer months, shade and shelter should be provided. When animals are housed indoors, temperatures should remain between 22-25 ºC (71-78 ºF). Generally, in localities where ambient temperatures fall below these temperatures, an artificial heat source should be provided (Carnio 1996). Owston's, masked palm, and small Indian civets can handle higher single digit temperatures (in °C) well if ample bedding is added to their nest boxes (S. Roberton, personal experience). Temperature gradients should be provided to allow the animals an opportunity to select the ambient range comfortable to them. This can be done by using hot rocks or localized heat lamps.

Those species that experience lower evening winter temperatures can tolerate cooler temperatures (down to 13 ºC or 55 ºF) if they are protected from cold winds and allowed access to protected or heated dens or alcoves (M. Dulaney, personal communication). Binturongs can tolerate temperatures of 4.4-10 ºC (40-50 ºF) as long as heat and shelter are provided (Green 2001). Some species (e.g., binturong) are known to suffer from frostbite on their toes and tails (particularly in damp conditions), and so care should be taken to provide them with protection from extremely cold temperatures or winds (C. Schultz, personal communication; M. Stinner, personal experience, A. Moresco personal experience). With extreme heat, relief should be provided when temperatures reach 26.67-32.3 ºC (80-90 ºF) by supplying shade, ice, misters, or pools (Green 2001).

It is important to remember that appropriate temperature ranges vary from individual to individual as well as species to species; animals should be given the opportunity to select an ambient temperature comfortable to them.

Owston's civet: There should be ample shade provided in outdoor exhibits as well as other cool hiding places. In the winter (<13 ºC or ~56 ºF), nest boxes should be provided with a thick layer of bedding (~6cm or 2 in) to provide some insulation against the cold, and the animals should be given access to heated quarters (Roberton et al. 2002). Seasonal temperature gradients in indoor exhibits should mirror the seasonal changes in the species natural range.

Humidity: Little specific information is available on the humidity requirements for these species. However, if humidity can be controlled, it should be set to mimic what might be found in the species' natural environment and reflect seasonal changes. For example, a higher humidity level (55-65%) is suggested for tropical forest species; savanna and forest edge species may be more comfortable at a lower humidity (45-50%) and desert species at 30% humidity (Carnio 1996; C. Schultz, personal communication).

Binturong: This species should not be maintained in environments that are chronically wet. They should be provided with the ability to dry off, especially at colder temperatures (<9.4 °C/49 °F); exposure to chronic damp at lower temperatures can lead to cold damage to their extremities (M. Stinner, personal communication).

Linsang/palm civet: Experience at an AZA-accredited zoo with *H. derbyanus* (banded palm civet) and *P. linsang* (banded linsang) indicates that neither of these species appears to have specific humidity requirements (M. Dulaney, personal communication).

1.2 Light

Careful consideration should be given to the spectral, intensity, and duration of light needs for all animals in the care of AZA-accredited zoos and aquariums.

Proper lighting is necessary to the health and well-being of *ex situ* populations of viverrids (Bernard 1997). Lights should be evenly distributed and of sufficient intensity to permit routine inspection and cleaning. Indoor exhibits should offer a 12hour/12hour day/night cycle, or one similar to the seasonal photoperiod of the species' natural habitat (M. Dulaney, personal communication). Nocturnal species may be housed under reversed light cycles (blue or red lighting) to encourage natural activity patterns (Carnio 1996; C. Schultz, personal communication). Outdoor natural exhibits or indoor exhibits with natural light need no extra lighting system (M. Dulaney, personal communication).

The impact of light cycle intensity or duration on equatorial species requires research, and will undoubtedly be found to be species-specific. Until further insight is gained into this, the SCTAG recommends that light cycles be set to mimic the seasonal intensity and duration of that found in the species' natural habitat.

1.3 Water and Air Quality

AZA-accredited institutions must have a regular program of monitoring water quality for collections of aquatic animals and a written record must document long-term water quality results and chemical additions (AZA Accreditation Standard 1.5.9). Monitoring selected water quality parameters provides confirmation of the correct operation of filtration and disinfection of the water supply available for the collection. Additionally, high quality water enhances animal health programs instituted for aquatic collections.

AZA Accreditation Standard

(1.5.9) The institution must have a regular program of monitoring water quality for collections of fish, pinnipeds, cetaceans, and other aquatic animals. A written record must be maintained to document long-term water quality results and chemical additions.

The number of air changes per hour needed to maintain desired temperature ranges will vary according to the volume of the enclosure. Standardized rates of change for various human occupied enclosures suggest that pet shops require a rate of air exchange, on non-recirculated air, equal to 1 cubic foot of air per minute per square foot of floor space in order to keep odors down to a level acceptable by the public. Cubbing dens may well need higher rates of air exchange in order to maintain air quality (Anon 1981).

Pool water should be kept free of food remains and fecal material. There are no standards for non-aquatic animal pools, but common practice dictates that these water bodies should be kept clean and free of bacterial build-up, especially those in exhibits with animals that could use them for swimming (e.g., binturong). Enclosure pools should be filtered or the water changed regularly if an unfiltered system is used. If chlorine is used to clean the pool, it should be thoroughly washed out before being refilled and the animals allowed access to the pool. At this time the AZA SCTAG has no specific testing recommendations for pools in viverrid exhibits; protocols should be set by each institution (e.g. coliform, pH, etc). If animals regularly swim, chlorine levels should be maintained below 0.5ppm.

1.4 Sound and Vibration

Consideration should be given to controlling sounds and vibrations that can be heard by viverrids in the care of AZA-accredited zoos and aquariums. Many of the viverrid species are sensitive to sudden or loud noises, and these should be kept to a minimum as far away as possible, especially after young are born. At this time, there is no information available indicating that these species are disturbed by the scent or sound of other animals, but caution should be used when placing animals next to them (i.e., avoid locating next to a predator, a prey species next to a genet, or next to conspecifics, etc.).

Chapter 2. Habitat Design and Containment

2.1 Space and Complexity

Careful consideration should be given to exhibit design so that all areas meet the physical, social, behavioral and psychological needs of the species. Viverrids should be displayed, whenever possible, in exhibits replicating their wild habitat and in numbers sufficient to meet their social and behavioral needs (AZA Accreditation Standard 1.5.2).

AZA Accreditation Standard

(1.5.2) Animals should be displayed, whenever possible, in exhibits replicating their wild habitat and in numbers sufficient to meet their social and behavioral needs. Display of single specimens should be avoided unless biologically correct for the species involved.

The same careful consideration regarding exhibit size and complexity and its relationship to the viverrid's overall well-being must be given to the design and size of all enclosures, including those used in exhibits, holding areas, hospital, and quarantine/isolation (AZA Accreditation Standard 10.3.3).

AZA Accreditation Standard

(10.3.3) All animal enclosures (exhibits, holding areas, hospital, and quarantine/isolation) must be of a size and complexity sufficient to provide for the animal's physical, social, and psychological well-being; and exhibit enclosures must include provisions for the behavioral enrichment of the animals.

The quality of space is very important for all viverrids (Wallach & Boever 1983). Hollow logs, digging sites, natural trees, bushes, vines, water features, vertical space, comfortable hiding places, and species appropriate enrichment items (e.g., browse, whole carcass foods, insects, scents, sounds, items to manipulate or carry, climbing structures, etc.), will contribute to the overall quality of the environment, and provide opportunities for the expression of species-appropriate behaviors.

Viverrid Spatial Requirements: Determining appropriate exhibit size for each species is more of an art form than a science. Successful exhibits will take into account the needs of the species and individuals; highly enriched and structurally varied exhibits may be smaller than exhibits with less spatial, visual, and furniture complexity.

Ideal viverrid exhibit size will vary with the species and their typical activity pattern. In general, bigger is better. No viverrid should be housed in an exhibit less than ten times the length of the animal as its smallest dimension. The depth of the enclosure should be at least 2-3 times the flight distance (which will vary with the species and individual animal). Vertical height also can be important for some viverrids; arboreal species should be provided with complex climbing structures and at least 2.4-3 m (8-10 ft) of vertical space. Enclosures should be made 25% larger for each individual animal added.

Exhibit sizes recommended here (see Table 4) are based on the species size, behavioral repertoire, home range size, activity pattern and daily movements, and professional experience with *ex situ* populations of these species.

Table 4: AZA SCTAG exhibit size guidelines for managed Viverrids

Species	Ave. HBL (centimeters)	Formula used or basis for recommendation	Exhibit size (LxWxH) for 2 animals or total
Banded linsang	45.7 cm (18 in)	Formula IVa	7.5 m^2/81 ft^2
Owston's civet+	71.1 cm (28 in)	Formula IVb	50.5 m^2/544 ft^2
Binturong*	96.5 cm (38 in)	Formula IIIc	42 m^2/450 ft^2

+ The Owston's civet recommendation exceeds that of Roberton et al. (2002); he suggests 323 ft^2/30 m^2 which is acceptable if the exhibit is spatially highly complex. The SCTAG standards are larger based on the average head-body length, home range size, and daily activity pattern (see Owston's civet below for more information).
* The formula used for the binturong exhibit resulted in a size considered somewhat small by experienced professionals, therefore it was increased in size to match exhibits considered to be excellent examples.

The formulas used are based on three areas: 1) Species average head and body length; 2) Typical home range size, daily travel distances, and activity level; and 3) professional experience with these species to date. These recommendations were reviewed by the AZA SCTAG Institutional Representatives (IRs), and responses were incorporated.

Exhibit Size Formulas based on HBL (head and body length) given in inches:

- Formula I – $(HBL/12 \times X)^2$ (with a large home range/daily travel distance). Seven to eight feet vertical space should be allowed for more arboreal species. For highly terrestrial social species go up one size group.
- Small animals: 10-15 inches – $(HBL/12 \times 6)^2 = \#\ feet^2$
- Medium animals: 15-30 inches – $(HBL/12 \times 10)^2 = \#\ feet^2$
- Large animals: over 30 inches – $(HBL/12 \times 12)^2 = \#\ feet^2$
- Formula II – (HBL/12 x X) x given dimension for depth (with a small home range/daily travel distance). Seven to eight feet vertical space should be allowed for more arboreal species. For highly terrestrial social species go up one size group.
- Small animals: 10-15 inches – $(HBL \times 6)/12 \times 3$ feet $= \#\ feet^2$
- Medium animals: 15-30 inches – $(HBL \times 10)/12 \times 6$ feet $= \#\ feet^2$
- Large animals: over 30 inches – $(HBL \times 12)/12 \times 10$ feet $= \#\ feet^2$
    - Formula III – A minimum of 8-10 feet vertical useable space and Formula II floor space.
    - Formula IV – A minimum of 8-10 feet vertical useable space and Formula I floor space.

Temporary or overnight holding: For a single individual, the smallest holding space dimension should be at least four times the average adult head-body length; basic nest boxes used for sleeping/hiding need only be large enough for the animal to turn around in. Night enclosures should be at least 50% larger per additional animal, and larger than that for breeding pairs (Carnio 1996).

Other exhibit considerations: Species that will use water features such as pools or streams (e.g., binturong) should be provided with these as a means of cooling off and as a form of psychological/behavioral stimulation (C. Schultz, personal communication; Reed-Smith et al. 2003). Pool space should be subtracted from the available square footage when calculating exhibit size. Exhibits designed to accommodate breeding should provide ample room for the female to separate herself, both visually and physically (e.g., binturong) (Green 2001; C. Schultz, personal communication), or an area in which the female or male can be confined (e.g., banded palm civets) (M. Dulaney, personal communication).

Owston's civet: The Owston's Civet Conservation Program (OCP) in Cuc Phuong National Park, Vietnam determined cage space of the following dimensions to be the minimum advisable to encourage breeding: length – 6 m (19.7 ft), width – 5 m (16.4 ft), height – 3.5 m (11.5 ft) or 30 m^2 (323 ft^2); this space will easily house a pair and their offspring up to one year. The AZA SCTAG recommends slightly larger dimensions (50.5 m^2/543.36 ft^2) for animals living in public displays, in order to accommodate additional behavioral and environmental enrichment, and to inhibit psychological stress in high traffic areas.

The OCP separates breeding cages with a concrete wall that has a wire mesh shift door (30 cm x 45 cm/ 12 in x 18 in) within it to allow for pair introduction; this door should be mesh and replaceable with a solid material to allow for varying degrees of contact. Containment barriers should be sunk at least 40 cm (15.7 in) deep to prevent escapes and to prevent rodents from burrowing into the space. All mesh and wiring used should be of good quality and rust resistant. Outdoor exhibits should have doors that open onto a secondary containment area (Roberton et al. 2002).

Ideally, all exhibits should be provided with a leaf litter substrate that can be mixed with other substrates to provide different foraging levels (concrete floors of indoor exhibits also should be covered with natural substrates). Covered shelter of some type should be provided; this can be a nest box, small cave, hollow log, etc. for on exhibit, or in warm climates. Animals housed in more temperate climates should be provided with heated housing in addition to the above (Roberton et al. 2002).

Other Factors Influencing Space: Pregnant or nursing females may need to be separated depending on the species (see species information below, Section 4 and Section 7). Removal of the female to an off-exhibit holding area, or removal of the male/other individuals will depend on the institutional set-up and temperament of the female. If she is made nervous by change, and the public space around the exhibit can be closed for a time, it may be best to leave the female in her familiar exhibit and move exhibit mates.

If this is not an option, the female should be moved to her birthing holding area early enough to have time to adjust to all new routines (this will vary with individuals).

Typically, solitary species may sometimes be successfully kept as pairs; in these cases, enough room should be provided to allow the animals to separate, visually and physically, from one another if they desire. The AZA SCTAG has taken this into consideration in developing exhibit size recommendations. While exhibits of the suggested size should be large enough to accommodate pairs, all individuals are unique and should be monitored for signs of aggression (e.g., fights, growling, etc.), stress (e.g., lethargy, lack of appetite, hair loss, etc.), and illness. Animals housed adjacent to one another will benefit from having areas to which they can visually escape their neighboring conspecific.

Binturong: Binturong females should not be removed from the exhibit, and the male can be left in with her (C. Schultz, personal communication). However, the situation should be monitored for signs of stress, and advance preparations made for separating the adults if it becomes necessary. It is recommended that a separate nest box be provided for the male if the pair is left together (A. Moresco, personal experience). See Section 7.4 for birthing management alternatives.

Spatial Complexity (Vertical/Horizontal) and Shelters: Nest boxes, feeding stations, waterers, and covered sleeping/hiding spots should be located in the trees (e.g., banded palm civet) or on the ground (e.g., banded linsangs) as appropriate for each species and their species-typical behavioral patterns (i.e., arboreal or terrestrial) (M. Dulaney, personal communication). Arboreal species should be provided with extensive branching to allow for movement from one part of the exhibit to another without having to descend to the ground. These arboreal pathways should be of varying sizes and stability. Limbs, branches, vines, etc. should all be secured against falling; however, not all limbs should be fixed in place, but instead allowed to sway with the animal's weight.

A sleeping/sheltered location should be provided for each animal in the exhibit (C. Schultz, personal communication). At least one sleeping/sheltered location should be large enough to accommodate two adults (particularly for binturong, banded palm civet, Owston's civet, and banded linsang) (M. Dulaney, personal communication; C. Schultz, personal communication), as well as a sleeping shelf/tree branch, etc. that is large enough for more than two in the case of groups of binturongs. Binturong den boxes should be placed where they can be cleaned easily as many individuals show a tendency to defecate in or on their boxes. Additionally, binturongs frequently mark their denning boxes with urine and may cache leftover meat in the box (M. Stinner, personal communication). However, care should be taken not to over clean these areas. Bedding material such as sticks, leaves, etc. that the animals can gather should be provided (Nowak 1999; C. Schultz, personal communication).

It is recommended that the floor of the enclosure be covered with leaf litter, or something similar, for the banded linsang and Owston's civet (Roberton et al. 2002). The former species frequently spends most of its time at or below three feet, while the latter spends a great deal of time on the ground foraging for insects (Roberton et al. 2002). These behaviors, and similar considerations, should be taken into account when designing exhibits and furnishings for these species, as they stay closer to the ground than some of the other viverrids (Carnio 1996).

Due to the naturally inquisitive nature of viverrid species, it is very important that all loose and fallen wires, screws, nails, etc. be removed from the exhibit before the animals are allowed access. Items of this sort should be checked for daily (Roberton et al. 2002; M. Stinner, personal communication).

Binturong: This species exhibits great gymnastic ability. They can rotate their rear ankles allowing them to hang from two rear toes and their tail, or just by the rear feet. Appropriate climbing structures will allow binturongs to exercise this agility. Exhibits should have ample climbing structures and trees that will allow this species to show its agility and habit of descending from trees head first (M. Stinner, personal communication). Elevated, horizontal branches large enough to allow animals to lie prone on are highly recommended.

Owston's civet: The OCP recommends that nest boxes (at least one for each adult) be placed 1.2 m (~4 ft) off the ground for Owston's civets; these should be easily approached by the animals from at least three directions (Roberton et al. 2002). It is important to ensure that none of the boxes are obviously more

preferable than the others. This can be accomplished by placing all nest boxes in well-sheltered, accessible areas at the same height (see nest box photo, S. Roberton). Furniture in Owston's civet exhibits should be constructed so that all cage levels are utilized, and the animals have the maximum amount of usable space. Branch runways should be constructed at lower, middle, and upper levels of the cage. Resting platforms also should be available at different heights. Branch work should be sufficiently complex to allow animals to avoid each other when climbing in the exhibit. It is strongly recommended by the OCP that log piles, rotting logs, substrates, etc. that encourage the presence of insects, and provide good hiding for enrichment items, should be incorporated in all Owston's civet enclosures (Roberton et al. 2002).

Nest boxes should be large enough to accommodate two animals (~45 cm x 40 cm x 40 cm or ~18 in x 16 in x 16 in); if more animals are housed together (i.e., mother and young), nest boxes should be large enough to allow all animals to enter and rest easily inside. At least one box per adult should be provided (Roberton et al. 2002).

Substrates: Again, we stress that natural substrates are preferred for all viverrid species; choices include sod, soil, wood chips, sand, or any combination of these. Artificial surfaces can be covered with a variety of substrates including leaf litter, sand, soil, etc. Preferred bedding materials may vary from species to species, or individual to individual. For example linsangs use sticks and leaves in the wild to make nests (Nowak 1999). Compressed or shredded cardboard, shredded paper, shavings, or natural beddings such as leaves, etc. have all been used (M. Dulaney, personal communication). All natural substrates should be checked regularly and changed if they become soiled, too damp, or moldy (A. Moresco, personal communication).

Binturong: It is important to offer this species a wide variety of substrates and materials they can handle or manipulate. Materials used successfully in the past include branches, thin bamboo, milkweed, woody browse (M. Stinner, personal communication), straw, and hay.

Owston's civet: Bedding should always be provided for Owston's civet nest boxes. During hot weather, >30 ºC (86 ºF), animals may become overheated and so little to no bedding is necessary; nest boxes should be placed where they receive some air circulation or lids can be safely locked in an open position. During cooler weather (<13 ºC or ~56 ºF), nest boxes should be provided with a thick layer of bedding (~6 cm or 2 in) to provide some insulation against the cold. All bedding should be replaced as it becomes soiled (Roberton et al. 2002). Bedding that the animals can manipulate also should be provided to allow the animals choice and to encourage activity.

Enclosure Water Spaces: No water quality standards have been set for non- or semi-aquatic species; a maximum coliform count of 100 per ml (human standard) is used as a guideline. Chemical residues, bacterial counts, mineral levels, and salts should be kept as low as possible. Fecal material and food remnants should be removed daily. The pH tolerance is not known, but is not likely to be vitally important for these species.

Some of the viverrid species (e.g., binturong) may benefit from a small pool or stream located in their exhibit. Misters and waterfalls also provide opportunities for the animals to cool off and explore other dimensions of their surroundings. All water features should be constructed in such a way to allow for easy cleaning. Space dedicated to pools/streams, etc. should be deducted from the usable floor-space calculations (C. Schultz, personal communication). Water depth will vary with the species exhibited.

Misters can be excellent enrichment devices for some viverrid species (e.g., binturong). These should be placed where the animals can avoid them, or where they can be activated by the animal (M. Stinner, personal communication).

Typically, water features of varying depths and bank complexity are recommended. Care should be taken that animals can easily get in and out of the water (particularly for young or geriatric animals). Currents of varying strengths are not as important in these species as in some of the mustelids (i.e.,

otters), but the presence of small waterfalls may stimulate interest if incorporated into an active enrichment program. Turbulence, except for isolated areas, should be kept to a minimum to encourage use of the pool.

Binturong: This species is known to go in the water, at times swimming. Pools should be deep enough to allow the animal the choice of total submersion, roughly a few inches to 0.9-1.2 m (3-4 ft), with an incline for easy ingress and egress. Branches placed over the pool provide good launching points for some juveniles who will repeatedly jump into the water, something they appear highly motivated to perform. While not typical, some binturong will defecate in the water; in these cases, an additional drinking water source should be provided several feet away (M. Stinner, personal communication).

Genet and civet: These species may benefit from shallow streams or ponds in their exhibits. These features, and the associated shoreline, can be used for placement of enrichment items (hidden food, scent on rocks, cover for speakers used to broadcast sounds, etc.). The water features should be shallow, 15.2–30.5 cm (6-12 in).

Changing and Cleaning Enclosure Furnishings: Exhibits should always be constructed in a manner that allows for periodic change of furniture and other physical attributes of the enclosure. Furniture should be rearranged, or changed, at least twice a year to provide variety and novelty for the inhabitants. When furnishings are changed, some of the old furnishings should always be left to maintain the animal's scent and sense of 'home'. More frequent re-arranging of smaller exhibit furnishings can help stimulate interest and reduce the risk of stereotypies developing; it is suggested that these types of changes take place roughly every four weeks (Carnio 1996; Roberton et al. 2002).

Scent marking is an important form of communication for viverrids, and should be taken into account whenever cleaning or renovating an exhibit. Enclosure furniture, including perches and nest boxes, should not be included in the daily cleaning regime (unless the animal has defecated or urinated on them) because these species scent mark their territory and a thorough cleaning of their home space may cause stress. One quarter of the enclosure furniture may be disinfected at a time, leaving scent marks on the rest. Old, soiled furnishings may be replaced 25% at a time rather than total replacement as is commonly done for species that do not scent mark heavily. Substrates from large "naturalistic" enclosures should be removed and replaced as necessary; the larger the enclosure, the less frequently this activity will need to be performed. Only cleansing/disinfecting agents that can be thoroughly washed off should be used (Carnio 1996).

Binturong: Anal gland secretions are used by both sexes for scent marking (Kleiman 1974). Weldon et al. (2000) provide an analysis of binturong scent gland secretions.

Owston's civet: Roberton et al. (2002) suggest that absence of their scent can be a stressor for this species. Exhibit furniture, plantings, nest boxes, etc. should never all be replaced simultaneously. Small furniture items should be replaced on a regular rotating basis. Larger furniture items and plantings should be replaced on a scheduled, graduated basis. Nest boxes should be checked daily for any leftover food, cleaned with water, and replaced if they become too soiled (it is very important that the animals are left with a nest box per animal with their scent, if a box is replaced).

2.2 Safety and Containment

AZA SCTAG Recommendations: Because many viverrid species are arboreal, or partially so, these animals are best kept in exhibits with an overhead containment barrier of some kind. If the top is open, the exhibit walls need to be of a non-climbable material and escape-proof (C. Schultz, personal communication).

Binturong: Binturongs are known escape artists and have been known to remove retaining pins and other devices used to hold together caging (C. Schultz, personal communication). M. Stinner (personal communication) reports they are capable of removing pins in feeding doors, unhook S-latches, open door handles of various designs, and slide bolts open; binturongs can open doors

AZA Accreditation Standard

(11.3.3) Special attention must be given to free-ranging animals so that no undue threat is posed to the animal collection, free-ranging animals, or the visiting public. Animals maintained where they will be in contact with the visiting public must be carefully selected, monitored, and treated humanely at all times.

AZA Accreditation Standard

(11.3.1) All animal exhibits and holding areas must be secured to prevent unintentional animal egress.

on standard shipping crates so these should be secured with zip ties or similar devices. All openings not secured with locks should be fastened with clips that require thumb movement, carabineers, or something similar and be maintained in good condition.

Animals housed in free-ranging environments should be carefully selected, monitored and treated humanely so that the safety of these animals and persons viewing them is ensured (AZA Accreditation Standard 11.3.3). Viverrids are not recommended for free-ranging environments.

Viverrid exhibits and holding areas in all AZA-accredited institutions must be secured to prevent unintentional animal egress (AZA Accreditation Standard 11.3.1). Exhibit design must be considered carefully to ensure that all areas are secure and particular attention must be given to shift doors, gates, keeper access doors, locking mechanisms and exhibit barrier dimensions and construction.

Exhibits in which the visiting public may have contact with viverrids must have a guardrail/barrier that separates the two (AZA Accreditation Standard 11.3.6).

All emergency safety procedures must be clearly written, provided to appropriate staff and volunteers, and readily available for reference in the event of an actual emergency (AZA Accreditation Standard 11.2.3).

Staff training for emergencies must be undertaken and records of such training maintained. Security personnel must be trained to handle all emergencies in full accordance with the policies and procedures of the institution and in some cases, may be in charge of the respective emergency (AZA Accreditation Standard 11.6.2).

Emergency drills should be conducted at least once annually for each basic type of emergency to ensure all staff is aware of emergency procedures and to identify potential problematic areas that may require adjustment. These drills should be recorded and evaluated to ensure that procedures are being followed, that staff training is effective and that what is learned is used to correct and/or improve the emergency procedures. Records of these drills should be maintained and improvements in the procedures duly noted whenever such are identified. AZA-accredited institutions must have a communication system that can be quickly accessed in case of an emergency (AZA Accreditation Standard 11.2.4).

AZA-accredited institutions must also ensure that written protocols define how and when local police or other emergency agencies are contacted and specify response times to emergencies (AZA Accreditation Standard 11.2.5).

AZA-accredited institutions which care for potentially dangerous animals must have appropriate safety procedures in place to prevent attacks and injuries by these animals (AZA Accreditation Standard 11.5.3).

Animal attack emergency response procedures must be defined and personnel must be trained for these protocols (AZA Accreditation Standard 11.5.3).

Animal attack emergency drills should be conducted at least once annually to ensure that the institution's staff know their duties and responsibilities and know how to handle emergencies properly when they occur. All drills need to be recorded and

AZA Accreditation Standard

(11.3.6) Guardrails/barriers must be constructed in all areas where the visiting public could have contact with other than handleable animals.

AZA Accreditation Standard

(11.2.3) All emergency procedures must be written and provided to staff and, where appropriate, to volunteers. Appropriate emergency procedures must be readily available for reference in the event of an actual emergency. These procedures should deal with four basic types of emergencies: fire, weather/environment; injury to staff or a visitor; animal escape.

AZA Accreditation Standard

(11.6.2) Security personnel, whether staff of the institution, or a provided and/or contracted service, must be trained to handle all emergencies in full accordance with the policies and procedures of the institution. In some cases, it is recognized that Security personnel may be in charge of the respective emergency (i.e., shooting teams).

AZA Accreditation Standard

(11.2.4) The institution must have a communication system that can be quickly accessed in case of an emergency.

AZA Accreditation Standard

(11.2.5) A written protocol should be developed involving local police or other emergency agencies and include response times to emergencies.

AZA Accreditation Standard

(11.5.3) Institutions maintaining potentially dangerous animals (sharks, whales, tigers, bears, etc.) must have appropriate safety procedures in place to prevent attacks and injuries by these animals. Appropriate response procedures must also be in place to deal with an attack resulting in an injury. These procedures must be practiced routinely per the emergency drill requirements contained in these standards. Whenever injuries result from these incidents, a written account outlining the cause of the incident, how the injury was handled, and a description of any resulting changes to either the safety procedures or the physical facility must be prepared and maintained for five years from the date of the incident.

evaluated to ensure that procedures are being followed, that staff training is effective, and that what is learned is used to correct and/or improve the emergency procedures. Records of these drills must be maintained and improvements in the procedures duly noted whenever such are identified (AZA Accreditation Standard 11.5.3).

If an animal attack occurs and injuries result from the incident, a written account outlining the cause of the incident, how the injury was handled, and a description of any resulting changes to either the safety procedures or the physical facility must be prepared and maintained for five years from the date of the incident (AZA Accreditation Standard 11.5.3).

Chapter 3. Transport

3.1 Preparations

> **AZA Accreditation Standard**
>
> **(1.5.11)** Animal transportation must be conducted in a manner that is safe, well-planned and coordinated, and minimizes risk to the animal(s), employees, and general public. All applicable local, state, and federal laws must be adhered to.

Animal transportation must be conducted in a manner that adheres to all laws, is safe, and minimizes risk to the animal(s), employees, and general public (AZA Accreditation Standard 1.5.11). Safe animal transport requires the use of appropriate conveyance and equipment that is in good working order. The equipment must provide for the adequate containment, life support, comfort, temperature control, food/water, and safety of the animal(s).

Safe transport also requires the assignment of an adequate number of appropriately trained personnel (by institution or contractor) who are equipped and prepared to handle contingencies and/or emergencies that may occur in the course of transport. Planning and coordination for animal transport requires good communication among all affected parties, plans for a variety of emergencies and contingencies that may arise, and timely execution of the transport. At no time should the animal(s) or people be subjected to unnecessary risk or danger.

When transporting viverrids, there always should be at least two people present; if animals have been anesthetized the veterinarian always should be present. Staff involved in transports should understand their duties and have a clear idea of the institution's policies regarding transports. The AZA SCTAG has no specific recommendations regarding staff roles in transports but does recommend procedures and policies be clearly defined and understood in advance by all participating staff.

All possible relevant regulatory agencies should always be checked for shipping, health, and permit requirements before transporting animals (USFW, State, CITES, etc.). The International Air Transport Association (IATA) publishes specific guidelines for transport containers used for animal shipments. These guidelines are available from the Publication Assistant, IATA, 2000 Peel Street, Montreal, Quebec, Canada, H3A 2R4 (Ott Joslin & Collins 1999). An alternate address for IATA is International Air Transport Association, 800 Place Victoria, P.O. Box 113, Montreal, Quebec, Canada, H4Z 1M1. The Live Animals Regulations document is available in print or CD ROM format and can be ordered from sales@iata.org.

According to published IATA regulations (IATA 2009), "…crates must be able to withstand external damage from other freight, and be able to withstand any internal destruction that may be caused by the animal." "All shipping crates must allow for adequate ventilation. Ventilation apertures must be small enough to prevent the escape of the animal, and small enough that the animal cannot get any part of its body through the opening." "Crate doors should not come open accidentally, but must be securely fastened." "Crates must be large enough to allow the animal to stand up and turn around." "The crate bottom must be leak-proof and bedded with some form of absorbent material", the SCTAG recommends using a material the animal is familiar with. Some air carriers prohibit certain bedding materials; therefore, in the case of air shipments, the selected carrier should be consulted first for any specific restrictions. (IATA 2009)

All appropriate IATA, State, and Federal regulations should be checked well in advance for specific requirements regarding type and size of crate required for shipment of the viverrid species being transported. Requirements change with some regularity so the SCTAG does not provide specifics within this document.

3.2 Protocols

Transport protocols should be well defined and clear to all animal care staff. Viverrid species should always be shipped individually. Pregnant or lactating females should not be shipped.

Food and Water: While feeding is generally not required or advised for most viverrid species (see civet exception and kibble recommendation below) during transportation, the crate should allow for feeding and watering of the animal if needed. The food and water ports should be clearly marked on the outside of the crate. On long transports (>24 hours), provisions should be made for feeding in transit (this may necessitate shipping food with the animal).

In general, many of the Viverridae species should be fine for 12 hours without water and 24 hours without food (e.g., linsangs). However, it is advised that pieces of apple or grapes be placed in with civets as a means of supplying them with moisture (M. Dulaney, personal communication).

Prior to shipments longer than 12 hours, animals should be fed extra protein. Animals accustomed to dry kibble should have a small quantity placed inside their shipping crate. None of these species should go longer than 24 hours without food and 12 hours without water, even if it is offered and then removed (M. Stinner, personal communication).

Temperature: USFW and IATA regulations for shipments to the U.S. indicate that temperatures in the holding area, cargo, or terminal should be a minimum of 12.8 ºC (55 ºF) and a maximum of 26.7 ºC (80 ºF). If ambient temperatures are higher than 23.9 ºC (75 ºF), ancillary ventilation should be provided (Ott Joslin & Collins 1999).

For shipments within the U.S., the AWA (Animal Welfare Act) requires that ambient temperatures in the holding area should not be less than 7.2 ºC (45 ºF) or more than 29.5 ºC (85 ºF) for more than 4 consecutive hours. Animals being transported between holding areas to the aircraft should not be exposed to ambient temperatures of more than 29.5 ºC (85 ºF) or less than 7.2 ºC (45 ºF) for more than 45 minutes (Ott Joslin & Collins 1999).

These guidelines are suitable for viverrid species, but shipments should be planned to avoid temperatures at either extreme, whenever possible, due to the potential of overheating in particular. It is highly recommended that shipments requiring stops prior to reaching the destination be cancelled if temperatures at the intermediate transfer point are higher than 23.9 °C (75 °F). This is due to lack of control over where the crate is placed during the lay over; if placed in the sun, animals may easily overheat.

Light/Sound Control: Mesh doors or side windows (e.g., as in air kennels) should be covered with a breathable, opaque material to allow for ventilation and privacy for the animal (Ott Joslin & Collins 1999). Covering the openings with air-permeable material will help to provide a sense of security for animals being shipped. Polite requests to the airline staff to place live animals in locations where loud noises are at a minimum during layovers and away from any other live animal shipments in the cargo hold are advised.

Transport Duration: Animals involved in shipments longer than 24 hours, or in situations where multiple flights are required, should be accompanied by trained staff so they can be monitored and their needs assessed on site.

Handler/Veterinary Access: Shipments requiring more than 12 hours should be accompanied with food and watering instructions. In these cases, it may be necessary to make arrangements with a zoological facility close to one of the layover points. A contact number for the closest zoological facility should be provided, and after 12 hours the animal(s) checked on by trained professionals from this facility; if needed, water and food should be provided. Alternatively, the animal can be accompanied by trained personnel.

The food offered, and whether it is offered, will depend on the species involved. These decisions should be made by the zoological institutions concerned. In the case of international shipments, food may need to be provided; generally a dry food is recommended (M. Dulaney, personal communication).

Release at Destination: Shipping crates should be placed directly into the quarantine space and the animals allowed to exit on their own volition and at their own pace. It is recommended that all animals be weighed at this time. The crate and animal can be weighed first and the crate weighed again after the animal has exited.

Chapter 4. Social Environment

4.1 Group Structure and Size

Careful consideration should be given to ensure that viverrid group structures and sizes meet the social, physical, and psychological well-being of those animals and facilitate species-appropriate behaviors.

Many species live amicably in pairs (e.g., binturong, Owston's civet), others may take time to establish successful pairs (e.g., banded palm civets may require several introductions before the animals become comfortable with one another), and others have the potential to be successfully kept in groups (e.g., binturong, Owston's civet, African linsang). Once pairs have been established, the animals may or may not sleep together (e.g., banded palm civets) (M. Dulaney, personal communication).

Binturong: As one of the more social viverrid species, binturongs live well in a wide variety of social settings. Binturongs socialize best with animals they are raised with, and so maintaining young from one generation together is a good way to continue this socialization (C. Schultz, personal communication). This is best done with single-sex groupings unless contraception is used to prevent possible inbreeding. They do particularly well in pairs or "large, non-competitive groups" that have been raised together. Males and estrous females may periodically experience competition amongst themselves for access to resources (C. Schultz, personal communication). M. Stinner (personal communication) reports that binturongs do well in mixed or single sex groups if they are introduced before roughly 12-18 months of age. Introductions of adult pairs are occasionally successful, but can end in aggression or with individuals simply tolerating one another. In general terms, binturongs should be raised together or introduced when younger than 18 months of age (F. Kohn, personal communication; M. Stinner, personal communication). However, estrous females typically do not get along (F. Kohn, personal communication).

Desmoulins (personal communication) reports that a family group of binturong has been housed together successfully for several years, but that the kits of the subordinate sister were always killed by other group members; only the young of the dominant female were allowed to survive. Stinner (personal communication) reports a different experience, stating that sister pairings with a single male (three cases) have been successful and that the females "group parented." However, introduced females, even when performed at a young age, will not always behave as amicably. All binturong groups, particularly breeding groups, should be regularly monitored for aggression. This is particularly true for facilities open to the public where disruptions from visitors may affect the group dynamic.

The more social binturong also does well in a nursery group situation; lactating females will co-mother and nurse one another's cubs (M. Stinner, personal communication; C. Schultz, personal communication). This is the most effective way to establish binturong groups, as the introduction of multiple adults generally is not successful. As noted previously, one facility reported that only the dominant female binturong in a group situation raised her young successfully (A. Desmoulins, personal communication), but this does not appear to be the norm in the case of co-habiting sisters (M. Stinner, personal communication), where it is more typical for all young to be raised successfully.

Nothing in the literature indicates multi-generational groups of binturongs are contra-indicated; to the contrary, empirical evidence implies that these groups would be the most successful because binturongs do best when housed with other animals they have known for a long time (C. Schultz, personal communication). However, in-breeding prevention should be determined well in advance, and should take into consideration possible future breeding recommendations for each individual.

Adult male binturongs have been kept together successfully in groups of up to seven animals if they are introduced early; all male groups introduced as adults have not been successful (C. Schultz, personal communication), and should not be attempted.

Binturong should not be kept as singletons except in rare, individually assessed situations (M. Stinner, personal communication).

Civet/Palm Civet: Siblings should be kept together when separated from their mother (M. Dulaney, personal communication). Littermates do fine in all male groups. In at least some of the species (e.g., banded palm civets), it is possible to introduce adult males (M. Dulaney, personal communication).

Genet: It is possible to house young with the adult pair for extended periods, but the males should be neutered (T. Boyd, unpublished information)

Linsang: Banded linsangs should be kept in pairs, rather than alone, if possible (Carnio 1996). Linsang siblings should be kept together when separated from their mother (M. Dulaney, personal communication). Two adult, female banded linsangs, introduced as adults, have been kept together successfully (M. Dulaney, personal communication).

Owston's Civet: The best social grouping in which to house this species is still being determined. It is likely that same sex siblings will live together indefinitely without incidence if not separated for any length of time (Roberton et al. 2002). Young animals introduced to one another at a very early age have done well, but attempted introductions of multiple animals of different origins have not been as successful. Before introductions of this type are attempted, the AZA SCTAG should be contacted for the most recent information available on managing this species. In general, it appears to be best to house mixed-sex pairs (Roberton et al. 2002). There have been no cases of a male harming their offspring, but it is important to monitor that the mother is receiving adequate food while nursing the young (Roberton et al. 2002). In summary, it appears that mixed-sex pairs are the easiest grouping to maintain; same sex siblings also can be housed together as long as they are not separated for extended periods. The success of single-sex pairings appears to depend on the temperament of the individuals involved, and in general, it is easier to house a mixed-sex pair than three or more unrelated animals (Roberton et al. 2002).

4.2 Influence of Others and Conspecifics

Animals cared for by AZA-accredited institutions are often found residing with conspecifics, but also may be found residing with other species. Research in this area is required. At this time, there is no information available indicating that viverrid species are particularly disturbed by the scent or sound of other animals, but caution should be used when determining which animals to place in adjacent enclosures (i.e., avoid locating animals next to a predator; a prey species next to a genet; or next to conspecifics, etc.).

Viverridae species are generally not good candidates for mixed species exhibits; however, there are some exceptions. Before any mixed exhibits are considered, the potential for inter-species aggression or disease transmission should be evaluated.

Species appropriate sleeping platforms/nest boxes/rest areas, shade, feeding stations, watering spots, and visual barriers should be provided for each species within a mixed exhibit. These comfort and sustenance areas should be available to all individuals of every species housed in an exhibit.

Binturong: This species has been successfully exhibited with tufted deer, Asian butterflies, and lion-tailed macaques (Green 2001), as well as with Asian small-clawed otters, Prevost's squirrels, and giant Asian squirrels (M. Burke, personal communication). Binturongs have been housed successfully at Institution A with Asian small-clawed otter and monitor lizard.

An attempt to exhibit binturong with spectacled langur, Reeve's muntjac, and Provost's squirrel was not successful, primarily due to the binturong's aggression towards the langurs (K. Kimble, personal communication). Rodrigues fruit bats were removed from a binturong exhibit after several were injured by the binturongs over a long period; in this case, the binturongs were not believed to be hunting the bats (M. Burke, personal communication).

Owston's Civet: Owston's civets have been exhibited with tortoise. This combination did well, but the tortoise needed to be fed in a different location to keep the OCs from eating their food (Roberton et al. 2002).

Management of Special Need Individuals:

Neonates or geriatric animals: Management of neonates may vary from species to species. Recent experience with each species should be thoroughly researched prior to all births. Binturong young have shown a tendency to compete for favorite teats, sometimes resulting in injury to one or more of the cubs. As a means of preventing this, the practice of periodically trimming the cubs' nails has been successful (Thompson 1996). This nail trimming should be done, as needed, using a small set of nail clippers. Care should be taken that brief removal of the cubs does not agitate the female. See Appendix I for a neonatal examination and monitoring protocol (Read & Meier 1996).

Pregnant females: A pregnant female may need to be separated from the male (e.g., banded linsang/palm civet, some binturong), or offered a choice of whelping boxes and enough room to separate herself from the male or other exhibit mates (e.g., binturong) (Baker et al. 1996). It is always important to

provide more than one nest box to allow the female a choice, as well as providing an ad-lib supply of nesting material. See Section 7.

4.3 Introductions and Reintroductions

Managed care for and reproduction of animals housed in AZA-accredited institutions are dynamic processes. Viverrids born in or moved between and within institutions require introduction and sometimes reintroductions to other animals. It is important that all introductions are conducted in a manner that is safe for all animals and humans involved.

Introductions should follow the standard *ex situ* population format of oral/olfactory, visual, and then tactile introductions. The exact method followed, and duration of the steps taken, may vary with the species and individuals involved. Binturongs generally do not do well when introduced as adults (C. Schultz, personal communication), whereas some of the other viverrids can be introduced successfully as adults (e.g., civets). Seasonal re-introductions of pairs, in some cases, may need to follow the same protocol as initial introductions; animal management staff should develop their plan on a case-by-case basis (M. Dulaney, personal communication; C. Schultz, personal communication).

Large Spotted Genet: Very young animals should not be introduced to adults. In one case, it was recommended that introductions not be attempted until the young animal (male) was 7 months old (M. Stinner, personal communication). After this age, the introduction was successful. More research is required in this area.

Owston's Civet: During introductions, it is recommended that a staff member remain present for the animals' first interactions, and be prepared to separate the animals if necessary (e.g., escalating aggression that threatens injury). Animals housed in adjacent cages should exhibit affiliative behavior (will vary with the individual but may include, purring, rubbing, or sleeping side-by-side) before attempting introductions. Introductions in which individuals exhibit these behaviors are generally successful. Maintaining a record of individual animal behavior profiles leading up to and during introductions can be helpful (Roberton et al. 2002).

Breeding pairs, or other animals newly introduced to each other, should be provided with a minimum of one nest box per animal. It is important that one box is not obviously preferable to another. This can be achieved by locating all boxes in well-sheltered, accessible areas at the same height (Roberton et al. 2002).

If a pair of animals shows constant aggressive or stressful interactions (such as hissing, hiding, threatening movements, striking at, or biting and/or increased pacing or deteriorating coat condition) that limit their foraging or enclosure use, they should be considered incompatible. If aggression lasts longer than a few days, the animals should be separated and considered incompatible. As part of the introduction and familiarization process, it is important to check nest boxes daily for signs of feces, because stressed animals will defecate in their box. If feces are found in a nest box, the occupant should be considered as being under high stress and removed from the introduction area to another cage (Roberton et al. 2002).

Chapter 5. Nutrition

5.1 Nutritional Requirements

A formal nutrition program is recommended to meet the behavioral and nutritional needs of all viverrids (AZA Accreditation Standard 2.6.2). Diets should be developed using the recommendations of nutritionists, AZA Taxon Advisory Groups, Species Survival Plans®, the Nutrition Advisory Group's feeding guidelines (www.nagonline.net/feeding_guidelines.htm), and qualified veterinarians. Diet formulation criteria should address the animal's nutritional needs, feeding ecology, as well as individual and natural histories to ensure that species-specific feeding patterns and behaviors are stimulated.

AZA Accreditation Standard

(2.6.2) A formal nutrition program is recommended to meet the behavioral and nutritional needs of all species and specimens within the collection.

Digestive System Morphology and Physiology: The gastrointestinal tract of Viverridae are reported to be quite similar to that of a domestic cat, however, the cecum is very rudimentary in at least some of the viverrids (Stevens & Hume 1995), and absent in the binturong (Crapo et al. 2002). The cat gastrointestinal tract is relatively short and the hindgut contains a small cecum and unsacculated colon. See Kawahty et al. (2003) for a discussion of viverrid digestive physiology.

Crapo et al. (2002) postulated that "….the characteristics of the GIT suggest that the binturong may be unable to digest and utilize fruits as efficiently as most monogastric animals with a cecum do. Considering that the binturong is known to ingest fruits in its natural habitat, it is possible that such fruits serve as a main source of water and that binturongs may require the ingestion of a large volume of fruits and other feeds to meet its nutritional requirements." Further research is needed to better understand this and other aspects of binturong nutritional needs.

Nutrient Requirements: Whereas nutritional requirements for the viverrid species are not currently available, target nutrient values are proposed. Although many of the items consumed by viverrids are known, the nutrient content of these items has not been completely characterized. In the case of viverrids, target nutrient levels are based on those of well-studied carnivores and omnivores (dogs, Arctic fox/mink, and cats). Ranges are provided to best describe the needs across a variety of genera, with the high ends of each range for growing and lactating animals. In most cases, the highest values reported are reflected. Based on the emphasis of foraging strategy of the genus or species in question, a range of target nutrient values has been provided for more omnivorous or more carnivorous individuals (Table 5). These values are provided in comparison to straight cat (NRC 1986; Legrand-Defretin & Munday 1993; AAFCO 1994), dog (NRC 1974; AAFCO 1999), and Arctic fox/mink (NRC 1982) requirements. As additional information becomes available, these ranges should be adjusted to reflect new knowledge. In 2005 the National Research Council of the National Academies (dels.nas.edu/banr/petdoor.html) published updated information on the nutritional needs of cats and dogs. This new report "provides nutrient recommendations based on physical activity and stage in life, major factors that influence nutrient needs." This information is assimilated into Table 5 as well. See Appendix G for a description of nutrients.

Table 5: Target nutrient ranges for baseline species (dry matter basis)

Nutrient	More Omnivorous[1] Binturong	More Carnivorous[2] Owston's Palm Civet and Genet
Protein (%)	17.5-26.0[1a]	19.7-32.5
Fat (%)	5-8.5	9.0-30[2a]
Linoleic Acid (%)	1.0-1.3	0.5-0.55
Vitamin A (IU/g)	0.5-5.9	2.44-10
Vitamin D (IU/g)	0.5-0.55	0.25-1.0
Vitamin E (mg/kg)	27-50	27-120
Thiamin (mg/kg)	1.0-2.25	1.0-5.6[2b]
Riboflavin (mg/kg)	1.6-10.5	1.6-4.25
Pantothenic acid (mg/kg)	7.4-15.0	5.0-8.0
Niacin (mg/kg)	11.4-20.0	9.6-60
Pyridoxine (mg/kg)	1.0-1.8	1.6-4.0
Folacin (mg/kg)	0.18-0.5	0.2-1.3
Biotin (mg/kg)	0.1-0.12	0.07-0.12
Vitamin B_{12} (mg/kg)	0.022-0.035	0.02-0.035
Calcium (%)	0.3-1.2[1b]	0.29-1.0[2c]
Phosphorus (%)	0.3-1.0[1b]	0.26-0.8[2c]
Potassium (%)	0.4-0.6	0.4-0.6
Sodium (%)	0.04-0.3	0.05-0.4
Magnesium (%)	0.04-0.06	0.03-0.08
Iron (mg/kg)	30-90	80-114
Zinc (mg/kg)	50-120	50-94
Copper (mg/kg)	6.0-12.4	5.0-8.8
Iodine (mg/kg)	0.9-1.54	0.35-2.2
Selenium (mg/kg)	0.1-0.35	0.1-0.4

[1]Dog NRC (2006), Dog AAFCO (1999) (All numbers are based on requirement set for maintenance); Mink NRC (1982); Fox NRC (1982) (for mink and fox NRC protein is range of growth and maintenance, vitamins are for growth, and minerals for growth and maintenance).

[1a] Authors of this chapter are not comfortable recommending a 10% protein for maintenance as the Dog NRC 2006 suggests.

[1b] Authors of this chapter would caution feeding diets with 0.3% calcium and/or phosphorus as the Dog NRC 2006 suggests.

[2] Cat NRC (2006), Legrand-Defretin & Munday (1993), Cat AAFCO (1994); Maslanka & Crissey, 1999; Mink NRC (1982); Fox NRC (1982) (for mink and fox NRC protein is range of growth and maintenance, vitamins are for growth, and minerals for growth and maintenance).

[2a] Lewington (2002) indicated that lactation demand on female mink (*Mustela*) may require up to 45.7% CP on a dry matter basis (based on a calculated 83% protein digestibility).

[2b]Blomqvist (2001) has indicated that wolverines (*Gulo gulo*) may have a higher requirement for thiamin than other mustelids.

[2c] Authors of this chapter would caution feeding diets with 0.29% calcium and 0.26% phosphorus as the Cat NRC 2006 suggests.

Energy Requirements: Available information suggests that energy requirements are closely related to body mass, food habits, climate, and activity level, but these factors are all interrelated, and some exert more influence than others. *Derbyanus* tend to have low metabolism because they feed principally on invertebrate prey, fruit or a combination of these food items, not simply because they are viverrids. Gittleman & Oftedal (1987) reported that frugivorous carnivores such as binturong have a low basal metabolic rate and a low growth rate due to their foraging habits (McNab 1989). Work done by Muñoz-Garcia and Williams (2005) on the basal metabolic rate (BMR) of 58 carnivora species indicated, after controlling for body mass, a strong correlation between home range size (used as a proxy for level of activity), diet, and BMR (Table 6). Based upon this work Muñoz-Garcia and Williams (2005) concluded that "…species that eat meat have larger home ranges and higher BMR than species that eat vegetable matter." Nagy et al (1998) propose that a reasonable equation to calculate BMR for omnivorous species is KJ/d = 6.03 BWg ^ 0.678), but a viverrid specific equation has not been developed.

Table 6. Basal Metabolic Rate (BMR) of Selected Viverridae Species [1]

Species	Body Mass (g)	BMR (kJ/d)	Diet (Meat %/Invert %/Veg %)	Home Range (km^2) (females only)
Arctictis binturong	14,280 ± 3,514	541.5 ± 192	20/0/80	Not listed
Genetta tigrina	1,698 ± 271	358.62 ± 16	68.1/31.8/0.1	0.06
Genetta felina	1,203.2 ± 191	286.46 ± 25	Not listed	Not listed
Nandinia binotata	4,270	414.02	15.1/24.4/43.6	0.45
Paradoxurus hermaphroditus	3,160	365.55	23.1/9.4/67.5	3.2
Arctogalidia tirvigata	2,010 ± 260	265.32 ± 76	0/10/90	Not listed

[1] Munoz-Garcia and Williams, 2005

5.2 Diets

The formulation, preparation, and delivery of all diets must be of a quality and quantity suitable to meet the animal's psychological and behavioral needs (AZA Accreditation Standard 2.6.3). Food should be purchased from reliable, sustainable and well-managed sources. The nutritional analysis of the food should be regularly tested and recorded.

AZA Accreditation Standard

(2.6.3) Animal diets must be of a quality and quantity suitable for each animal's nutritional and psychological needs. Diet formulations and records of analysis of appropriate feed items should be maintained and may be examined by the Visiting Committee. Animal food, especially seafood products, should be purchased from reliable sources that are sustainable and/or well managed.

Food preparation must be performed in accordance with all relevant federal, state, or local regulations (AZA Accreditation Standard 2.6.1). Meat processed on site must be processed following all USDA standards.

AZA Accreditation Standard

(2.6.1) Animal food preparations must meet all local, state/provincial, and federal regulations.

If browse plants are used within the animal's diet or for enrichment, all plants must be identified and assessed for safety. The responsibility for approval of plants and oversight of the program should be assigned to at least one qualified individual (AZA Accreditation Standard 2.6.4). The program should identify if the plants have been treated with any chemicals or near any point sources of pollution and if the plants are safe for the species. If animals have access to plants in and around their exhibits, there should be a staff member responsible for ensuring that toxic plants are not available.

AZA Accreditation Standard

(2.6.4) The institution should assign at least one person to oversee appropriate browse material for the collection.

Typically browse is not a dietary item for viverrid species. However, all plant items used in or around exhibits or those used for enrichment should be cleared by institutional management including the nutritionist, veterinarian, and horticulturists. If there are any questions regarding the safety of a plant it should not be used.

Diet Composition: The family Viverridae consists of binturong, civets, genets, and linsangs. This family ranges from mostly omnivorous to insectivorous or carnivorous. For example, Owston's civets (*Chrotogale owstoni*) have long narrow snouts and feed mostly on invertebrate prey, consuming some fruit and vertebrate prey as well (Gould & McKay 1998; Nowak 1999). Banded palm civets (*Hemigalus derbyanus*) are very carnivorous, foraging at night on the ground and in trees and consuming invertebrate and vertebrate prey (MacDonald 1999). Large spotted civets (*Viverra megaspila*) forage on small vertebrate prey, eggs, invertebrate prey, fruit, and vegetation (Nowak 1999). The banded linsang (*Prionodon linsang*) are small, quick, trimly built, secretive forest animals with banded tails. They depend almost entirely on small vertebrates as their diet, along with consuming some invertebrate prey (MacDonald 1999). The binturong (*Arctictis binturong*) has a massively muscular tail that, along with the hind-feet, is used to grasp branches while the forelimbs pull fruiting branches to the mouth (MacDonald 1999). Binturongs also have been reported to swim in water and catch fish (Nowak 1999). For the most part, all species in this family consume small mammals, fruit, and insects. Obesity in zoos is a common problem for viverrids (Denver 2003).

There are a wide range of diets that may be available to viverrids. As omnivores and carnivores, diets that contain a mix of food items and groups appear most appropriate, with emphasis added toward vertebrate and invertebrate portions of the diet for more carnivorous members (*Derbyanus* and *Linsang*). Based on the species in question, viverrid diets can consist of a commercially available, nutritionally complete meat product (moist or dry), fruits and vegetables, and occasional whole prey, eggs, and

insects. Many viverrid species not addressed in these guidelines (not maintained in AZA institutions) may require specific diets that should be thoroughly researched for current practices prior to acquisition (Carnio 2003). Example diets from AZA institutions are provided in Table 7, and their respective nutrient contents are listed in Table 8.

Civets: Civets should be provided with nutritionally complete, commercially available feline diet, rodents, fruits, day-old chicks, etc. Ideally, across the family, a palatable nutritionally complete food may be used as the base of the diet, to which other items can be added as appropriate and based on feeding strategy. A diet offered to Owston's civets at a facility in Viet Nam is listed in Table 9, but no nutrient content information is available. This facility has housed this species successfully for over ten years. These items are fed three times a night; items are either scattered or fed in enrichment devices. Food bowls are only used in quarantine quarters (Roberton et al. 2002). One item is selected from each food group daily.

Banded linsangs: For banded linsangs, a diet of ground meat with vitamins and minerals (commercially available meat mixes), fruits, vegetables, whole animals, eggs, and some insects may be appropriate (Carnio 1996).

Binturongs: Binturong diets should consist of a wide variety of fruits, vegetables, seeds, and a commercially available, nutritionally complete meat product. The addition, several times a week, of small or large carnivore kibble as a supplement to the meat fed binturongs has led to good health and excellent coat quality (M. Stinner, personal communication). Sweet foods such as bananas may be preferred, but every effort should be made to encourage consumption of a balanced diet that meets the target nutrient values discussed later in this chapter. Binturong also will readily eat raw (caution should be exercised) or cooked meat as a training treat or enrichment. Binturong should be fed daily, with no fast days (C. Schultz, personal communication). In the past, many facilities fed a very low level of protein to binturong that may have resulted in health issues associated with hypoproteinemia (A. Moresco, personal experience). Yogurt and natural/organic peanut butter (to avoid the added sugars of commercial peanut butters) were used as additional sources of protein for the binturong diets in that case. The target nutrient values in Table 5 are designed to avoid this occurrence. Due to their heavy coat, it is recommended that this species be handled or weighed regularly to monitor for weight gain or loss.

The AZA Nutrition Advisory Group cautions against feeding raw meat due to significant food sanitation concerns associated with the practice. If chosen as a food item, raw meat should only come from lab raised carcass foods or parasite free thawed meat (verified by independent screening). The AZA SCTAG recommends that facility policy be set in conjunction with the nutritionist, animal care staff, and veterinary staff, taking into consideration safety of food sources, animal health, and institutional policies. Young binturongs have been known to consume spoiled meat; care should be taken to remove all meat products before they become rancid (M. Stinner, personal communication).

Table 7: Sample diet from AZA institutions of viverrid species as fed daily*

Species	Common Name	Institution	Food Item[1]	grams/day	% in diet
Arctictis binturong	Binturong	Institution B	Pro-Plan chicken and rice canine[1]	208	42.3
			Fruit used apple	188	38.2
			Vegetables used carrot	46	9.3
			Natural Balance Carnivore 5%	50	10.2
			Total	492	100
		Institution C	IAMS chunk dog food	60	11.8
			Marion Leafeater gorilla size	60	11.8
			Natural Balance Carnivore 5%	35	6.9
			Root Vegetable used carrot	130	25.5
			Fruit used apple	200	39.2
			Egg, hard-boiled	25	4.8
			Total	510	100
		Institution D	Mazuri Primate Basix	60	10.0
			ZuPreem Feline Canned	60	10.0
			ZuPreem Primate canned	60	10.0
			Fruit Mix[2]	288	48.0
			Vegetable Mix[2]	120	20.0
			Grapes	12	2.0
			Total	600	100
Chrotogale owstoni	Owston's civet	Institution E	ZuPreemFeline Canned	8	4.3
			Fruit, mixed used apple	60	32.0
			Mouse	24.5	13.1
			Natural Balance Carnivore 10%	95	50.6
			Total	187.5	100
		Institution F	Mouse	10.7	8.4
			Earthworms	14.0	11.0
			IAMS cat food adult	25.0	19.6
			Natural Balance Carnivore 10%	45.4	35.5
			Sweet Potato	6.5	5.1
			Grapes	6.5	5.1
			Orange	6.5	5.1
			Apple	6.5	5.1
			Banana	6.5	5.1
			Total	127.6	100
		Institution D	IAMS adult weight control cat dry	15	9.3
			Natural Balance Carnivore 10%	31	19.1
			ZuPreem Feline Canned	20	12.3
			Fruit Mix[2]	71	43.8
			Mouse	16	9.9
			Cricket	6	3.7
			Mealworm	3	1.9
			Total	162	100
Genetta tigrina/genetta	Genet	Institution D	IAMS cat food adult	40	47.2
			Mouse	12.8	15.3
			Natural Balance Carnivore 5%	30	35.4
			Bone Marrow 2x/wk		
			Mealworms	1.8	2.1
			Total	84.6	100
		Institution C	Nebraska Premium Beef Feline	85	57.0
			Chick	32	21.5
			Mouse	32	21.5
			Total	149	100

[1] ProVision, Pet Specialty Enterprises, Ralston Purina, St. Louis, MO 63164; Natural Balance Pet Foods, Inc. Pacoima, CA 91331; P&G Pet Care (IAMS), Cincinnati, OH 45220; Marion Zoological, Plymouth, MN 55441; PMI Nutrition International. Brentwood, MO 63144; Zupreem; Shawnee, KS 66214; Central Nebraska Packing, Inc. North Platte, NE 69103.

[2]Fruit mix is a combination of 16.26% apple, 27.49% banana, 6.71% grape, 3.47% orange, 6.35% papaya, 11.73% pear, 4.27% white potato, 13.63% sweet potato, 6.76% carrot, and 3.33% hard-boiled egg; Vegetable mix is a combination of 11.15% apple, 6.15% carrots, 8.92% pear, 1.44% collard greens, 6.34% green beans, 3.70% kale, 13.74% romaine, 10.94% pear, 9.87% white potato, 5.21% spinach, and 22.54% sweet potato.

- The AZA SCTAG does not specifically endorse the use of any mentioned products.

Table 8: Nutrient content of sample diets[1] (dry matter basis)

Nutrient	Institution B Binturong	Institution C Binturong	Institution D Binturong	More Omnivorous
Protein (%)	26.0	22.0	18.4	17.5-26.0
Fat (%)	16.6	9.1	9.3	5-8.5
Vitamin A (IU/g)	73.5	222	96.4	0.5-5.9
Vitamin D (IU/g)	2.2	1.3	2.8	0.5-0.55
Vitamin E (mg/kg)	90.5	157	162	27-50
Thiamin (mg/kg)	36.2	10.7	21.6	1.0-2.25
Riboflavin (mg/kg)	19.7	10.5	11.0	1.6-10.5
Pantothenic acid (mg/kg)	42.2	33.2	10.7	7.4-15.0
Niacin (mg/kg)	135	80.2	86.8	11.4-20.0
Pyridoxine (mg/kg)	13.4	9.4	11.5	1.0-1.8
Folacin (mg/kg)	4.1	1.1	5.6	0.18-0.5
Biotin (mg/kg)	0.24	0.37	0.34	0.1-0.12
Vitamin B_{12} (mg/kg)	0.2	0.09	0.04	0.022-0.035
Calcium (%)	1.16	1.08	0.68	0.3-1.2
Phosphorus (%)	0.87	0.84	0.50	0.3-1.0
Potassium (%)	0.65	1.04	1.0	0.4-0.6
Sodium (%)	0.40	0.38	0.23	0.04-0.3
Magnesium (%)	0.13	0.19	0.11	0.04-0.06
Iron (mg/kg)	260	155	192	30-90
Zinc (mg/kg)	194	133	84.4	50-120
Copper (mg/kg)	15.4	22.6	14.1	6.0-12.4
Iodine (mg/kg)	1.7	1.1	1.01	0.9-1.54
Selenium (mg/kg)	0.04[2]	0.34	0.20	0.1-0.35

Nutrient	Institution E Civet	Institution F Civet	Institution D Civet	More Carnivorous
Protein (%)	42.8	39.9	34.5	19.7-32.5
Fat (%)	24.3	22.8	19.1	9.0-30
Vitamin A (IU/g)	11.4	12.7	43.7	2.44-10
Vitamin D (IU/g)	1.0	1.6	1.2	0.25-1.0
Vitamin E (mg/kg)	240	175	150	27-120
Thiamin (mg/kg)	8.2	18.7	13.6	1.0-5.6
Riboflavin (mg/kg)	13.3	13.5	13.3	1.6-4.25
Pantothenic acid (mg/kg)	25.0	32.8	28.7	5.0-8.0
Niacin (mg/kg)	99.1	122	99.8	9.6-60
Pyridoxine (mg/kg)	9.2	15.9	12.2	1.6-4.0
Folacin (mg/kg)	18.7	10.9	7.5	0.2-1.3
Biotin (mg/kg)	1.1	0.95	0.73	0.07-0.12
Vitamin B_{12} (mg/kg)	0.09	0.17	0.13	0.02-0.035
Calcium (%)	1.59	1.37	1.0	0.29-1.0
Phosphorus (%)	0.94	0.95	0.63	0.26-0.8
Potassium (%)	0.35	0.55	0.71	0.4-0.6
Sodium (%)	0.71	0.49	0.38	0.05-0.4
Magnesium (%)	0.23	0.17	0.15	0.03-0.08
Iron (mg/kg)	141	428	127	80-114
Zinc (mg/kg)	166	196	156	50-94
Copper (mg/kg)	14.4	22.2	14.6	5.0-8.8
Iodine (mg/kg)	0.66	1.4	1.2	0.35-2.2
Selenium (mg/kg)	0.14	0.41	0.24	0.1-0.4

Nutrient	Institution C Genet	Institution D Genet	More Carnivorous
Protein (%)	42.7	35.0	19.7-32.5
Fat (%)	23.9	52.0	9.0-30
Vitamin A (IU/g)	15.0	40.4	2.44-10
Vitamin D (IU/g)	2.2	0.71	0.25-1.0
Vitamin E (mg/kg)	174	281	27-120
Thiamin (mg/kg)	27.3	[2]	1.0-5.6
Riboflavin (mg/kg)	16.6	[2]	1.6-4.25
Pantothenic acid (mg/kg)	45.8	[2]	5.0-8.0
Niacin (mg/kg)	178	[2]	9.6-60
Pyridoxine (mg/kg)	20.7	[2]	1.6-4.0
Folacin (mg/kg)	2.4	[2]	0.2-1.3
Biotin (mg/kg)	0.96	[2]	0.07-0.12
Vitamin B_{12} (mg/kg)	0.24	0.07	0.02-0.035
Calcium (%)	1.4	1.75	0.29-1.0
Phosphorus (%)	1.1	0.84	0.26-0.8
Potassium (%)	0.69	0.67	0.4-0.6
Sodium (%)	0.37	0.32	0.05-0.4
Magnesium (%)	0.17	0.09	0.03-0.08
Iron (mg/kg)	278	381	80-114
Zinc (mg/kg)	203	103	50-94
Copper (mg/kg)	28.5	10.0	5.0-8.8
Iodine (mg/kg)	2.1	[2]	0.35-2.2
Selenium (mg/kg)	0.58	0.41	0.1-0.4

[1] Target nutrient levels listed in Table 6.
[2] Missing values in database so nutrients most likely meet targets.

Table 9: Diet provided to *ex situ* populations of Owston's civets at the Institution G (from Roberton et al. 2002)

Food	Item	Daily amount	Notes
Meat*	Pork	30g	Raw, minced
	Beef	30g	Raw, minced
	Chicken	30g	Raw, minced
Egg	Duck	1 per week	Raw/boiled & chopped
	Chicken	1 per week	Raw/boiled & chopped
Fruit	Apple	30g	Chopped
	Pear	30g	Chopped
	Papaya	30g	Chopped
	Custard apple	30g	Chopped
	Grape	30g	Whole
	Banana	1 medium size	Skinned & chopped
Vegetable**	Sweet potato	50g per week	Cooked/mashed, etc.
	Red sweet potato	50g per week	Cooked/mashed, etc.
	Sugar beet	50g per week	Cooked/mashed, etc.
Worms	-	150g	Live
Live food	Stick insects	Ad lib	Live
	Grasshoppers	Ad lib	Live
	Locusts	Ad lib	Live
	Crickets	Ad lib	Live
	Geckos	Ad lib	Live
	Centipedes	Ad lib	Live
	Tadpoles	Ad lib	Live
	Preying mantis	Ad lib	Live
	Small snails	Ad lib	Live
	Frogs	1 (week)	Live
	Small fish	2 (week)	Live
	Beetles	Ad lib	Live
	Moths	When available	Live

* Diet is fed in Viet Nam; all institutions should evaluate the risks of feeding raw meat.
** Fed in winter when insects are scarce.

General Feeding Information: Clean drinking water should always be available. Water can be provided in a bowl or water bottles, but care should be taken to ensure that every individual knows how to use a water bottle (spouts should be wedged open and gradually closed as all animals are observed using an automatic waterer of any type). Food should be offered in multiple non-tippable containers. These can be made from any material and can be disguised as necessary; however, bowls should be monitored for chewing by the animals. Whenever possible, enrichment food items and the regular diet should be scattered to encourage foraging (M. Dulaney, personal communication**).**

Water and food should be offered in multiple locations to prevent more dominant animals from monopolizing these resources in group housing situations; they should also be offered at varying heights to accommodate strata. Water and feeding stations should be located off the ground, in the branches or trees, for arboreal species (e.g., binturong, genet), and on or near the ground for terrestrial ones (e.g., banded linsang, Owston's civet, genet). There should be multiple food and water stations for groups of animals (e.g., binturong).

Binturong: Many binturongs do not adapt well to water bottles, and so watering systems of this type should be monitored closely to ensure all individuals are using them (M. Stinner, personal communication).

Owston's civet: In zoos and aquariums, the Owston's civets have shown a tendency to defecate in water. Therefore, it is recommended that at least two water bowls be provided in the exhibit; one of these can be sunk into the ground to encourage its use as a latrine. The animals will distinguish between the two and only use one as a toilet (Roberton et al. 2002).

Provision of Diet: Typically, animals should be fed in accordance with their species-typical activity pattern, i.e., nocturnal animals fed prior to their 'night,' which can be reversed for exhibition purposes, and diurnal animals fed in the morning (M. Dulaney, personal communication). Some species/individuals

benefit from more frequent feedings, with the added bonus that this also can raise the activity level in an exhibit. An effective method is to provide the primary diet in one or two feedings, and schedule enrichment foods that can be scattered to encourage foraging/hunting during public hours. All food enrichment should be accounted for in the individual animal's daily caloric intake.

Binturong: In general, binturongs do not respond well when their primary diet is hidden, but will forage for highly desirable treats (M. Stinner, personal communication). Sweet, aromatic foods such as mashed bananas are also useful for hiding oral medications. Mashed bananas, in particular, can be mixed with kibbles to encourage their consumption by animals that tend not to consume these dry foods. Binturong groups generally show little aggression over food, but may become competitive for the last piece of a favored food item (C. Schultz, personal communication). As stated previously, the bulk of binturong diet should be fed at feeding stations, and highly preferred items only used for scatter feeds (M. Stinner, personal communication).

Linsang: Banded linsang should be fed a commercially available, nutritionally complete meat mix, as well as fruit, vegetables, whole animals, eggs, and occasional insects (K. Gilchrist, personal communication).

Owston's civet: Owston's civets should be fed on the ground (Roberton et al. 2002), and at least twice in 24 hours, preferably three times. Due to their nocturnal nature, feedings should actually take place at "dusk" within the exhibit, and again one to two hours later. Food should be scattered or hidden to promote activity, as this encourages activity and limits their tendency to develop stereotypies (Roberton et al. 2002).

Promoting Species-specific Behaviors: Whole prey (e.g., mice), insects, and favorite fruit/forage items can be placed around the exhibit to encourage movement and exploration; this is important for animals of all ages but can be particularly useful in encouraging movement of older animals. Foods can be hidden in locations that fit with the animal's natural feeding style (i.e., ground feeders vs. arboreal feeders). It is recommended that the diet be offered in several feeds over the course of the day. Offering several meals will allow for more opportunities to adequately distribute food items to animals within a group. A minimum of two feedings per day is recommended. Easily contaminated foods (mashed fruit, banana, prepared meat mixtures or similar) should be offered for short periods of time only (removed quickly if not consumed) and the entire diet should be offered in containers that are cleaned and sanitized after each use.

The provision of species appropriate enrichment items, including food, is advisable. The nutrient content of food items used for enrichment should be accounted for within the overall diet, varied in terms of content when it is offered, and presented in such a way as to encourage species-appropriate foraging activities (e.g., on the ground, in the trees, hidden in holes, etc.). Live insects, fruit pieces, kibble, frozen mice are just some of the food items that can be used.

Binturong: Binturongs have been observed diving and swimming to catch fish, and so the placement of some of their enrichment diet at the bottom of a pool may stimulate this activity (Nowak 1999; C.Schultz, personal communication). They also will eat frozen-thawed pinkies, which can be used as special treats. Binturongs have been reported to adjust well to cooked meat, eliminating health concerns associated with feeding raw meat (C. Schultz, personal communication). Selection of a dry kibble should be made based on the nutrient content of the diet, ability to maintain weight and condition of the animal, and other criteria as assigned by animal managers (maintenance of coat condition, etc).

Genet: Genets will eagerly forage for scattered items, especially mealworms, pinkie rats, and live crickets (M. Stinner, personal communication). These species will benefit from receiving whole prey such as rodents and chickens. These species are excellent foragers and should be provided the opportunity to do so as often as possible. Genets also will forage for a wide variety of fruits and vegetables (M. Stinner, personal communication).

Linsang: If animals are slow to adjust to their diet at a new facility, mixing in ground meat may help them to adjust (M. Dulaney, personal communication). Situations of this type should be closely monitored to ensure the animal is receiving a nutritionally complete diet.

Owston's civet: Owston's civet are believed to spend a great deal of time foraging in the substrate looking for insects, etc.; this species will benefit from the provision of live insects (e.g., crickets, worms, etc.) and other food items scattered throughout their enclosure on a regular basis (Roberton et al. 2002). As much

as possible, a variety of live insects should be incorporated into the diet, as Owston's civets are known to require constant stimulation to prevent stereotypies from developing. They often eat the leaves of bamboo, grasses, and wild ginger planted in their enclosures. Enclosures should be planted with bamboo, grasses, or plants with similar leaf structure, or these browse items should be supplemented in the diet. Some researchers have speculated that the consumption of this plant matter is required to assist in the passage of dirt consumed while eating worms, and as an intestinal scourer (Roberton et al. 2002).

Special Diets: Several factors affect nutrient requirements. These factors include: age, physiological state, health status, environment, activity, and group dynamics. The target nutrient values in these standard recommendations encompass the needs for maintenance adults, reproducing animals (gestation and lactation), as well as needs for growing animals. The sample diets included herein have supported all life stages. Increased or decreased requirements for illness, thermoregulation, or activity can be met by offering diets ad libitum, and monitoring body weight and condition over time. In general, diets should be offered so that a small amount of food remains at the end of the feeding period. However, each animal should be managed on an individual basis to avoid obesity. Group dynamics often play a role in the nutrient content of the consumed diet. Feeding should be observed to ensure the subordinate animals in group feeding situations receive the correct proportions of ingredients. When feeding groups of animals, increasing the number of feeding times per day, placing the food in several locations, distracting some of the animals to allow others adequate access, or separating animals when possible, are often necessary to ensure adequate nutritionally complete feed consumption. Foods should be hidden in locations that identify with the animals' natural foraging behavior.

Dietary items offered, how they are offered, when they are offered, and how often they are offered should be age appropriate, e.g. young animals may require feeding more often, older individuals may require chopping of food, softer items, etc.

Owston's civet: For this species, from the time young are weaned until about eight months of age, their food can be chopped smaller than the adults' food, thus allowing them to chew the food more easily (Roberton et al. 2002).

Linsang: Offering vertebrate prey to linsang females with kits has been suggested to be helpful in preventing cannibalism of the kits (M. Dulaney, personal communication).

Reproductive Status: Diet increases may be necessary during lactation to keep females at a good weight level (M. Dulaney, personal communication) but, as with all diet adjustments, should be based on the objectively assessed weight/condition of the animal in question.. The increased amount should be based on the maintenance amount fed and the animal's weight/condition; increases should be designed to maintain the animal's desired weight as set by management.

Seasonal Changes in Temperature, Body Condition, Nutritional Requirements, and/or Activity Level: Not much is currently understood about the impact of seasonal changes on viverrid species; this is an area requiring further research. Members of the family Viverridae have been noted to easily gain weight in zoos and aquariums; this can be managed by closely and regularly monitoring their weight and adjusting diets as needed (Denver 2003).

Binturong: For binturongs, the amounts and frequency of feedings can be increased during cold months (C. Schultz, personal communication) based on the objectively assessed weight/condition of the animal in question; it is suggested that this species appears to voluntarily increase consumption during cold winter months (A. Moresco personal communication). Any diet increase should be based on the maintenance amount fed and the animal's weight/condition; increases should be designed to maintain the animal's desired weight as set by management.

The health status of an individual should be considered when formulating a diet. Animals with chronic conditions should be monitored to ensure that they are consuming sufficient energy and nutrients meeting the target nutrient values described herein. Conditions caused by nutritional deficiencies should be addressed promptly.

5.3 Nutritional Evaluations

As has been indicated through this chapter, an animal's weight should be objectively monitored on a regular basis, and the diet adjusted to maintain the individual at its optimum overall or seasonal target

weight. An individual's body size (structural) should be taken into consideration when formulating a diet instead of using generic male, female, or life stage diets. Some individuals have a tendency towards obesity and seasonal activity patterns may compound the problem. For these reasons, "goal weights" for individuals should be established. Body weight should be checked frequently so that diet adjustments can be made in a timely fashion to avoid over- or under-conditioned animals.

The diet should be evaluated (nutrient content determined and compared to target nutrient values listed herein) any time that a composition change is made (i.e. not a percentage increase or decrease across the entire diet, but when ingredients are increased or decreased without simultaneous and similarly proportionate increases and decreases of all items).

Chapter 6. Veterinary Care

6.1 Veterinary Services

Veterinary services are a vital component of excellent animal care practices. A full-time staff veterinarian is recommended, however, in cases where this is not practical, a consulting/part-time veterinarian must be under contract to make at least twice monthly inspections of the animal collection and to any emergencies (AZA Accreditation Standard 2.1.1). Veterinary coverage must also be available at all times so that any indications of disease, injury, or stress may be responded to in a timely manner (AZA Accreditation Standard 2.1.2). All AZA-accredited institutions should adopt the guidelines for medical programs developed by the American Association of Zoo Veterinarians (AAZV) www.aazv.org/associations/6442files/zoo_aquarium_vet_med_guidelines.pdf. The current Veterinary Advisor for the SCTAG is Anneke Moresco, Institution H, (Anneke_Moresco@hotmail.com; 530-754-2259).

AZA Accreditation Standard

(2.1.1) A full-time staff veterinarian is recommended. However, the Commission realizes that in some cases such is not practical. In those cases, a consulting/part-time veterinarian must be under contract to make at least twice monthly inspections of the animal collection and respond as soon as possible to any emergencies. The Commission also recognizes that certain collections, because of their size and/or nature, may require different considerations in veterinary care.

AZA Accreditation Standard

(2.1.2) So that indications of disease, injury, or stress may be dealt with promptly, veterinary coverage must be available to the animal collection 24 hours a day, 7 days a week.

AZA Accreditation Standard

(2.2.1) Written, formal procedures must be available to the animal care staff for the use of animal drugs for veterinary purposes and appropriate security of the drugs must be provided.

Veterinary resources recommended by the SCTAG Veterinary Advisor are:

- International Zoo Vet Forum (requires AAZV membership)
- AAZV listserve (requires AAZV membership)
- For contraception questions and issues (www.stlzoo.org/animals/scienceresearch/contraceptioncenter)
- The Latinvets forum, to join e-mail Dr. Roberto Aguilar (raguilardvm@yahoo.com)
- Zoo and Wild Animal Medicine series of books, edited by M.E. Fowler
- Current journals
- For immobilization, anesthesia and analgesia : Zoo Animal and Wildlife Immobilization and Anesthesia by Gary West, Darryl Heard, and Nigel Caulkett (www.amazon.com/Zoo-Animal-Wildlife-Immobilization-Anesthesia/dp/0813825660/ref=sr_1_1?ie=UTF8&s=books&qid=1248108862&sr=8-1
- For drug dosages:
  - Exotic Animal Formulary (3rd Edition) by James W. Carpenter (www.amazon.com/Exotic-Animal-Formulary-James-Carpenter/dp/0721601804/ref=sr_1_1?ie=UTF8&s=books&qid=1248110295&sr=8-1)
  - Plumb's Veterinary Drug Handbook: Desk Edition by Donald C. Plumb (www.amazon.com/Plumbs-Veterinary-Drug-Handbook-Desk/dp/0813810973/ref=sr_1_1?ie=UTF8&s=books&qid=1248110333&sr=8-1)
- For neonatal care: Hand-Rearing Wild and Domestic Mammals by Laurie J. Gage (www.amazon.com/Hand-Rearing-Wild-Domestic-Mammals-Laurie/dp/0813826837/ref=sr_1_1?ie=UTF8&s=books&qid=1248110366&sr=8-1)

There are no training programs that specialize in Viverrids, however, the residencies listed on the American College of Zoo Medicine website (www.aczm.org) are good resources. Contact any residency ahead of time to obtain more detail regarding the focus of the upcoming year, as some residencies have a rotating focus.

Protocols for the use and security of drugs used for veterinary purposes must be formally written and available to animal care staff (AZA Accreditation Standard 2.2.1). Procedures should include, but are not limited to: a list of persons authorized to administer animal drugs, situations in which they are to be

utilized, location of animal drugs and those persons with access to them, and emergency procedures in the event of accidental human exposure.

Common pharmaceuticals used for viverrids include those for preventive care (vaccines) and therapeutic use (antibiotics). These drugs should be securely stored in a locked pharmacy to which only the veterinary staff and selected animal keeper staff have access. It should be a dry, cool, dark place (e.g. locked cabinets in the hospital). Additionally all controlled drugs need to be kept in compliance with DEA guidelines.

Antibiotics: Antibiotic treatment options for binturong include Amoxicillin, Baytril, and Clavamox (M. Stinner, personal communication). For Owston's civet, the following antibiotics have all proven successful: Penicillin, Streptomycin, Enrofloxacin, Sulfonamide, and Trimetoprim (Roberton et al. 2002).

Any of the drugs kept in a veterinary pharmacy may pose a toxicology hazard when used inappropriately. Some antibiotics have been shown to have immunosuppressive effects on some humans, humans are also more sensitive than certain animal taxa to some of the opioids used and depending on the potency of the opioids, they can severely suppress the respiratory system; other drugs may trigger anaphylactic reactions in sensitive individuals. It is not possible to know ahead of time which animals may develop an allergic reaction.

Animal recordkeeping is an important element of animal care and ensures that information about individual viverrids and their treatment is always available. A designated staff member should be responsible for maintaining an animal record keeping system and for conveying relevant laws and regulations to the animal care staff (AZA Accreditation Standard 1.4.6). Recordkeeping must be accurate and documented on a daily basis (AZA Accreditation Standard 1.4.7). Complete and up-to-date animal records must be duplicated and retained in a fireproof container within the institution (AZA Accreditation Standard 1.4.5) as well as be duplicated and stored at a separate location (AZA Accreditation Standard 1.4.4).

AZA Accreditation Standard

(1.4.6) A staff member must be designated as being responsible for the institution's animal record-keeping system. That person must be charged with establishing and maintaining the institution's animal records, as well as with keeping all animal care staff members apprised of relevant laws and regulations regarding the institution's animal collection.

AZA Accreditation Standard

(1.4.7) Animal records must be kept current, and data must be logged daily.

AZA Accreditation Standard

(1.4.5) At least one set of the institution's historical animal records must be stored and protected. Those records should include permits, titles, declaration forms, and other pertinent information.

AZA Accreditation Standard

(1.4.4) Animal records, whether in electronic or paper form, including health records, must be duplicated and stored in a separate location.

Thorough and accurate medical records are essential to learn and understand more about the medical problems of any *ex situ* population species. Medical records should be systematic, and entries should identify the history, physical findings, procedures performed, treatments administered, differential diagnosis, assessment, and future plans for treatment. A computerized medical record system, which can help track problems and can be easily transmitted from one institution to the next, is extremely beneficial. The AZA SCTAG encourages the use of Med ARKS (International Species Information System, 12101 Johnny Cake Ridge Road, Apple Valley, MN 55124, U.S.A.) as a universal medical record program. Many institutions already use this program, making it easy to transfer information between them. ISIS is developing a new product called ZIMS (Zoological Information Management System), which will take the place of Med ARKS in the future. Information that should be included in all viverrid health records includes:

1. Medical history
2. Identification (current ARKS record, transponder numbers, tattoos, etc.)
3. Clinical notes (including exam findings, diagnoses, vaccination history, etc.)
4. Parasitology
5. Anesthesia
6. Clinical pathology
7. Treatments (current medications, recent treatments, etc.)
8. Pathology
9. Reproductive status (contracepted, drug used with dosages and dates, cycle details or abnormalities, any adverse reactions etc.)

10. Nutritional information (nutritional deficiencies, supplements, allergies, etc.)
11. Behavioral/social group notes (social traumas, aggression, training for medical procedures, etc.)
12. Any pertinent group history should be included as well, especially if there is a history of infectious disease within the group or exhibit.
13. As small carnivores are prone to dental disease, a thorough history of dental problems and, preferably, a dental chart noting extractions, root canals, problems, etc. is recommended.

6.2 Identification Methods

Ensuring that viverrids are identifiable through various means increases the ability to care for individuals more effectively. Animals must be identifiable and have corresponding ID numbers whenever practical, or a means for accurately maintaining animal records must be identified if individual identifications are not practical (AZA Accreditation Standard 1.4.3).

AZA Accreditation Standard

(1.4.3) Animals must be identifiable, whenever practical, and have corresponding ID numbers. For animals maintained in colonies or other animals not considered readily identifiable, the institution must provide a statement explaining how record keeping is maintained.

The AZA SCTAG recommends that all animals be identified as soon as possible after birth with a transponder chip placed subcutaneously in the shoulder. If it is not possible to identify the animal with a transponder chip, they should be tattooed on the inside of their thigh with the institutional identifier or Studbook number. Every animal should have a unique institutional accession number or other ID, as well as a Studbook number for those species with an SSP. Animals should be permanently identified to prevent confusion when animals are housed together. If a microchip is used, the number on the chip should be included in the medical record and verified every time the animal is examined. Placement is commonly intrascapular, however migration does occur. Before implanting a microchip in an animal whose record indicates that it has one, the entire body should be scanned and/ or radiographed to verify that the chip on record is missing. The type of reader needed also should be included in the record as more than one system is available. We recommend that zoos have universal readers.

AZA Accreditation Standard

(1.4.1) An animal inventory must be compiled at least once a year and include data regarding acquisitions and dispositions in the animal collection.

AZA Accreditation Standard

(1.4.2) All species owned by the institution must be listed on the inventory, including those animals on loan to and from the institution. In both cases, notations should be made on the inventory.

AZA member institutions must inventory their population at least annually and document all viverrid acquisitions and dispositions (AZA Accreditation Standard 1.4.1). Transaction forms help document that potential recipients or providers of the animals should adhere to the AZA Code of Professional Ethics, the AZA Acquisition/Disposition Policy (see Appendix B), and all relevant AZA and member policies, procedures and guidelines. In addition, transaction forms must insist on compliance with the applicable laws and regulations of local, state, federal and international authorities. All AZA-accredited institutions must abide by the AZA Acquisition and Disposition policy (Appendix B) and the long-term welfare of animals should be considered in all acquisition and disposition decisions. All species owned by an AZA institution must be listed on the inventory, including those animals on loan to and from the institution (AZA Accreditation Standard 1.4.2).

6.3 Transfer Examination and Diagnostic Testing Recommendations

The transfer of animals between AZA-accredited institutions or certified related facilities (CRFs) due to SSP or PMP recommendations occurs often as part of a concerted effort to preserve these species. These transfers should be done as altruistically as possible and the costs associated with specific examination and diagnostic testing for determining the health of these animals should be considered. See Section 6.5 for standard testing to be done before any transfers. Diagnostic tests should be planned in communication between the veterinarian at the sending and at the receiving institution; additionally the state requirements should be taken into account. Viverrids should be examined for ecto- and endoparasites and treated appropriately; a minimum of three negative fecal examinations is recommended. If possible, hematology, serum biochemistry, and urinalysis can be performed. Serum can be frozen (banked) for future reference and possible epidemiologic studies. All procedures and results should be recorded in the animal's medical record. Serological tests for certain diseases may not be

possible to interpret as most of these have been validated for domestic animals, however it depends on the specific test.

6.4 Quarantine

AZA institutions must have holding facilities or procedures for the quarantine of newly arrived animals and isolation facilities or procedures for the treatment of sick/injured viverrids (AZA Accreditation Standard 2.7.1). All quarantine, hospital, and isolation areas should be in compliance with AZA standards/guidelines (AZA Accreditation Standard 2.7.3; Appendix C). All quarantine procedures should be supervised by a veterinarian, formally written and available to staff working with quarantined viverrids (AZA Accreditation Standard 2.7.2). If a specific quarantine facility is not present, then newly acquired animals should be kept separate from the established collection to prohibit physical contact, prevent disease transmission, and avoid aerosol and drainage contamination. If the receiving institution lacks appropriate facilities for quarantine, pre-shipment quarantine at an AZA or AALAS accredited institution may be applicable. Local, state, or federal regulations that are more stringent than AZA Standards and recommendation have precedence.

AZA Accreditation Standard

(2.7.1) The institution must have holding facilities or procedures for the quarantine of newly arrived animals and isolation facilities or procedures for the treatment of sick/injured animals.

AZA Accreditation Standard

(2.7.3) Quarantine, hospital, and isolation areas should be in compliance with standards or guidelines adopted by the AZA.

AZA Accreditation Standard

(2.7.2) Written, formal procedures for quarantine must be available and familiar to all staff working with quarantined animals.

AZA institutions must have zoonotic disease prevention procedures and training protocols established to minimize the risk of transferable diseases (AZA Accreditation Standard 11.1.2) with all viverrids, including those newly acquired in quarantine. Keepers should be designated to care only for quarantined animals if possible. If keepers must care for both quarantined and resident animals of the same class, they should care for the quarantined animals only after caring for the resident animals. Equipment used to feed, care for, and enrich animals in quarantine should be used only with these animals. If this is not possible, then all items must be appropriately disinfected, as designated by the veterinarian supervising quarantine before use with resident animals.

AZA Accreditation Standard

(11.1.2) Training and procedures must be in place regarding zoonotic diseases.

Quarantine durations span a minimum of 30 days (unless otherwise directed by the staff veterinarian). If additional mammals, birds, reptiles, amphibians or fish of the same order are introduced into their corresponding quarantine areas, the minimum quarantine period must begin over again. However, the addition of mammals of a different order to those already in quarantine will not require the re-initiation of the quarantine period.

During the quarantine period, specific diagnostic tests should be conducted with each animal if possible or from a representative sample of a larger population (e.g., birds in an aviary or frogs in a terrarium) (see Appendix C). A complete physical, including a dental examination if applicable, should be performed. Animals should be evaluated for ectoparasites and treated accordingly. Blood should be collected, analyzed and the sera banked in either a -70 ºC (-94 °F) freezer or a frost-free -20 ºC (-4 °F) freezer for retrospective evaluation. Fecal samples should be collected and analyzed for gastrointestinal parasites and the animals should be treated accordingly. Vaccinations should be updated as appropriate, and if the vaccination history is not known, the animal should be treated as immunologically naive and given the appropriate series of vaccinations.

A tuberculin testing and surveillance program must be established for animal care staff as appropriate to protect both the health of both staff and animals (AZA Accreditation Standard 11.1.3). Depending on the disease and history of the animals, testing protocols for viverrids may vary from an initial quarantine test to yearly repetitions of diagnostic tests as determined by the veterinarian. Animals should be permanently identified by their natural markings or, if necessary, marked when anesthetized or restrained (e.g., tattoo, ear notch, ear tag, etc.). Release from quarantine should be contingent upon normal results from diagnostic testing and two negative fecal tests that are spaced a

AZA Accreditation Standard

(11.1.3) A tuberculin testing and surveillance program must be established for appropriate staff in order to ensure the health of both the employees and the animal collection.

minimum of two weeks apart. Medical records for each animal should be accurately maintained and easily available during the quarantine period. At this time viverrids are not routinely tested for TB.

AZA Accreditation Standard

(2.5.1) Deceased animals should be necropsied to determine the cause of death. Disposal after necropsy must be done in accordance with local/federal laws.

Viverrids which die during the quarantine period should have a necropsy performed to determine the cause of death and the subsequent disposal of the body must be done in accordance with any local or federal laws (AZA Accreditation Standard 2.5.1). Necropsies should include a detailed external and internal gross morphological examination and representative tissue samples from the body organs should be submitted for histopathological examination. See Appendix O for AZA SCTAG necropsy protocol.

After it has been decided by authorized staff that euthanasia is indicated, these species can be anesthetized (see anesthesia section). Once the animal is adequately anesthetized, an injection of pentobarbital can be given intravenously or intraperitoneally. NOTE that pentobarbital is a controlled substance and DEA regulations for its use should be followed. Heart should be auscultated to ensure the animal has died prior to disposing of the animal according to institutional guidelines. For more detailed information on alternative methods and on euthanasia guidelines please refer to the AVMA guidelines on euthanasia, a copy can be found at: www.avma.org/issues/animal_welfare/euthanasia.pdf.

AZA SCTAG Recommendations: The foundation of a medical program for zoo animals is preventive medicine because diagnostic procedures and treatment are inherently difficult. Viverrids entering a collection must undergo quarantine in an isolated facility designed to allow handling of the animals and proper cleaning and sanitizing of the enclosures. The shipping crate should be cleaned and disinfected before it leaves the quarantine area, and the crate's contents disposed of appropriately. Quarantine facilities require barriers against ingress of potential vectors and vermin. Animals in quarantine should be cared for by separate keepers, or a protocol should be put in place by the institution to ensure that keepers use different tools, clothing, and footbaths; keepers working in quarantine areas must be skilled at recognizing signs of stress and disease, and able to monitor carefully feed intake and fecal characteristics. Quarantined animals require specialized care during acclimation to new surroundings and diets (Aiello & Mays 1997).

During quarantine, viverrids should have their permanent ID checked, receive appropriate vaccinations and diagnostic testing (e.g., heartworm, where endemic, and any others required by the institution), be examined for ecto- and endoparasites, and be treated for any parasites appropriately. Before release from quarantine, the animal should receive physical and laboratory examinations, including radiographs, hematology, and clinical chemistry. Serum should be frozen for future reference and possible epidemiologic studies. All procedures and results should be recorded and become the start of the animal's record (Aiello & Mays 1997).

Binturong: Housing this species alone is not recommended. They are prone to developing stereotypies and self-destructive behaviors if housed alone for any length of time. Once repetitive behaviors are established they can be difficult to eradicate; when at all possible animals should be quarantined as pairs. (M. Stinner, personal communication)

The AZA SCTAG general necropsy protocol and forms can be found in Appendix O.

6.5 Preventive Medicine

AZA-accredited institutions should have an extensive veterinary program that must emphasize disease prevention (AZA Accreditation Standard 2.4.1). The American Association of Zoo Veterinarians (AAZV) has developed an outline of an effective preventative veterinary medicine program that should be implemented to ensure proactive veterinary care for all viverrids (www.aazv.org/associations/6442/files/zoo_aquarium_vet_med_guidelines.pdf).

AZA Accreditation Standard

(2.4.1) The veterinary care program must emphasize disease prevention.

AZA Accreditation Standard

(11.1.2) Training and procedures must be in place regarding zoonotic diseases.

As stated in the Chapter 6.4, AZA institutions must have zoonotic disease prevention procedures and training protocols established to minimize the risk of transferable diseases (AZA Accreditation Standard 11.1.2) with all animals. Keepers should be designated to care for only healthy resident animals, however

if they need to care for both quarantined and resident mammals, they should care for the resident animals before caring for the quarantined animals. Care should be taken to ensure that these keepers are "decontaminated" before caring for the healthy resident animals again. Equipment used to feed, care for, and enrich the healthy resident animals should only be used with those animals.

Viverrids that are taken off zoo/aquarium grounds for any purpose have the potential to be exposed to infectious agents that could spread to the rest of the institution's healthy population. AZA-accredited institutions must have adequate protocols in place to avoid this (AZA Accreditation Standard 1.5.5).

AZA Accreditation Standard

(1.5.5) For animals used in offsite programs and for educational purposes, the institution must have adequate protocols in place to protect the rest of the collection from exposure to infectious agents.

Also stated in Chapter 6.4, a tuberculin testing and surveillance program must be established for animal care staff, as appropriate, to protect the health of both staff and animals (AZA Accreditation Standard 11.1.3). Depending on the disease and history of the animals, testing protocols for animals may vary from an initial quarantine test, to annual repetitions of diagnostic tests as determined by the veterinarian. To prevent specific disease transmission, vaccinations should be updated as appropriate for the species.

AZA Accreditation Standard

(11.1.3) A tuberculin testing and surveillance program must be established for appropriate staff in order to ensure the health of both the employees and the animal collection.

Vaccinations: Preventive medicine should be tailored to the risk, which varies by location and with management practices. The veterinary staff at each institution should set up a preventive protocol that is appropriate for the risk of exposure and clinical disease. Vaccination schedules should be viewed in light of the risk of animals contracting these diseases, keeping in mind that overly aggressive vaccination schedules may carry some risk. Titers are useful if the assay that measures them has been validated for the species in particular. However, in many (most) zoo species it is not known for certain what constitutes a protective titer. For example, even if we know the titers are measured accurately, what do they mean in terms of protection? More information is needed to gather information on protective titers in these species. The AZA SCTAG encourages institutions to begin collecting this information.

The use of most vaccines in non-domestic animals is extra-label. In all cases, regulatory officials should be consulted regarding the legality of extra-label use of rabies vaccine, as some areas may have restrictions (Joslin et al. 1998), and will not be considered protective in the event of a bite. Due to the potential for vaccine induced disease that has occurred, use of live or modified live vaccines should be minimized as far as possible. Viral shedding is possible when modified live vaccines are used. Origin of the vaccine (i.e., cell line of viral culture) should also be considered (Joslin et al. 1998).

Specifics regarding type/lot of vaccine and site of injection should be recorded in the animal's record. The following recommendations are based on the Guidelines for Zoo and Aquarium Veterinary Medical Programs and Veterinary Hospitals available at the AAZV's website (www.aazv.org) (Manharth and Shellabarger 2003); this website can be checked for updates. For more information, also see resources listed in Section 6.1.

Viverrids appear to be susceptible to canine distemper and feline panleukopenia (Rettig & Divers 1978). For vaccination against canine distemper, it is recommended that the recombinant canary pox vectored Purevax® Ferret Distemper vaccine by Merial (Athens, Georgia) be used; the previously used killed vaccines are no longer available, and traditional modified live vaccines have resulted in post-vaccinal encephalitis (Denver 2003). In some areas where rabies, canine leptospirosis, and canine hepatitis are a problem, vaccination also should be considered (Carnio 1996). While most experts recommend animals should be vaccinated annually (Denver 2003), some recent discussions have suggested that titers should be checked first before revaccinating; however, interpretation of the results needs to be in light of the type of test and for what species it was validated. At this time, the AZA SCTAG recommends annual vaccination until additional information is available on this. The attending veterinarian should decide which vaccines are appropriate based on the risk of exposure to the animals. Table 7 lists possible vaccines for viverrids.

1. Rabies
    a. Only a killed rabies vaccine product should be used. Though it is recommended, use of rabies vaccines in these species will be extra-label and will not be considered protective in the event of a bite.

b. Imrab®3 (Merial Ltd., 3239 Satellite Blvd., Duluth, GA 30096) is a killed rabies vaccine that has been used extensively in small carnivores without apparent adverse effects.
    i. Dose: 1ml
    ii. Route: IM
    iii. Frequency: once at 16 weeks of age, then annually
c. PUREVAX® Feline Rabies (Merial Ltd., 3239 Satellite Blvd., Duluth, GA 30096) is a live canarypox vectored, nonadjuvanted recombinant rabies vaccine that is currently being used at some institutions for small carnivores.
    i. Dose: 1ml
    ii. Route: IM
    iii. Frequency: once at age 8 weeks or older, then annually

2. Canine Distemper
    a. PUREVAX® Ferret Distemper Vaccine (Merial Ltd., 3239 Satellite Blvd.,
        1. Duluth, GA 30096) is a monovalent recombinant canary pox vectored vaccine. It has been used in a number of small carnivores with minimal adverse effects and development of titers, which appear to be protective (www.aazv.org/displaycommon.cfm?an=1&subarticlenbr=272) for recommendations based on Dr. Montali's study).
            i. Dose: 1ml
            ii. Route: IM
            iii. Frequency
                1. Vaccinated adults: annually
                2. Unvaccinated adults: two vaccinations 3-4 weeks apart, then annually
                3. Juveniles: three vaccinations, every three to four weeks from 8 to 16 weeks of age (e.g. 8, 12 and 16 weeks)
3. Parvovirus
    a. Parvocine® (Biocor Animal Health Inc., 2720 North 84th Street, Omaha, NE 68134) is a killed univalent parvovirus vaccine.
        i. Dose: 1ml
        ii. Route: IM
        iii. Frequency: same as listed above for Distemper
4. Leptospirosis
    a. If leptospirosis has been diagnosed or is endemic in the area, a killed bacterin could be used, though most of these are currently in combination vaccines.
5. Feline Panleukopenia
    a. AAZV's Infectious Disease Notebook notes that some small carnivores are susceptible to feline panleukopenia and should be vaccinated and many small carnivores have been vaccinated with a combination product in the past. However, a number of veterinary advisors do not suggest vaccination in their recommendations, including red pandas and black-footed ferrets. Veterinary advisor recommendations should be followed primarily.
    b. If there is significant risk of exposure to feline panleukopenia (e.g. feral cat population), vaccination should be considered.
    c. FPV-1® Feline Panleukopenia Vaccine (Biocor Animal Health Inc., 2720 North 84th Street, Omaha, NE 68134) is a new non-adjuvanted, killed vaccine.
        i. Dose: 1ml
        ii. Route: SQ
        iii. Frequency: at least two vaccines three weeks apart at/after 12 weeks of age. If started before 12 weeks, give a third vaccine.
            1. Then annually there after.
        iv. This vaccine has been shown to be safe in pregnant domestic cats.

6. Titer Evaluations
    a. Distemper, parvovirus, and leptospiral titers can be evaluated by submitting serum to: Cornell Diagnostic Laboratory:
        College of Veterinary Medicine
        Cornell University
        Upper Tower Road
        Ithaca, NY 14851-0786
        Ph: 607-253-3900

Table 7. Summary table of possible vaccines for viverrids

Vaccine	Vaccine type	Frequency in vaccinated adults
Rabies	Killed/ canary pox vectored	Annual
Canine distemper	Canary pox vectored	Annual
Parvovirus	Killed	Annual
Leptospira Bacterin-CI	Killed	Annual
Feline panleukopenia	Killed	Annual

Binturong: Binturongs are known to be susceptible to canine distemper, feline panleukopenia, rabies, canine leptospirosis, and canine hepatitis (Carnio 1996; C. Schultz, personal communication), and should be vaccinated annually, particularly if housed out of doors. For the diagnosis of canine distemper, Chandra et al. (2000) suggest looking for inclusion bodies and/or antigens in conjunctival smears, buffy coat, or footpad biopsy to confirm a clinical distemper diagnoses. More information is needed on the advisability of using killed distemper vaccine in binturong; please contact the SCTAG Veterinary Advisor with your experiences. No problems have been reported in binturongs from rabies or feline panleukopenia vaccinations (A. Moresco, M. Stinner, personal communication). Chandra et al. (2000) and Hur et al. (1999) provide current information on distemper in binturong.

Annual Physical Examinations: It is recommended that all animals have regular routine physical examinations. Young healthy adult animals can be examined biennially, while clinically healthy but geriatric animals or those with shorter life-spans may be examined more frequently, at the discretion of the attending veterinarian. Additionally any animal that has clinical signs of disease should be evaluated sooner by the attending veterinarian and if indicated, the animal should be anesthetized to obtain diagnostic samples and physiologic parameters. Ideally, animals should be trained to cooperate in the collection of samples (e.g. blood) and administration of vaccinations without anesthesia or netting; this facilitates closer monitoring of the animal without the need of anesthesia.

During the physical examination the following procedures should be performed (this also is the exam regime recommended for quarantine):

- Transponders and/or tattoos should be checked and reapplied if they are not readable.
- Baseline physiological parameters, such as weight, body temperature, heart rate, and respiratory rate, should be obtained and recorded.
- The oral cavity and all dentition should be examined. Teeth should be cleaned and polished, if necessary. Any tooth that is fractured or in need of repair should be noted in the medical record and the condition corrected as soon as possible.
- Ophthalmologic exam; Cataracts and corneal ulcers should be checked for annually in older animals.
- Ear exam: appropriate diagnostics should be completed if there is any indication of problems. Cleaning and treatment should be done if necessary.
- The reproductive tract should be evaluated. Care should be taken to record any changes in the external genitalia, such as vulvar swelling or discharge, testicular enlargement, and mammary gland changes. Contraceptive implants should also be checked to make sure they are in place and not causing any local irritation.
- Radiographs may be taken to check for any abnormalities and subtle changes from previous examinations.
- Blood should be collected and complete blood count and serum biochemistry profile performed. Animals that are housed outside in heartworm endemic areas should be checked for heartworm

disease by performing a heartworm ELISA antigen test. See Appendix H for information on venipuncture in the binturong.
- If possible, serum should be banked.
- In some cases urine can be collected from the cage before anesthesia and a urinalysis performed. If any abnormalities are detected, urine should be collected by cystocentesis for a complete urinalysis (may need to include culture and sensitivity)
- Fecal examination should be performed during full physical examinations to check for internal parasites. Anthelmintics should be administered if necessary.
- Vaccines should be updated as necessary (Petrini 1998).

Parasite Control: Animals should have fecal examinations performed regularly. The frequency of these examinations depends on the incidence of parasitism in the geographic region and the animals' likelihood of exposure. Animals also should be screened for parasites before shipment and during quarantine. Fecal testing should include a direct smear examination and a fecal flotation, as well as sedimentation techniques if possible. Baermann fecal examination techniques help identify certain parasites such as lungworms that are otherwise difficult to detect. Heartworm ELISA antigen tests should be conducted annually in animals exposed to mosquitoes in heartworm endemic areas. External parasites such as ear mites, fleas, ticks, etc., can be detected during a physical examination (Petrini 1998).

Viverrid species are susceptible to the same parasites as the domestic carnivores; in general, treatment for these parasites is the same. Species housed out of doors should be routinely administered heartworm preventative in areas where this parasite is endemic (Denver 2003). The following summary provides recommendations for parasite testing:

Table 8. Recommendations for parasite testing

Internal	External
- Annual fecal examination should include a direct smear, fecal flotation, and sedimentation or Baermann. - Pre-shipment fecal examinations, direct smear and flotation. - Quarantine fecal examination, 3 direct smears, 3 fecal flotations. - Heartworm ELISA antigen tests should be conducted annually in animals exposed to mosquitoes in heartworm endemic areas.	- Animals should be inspected for external parasites, including ear mites, during any physical examination (Petrini 1998).

Binturong: Binturongs, especially the young, are susceptible to round worms and mange (C.Schultz, personal communication; M.Stinner, personal communication). Ivomec® (both oral and injectable solutions), Strongid®, and Panacur® have all been used in binturong successfully. Binturong should be regularly checked for worms; monthly during warm weather, every other month in cooler weather. If regular worming is required, products should be used on a rotational basis. This species can develop fungal infections when housed in chronically wet, damp, or moldy conditions (A.Moresco personal experience). Treatment for this includes sanitizing their environment (exhibit and holding), ensuring they are not housed in chronically moist environments, and shaving the affected areas so anti-fungals can be applied (M.Stinner, personal communication; A.Moresco, personal communication).

Pre-shipment Examination Recommendations: All animals should receive a thorough pre-shipment physical examination as outlined above in the preventative health care section. Ideally, a copy of the pre-shipment physical exam findings and laboratory work should be sent to the veterinarian at the receiving institution before the animal is transferred. If an animal has a current medical condition requiring ongoing treatment, the case should be discussed between the shipping and receiving institutions' veterinarians before the animal is moved. All animal shipments should be accompanied by a hard copy of the medical record, as well as a health certificate and the USDA acquisition, disposition, or transport form (APHIS form #7020). Institutions using MedARKS should provide the receiving institution with the medical records on a floppy disc or send them via e-mail (Petrini 1998).

6.6 Capture, Restraint, and Immobilization

The need for capturing, restraining and/or immobilizing a viverrid for normal or emergency husbandry procedures may be required. All capture equipment must be in good working order and available to authorized and trained animal care staff at all times (AZA Accreditation Standard 2.3.1).

AZA Accreditation Standard

(2.3.1) Capture equipment must be in good working order and available to authorized, trained personnel at all times.

Physical Capture and Restraint: The use of operant conditioning training to aid in the capture and restraint of viverrids is highly recommended, and enclosures and training programs should be designed to accommodate these behaviors.

Binturongs: Binturongs are best trained to voluntarily enter a crate, or they should be baited into a crate if they are not trained. Animals also can be familiarized with squeeze cages that are permanent parts of the enclosure. Some zoo professionals recommend that in general, netting or hand catching a binturong is not advised (F. Kohn, personal communication). However, it is possible to net them and can be done successfully with experience, knowledge of the animal's behavior, and an advance plan (A. Moresco, personal communication). In this case, large hoop nets should be used, and capture should be attempted in the morning when the animals come down for a morning feed (i.e., they should be netted while on the ground). Up to three keepers working in coordination are needed to capture binturongs. If the binturongs climb a tree that is out of reach, keepers should abandon capture that day (Ginman 2001). Once the animal has been netted, other staff may need to guide the rest of the binturong's body into the net. Binturongs will use their prehensile tails and sharp claws to grasp branches or anything available; this should be taken into consideration when trying to retrieve the netted animal. Once netted the animal plus net(s) should be placed inside a larger sack and secured with rope, or placed in a crate (Ginman 2001) for transport from enclosure to veterinary hospital. However, it is highly recommended that these animals be trained to enter crates, kennels, or squeeze cages, as this is less stressful to the animal and the keeper staff. It is possible to hand-inject binturong in any large muscle if desensitized to touch and trained to take the injection. The tail base is often used for injections because it is accessible, with training, from outside a holding den. However, drug absorption from the tail can be highly variable (A. Moresco personal communication)

Owston's civet: This species is best trapped in its nest box or by the use of a catch bag attached to the door of the nest box; chasing an individual to net it can be highly stressful to the animal and the keeper. When handling OC, it is best to grasp the animal by the scruff of the neck and the base of the tail; it is strongly advised that handlers wear thick gloves while handling this species (Roberton et al. 2002).

Genet: Genet species are easily trained to enter a kennel on cue, get on a scale for weighing, target and station (T. Boyd unpublished information). They also are commonly "bagged" while crated, and then anesthetized with Isoflurane only (M. Stinner, personal communication). While this process leads to gas wastage, the animals go down well and recover quickly.

Chemical Restraint: The following table (Table 9) lists drugs and dosages for immobilization of Viverridae species. Isoflurane chamber induction can be used; isoflurane should also be used as a supplement or for maintenance, during long procedures. Ketamine alone can produce a number of adverse effects such as excessive salivation, tonic clonic convulsions, hyperthermia, muscular rigidity, and apnea (Maran & Robinson 1996; Blomqvist & Rudbäck 2001).

Table 9: Drug doses for immobilization of viverrid species (Moresco and Larsen 2007)

Drug combination (dose)	Species	Comment	Reference
Ketamine(10-15mg/kg) Xylazine(1-2mg/kg)	1)Viverrids 2)*P. jerdoni*	2)Induction:3-15min. Recovery: 49-138min.	1)Denver 2003 2)Mudappa and Chellam 2001
Ketamine(3-8mg/kg) Medetomidine(0.02-.06mg/kg) Butorphanol(0.2-0.5mg/kg)	*A. binturong*	Lower ketamine and higher medetomidine doses provide shorter recovery	Moresco and Larsen 2003 Klaphake et al. 2005
Ketamine(10mg/kg) Diazepam(0.5mg/kg)	Viverrids		Denver 2003
Tiletamine/zolazepam 1) 3-5mg/kg 2)5mg/kg 3)15mg/kg	 1)Viverrids 2) *V. tangalunga* 3)Madagascar carnivores	 2)Induction: 15-20min. Need redosing if excited, silence during induction. Recovery: 60-120min. More docile in trap than *A. binturong* or *P. larvata*	 1)Denver 2003 2) Colon 2002 and Colon pers. comm. 3)Louis pers. comm.

Ketamine/medetomidine has been used, however, combinations that include ketamine and medetomidine have been shown to produce hypertension in other carnivores (Larsen et al 2002). Monitor blood pressure. Medetomidine and xylazine can be reversed with atipamezole, thus recoveries from anesthesia using these agents can be shortened. In ketamine–medetomidine combinations, medetomidine should not be reversed before 30-45 min after the administration of anesthetics to minimize the effects of straight ketamine. Tiletamine/zolazepam (Telazol or Zolatetil) is very safe but recoveries are prolonged compared to other combinations.

For a more comprehensive review of anesthetic or a more comprehensive review of anesthetic protocols in viverrids see:

Moresco A, Larsen RS. Viverrids. 2007. In: Zoo Animal and Wildlife Anesthesia and Immobilization. West G, Heard D, Caulkett N (Eds.). Blackwell Publishing. Pp 429-435.

Binturong: Some binturongs are very resistant to many drugs, and they are difficult to anesthetize even when using injectable diazepam or a diazepam/Ketamine combination (C. Schultz, personal communication). IM injection of Ketamine/medetomidine/butorphanol at a dosage of 4mg/kg ketamine, 0.04mg/kg medetomidine, and 0.4mg/kg butorphanol was found to be effective (Moresco & Larsen 2003). This allowed for a lower ketamine dose making recovery time shorter and reversal if required. Oxygen readings on the pulse ox were a little low, but easily handled by using supplemental oxygen or reversing the medetomidine and administering isoflurane.

6.7 Management of Diseases, Disorders, Injuries and/or Isolation

AZA-accredited institutions should have an extensive veterinary program that manages viverrid diseases, disorders, or injuries and has the ability to isolate these animals in a hospital setting for treatment if necessary. Staff should be trained for meeting the animal's dietary, husbandry, and enrichment needs, as well as in restraint techniques, and recognizing behavioral indicators animals may display when their health becomes compromised (AZA Accreditation Standard 2.4.2). Protocols should be established for reporting these observations to the veterinary department. Hospital facilities should have x-ray equipment or access to x-ray services (AZA Accreditation Standard 2.3.2), contain appropriate equipment and supplies on hand for treatment of diseases, disorders or injuries, and have staff available that are trained to address health issues, manage short and long term medical treatments and control for zoonotic disease transmission.

AZA Accreditation Standard

(2.4.2) Keepers should be trained to recognize abnormal behavior and clinical symptoms of illness and have knowledge of the diets, husbandry (including enrichment items and strategies), and restraint procedures required for the animals under their care. However, keepers should not evaluate illnesses nor prescribe treatment.

AZA Accreditation Standard

(2.3.2) Hospital facilities should have x-ray equipment or have access to x-ray services.

AZA-accredited institutions must have a clear process for identifying and addressing animal welfare concerns within the institution (AZA Accreditation Standard 1.5.8) and should have an established Institutional Animal Welfare Committee. This process should identify the protocols needed for animal care staff members to communicate animal welfare questions or concerns to their supervisors, their Institutional Animal Welfare Committee or if necessary, the AZA Animal Welfare Committee. Protocols should be in place to document the training of staff about animal welfare issues, identification of any animal welfare issues, coordination and implementation of appropriate responses to these issues, evaluation (and adjustment of these responses if necessary) of the outcome of these responses, and the dissemination of the knowledge gained from these issues.

AZA Accreditation Standard

(1.5.8) The institution must develop a clear process for identifying and addressing animal welfare concerns within the institution.

AZA Accreditation Standard

(2.5.1) Deceased animals should be necropsied to determine the cause of death. Disposal after necropsy must be done in accordance with local/federal laws.

As care givers for the animals residing in our zoos and aquariums, it is vital that we provide the best care possible for them until the time their health deteriorates to a point where euthanasia is the most humane treatment, or the animal dies on its own. Necropsies should be conducted on deceased animals to determine their cause of death and the subsequent disposal of the body must be done in accordance with any local, state, or federal laws (AZA Accreditation Standard 2.5.1). Necropsies should include a detailed external and internal gross morphological examination and representative tissue samples form the body organs should be submitted for histopathological examination.

After it has been decided by authorized staff that euthanasia is indicated, viverrids can be anesthetized (see anesthesia section). Once the animal is adequately anesthetized, an injection of pentobarbital can be given intravenously or intraperitoneally. NOTE that pentobarbital is a controlled substance and DEA regulations for its use should be followed. Heart should be auscultated to ensure the animal has died prior to disposing of the animal according to institutional guidelines. For more detailed information on alternative methods and on euthanasia guidelines please refer to the AVMA guidelines on euthanasia, a copy can be found at: www.avma.org/issues/animal_welfare/euthanasia.pdf. See Section 7.6 for contraception information and Appendix O for necropsy information.

Owston's Civet: From roughly March through June or July, Owston's civets go through a molting process. During this period the animal's coat condition deteriorates, and there is some loss of marking definition; the animal is particularly vulnerable to ectoparasites at this time. Also during molt, the animal may develop lesions, particularly on the hindquarters. This condition should be addressed if it appears. Animals experiencing a poor molt or lesions should be treated with a multi-vitamin supplement and an antibiotic spray on the lesions if needed (Roberton et al. 2002). In all cases, a veterinarian should be consulted first to determine the most appropriate treatment course.

Useful Veterinary References: The following sampling of articles, not referenced in this document, deal with health issues observed in binturong. There is relatively little information available on diseases or common causes of death in viverrids; this information should be collected and documented.

Spriggs M, Arble J, Myers G. 2007. Intervertebral disc extrusion and spinal decompression in a binturong (*Arctictus binturong*). Journal of Zoo & Wildlife Medicine 38(1):135-138.

Childs-Sanford SE, Peters RM, Morrisey JK, Alcaraz A. 2005. Sarcomatoid renal cell carcinoma in a binturong (*Arctictus binturong*). Journal of Zoo & Wildlife Medicine 36(2):308-312.

Klaphake E, Shoieb A, Ramsay E, Schumacher J, Craig L. 2005. Renal adenocarcinoma, hepatocellular carcinoma, and pancreatic islet cell carcinoma in a binturong (*Arctictus binturong*). Journal of Zoo & Wildlife Medicine 36(1):127-130.

Grassman Jr. LI, Janecka JE, Austin SC, Tewes ME, Silvy NJ. 2006. Chemical immobilization of free-ranging dhole (*Cuon alpines*), binturong (*Arctictus binturong*), and yellow-throated marten (*Martes flavigula*) in Thailand. European Journal of Wildlife Medicine 52(4):297-300.

Chapter 7. Reproduction

7.1 Reproductive Physiology and Behavior

It is important to have a comprehensive understanding of the reproductive physiology and behaviors of the animals in our care. This knowledge facilitates all aspects of reproduction, artificial insemination, birthing, rearing, and even contraception efforts that AZA-accredited zoos and aquariums strive to achieve.

Appendix J provides information on the developmental and reproductive parameters of selected viverrid species. Appendix N provides additional information on the binturong. While this information lists the basics of selected viverrid reproductive behavior and physiology, additional information for some of these species will be helpful when determining management practices for breeding pairs or groups.

Binturong: Animals kept outside in the Northern Hemisphere generally give birth in February, March, May, June, August, or September, while pairs housed indoors breed year round. In Malaysia (Ismail et al. Undated) births are reported as occurring in March, April, October, and November. It is unclear whether reproduction is affected by the light cycle. Signs of courtship are clear and frequently initiated by the female (Ismail et al. Undated). It generally begins with the female emitting a scent attractive to the male, and causing him to mark excessively with copious amounts of urine. The female becomes affectionate with everyone (exhibit mates and keepers); the male becomes surly and occasionally aggressive. He will continue scent marking and may pick up branches and toys with his tail while charging forward. The pair will lick and touch each other often, frequently sleeping with tails intertwined. Copulation is accompanied by a low purr or whuffing sound (Kleiman 1974). Short chain carboxylic acids from their anal gland secretions are presumed to be the source of the binturong's scent used extensively for marking (Weldon et al. 2000). There is a record of at least one 8-month-old male reproducing successfully (C.Schultz, personal communication).

Owston's Civet: During courtship, the occurrence of scent marking and flank rubbing increases, and both animals are observed following each other more frequently. A female will cooperate during successful copulatory bouts by lifting her tail while lying prone on the ground and purring. Males have been observed attempting to breed females throughout the year, but this is often ignored, or the female will snap at the male in response (Roberton et al. 2002).

Aggression between breeding pairs has been observed at varying intensities, often peaking throughout the breeding season. Throughout the breeding season, two nest boxes should be provided (in general they should always have access to two nest boxes), allowing the animals to sleep separately if desired. Daily checks should be made to determine if either animal was injured the previous night, and treatment administered as required (Roberton et al. 2002).

Hormonal Monitoring: Hormonal monitoring of a male or female's reproductive status is possible using fecal or urine hormonal metabolite testing. If this is required, the AZA SCTAG Chair should be contacted for the current Reproductive Advisor's name and contact information.

7.2 Assisted Reproductive Technology

The practical use of artificial insemination (AI) with animals was developed during the early 1900s to replicate desirable livestock characteristics to more progeny. Over the last decade or so, AZA-accredited zoos and aquariums have begun using AI processes more often with many of the animals residing in their care. AZA Studbooks are designed to help manage animal populations by providing detailed genetic and demographic analyses to promote genetic diversity with breeding pair decisions within and between our institutions. While these decisions are based upon sound biological reasoning, the efforts needed to ensure that transports and introductions are done properly to facilitate breeding between the animals are often quite complex, exhaustive, and expensive, and conception is not guaranteed.

AI has become an increasingly popular technology that is being used to meet the needs identified in the AZA Studbooks without having to re-locate animals. Males are trained to voluntarily produce semen samples and females are being trained for voluntary insemination and pregnancy monitoring procedures such as blood and urine hormone measurements and ultrasound evaluations. Techniques used to preserve and freeze semen has been achieved with a variety of, but not all taxa and should be investigated further. At this time AI is not used in any of the viverrid species and is not recommended.

7.3 Pregnancy and Parturition

It is extremely important to understand the physiological and behavioral changes that occur throughout a viverrid's pregnancy. See Appendix J, Sections 4.1, 7.1 and 7.4 for reproduction information and management discussion.

7.4 Birthing Facilities

As parturition approaches, animal care staff should ensure that the mother is comfortable in the area where the birth will take place, and that this area is "kit-proofed."

A female should be given at least two well-bedded nest boxes so she can choose which den is most comfortable for her. It is not advisable to lock pregnant females into small areas to which they are not accustomed; it is better to give them choices.

Pregnant or nursing females may need to be separated depending on the species (see below for species information) or in individual cases based on female temperament. Removal of the female to an off-exhibit holding area, or removal of the male/other individuals, will depend on the institutional set-up and temperament of the female. If she is made nervous by change, and the public space around the exhibit can be closed for a time, it may be best to leave the female in her familiar exhibit and move exhibit mates. If this is not an option, the female should be moved to her birthing holding area early enough to have time to adjust to all new routines (this will vary with individuals).

Banded Palm Civet: At least sometimes, banded palm civets refuse bedding. For this species, the floor should be bedded down in case a kit falls from an elevated nest box (M. Dulaney, personal communication).

Binturong: How a parturient female is managed is variable and should depend on the individual animal and the exhibit layout. Some facilities separate a female prior to birth (F. Kohn, personal communication), others allow her to stay in the exhibit with her mate (J. Creviston, personal communication), while other facilities allow the female to remain with the entire group (A. Desmoulins, personal communication). Some professionals recommend (C. Schultz, personal communication) binturong females should not be removed from the exhibit, and the male can be left in with her. However, if this approach is used, the situation should be monitored for signs of stress, and advance preparations made for separating the adults if it becomes necessary. It is recommended that a separate nest box be provided for the male if the pair is left together (A. Moresco, personal experience).

The method selected should be decided on prior to parturition with input from all involved animal staff. The female should be offered a choice of nest boxes, in secluded areas of the exhibit, or given time to become familiar with an off-exhibit set-up. If the male and female are left together, it is recommended that:

- The exhibit is large (AZA SCTAG recommended size or larger) with several climbing and escape options to prevent any individuals from being cornered.
- A number of nest box types in various locations should be provided.
- A contingency plan for dividing the exhibit or removing the other animal(s) should be developed in advance in case of problems (J. Creviston, personal communication).

Pools should be drained while kits are young, at least until the young are moving well and able to get out of the water if an accident happens (C. Schultz, unpublished information, 2003).

Linsang: At least two nest boxes should be provided for pregnant females. When they first have kittens, the area should be kept quiet. The dam should not be disturbed for the first few days, as it is vitally important to allow for bonding time between dam and kittens. For the first several days, it may be necessary to close the building, or at least the exhibit, to allow her time to bond with her offspring. If the female is being held off-exhibit, staff members need to keep noise to a minimum. Prior to, and after births, keepers should keep to their normal routine (M. Dulaney, personal communication).

Palm Civet: Twins have been recorded in some of the palm civet species (e.g., banded palm civet) (M. Dulaney, personal communication).

Genet: Female genets should be provided with a secure, closed nest box and left undisturbed. It is important that the nest box not be opened while she has kittens, as female genets have been known to kill their young simply because the nest box was opened. This may not be true for all females, but extreme caution should be taken (DJ. Hartley, unpublished information).

7.5 Assisted Rearing

Although mothers may successfully give birth, there are times when they are not able to properly care for their offspring, both in the wild and in *ex situ* populations. Fortunately, animal care staff in AZA-accredited institutions are able to assist with the rearing of these offspring if necessary. Hand-rearing may be necessary for a variety of reasons: rejection by the parents, ill health of the mother, or weakness of the offspring. Careful consideration should be given as hand-rearing requires a great deal of time and commitment (Muir 2003).

Before the decision to hand-rear is made, the potential for undesirable behavioral problems in a hand-reared adult (e.g., aggression towards humans, inappropriate species-specific behavior, etc.) should be carefully weighed, and plans made to minimize deleterious effects on the development of natural behaviors as far as possible. This may require extensive time commitment on the part of staff, plans for fostering, relocation of the young, exposure to species-specific sounds, etc.

Once the decision has been made, and the young have been abandoned by the mother or are consistently getting weaker/losing weight, it is best to remove the kits sooner rather than later. If young have been abandoned by their mother, it is best to remove them to prevent infanticide. If the offspring are being cared for but receiving no milk they will be restless, possibly calling continuously, or conversely they may be hyperthermic and scattered around the enclosure. Another indicator of trouble would be the female moving around the exhibit continuously while carrying the young; this could mean she is not comfortable with the denning provided or there is something wrong with her or the young (Muir 2003). See Appendix I for a neonatal examination and monitoring protocol (Read & Meier 1996).

If it is necessary to remove offspring because of an exceptionally large litter, it is best to remove two of the largest kits. The temptation is often to take the smallest, but they stand the best chance if raised by their mother. Hand-rearing of singletons is more likely to lead to severe imprinting than if they have a conspecific to develop and interact with (Muir 2003).

Physical Care: Incubators are the best source of warmth for hand-reared viverrids. Heat lamps are too intense and can be dehydrating, hot water bottles can be used if necessary, and hypothermic kits can be warmed slowly by placing them next to a warm body (Muir 2003).

Small kits should be kept at a temperature between 26.5-29ºC (80-85ºF); young animals die very quickly if they are kept at too high a temperature (Muir 2003). Wallach & Boever (1983) give 29.4°C (85°F) and a minimum of 50% humidity as the desired incubator setting for viverrids. Meier (1986) suggests 29.4-32°C (85-90°F) and 50-60% humidity. The temperature should be gradually reduced to room temperature (roughly 21.2-23.9°C (70-75°F)) over the course of about three weeks (unless the neonate becomes ill). If the ambient temperature is too high, it may cause hair loss. Most kits will feel more secure if wrapped in layers of towels; this also aids in keeping them warm (Muir 2003).

Feeding: Some experienced hand-rearers recommend using formulas based on goat's milk (see binturong formula below) because small carnivores cannot absorb the fat globules in cow's milk; others prefer using feline or canine milk replacers – both of which have been used successfully in small carnivores (Muir 2003).

Kits should first be fed every two hours. The kit should be fed only if it is hungry and suckling vigorously, encouraging it to keep taking more milk will be fatal. Kits will not die of being slightly underfed, but overfeeding will kill them. As the volume of the feeds increases, the frequency can be reduced; every three hours during the second week, every four hours during the third week, etc. Kits will be hungry at some feeds, less at others, but this is quite normal (Muir 2003).

After the first week, it is not necessary to feed throughout the night and feedings between 6:00am and 12:00am should be sufficient. By 5-6 weeks of age, solids should be introduced, such as a finely ground, commercially available, nutritionally complete, meat mix with the formula or something similar depending on the species (chicken has tended to cause diarrhea in some small carnivore species). Solid foods can be offered on the handler's fingers to encourage them to eat (Muir 2003). Some experienced handlers recommend that milk be offered in a bowl, as long as the animal will take it, as this will help in building up their calcium; it is important though that the animal is eating its adult diet as well (Muir 2003).

Aspirated formula is frequently a contributing factor to neonatal respiratory infections, and care should be taken to select the appropriate nipple. "Neonates are obligate nose breathers. They cannot breathe through their mouths and nurse at the same time." "Respiratory infections cause a great deal of trouble because they not only interfere with breathing but they also make nursing difficult or impossible" (Meier

1985). The nipple's hole needs to suit the neonate's sucking reflex. Also, if a nipple is too stiff, the pup may tire and refuse to nurse.

When feeding kits, they should be held in the correct nursing position; ventrally or sternally recumbent, with the head up. The hand holding the bottle should be placed in such a way that it provides a surface for the pup to push against with its front feet. If milk comes through the nose of the kit, the nipple hole may be too large, or the pup may be trying to eat too quickly.

If a kit aspirates fluids, the recommended protocol is to hold it with head and chest lower than the hind end. A rubber bulb syringe should be used to suck out as much fluid from the nostrils and the back of the throat as possible. If a large amount of fluid is aspirated, or if fluid is heard in the lungs, Lasix™ (Furosemide) may be given, under the supervision of a veterinarian (K. Grant, personal communication). If an animal is placed on antibiotics, they should be given Benebac® before diarrhea begins (yogurt also can be helpful) (A. Moresco, personal experience). In these cases, a veterinarian should always be contacted first.

Only enough formula that will be used within a 24-hour period should be made at one time and any formula left after this period should be discarded. Formula should be strictly refrigerated, and any formula in bottles should not be warmed more than twice. Milk is an excellent medium for growing bacteria and so sanitation is vital. Bottles should be washed with hot water and a bottlebrush (soap left in the bottles can cause diarrhea and death), and then boiled for several minutes. The bottles should be cleaned well after every feeding, and boiled at least after every second feeding.

Hand-reared animals should be stimulated to urinate and defecate at least 4-5 times each day, generally before feeding. The genitals and anal area should be rubbed gently with a finger or towel to stimulate the baby to urinate and have a bowel movement. Species will differ in how often they defecate. Civets/binturong should have a generally solid stool, although a bit of runniness at the end is not a matter to worry over. The color of a civet/binturong stool will vary based on the fruit mixed into its formula.

If there appears to be a dietary problem, only one component should be changed at a time. "If several items are changed simultaneously, it is difficult to analyze problems. The formula itself may not be creating the illness; formula concentration, feeding frequency, gastric overload, and rapid changes can also produce gastrointestinal signs. Over feeding and extremely rapid feedings should be avoided" (Meier 1985).

It is important to monitor any diarrhea very carefully, as this can be a sign of bacterial overgrowth (e.g., *E. coli* or even *Salmonella*) or disbiosis. Yogurt may help prevent or alleviate this; Benebac® also may be helpful. Protracted diarrhea carries the risk of dehydration, as well as other more severe conditions, such as intussusceptions.

If an animal becomes constipated, often just adding a little bit more goat's milk to a civet/binturong formula will solve the problem. If a calcium supplement has been added to the formula, this should be stopped or the amount used significantly reduced. Any changes to the diet should be made slowly to avoid causing diarrhea. Be aware that the kits may become sore from repeated unsuccessful attempts to stimulate defecation. Using Vaseline® or another lubricant may lessen any soreness. In the event a formula adjustment does not work, a warm water enema often does; however, a veterinarian should be consulted before this is tried. If a kit goes for more than 36 hours without a bowel movement, there is probably a blockage of some sort, and veterinary attention should be sought. If at any time before this the animal becomes listless or will not eat, veterinary attention should be sought immediately.

Binturong: Binturongs requiring hand-rearing have been raised successfully using the formula below. The formula should be blended well and shaken or re-blended before each feeding (sometimes the banana can clog the nipple). Mixed formula should be refrigerated and replaced after 24 hours. Binturongs will eat between 2-4 ounces per feeding, four times a day. There is no information available on successful cross-fostering of binturong or any of the viverrid species (C. Schultz & M. Stinner, personal communication). From the age of about 5 weeks young binturong can be weaned onto a slurry of natural or organic peanut butter, bananas, yogurt, and vitamins (M. Stinner, personal communication). Cooked meat, or baby food meats without onions or other additives can be introduced at 6+ weeks, gradually introducing them to sliced/ground chicken, pinkies, and commercially prepared meat mix (M. Stinner, personal experience).

Table 10: Carnivore Preservation Trust formula for civets & binturong (M.Stinner)

Ingredients	Amount
Boiled water (allow to cool before adding to formula)	2½ C
Canned or fresh goat's milk	¼ C
Goat-A-Lac	¼ C
Banana, mashed	1
Pediatric vitamins	3-6 drops
Taurine	1 pinch
Yogurt	1 tablespoon
Fatty-acid coat supplement (Diet Derm® or similar)	-

Other viverrid species: There has not been much experience in hand-raising, nor are there records of cross-fostering, the other viverrids. More information is required.

7.6 Contraception

Many animals cared for in AZA-accredited institutions breed so successfully that contraception techniques are implemented to ensure that the population remains at a healthy size. In the solitary species, contraception is not a large issue, as animals are typically housed as singletons. The AZA SCTAG Chair and the AZA Wildlife Contraception Center (www.stlzoo.org/contraception) should always be contacted for current contraception recommendations. The contraceptive methods currently (2010) most suitable for viverrids are outlined below. More details on contraception recommendations, products, application, and ordering information, can be found on the AZA Wildlife Contraception Center (WCC) website: www.stlzoo.org/contraception.

The progestin-based melengestrol acetate (MGA) implant, previously the most widely used contraceptive in zoos, has been associated with mammary pathology in felids and uterine pathology in felids and canids (Munson 2006, Moresco 2009). Other progestins (e.g., Depo-Provera®, Ovaban®) are likely to have the same deleterious effects. For carnivores, the AZA Wildlife Contraception Center now recommends GnRH agonists, e.g., Suprelorin® (deslorelin) implants or Lupron Depot® (leuprolide acetate) as safer alternatives. Although it appears safe and effective, dosages and duration of efficacy have not been systematically evaluated for all species. GnRH agonists can be used in either females or males, and side effects are generally those associated with gonadectomy, especially weight gain, which should be managed through diet. Suprelorin® was developed for domestic dogs but has not been tested in viverrids at this time.

Gonadotropin Releasing Hormone (GnRH) Agonists: GnRH agonists (Suprelorin® implants, or Lupron Depot®) achieve contraception by reversibly suppressing the reproductive endocrine system, preventing production of pituitary (FSH and LH) and gonadal hormones (estradiol and progesterone in females and testosterone in males). The observed effects are similar to those following either ovariectomy in females or castration in males, but are reversible. GnRH agonists first stimulate the reproductive system, which can result in estrus and ovulation in females or temporary enhancement of testosterone and semen production in males. Then, down-regulation follows the initial stimulation. The stimulatory phase can be prevented in females by daily Ovaban administration for one week before and one week after implant placement (Wright et al. 2001).

GnRH agonists should not be used during pregnancy, since they may cause spontaneous abortion or prevent mammary development necessary for lactation. They may prevent initiation of lactation by inhibiting progesterone secretion, but effects on established lactation are less likely. New data from domestic cats have shown no effect on subsequent reproduction when treatment began before puberty; no research in prepubertal viverrids has been conducted.

A drawback of these products is that time of reversal cannot be controlled. Neither the implant (Suprelorin®) nor the depot vehicle (Lupron®) can be removed to shorten the duration of efficacy to time reversals. The most widely used formulations are designed to be effective either 6 or 12 months, but those are for the most part minimum durations, which can be longer in some individuals.

Although GnRH agonists can also be an effective contraceptive in males, they are more commonly used in females. Monitoring efficacy by suppression of estrous behavior or cyclic gonadal steroids in feces is usually easier than ensuring continued absence of sperm in males, since most institutions cannot perform regular semen collections. Suprelorin® has been tested primarily in domestic dogs, whereas Lupron Depot® has been used primarily in humans, but should be as effective as Suprelorin® since the GnRH molecule is identical in all mammalian species.

If used in males, disappearance of sperm from the ejaculate following down-regulation of testosterone may take an additional 6 weeks, as with vasectomy. It should be easier to suppress the onset of spermatogenesis in seasonally breeding species, but that process begins at least 2 months before the first typical appearance of sperm. Thus, treatment should be initiated at least 2 months before the anticipated onset of breeding.

Progestins: If progestins (e.g., Melengestrol acetate (MGA) implants, Depo-Provera® injections, Ovaban® pills) have to be used, they should be administered for no more than 2 years and then discontinued to allow for a pregnancy. Discontinuing progestin contraception and allowing non-pregnant cycles does not substitute for a pregnancy. Use of progestins for more than a total of 4 years is not recommended. MGA implants last at least 2 years, and clearance of the hormone from the system occurs rapidly after implant removal. Progestins are considered safe to use during lactation.

Vaccines: The porcine zona pellucida (PZP) vaccine has not been tested in viverrids, but may cause permanent sterility in many carnivore species after only one or two treatments. This method is not recommended.

Ovariectomy or Ovariohysterectomy: Removal of ovaries is a safe and effective method to prevent reproduction for animals that are eligible for permanent sterilization. In general, ovariectomy is sufficient in young females, whereas removal of the uterus as well as ovaries is preferable in older females, due to the increased likelihood of uterine pathology with age.

Owston's civet: At this time, it is recommended that Owston's civet pairs be separated if breeding is not desired; no animals should be permanently sterilized (Roberton et al. 2002).

Vasectomy: As details of reproduction are not known for most viverrids, information from other carnivores is utilized. For species with induced ovulation, vasectomy of males will not prevent potential adverse effects to females that can result from prolonged, cyclic exposure to the endogenous progesterone associated with the pseudo-pregnancy that follows ovulation. This method is not recommended for viverrids.

Owston's civet: At this time, it is recommended that Owston's civet pairs be separated if breeding is not desired; no animals should be permanently sterilized (Roberton et al. 2002).

Chapter 8. Behavior Management

8.1 Animal Training

Classical and operant conditioning techniques have been used to train animals for over a century. Classical conditioning is a form of associative learning demonstrated by Ivan Pavlov. Classical conditioning involves the presentation of a neutral stimulus that will be conditioned (CS) along with an unconditioned stimulus that evokes an innate, often reflexive, response (US). If the CS and the US are repeatedly paired, eventually the two stimuli become associated and the animal will begin to produce a conditioned behavioral response to the CS.

Operant conditioning uses the consequences of a behavior to modify the occurrence and form of that behavior. Reinforcement and punishment are the core tools of operant conditioning. Positive reinforcement occurs when a behavior is followed by a favorable stimulus to increase the frequency of that behavior. Negative reinforcement occurs when a behavior is followed by the removal of an aversive stimulus to also increase the frequency of that behavior. Positive punishment occurs when a behavior is followed by an aversive stimulus to decrease the frequency of that behavior. Negative punishment occurs when a behavior is followed by the removal of a favorable stimulus also to decrease the frequency of that behavior.

AZA-accredited institutions are expected to utilize reinforcing conditioning techniques to facilitate husbandry procedures and behavioral research investigations.

Keepers should avoid use of aversive stimuli in the daily management of viverrids. Profound aversive stimuli such as squirting with hoses, loud noises, harsh sounds, and long-term withholding of food are inappropriate unless serious injury of keeper or animal is imminent (e.g., serious fight). Many of the viverrids respond to profound aversive stimuli with fear and/or aggression. It is best to keep keeper/animal interactions positive and pleasant. Assessing the animal's motivation (e.g., why should it "want" to come in? Why does it "want" to stay outside?) is a useful exercise when training problems occur. Patience and planning are keys to success (Wooster 1998).

In general, the viverrid species should be trained in a protected contact situation (i.e., keeper and animal should be separated by a mesh barrier). Some institutions may decide that this precaution is not necessary for certain species, but these decisions should be carefully evaluated on an ongoing basis. It is advised that all facilities have holding areas in order to shift animals into/out of their primary enclosure. Husbandry training may occur anywhere the individual animal seems to feel comfortable, and where the keeper can safely access them through a mesh screen. Care should be given not to encroach upon the animal's flight distance, which may vary from one individual to another. Managers and caretakers should decide if food rewards can be hand fed through/under mesh screen or if a 'meat' stick (or similar) should be used to deliver the food.

As far as possible, all animals should be routinely trained to shift into a holding facility, and readily separate into specific holding areas on cue. Animals should be trained to come to the keeper when called for daily health checks; this is most often accomplished with fencing or a mesh barrier between keeper and animal. A goal should be to have the individual animal calm and not aggressive during these checks. A third important routine husbandry behavior is to have an animal enter a crate on cue (Wooster 1998). See Appendix K for additional training resources.

The use of howdy doors, scent, visual and tactile acclimation are all useful tools when introducing new animals. The use of training techniques in the management of the viverrid species (except the binturong) has not been explored as thoroughly as it has for some of the other mammal and avian species. During introductions, animals should first be allowed to become familiar with the other animals smell and sound. They can then be introduced through a screen or wire mesh barrier, moving on to actual physical introductions. Full physical introductions should be carried out in an enclosure with lots of escape options available.

Genet: Genet species are easily trained to enter a kennel on cue, get on a scale for weighing, target and station (T. Boyd, unpublished information).

Binturong: This species responds well to training, both free and protected-contact is appropriate, and animals from this species are often used as education animals (F. Kohn, personal communication). See Appendix P for sample behaviors trained, and cues used for binturong.

The following is a list of commonly trained behaviors for binturongs (American Association of Zoo Keepers (AAZK) Animal Training Committee Survey 2002) (See also Appendix P):

Target	Climb
Shift	Enter a crate/squeeze cage
Stand on a scale	Present paws/feet/head/belly/side/back/ears/eyes/mouth

Recognizing the meaning of calls is useful when training binturong. In general, “ninja” noises are threats, the “eh-eh-eh” nasal sounding call is commentary only, and the “whuffing purr-like” vocalization expresses pleasure (M.Stinner, personal experience).

Binturongs can be trained to urinate over a surface where urine collection is possible, facilitating the collection of samples. These are useful in the context of health checks, as well as in reproductive assessments. Binturongs can also be trained to stand for a person to take a rectal temperature, or perform a chest auscultation (unprotected contact). This eliminates the effects of anesthesia if these procedures are required (A.Moresco, personal experience).

8.2 Environmental Enrichment

Environmental enrichment, also called behavioral enrichment, refers to the practice of providing a variety of stimuli to the animal’s environment, or changing the environment itself to increase physical activity, stimulate cognition, and promote natural behaviors. Stimuli, including natural and artificial objects, scents, and sounds are presented in a safe way for the animals to interact with. Some suggestions include providing food in a variety of ways (i.e., frozen in ice or in a manner that requires an animal to solve simple puzzles to obtain it), using the presence or scent/sounds of other animals of the same or different species, and incorporating an animal training (husbandry or behavioral research) regime in the daily schedule.

AZA Accreditation Standard

(1.6.1) The institution must have a formal written enrichment program that promotes species-appropriate behavioral opportunities.

AZA Accreditation Standard

(1.6.2) The institution must have a specific staff member(s) or committee assigned for enrichment program oversight, implementation, training, and interdepartmental coordination of enrichment efforts.

It is recommended that an enrichment program be based on current information in biology, and should include the following elements: goal-setting, planning and approval process, implementation, documentation/record-keeping, evaluation, and subsequent program refinement. Environmental enrichment programs should ensure that all environmental enrichment devices (EEDs) are safe and are presented on a variable schedule to prevent habituation. AZA-accredited institutions must have a formal written enrichment program that promotes species-appropriate behavioral opportunities (AZA Accreditation Standard 1.6.1). Enrichment programs should be integrated with veterinary care, nutrition, and animal training programs to maximize the effectiveness and quality of animal care provided. AZA-accredited institutions must have specific staff members assigned to oversee, implement, train, and coordinate interdepartmental enrichment programs (AZA Accreditation Standard 1.6.2).

Development of enrichment ideas should be goal-oriented, proactive, based upon the animal’s natural history, individual history, and exhibit constraints, and should be integrated into all aspects of their *ex situ* population management. Successful enrichment techniques include: variation of exhibit schedule or exhibit mates (where appropriate only), re-arranging of exhibit furniture/features, complete change of furniture (some of the old should always be retained to maintain the animal’s scent and an element of the familiar), scents, sounds, toys (natural and artificial), herbs, spices, different substrates for digging/rolling, food items, and novel presentation of food items. It is important that enrichment items are not merely thrown in an exhibit and allowed to stay for extended periods – an enrichment program is only successful and useful if actively managed and constantly reviewed to ensure it encourages natural behaviors. The AAZK Enrichment committee provides the following general guidelines about enrichment:

“The goal of enrichment should be to maximize the benefit while minimizing unacceptable risks. All enrichment should be evaluated on three levels: 1) whether the enrichment item itself poses an unacceptable risk to the animals; 2) what benefit the animals will derive from the enrichment; and 3) whether the manner of enrichment delivery is apt to lead to problems.

A written plan of action that eliminates the most dangerous risk factors while maintaining the benefits of a challenging and complex environment can help animal managers develop a safe and successful enrichment program. Keepers should evaluate new and creative enrichment ideas with their

managers and staff from other departments (curatorial, janitorial, maintenance, veterinary, nutritional, etc.) to decrease the frequency of abnormal and stereotypic behaviors or low activity levels, and to fine-tune enrichment ideas. For enrichment to be safely provided, it is strongly recommended that each institution establish enrichment procedures, protocols, and a chain of command that keepers can follow." (AAZK Enrichment Committee)

The AAZK Enrichment Committee also provides an excellent cautionary list for the various types of enrichment provided (accessed through www.aazk.org; see also Appendix L). This list includes key questions that should be answered for all enrichment items or programs to assess potential hazards. For example:

1. Can the animals get caught in it or become trapped by it?
2. Can it be used as a weapon?
3. Can an animal be cut or otherwise injured by it?
4. Can it fall on an animal?
5. Can the animal ingest the object or piece of it? Is any part of it toxic, including paint or epoxy?
6. Can it be choked on or cause asphyxiation or strangulation?
7. Can it become lodged in the digestive system and cause gut impaction or linear obstruction?
8. In a multi-species exhibit or other social grouping, could a larger or smaller animal become stuck or injured by the object or get hung up on it?
9. Can it destroy an exhibit?
10. If fecal material is used for enrichment, has it been determined to be free from harmful parasites?
11. Is food enrichment included as part of the animals' regular diet in a manner that will reduce the risk of obesity?
12. When introducing animals to conspecifics or in a multi-species exhibit, are there sufficient areas for them to escape undesirable interactions?
13. Can the manner of enrichment presentation (i.e., one item or items placed in a small area) promote aggression or harmful competition?
14. Has browse been determined to be non-toxic?
15. Do the animals show signs of allergies to new items (food, browse, substrates, etc.)?
16. Does the enrichment cause abnormally high stress levels?
17. Does the enrichment cause stimulation at a high level for extended periods of time that do not allow the animal natural down time in the species' normal repertoire (e.g., constant activity for public enjoyment when the animal would normally be inactive in its native habitat)?

Factors that should be considered when determining how often behavioral or environmental enrichment is offered include the species and individual(s) involved as well as the physical characteristics of the exhibit. Large, complex exhibits with appropriate enclosure designs, substrates, and furnishings may offer ample opportunities for animals to exercise natural behaviors with infrequent enrichment (once daily). Other exhibits or individuals may require more frequent enrichment (multiple times per day). Husbandry staff should monitor all individuals in an exhibit and structure an enrichment schedule for the needs of those animals, providing them opportunities several times a day to interact positively with their environment. Enrichment should never be offered on a regular schedule, instead times, items, and delivery methods should be rotated so there is always an element of novelty associated with each item or activity. It is important to note that the provision of well-designed, complex environments is the foundation of a successful enrichment program. Enrichment should also be evaluated to see if it is achieving its goals. Table 9 lists some enrichment items that have been used successfully with viverrids. Appendix K has additional enrichment resources. All enrichment items should be approved by the appropriate management staff, including the veterinarian, curator, horticulturist, and/or nutritionist.

Table 11: Examples of Viverrid enrichment items

Type of enrichment	Items or techniques
Sounds	Other animal calls and natural sounds
Environmental and manipulative	Bathtub, bird toys, boomer balls, boxes, browse, buckets, barrels, cardboard tubes, cow bells, crazy balls, feathers, gourds, grain bags, grapevines, cornstalks, hanging rope toy, hummingbird feeder, ice blocks, knotted rope, kong toys, paper bags, pine cones, PVC rattle, raffia, rawhide, rope toys, scents, extracts, snake skins, spools, sticks,
Foods and foraging	Coconut feeder, crickets, mealworms, dried mangos, Jell-O, kool-aid, pumpkins, PVC puzzle feeders, watermelon, hidden diet,

8.3 Staff and Animal Interactions

Animal training and environmental enrichment protocols and techniques should be based on interactions that promote safety for all involved.

8.4 Staff Skills and Training

Staff members should be trained in all areas of animal behavior management. Funding should be provided for AZA continuing education courses, related meetings, conference participation, and other professional opportunities. A reference library appropriate to the size and complexity of the institution should be available to all staff and volunteers to provide them with accurate information on the behavioral needs of the animals with which they work.

The following experience and skills are recommended for all animal care staff members working with viverrid species:

- Keepers and managers should have an in-depth understanding of the species' natural history and the individual's life history.
- Keepers and managers should have an in-depth understanding of the individual's behaviors, an understanding of the function of those behaviors, and the ability to describe those behaviors orally and in writing.
- Keepers should be able to recognize signs of illness and injury in the viverrid species they are working with, and to communicate those signs orally or in writing to managers and veterinarians.
- Keepers should be able to accurately assess the appropriate level of cleanliness and safety of the animal's exhibit, holding area, and food-preparation area.
- Keepers should have the skills to safely capture or restrain the viverrid species in question.
- Keepers should have some understanding of the species' natural diet and foraging style.
- Keepers and managers should have an understanding of enrichment concepts, and have a commitment to enhance the environments of the species in their care in a consistent manner.
- Keepers should understand the concepts of animal learning and training, be able to use a variety of techniques (e.g., habituation, operant conditioning) to train the animals under their care, and to create a training plan (identifying training steps, cues, and criteria). See www.animaltraining.org for additional details.
- Managers should understand the concepts of animal learning and training, be able to coach keepers in all aspects of training, review their training plans, look for consistency among keepers in their training techniques, and help their teams prioritize training, enrichment, and other husbandry goals.

Chapter 9. Program Animals

9.1 Program Animal Policy

AZA recognizes many public education and, ultimately, conservation benefits from program animal presentations. AZA's Conservation Education Committee's Program Animal Position Statement (Appendix D) summarizes the value of program animal presentations.

For the purpose of this policy, a program animal is described as an animal presented either within or outside of its normal exhibit or holding area that is intended to have regular proximity to or physical contact with trainers, handlers, the public, or will be part of an ongoing conservation education/outreach program.

Program animal presentations bring a host of responsibilities, including the welfare of the animals involved, the safety of the animal handler and public, and accountability for the take-home, educational messages received by the audience. Therefore, AZA requires all accredited institutions that give program animal presentations to develop an institutional program animal policy that clearly identifies and justifies those species and individuals approved as program animals and details their long-term management plan and educational program objectives.

AZA Accreditation Standard

(5.3) A written policy on the use of live animals in programs should be on file. Animals in education programs must be maintained and cared for by trained staff, and housing conditions must meet standards set for the remainder of the animal collection, including species-appropriate shelter, exercise, social and environmental enrichment, access to veterinary care, nutrition, etc. Since some of these requirements can be met outside of the primary enclosure, for example, enclosures may be reduced in size provided that the animal's physical and psychological needs are being met.

AZA's accreditation standards require that the conditions and treatment of animals in education programs must meet standards set for the remainder of the animal collection, including species-appropriate shelter, exercise, sound and environmental enrichment, access to veterinary care, nutrition, and other related standards (AZA Accreditation Standard 5.3). In addition, providing program animals with options to choose among a variety of conditions within their environment is essential to ensuring effective care, welfare, and management. Some of these requirements can be met outside of the primary exhibit enclosure while the animal is involved in a program or is being transported. For example, housing may be reduced in size compared to a primary enclosure as long as the animal's physical and psychological needs are being met during the program; upon return to the facility the animal should be returned to its species-appropriate housing as described above.

Education Animals: Most viverrids are not used in education programs, however, a few institutions use binturong. For an interesting account of hand-reared binturong behavior in Malaysia, see Ismail et al. (Undated). These individuals may be housed in somewhat smaller, less complex enclosures, provided the animals are routinely enriched, taken out for exercise and social interaction, and provided with other forms of stimulation, including climbing and play structures. Enclosure size should, at a minimum, be in compliance with USDA laboratory animal guidelines (e.g., www.nap.edu/readingroom/books/labrats/chaps.html). Currently, AZA accreditation standards state that education animals must be cared for by trained staff and housed in conditions that meet the enriched standards set for the remainder of the animal collection.

Many factors should be considered in planning for the adequate and appropriate physical and social environment, housing, space, and management of education animals. These include the following: (USDA 2003*, AZA SCTAG committee**, State specific housing requirements, etc.):

- The species of animal and individual characteristics such as age, sex, size, behavior, previous experience and housing, and health*.
- The ability of the animals to form social groups with conspecifics through sight, smell, and possible contact, whether the animals are maintained singly or in groups (two or more)*.
- Design and construction of housing*.
- Enrichment possibilities*.
- Exercise**.
- Animal and handler safety**.
- Socialization for species that may benefit from this**.
- Environmental enhancements – features required to stimulate natural activities, i.e., den boxes, chewing items, etc**.

Based on USDA Lab Animal Regulations (USDA 2003), primary enclosures should:

- Allow for the normal physiologic and behavioral needs of the animals, including urination and defecation, maintenance of normal body temperature, normal movement and postural adjustments, and where indicated, reproduction.
- Allow conspecific social interaction and development of hierarchies within or between enclosures.
- Make it possible for the animals to remain clean and dry (as is consistent with the species typical behavior).
- Allow adequate ventilation.
- Allow the animal access to food and water and permit easy filling, refilling, changing, servicing, and cleaning of food and water utensils.
- Provide a secure environment that does not allow escape of or accidental entrapment of animals or their appendages between opposing surfaces or by structural openings.
- Be free of sharp edges or projections that could cause injury to the animal.
- Allow easy observation of the animals without disturbing them.

9.2 Institutional Program Animal Plans

AZA's policy on the presentation of animals is as follows: AZA is dedicated to excellence in animal care and welfare, conservation, education, research, and the presentation of animals in ways that inspire respect for wildlife and nature. AZA's position is that animals should always be presented in adherence to the following core principles:

AZA-accredited institutions which have designated program animals are required to develop their own Institutional Program Animal Policy that articulates and evaluates the program benefits (see Appendix E for recommendations). Program animals should be consistently maintained in a manner that meets their social, physical, behavioral, and nutritional needs. Education and conservation messaging must be an integral component of any program animal demonstration (AZA Accreditation Standard 1.5.3).

Animal care and education staff should be trained in program animal-specific handling protocols, conservation and education messaging techniques, and public interaction procedures. These staff members should be competent in recognizing stress or discomfort behaviors exhibited by the program animals and be able to address any safety issues that arise.

Program animals that are taken off zoo or aquarium grounds for any purpose have the potential to be exposed to infectious agents that could spread to the rest of the institution's healthy population. AZA-accredited institutions must have adequate protocols in place to avoid this (AZA Accreditation Standard 1.5.5).

Careful consideration must be given to the design and size of all program animal enclosures, including exhibit, off-exhibit holding, hospital, quarantine, and isolation areas, such that the physical, social, behavioral, and psychological needs of the species are met and species-appropriate behaviors are facilitated (AZA Accreditation Standard 10.3.3; AZA Accreditation Standard 1.5.2).

Animal transportation must be conducted in a manner that is

AZA Accreditation Standard

(1.5.3) If animal demonstrations are a part of the institution's programs, an education and conservation message must be an integral component.

AZA Accreditation Standard

(1.5.5) For animals used in offsite programs and for educational purposes, the institution must have adequate protocols in place to protect the rest of the collection from exposure to infectious agents.

AZA Accreditation Standard

(10.3.3) All animal enclosures (exhibits, holding areas, hospital, and quarantine/isolation) must be of a size and complexity sufficient to provide for the animal's physical, social, and psychological well-being; and exhibit enclosures must include provisions for the behavioral enrichment of the animals.

AZA Accreditation Standard

(1.5.2) Animals should be displayed, whenever possible, in exhibits replicating their wild habitat and in numbers sufficient to meet their social and behavioral needs. Display of single specimens should be avoided unless biologically correct for the species involved.

AZA Accreditation Standard

(1.5.11) Animal transportation must be conducted in a manner that is safe, well-planned and coordinated, and minimizes risk to the animal(s), employees, and general public. All applicable local, state, and federal laws must be adhered to.

lawful, safe, well-planned and coordinated, and minimizes risk to the animal(s), employees, and general public (AZA Accreditation Standard 1.5.11).

Conservation Education Messages:

Binturong: The word binturong is of Malaysian origin. Although sometimes referred to in English as the "bearcat," it is neither a bear nor a cat. This arboreal animal typically lives alone or in female-dominated groups in the wild. Secretions from their perineal glands are deposited to advertise sexual receptivity. Due to their frequent consumption of fruit and consumption of rodents they are considered to be important to fruit seed dispersal and pest control. In the past there was some domestication of binturong as pets and currently they are considered a culinary delicacy in some countries (Ismail et al. Undated). Rarely aggressive, they will more typically urinate or defecate (…on an enemy) (Ismail et al. Undated).Ismail et al. (Undated) report:

> "They are endangered in large part because rainforest locals in Southeast Asia, who used to hunt them only for food, have found an ever-increasing profit in selling them to those who promote the Chinese medicine trade. Their penis bones, ingested as a powder or cooked into food, are said to help men stay virile and to help produce male children. Also threatening to their numbers in the wild is a loss of habitat due to deforestation and hunting. At the open markets in Laos they cost around the equivalent of three US dollars. As of 1998, in the exotic pet trade in the US, a young, breedable, healthy individual runs $1500-2500."

On the IUCN Red List of Threatened Species™ web site, Widmann et al. (2008) cite habitat loss and degradation as major threats to this species. They also state that in the Philippines and Lao PDR it is taken for the pet trade and in the south of its range (Vietnam, Lao PDR, Philippines cited) it is taken for food and considered a delicacy by many. Additionally, it has recently been discovered the binturong descends to the ground more frequently than thought making them vulnerable to snare traps set for other mammal species.

Owston's civet:

> "Habitat loss and degradation were assessed as the major threats to Owston's civet when it was still effectively unknown in the west (Schreiber et al. 1989). Throughout its distribution this species is threatened by intensive snare trapping for meat, traditional medicine, living trophies and skin, and there has been an increased demand for civet meat in Chinese and Vietnamese markets (Bell et al. 2004; Lyman et al. 2005; Long and Roberton in prep.). Although habitat fragmentation magnifies the impact of hunting on populations, insight on the direct effects of habitat factors is thus far limited (Roberton et al. 2008)."

An international breeding program for this highly threatened species was begun over 10 years ago in Viet Nam (Cuc Phuong National Park Small Carnivore Conservation Program) with a population established in Europe. The AZA SCTAG is working to expand this program to AZA institutions.

9.3 Program Evaluation

AZA-accredited institutions which have an Institutional Program Animal Plan are required to evaluate the efficacy of the plan routinely (see Appendix E for recommendations). Education and conservation messaging content retention, animal health and well-being, guest responses, policy effectiveness, and accountability and ramifications of policy violations should be assessed and revised as needed. At this time the AZA SCTAG has no taxa specific program evaluation recommendations.

Chapter 10. Research

10.1 Known Methodologies

AZA believes that contemporary animal management, husbandry, veterinary care and conservation practices should be based in science, and that a commitment to scientific research, both basic and applied, is a trademark of the modern zoological park and aquarium. AZA-accredited institutions have the invaluable opportunity, and are expected to, conduct or facilitate research both in *in situ* and *ex situ* settings to advance scientific knowledge of the animals in our care and enhance the conservation of wild populations. This knowledge might be achieved by participating in AZA Taxon Advisory Group or Species Survival Plan® sponsored research, conducting original research projects, affiliating with local universities, and/or employing staff with scientific credentials (AZA Accreditation Standard 5.3).

AZA Accreditation Standard

(5.3) Institutions should maximize the generation of scientific knowledge gained from the animal collection. This might be achieved by participating in AZA TAG/SSP sponsored research when applicable, conducting original research projects, affiliating with local universities, and/or employing staff with scientific credentials.

Research investigations, whether observational, behavioral, physiological, or genetically based, should have a clear scientific purpose with the reasonable expectation that they will increase our understanding of the species being investigated and may provide results which benefit the health or welfare of animals in wild populations. Many AZA-accredited institutions incorporate superior positive reinforcement training programs into their routine schedules to facilitate sensory, cognitive, and physiological research investigations and these types of programs are strongly encouraged by the AZA.

AZA Accreditation Standard

(5.2) Institutions must have a written policy that outlines the type of research that it conducts, methods, staff involvement, evaluations, animals to be involved, and guidelines for publication of findings.

AZA Accreditation Standard

(5.1) Research activities must be under the direction of a person qualified to make informed decisions regarding research.

AZA-accredited institutions are required to have a clearly written research policy that identifies the types of research being conducted, methods used, staff involved, evaluations of the projects, the animals included, and guidelines for the reporting or publication of any findings (AZA Accreditation Standard 5.2). Institutions must designate a qualified individual to oversee and direct its research program (AZA Accreditation Standard 5.1). If institutions are not able to conduct in-house research investigations, they are strongly encouraged to provide financial, personnel, logistical, and other support for priority research and conservation initiatives identified by Taxon Advisory Groups or Species Survival Plans®.

Research methodologies used on the binturong include:

Genetic

- Cosson et al. (2007) sequenced the hypervariable region 1 of the mitochondrial control region of 56 binturongs, among which 20 had a known geographic origin to determine the genetic diversity of binturongs held by European zoos. Their findings proved a low genetic diversity and they discuss future management implications.
- Pitra et al. (1996) looked at paternity of binturong in German zoos using the polymerase chain reaction (PCR)-based technique of random amplification of polymorphic DNA (RAPD).
- Tanomtong et al. (2005) conducted cytogenetic studies on several endangered Thailand viverrids.

Behavioral

- Grassman et al. (2005) radio collared five males in Thailand following them for 423 months. They recorded a mean range size of 6.2km^2±1), 35% range overlap of individuals. They demonstrated arrhythmic and crepuscular activity patterns.
- Grassman and Tewes (2006) used camera traps in north-central Thailand to assess activity patterns.
- Nettelbeck (1998) looked at interactions between binturong and Lar gibbon in the wild.

Chemical Analysis

- Weldon et al. (2000) analyzed short-chain carboxylic acids from the anal glands of the binturong.

Morphological

- Youlatos (2003) examined osteological characters associated with tail prehensility by comparing carnivorans with and without prehensile tails.
- Friscia et al. (2007) did an ecomorphological analysis of extant small carnivorans in which they included the binturong.

Field Survey

- Datta (1999) conducted a survey of small carnivores in two Indian nature reserves.

10.2 Future Research Needs

This Animal Care Manual is a dynamic document that will need to be updated as new information is acquired. Knowledge gaps have been identified throughout the Manual and are included in this section to promote future research investigations. Knowledge gained from areas will maximize AZA-accredited institutions' capacity for excellence in animal care and welfare as well as enhance conservation initiatives for the species.

Specific Areas of *Ex situ* Population Research Needed by Manual Heading:

Chapter 1: Ambient Environment

Section 1.2. Light**:** The impact of light cycle intensity or duration on equatorial species requires research, and will undoubtedly be found to be species-specific. Until further insight is gained into this, the AZA SCTAG recommends that light cycles be set to mimic the seasonal intensity and duration of that found in the species' natural habitat.

Section 1.4. Sound and Vibration**:** At this time, there is no information available indicating that these species are disturbed by the scent or sound of other animals, but common sense should be used when placing animals next to them (i.e., avoid locating next to a predator, a prey species next to a genet, or next to conspecifics, etc.).

Chapter 4: Social Environment

Section 4.2. Influences of Others and Conspecifics**:** Research in this area is required. At this time, there is no information available indicating that viverrid species are particularly disturbed by the scent or sound of other animals, but common sense should be used when determining which animals to place in adjacent enclosures (i.e., avoid locating animals next to a predator; a prey species next to a genet; or next to conspecifics, etc.).

Section 4.3. Introductions and Reintroductions**:** Large Spotted Genet**:** Very young animals should not be introduced to adults. In one case, it was recommended that introductions not be attempted until the young animal (male) was 7 months old (M.Stinner, personal communication). After this age, the introduction was successful. More research is required in this area.

Chapter 5: Nutrition

Section 5.2. Diets**:** Crapo et al. (2002) postulated that

> "….the characteristics of the GIT suggest that the binturong may be unable to digest and utilize fruits as efficiently as most monogastric animals with a cecum do. Considering that the binturong is known to ingest fruits in its natural habitat, it is possible that such fruits serve as a main source of water and that binturongs may require the ingestion of a large volume of fruits and other feeds to meet its nutritional requirements."

Further research is needed to better understand this and other aspects of binturong nutritional needs.
Section 5.1. Nutrtional Requirements: Nutritional requirements for the viverrid species are not currently available and should be researched in the future. Although many of the items consumed by viverrids are known, the nutrient content of these items has not been completely characterized.

Chapter 6: Veterinary Care

Section 6.5. Preventive Medicine**:** Viverrids appear to be susceptible to canine distemper and feline panleukopenia (Rettig & Divers 1978). Vaccination for these diseases is recommended; a titer check should be performed annually and animals revaccinated as needed. More information is needed to gather

information on protective titers in these species. The AZA SCTAG encourages institutions to begin collecting this information.

Chapter 7: Reproduction

Section 7.1. Reproductive Physiology & Behavior**:** Additional information on reproductive behavior and physiology for some of these species will be helpful when determining management practices for breeding pairs or groups.

Section 7.2. Assisted Reproductive Technology**:** Techniques used to preserve and freeze semen has been achieved with a variety of, but not all, taxa and should be investigated further.

Section 7.5. Assisted Rearing**:** There has not been much experience in hand-raising nor are there records of cross-fostering the other viverrids. More information is required.

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Appendix A: Accreditation Standards by Chapter

The following specific standards of care relevant to viverrids are taken from the AZA Accreditation Standards and Related Policies (AZA 2010) and are referenced fully within the chapters of this animal care manual:

General Information

(1.1.1) The institution must comply with all relevant local, state, and federal wildlife laws and regulations. It is understood that, in some cases, AZA accreditation standards are more stringent than existing laws and regulations. In these cases the AZA standard must be met.

Chapter 1

(1.5.7) The animal collection must be protected from weather detrimental to their health.

(10.2.1) Critical life-support systems for the animal collection, including but not limited to plumbing, heating, cooling, aeration, and filtration, must be equipped with a warning mechanism, and emergency backup systems must be available. All mechanical equipment should be under a preventative maintenance program as evidenced through a record-keeping system. Special equipment should be maintained under a maintenance agreement, or a training record should show that staff members are trained for specified maintenance of special equipment.

(1.5.9) The institution must have a regular program of monitoring water quality for collections of fish, pinnipeds, cetaceans, and other aquatic animals. A written record must be maintained to document long-term water quality results and chemical additions.

Chapter 2

(1.5.2) Animals should be displayed, whenever possible, in exhibits replicating their wild habitat and in numbers sufficient to meet their social and behavioral needs. Display of single specimens should be avoided unless biologically correct for the species involved.

(10.3.3) All animal enclosures (exhibits, holding areas, hospital, and quarantine/isolation) must be of a size and complexity sufficient to provide for the animal's physical, social, and psychological well-being; and exhibit enclosures must include provisions for the behavioral enrichment of the animals.

(11.3.3) Special attention must be given to free-ranging animals so that no undue threat is posed to the animal collection, free-ranging animals, or the visiting public. Animals maintained where they will be in contact with the visiting public must be carefully selected, monitored, and treated humanely at all times.

(11.3.1) All animal exhibits and holding areas must be secured to prevent unintentional animal egress.

(11.3.6) Guardrails/barriers must be constructed in all areas where the visiting public could have contact with other than handleable animals.

(11.2.3) All emergency procedures must be written and provided to staff and, where appropriate, to volunteers. Appropriate emergency procedures must be readily available for reference in the event of an actual emergency. These procedures should deal with four basic types of emergencies: fire, weather/environment; injury to staff or a visitor; animal escape.

(11.6.2) Security personnel, whether staff of the institution, or a provided and/or contracted service, must be trained to handle all emergencies in full accordance with the policies and procedures of the institution. In some cases, it is recognized that Security personnel may be in charge of the respective emergency (i.e., shooting teams).

(11.2.4) The institution must have a communication system that can be quickly accessed in case of an emergency.

(11.2.5) A written protocol should be developed involving local police or other emergency agencies and include response times to emergencies.

(11.5.3) Institutions maintaining potentially dangerous animals (sharks, whales, tigers, bears, etc.) must have appropriate safety procedures in place to prevent attacks and injuries by these animals. Appropriate response procedures must also be in place to deal with an attack resulting in an injury. These procedures must be practiced routinely per the emergency drill requirements contained in these standards. Whenever injuries result from these incidents, a written account outlining the cause of the incident, how the injury was handled, and a description of any resulting changes to either the safety procedures or the physical facility must be prepared and maintained for five years from the date of the incident.

Chapter 3

(1.5.11) Animal transportation must be conducted in a manner that is safe, well-planned and coordinated, and minimizes risk to the animal(s), employees, and general public. All applicable local, state, and federal laws must be adhered to.

Chapter 5

(2.6.2) A formal nutrition program is recommended to meet the behavioral and nutritional needs of all species and specimens within the collection.

(2.6.3) Animal diets must be of a quality and quantity suitable for each animal's nutritional and psychological needs. Diet formulations and records of analysis of appropriate feed items should be maintained and may be examined by the Visiting Committee. Animal food, especially seafood products, should be purchased from reliable sources that are sustainable and/or well managed.

(2.6.1) Animal food preparations must meet all local, state/provincial, and federal regulations.

(2.6.4) The institution should assign at least one person to oversee appropriate browse material for the collection.

Chapter 6

(2.1.1) A full-time staff veterinarian is recommended. However, the Commission realizes that in some cases such is not practical. In those cases, a consulting/part-time veterinarian must be under contract to make at least twice monthly inspections of the animal collection and respond as soon as possible to any emergencies. The Commission also recognizes that certain collections, because of their size and/or nature, may require different considerations in veterinary care.

(2.1.2) So that indications of disease, injury, or stress may be dealt with promptly, veterinary coverage must be available to the animal collection 24 hours a day, 7 days a week.

(2.2.1) Written, formal procedures must be available to the animal care staff for the use of animal drugs for veterinary purposes and appropriate security of the drugs must be provided.

(1.4.6) A staff member must be designated as being responsible for the institution's animal record-keeping system. That person must be charged with establishing and maintaining the institution's animal records, as well as with keeping all animal care staff members apprised of relevant laws and regulations regarding the institution's animal collection.

(1.4.7) Animal records must be kept current, and data must be logged daily.

(1.4.5) At least one set of the institution's historical animal records must be stored and protected. Those records should include permits, titles, declaration forms, and other pertinent information.

(1.4.4) Animal records, whether in electronic or paper form, including health records, must be duplicated and stored in a separate location.

(1.4.3) Animals must be identifiable, whenever practical, and have corresponding ID numbers. For animals maintained in colonies or other animals not considered readily identifiable, the institution must provide a statement explaining how record keeping is maintained.

(1.4.1) An animal inventory must be compiled at least once a year and include data regarding acquisitions and dispositions in the animal collection.

(1.4.2) All species owned by the institution must be listed on the inventory, including those animals on loan to and from the institution. In both cases, notations should be made on the inventory.

(2.7.1) The institution must have holding facilities or procedures for the quarantine of newly arrived animals and isolation facilities or procedures for the treatment of sick/injured animals.

(2.7.3) Quarantine, hospital, and isolation areas should be in compliance with standards or guidelines adopted by the AZA.

(2.7.2) Written, formal procedures for quarantine must be available and familiar to all staff working with quarantined animals.

(11.1.2) Training and procedures must be in place regarding zoonotic diseases.

(11.1.3) A tuberculin testing and surveillance program must be established for appropriate staff in order to ensure the health of both the employees and the animal collection.

(2.5.1) Deceased animals should be necropsied to determine the cause of death. Disposal after necropsy must be done in accordance with local/federal laws.

(2.4.1) The veterinary care program must emphasize disease prevention.

(1.5.5) For animals used in offsite programs and for educational purposes, the institution must have adequate protocols in place to protect the rest of the collection from exposure to infectious agents.

(2.3.1) Capture equipment must be in good working order and available to authorized, trained personnel at all times.

(2.4.2) Keepers should be trained to recognize abnormal behavior and clinical symptoms of illness and have knowledge of the diets, husbandry (including enrichment items and strategies), and restraint procedures required for the animals under their care. However, keepers should not evaluate illnesses nor prescribe treatment.

(2.3.2) Hospital facilities should have x-ray equipment or have access to x-ray services.

(1.5.8) The institution must develop a clear process for identifying and addressing animal welfare concerns within the institution.

Chapter 8

(1.6.1) The institution must have a formal written enrichment program that promotes species-appropriate behavioral opportunities.

(1.6.2) The institution must have a specific staff member(s) or committee assigned for enrichment program oversight, implementation, training, and interdepartmental coordination of enrichment efforts.

Chapter 9

(5.3) A written policy on the use of live animals in programs should be on file. Animals in education programs must be maintained and cared for by trained staff, and housing conditions must meet standards set for the remainder of the animal collection, including species-appropriate shelter, exercise, social and environmental enrichment, access to veterinary care, nutrition, etc. Since some of these requirements can be met outside of the primary enclosure, for example, enclosures may be reduced in size provided that the animal's physical and psychological needs are being met.

(1.5.3) If animal demonstrations are a part of the institution's programs, an education and conservation message must be an integral component.

Chapter 10

(5.3) Institutions should maximize the generation of scientific knowledge gained from the animal collection. This might be achieved by participating in AZA TAG/SSP sponsored research when applicable, conducting original research projects, affiliating with local universities, and/or employing staff with scientific credentials.

(5.2) Institutions must have a written policy that outlines the type of research that it conducts, methods, staff involvement, evaluations, animals to be involved, and guidelines for publication of findings.

(5.1) Research activities must be under the direction of a person qualified to make informed decisions regarding research.

Appendix B: Acquisition/Disposition Policy

I. Introduction**:** The Association of Zoos and Aquariums (AZA) was established, among other reasons, to foster continued improvement in the zoological park and aquarium profession. One of its most important roles is to provide a forum for debate and consensus building among its members, the intent of which is to attain high ethical standards, especially those related to animal care and professional conduct. The stringent requirements for AZA accreditation and high standards of professional conduct are unmatched by similar organizations and also far surpass the United States Department of Agriculture's Animal and Plant Health Inspection Service's requirements for licensed animal exhibitors. AZA member facilities must abide by a Code of Professional Ethics - a set of standards that guide all aspects of animal management and welfare. As a matter of priority, AZA institutions should acquire animals from other AZA institutions and dispose of animals to other AZA institutions.

AZA-accredited zoological parks and aquariums cannot fulfill their important missions of conservation, education and science without living animals. Responsible management of living animal populations necessitates that some individuals be acquired and that others be removed from the collection at certain times. Acquisition of animals can occur through propagation, trade, donation, loan, purchase, capture, or rescue. Animals used as animal feed are not accessioned into the collection.

Disposition occurs when an animal leaves the collection for any reason. Reasons for disposition vary widely, but include cooperative population management (genetic or demographic management), reintroduction, behavioral incompatibility, sexual maturation, animal health concerns, loan or transfer, or death.

The AZA Acquisition/Disposition Policy (A/D) was created to help (1) guide and support member institutions in their animal acquisition and disposition decisions, and (2) ensure that all additions and removals are compatible with the Association's stated commitment to "save and protect the wonders of the living natural world." More specifically, the AZA A/D Policy is intended to:

- Ensure that the welfare of individual animals and conservation of populations, species and ecosystems are carefully considered during acquisition and disposition activities;
- Maintain a proper standard of conduct for AZA members during acquisition and disposition activities;
- Ensure that animals from AZA member institutions are not transferred to individuals or organizations that lack the appropriate expertise or facilities to care for them.
- Support the goal of AZA's cooperatively managed populations and associated programs, including Species Survival Plans (SSPs), Population Management Plans (PMPs), and Taxon Advisory Groups (TAGs).

The AZA Acquisition/Disposition Policy will serve as the default policy for AZA member institutions. Institutions may develop their own A/D Policy in order to address specific local concerns. Any institutional policy must incorporate and not conflict with the AZA acquisition and disposition standards.

Violations of the AZA Acquisition/Disposition Policy will be dealt with in accordance with the AZA Code of Professional Ethics. Violations can result in an institution's or individual's expulsion from membership in the AZA.

II. Group or Colony-based Identification**:** For some colonial, group-living, or prolific species, such as certain insects, aquatic invertebrates, schooling fish, rodents, and bats, it is often impossible or highly impractical to identify individual specimens. These species are therefore maintained, acquisitioned, and disposed of as a group or colony. Therefore, when this A/D Policy refers to animals or specimens, it is in reference to both individuals and groups/colonies.

III. Germplasm**:** Acquisition and disposition of germplasm should follow the same guidelines outlined in this document if its intended use is to create live animal(s). Ownership of germplasm and any resulting animals should be clearly defined. Institutions acquiring or dispositioning germplasm or any animal parts or samples should consider not only its current use, but also future possible uses as new technologies become available.

IV(a). General Acquisitions**:** Animals are to be acquisitioned into an AZA member institution's collection if the following conditions are met:

1. Acquisitions must meet the requirements of all applicable local, state, federal and international regulations and laws.
2. The Director or Chief Executive Officer of the institution is charged with the final authority and responsibility for the monitoring and implementation of all acquisitions.
3. Acquisitions must be consistent with the mission of the institution, as reflected in its Institutional Collection Plan, by addressing its exhibition/education, conservation, and/or scientific goals.
4. Animals that are acquired for the collection, permanently or temporarily, must be listed on institutional records. All records should follow the Standards for Data Entry and Maintenance of North American Zoo and Aquarium Animal Records Databases®.
5. Animals may be acquired temporarily for reasons such as, holding for governmental agencies, rescue and/or rehabilitation, or special exhibits. Animals should only be accepted if they will not jeopardize the health, care or maintenance of the animals in the permanent collection or the animal being acquired.
6. The institution must have the necessary resources to support and provide for the professional care and management of a species, so that the physical and social needs of both specimen and species are met.
7. Attempts by members to circumvent AZA conservation programs in the acquisition of SSP animals are detrimental to the Association and its conservation programs. Such action may be detrimental to the species involved and is a violation of the Association's Code of Professional Ethics. All AZA members must work through the SSP program in efforts to acquire SSP species and adhere to the AZA Full Participation policy.
8. Animals are only to be acquired from sources that are known to operate legally and conduct their business in a manner that reflects and/or supports the spirit and intent of the AZA Code of Professional Ethics as well as this policy. Any convictions of state, federal, or international wildlife laws should be reviewed, as well as any previous dealings with other AZA-accredited institutions.
9. When acquiring specimens managed by a PMP, institutions should consult with the PMP manager.
10. Institutions should consult AZA Wildlife Conservation and Management Committee (WCMC)-approved Regional Collection Plans (RCPs) when making acquisition decisions.

IV(b). Acquisitions from the Wild**:** The maintenance of wild animal populations for education and wildlife conservation purposes is a unique responsibility of AZA member zoos and aquariums. To accomplish these goals, it may be necessary to acquire wild-caught specimens. Before acquiring animals from the wild, institutions are encouraged to examine sources including other AZA institutions or regional zoological associations.

When acquiring animals from the wild, careful consideration must be taken to evaluate the long-term impacts on the wild population. Any capture of free-ranging animals should be done in accordance with all local, state, federal, and international wildlife laws and regulations and not be detrimental to the long-term viability of the species or the wild or *ex situ* population(s). In crisis situations, when the survival of a population is at risk, rescue decisions are to be made on a case-by-case basis.

V(a). Disposition Requirements – living animals**:** Successful conservation and animal management efforts rely on the cooperation of many entities, both within and outside of AZA. While preference is given to placing animals within AZA member institutions, it is important to foster a cooperative culture among those who share the primary mission of AZA-accredited facilities. The AZA draws a strong distinction between the mission, stated or otherwise, of non-AZA member organizations and the mission of professionally managed zoological parks and aquariums accredited by the AZA.

An accredited AZA member balances public display, recreation, and entertainment with demonstrated efforts in education, conservation, and science. While some non-AZA member organizations may meet minimum daily standards of animal care for wildlife, the AZA recognizes that this, by itself, is insufficient to warrant either AZA membership or participation in AZA's cooperative animal management programs. When an animal is sent to a non-member of AZA, it is imperative that the member be confident that the animal will be cared for properly.

Animals may only be disposed of from an AZA member institution's collection if the following conditions are met:

1. Dispositions must meet the requirements of all applicable local, state, federal and international regulations and laws.
2. The Director or Chief Executive Officer of the institution is charged with the final authority and responsibility for the monitoring and implementation of all dispositions.
3. Any disposition must abide by the Mandatory Standards and General Advisories of the AZA Code of Professional Ethics. Specifically, "a member shall make every effort to assure that all animals in his/her collection and under his/her care are disposed of in a manner which meets the current disposition standards of the Association and do not find their way into the hands of those not qualified to care for them properly."
4. Non-domesticated animals shall not be disposed of at animal auctions. Additionally, animals shall not be disposed of to any organization or individual that may use or sell the animal at an animal auction. In transactions with AZA non-members, the recipient must ensure in writing that neither the animal nor its offspring will be disposed of at a wild animal auction or to an individual or organization that allows the hunting of the animal.
5. Animals shall not be disposed of to organizations or individuals that allow the hunting of these animals or their offspring. This does not apply to individuals or organizations which allow the hunting of only free-ranging game species (indigenous to North America) and established long-introduced species such as, but not limited to, white-tailed deer, quail, rabbit, waterfowl, boar, ring-necked pheasant, chukar, partridge, and trout. AZA distinguishes hunting/fishing for sport from culling for sustainable population management and wildlife conservation purposes.
6. Attempts by members to circumvent AZA conservation programs in the disposition of SSP animals are detrimental to the Association and its conservation programs. Such action may be detrimental to the species involved and is a violation of the Association's Code of Professional Ethics. All AZA members must work through the SSP program in efforts to deacquisition SSP species and adhere to the AZA Full Participation policy.
7. Domesticated animals are to be disposed of in a manner consistent with acceptable farm practices and subject to all relevant laws and regulations.
8. Live specimens may be released within native ranges, subject to all relevant laws and regulations. Releases may be a part of a recovery program and any release must be compatible with the AZA Guidelines for Reintroduction of Animals Born or Held in Captivity, dated June 3, 1992.
9. Detailed disposition records of all living or dead specimens must be maintained. Where applicable, proper animal identification techniques should be utilized.
10. It is the obligation of every loaning institution to monitor, at least annually, the conditions of any loaned specimens and the ability of the recipient to provide proper care. If the conditions and care of animals are in violation of the loan agreement, it is the obligation of the loaning institution to recall the animal. Furthermore, an institution's loaning policy must not be in conflict with this A/D Policy.
11. If live specimens are euthanized, it must be done in accordance with the established policy of the institution and the Report of the American Veterinary Medical Association Panel on Euthanasia (Journal of the American Veterinary Medical Association 218 (5): 669-696, 2001).
12. In dispositions to non-AZA members, the non-AZA member's mission (stated or implied) must not be in conflict with the mission of AZA, or with this A/D Policy.
13. In dispositions to non-AZA member facilities that are open to the public, the non-AZA member must balance public display, recreation, and entertainment with demonstrated efforts in conservation, education, and science.
14. In dispositions to non-AZA members, the AZA members must be convinced that the recipient has the expertise, records management practices, financial stability, facilities, and resources required to properly care for and maintain the animals and their offspring. It is recommended that this documentation be kept in the permanent record of the animals at the AZA member institution.
15. If living animals are sent to a non-AZA member research institution, the institution must be registered under the Animal Welfare Act by the U.S. Department of Agriculture Animal and Plant Health Inspection Service. For international transactions, the receiving facility should be registered by that country's equivalent body with enforcement over animal welfare.
16. No animal disposition should occur if it would create a health or safety risk (to the animal or humans) or have a negative impact on the conservation of the species.

17. Inherently dangerous wild animals or invasive species should not be dispositioned to the pet trade or those unqualified to care for them.
18. Under no circumstances should any primates be dispositioned to a private individual or to the pet trade.
19. Fish and aquatic invertebrate species that meet ANY of the following are inappropriate to be disposed of to private individuals or the pet trade:
    a. species that grow too large to be housed in a 72-inch long, 180 gallon aquarium (the largest tank commonly sold in retail stores)
    b. species that require extraordinary life support equipment to maintain an appropriate *ex situ* population environment (e.g., cold water fish and invertebrates)
    c. species deemed invasive (e.g., snakeheads)
    d. species capable of inflicting a serious bite or venomous sting (e.g., piranha, lion fish, blue-ringed octopus)
    e. species of wildlife conservation concern
20. When dispositioning specimens managed by a PMP, institutions should consult with the PMP manager.
21. Institutions should consult WCMC-approved RCPs when making disposition decisions.

V(b). Disposition Requirements – dead specimens**:** Dead specimens (including animal parts and samples) are only to be disposed of from an AZA member institution's collection if the following conditions are met:

1. Dispositions of dead specimens must meet the requirements of all applicable local, state, federal and international regulations and laws.
2. Maximum utilization is to be made of the remains, which could include use in educational programs or exhibits.
3. Consideration is given to scientific projects that provide data for species management and/or conservation.
4. Records (including ownership information) are to be kept on all dispositions, including animal body parts, when possible.
5. SSP and TAG necropsy protocols are to be accommodated insofar as possible.

VI. Transaction Forms**:** AZA member institutions will develop transaction forms to record animal acquisitions and dispositions. These forms will require the potential recipient or provider to adhere to the AZA Code of Professional Ethics, the AZA Acquisition/Disposition Policy, and all relevant AZA and member policies, procedures and guidelines. In addition, transaction forms must insist on compliance with the applicable laws and regulations of local, state, federal and international authorities.

Appendix C: Recommended Quarantine Procedures

Quarantine Facility**:** A separate quarantine facility, with the ability to accommodate mammals, birds, reptiles, amphibians, and fish should exist. If a specific quarantine facility is not present, then newly acquired animals should be isolated from the established collection in such a manner as to prohibit physical contact, to prevent disease transmission, and to avoid aerosol and drainage contamination.

Such separation should be obligatory for primates, small mammals, birds, and reptiles, and attempted wherever possible with larger mammals such as large ungulates and carnivores, marine mammals, and cetaceans. If the receiving institution lacks appropriate facilities for isolation of large primates, pre-shipment quarantine at an AZA or AALAS accredited institution may be applied to the receiving institutions protocol. In such a case, shipment must take place in isolation from other primates. More stringent local, state, or federal regulations take precedence over these recommendations.

Quarantine Length**:** Quarantine for all species should be under the supervision of a veterinarian and consist of a minimum of 30 days (unless otherwise directed by the staff veterinarian). Mammals: If during the 30-day quarantine period, additional mammals of the same order are introduced into a designated quarantine area, the 30-day period must begin over again. However, the addition of mammals of a different order to those already in quarantine will not have an adverse impact on the originally quarantined mammals. Birds, Reptiles, Amphibians, or Fish: The 30-day quarantine period must be closed for each of the above Classes. Therefore, the addition of any new birds into a bird quarantine area requires that the 30-day quarantine period begin again on the date of the addition of the new birds. The same applies for reptiles, amphibians, or fish.

Quarantine Personnel**:** A keeper should be designated to care only for quarantined animals or a keeper should attend quarantined animals only after fulfilling responsibilities for resident species. Equipment used to feed and clean animals in quarantine should be used only with these animals. If this is not possible, then equipment must be cleaned with an appropriate disinfectant (as designated by the veterinarian supervising quarantine) before use with post-quarantine animals.

Institutions must take precautions to minimize the risk of exposure of animal care personnel to zoonotic diseases that may be present in newly acquired animals. These precautions should include the use of disinfectant foot baths, wearing of appropriate protective clothing and masks in some cases, and minimizing physical exposure in some species; e.g., primates, by the use of chemical rather than physical restraint. A tuberculin testing/surveillance program must be established for zoo/aquarium employees in order to ensure the health of both the employees and the animal collection.

Quarantine Protocol**:** During this period, certain prophylactic measures should be instituted. Individual fecal samples or representative samples from large numbers of individuals housed in a limited area (e.g., birds of the same species in an aviary or frogs in a terrarium) should be collected at least twice and examined for gastrointestinal parasites. Treatment should be prescribed by the attending veterinarian. Ideally, release from quarantine should be dependent on obtaining two negative fecal results spaced a minimum of two weeks apart either initially or after parasiticide treatment. In addition, all animals should be evaluated for ectoparasites and treated accordingly.

Vaccinations should be updated as appropriate for each species. If the animal arrives without a vaccination history, it should be treated as an immunologically naive animal and given an appropriate series of vaccinations. Whenever possible, blood should be collected and sera banked. Either a -70ºC (-94°F) frost-free freezer or a -20ºC (-4°F) freezer that is not frost-free should be available to save sera. Such sera could provide an important resource for retrospective disease evaluation.

The quarantine period also represents an opportunity to, where possible, permanently identify all unmarked animals when anesthetized or restrained (e.g., tattoo, ear notch, ear tag, etc.). Also, whenever animals are restrained or immobilized, a complete physical, including a dental examination, should be performed. Complete medical records should be maintained and available for all animals during the quarantine period. Animals that die during quarantine should have a necropsy performed under the supervision of a veterinarian and representative tissues submitted for histopathologic examination.

Quarantine Procedures**:** The following are recommendations and suggestions for appropriate quarantine procedures for Viverridae:

Viverridae:

Required:

1. Direct and floatation fecals
2. Vaccinate as appropriate

Strongly Recommended:

1. CBC/sera profile
2. Urinalysis
3. Appropriate serology (FIP, FeLV, FIV)
4. Heartworm testing in appropriate species

Appendix D: Program Animal Policy and Position Statement

Program Animal Policy

Originally approved by the AZA Board of Directors – 2003

Updated and approved by the Board – July 2008 & June 2011

The Association of Zoos & Aquariums (AZA) recognizes many benefits for public education and, ultimately, for conservation in program animal presentations. AZA's Conservation Education Committee's *Program Animal Position Statement* summarizes the value of program animal presentations (see pages 42-44).

For the purpose of this policy, a Program Animal is defined as "an animal whose role includes handling and/or training by staff or volunteers for interaction with the public and in support of institutional education and conservation goals". Some animals are designated as Program Animals on a full-time basis, while others are designated as such only occasionally. Program Animal-related Accreditation Standards are applicable to all animals during the times that they are designated as Program Animals.

There are three main categories of Program Animal interactions:

1. On Grounds with the Program Animal Inside the Exhibit/Enclosure:
    i. Public access outside the exhibit/enclosure. Public may interact with animals from outside the exhibit/enclosure (e.g., giraffe feeding, touch tanks).
    ii. Public access inside the exhibit/enclosure. Public may interact with animals from inside the exhibit/enclosure (e.g., lorikeet feedings, 'swim with' programs, camel/pony rides).
2. On Grounds with the Program Animal Outside the Exhibit/Enclosure:
    i. Minimal handling and training techniques are used to present Program Animals to the public. Public has minimal or no opportunity to directly interact with Program Animals when they are outside the exhibit/enclosure (e.g., raptors on the glove, reptiles held "presentation style").
    ii. Moderate handling and training techniques are used to present Program Animals to the public. Public may be in close proximity to, or have direct contact with, Program Animals when they're outside the exhibit/enclosure (e.g., media, fund raising, photo, and/or touch opportunities).
    iii. Significant handling and training techniques are used to present Program Animals to the public. Public may have direct contact with Program Animals or simply observe the in-depth presentations when they're outside the exhibit/enclosure (e.g., wildlife education shows).
3. Off Grounds:
    i. Handling and training techniques are used to present Program Animals to the public outside of the zoo/aquarium grounds. Public may have minimal contact or be in close proximity to and have direct contact with Program Animals (e.g., animals transported to schools, media, fund raising events).

These categories assist staff and accreditation inspectors in determining when animals are designated as Program Animals and the periods during which the Program Animal-related Accreditation Standards are applicable. In addition, these Program Animal categories establish a framework for understanding increasing degrees of an animal's involvement in Program Animal activities.

Program animal presentations bring a host of responsibilities, including the safety and welfare of the animals involved, the safety of the animal handler and public, and accountability for the take-home, educational messages received by the audience. Therefore, AZA requires all accredited institutions that make program animal presentations to develop an institutional program animal policy that clearly identifies and justifies those species and individuals approved as program animals and details their long-term management plan and educational program objectives.

AZA's accreditation standards require that education and conservation messages must be an integral component of all program animal presentations. In addition, the accreditation standards require that the conditions and treatment of animals in education programs must meet standards set for the remainder of the animal collection, including species-appropriate shelter, exercise, appropriate environmental enrichment, access to veterinary care, nutrition, and other related standards. In addition, providing program animals with options to choose among a variety of conditions within their environment is

essential to ensuring effective care, welfare, and management. Some of these requirements can be met outside of the primary exhibit enclosure while the animal is involved in a program or is being transported. For example, free-flight birds may receive appropriate exercise during regular programs, reducing the need for additional exercise. However, the institution must ensure that in such cases, the animals participate in programs on a basis sufficient to meet these needs or provide for their needs in their home enclosures; upon return to the facility the animal should be returned to its species-appropriate housing as described above.

Program Animal Position Statement

Last revision 1/28/03
Re-authorized by the Board June 2011

The Conservation Education Committee (CEC) of the Association of Zoos and Aquariums supports the appropriate use of program animals as an important and powerful educational tool that provides a variety of benefits to zoo and aquarium educators seeking to convey cognitive and affective (emotional) messages about conservation, wildlife and animal welfare.

Utilizing these animals allows educators to strongly engage audiences. As discussed below, the use of program animals has been demonstrated to result in lengthened learning periods, increased knowledge acquisition and retention, enhanced environmental attitudes, and the creation of positive perceptions concerning zoo and aquarium animals.

Audience Engagement

Zoos and aquariums are ideal venues for developing emotional ties to wildlife and fostering an appreciation for the natural world. However, developing and delivering effective educational messages in the free-choice learning environments of zoos and aquariums is a difficult task.

Zoo and aquarium educators are constantly challenged to develop methods for engaging and teaching visitors who often view a trip to the zoo as a social or recreational experience (Morgan and Hodgkinson, 1999). The use of program animals can provide the compelling experience necessary to attract and maintain personal connections with visitors of all motivations, thus preparing them for learning and reflection on their own relationships with nature.

Program animals are powerful catalysts for learning for a variety of reasons. They are generally active, easily viewed, and usually presented in close proximity to the public. These factors have proven to contribute to increasing the length of time that people spend watching animals in zoo exhibits (Bitgood, Patterson and Benefield, 1986, 1988; Wolf and Tymitz, 1981).

In addition, the provocative nature of a handled animal likely plays an important role in captivating a visitor. In two studies (Povey, 2002; Povey and Rios, 2001), visitors viewed animals three and four times longer while they were being presented in demonstrations outside of their enclosure with an educator than while they were on exhibit. Clearly, the use of program animals in shows or informal presentations can be effective in lengthening the potential time period for learning and overall impact.

Program animals also provide the opportunity to personalize the learning experience, tailoring the teaching session to what interests the visitors. Traditional graphics offer little opportunity for this level of personalization of information delivery and are frequently not read by visitors (Churchman, 1985; Johnston, 1998). For example, Povey (2001) found that only 25% of visitors to an animal exhibit read the accompanying graphic; whereas, 45% of visitors watching the same animal handled in an educational presentation asked at least one question and some asked as many as seven questions. Having an animal accompany the educator allowed the visitors to make specific inquiries about topics in which they were interested.

Knowledge Acquisition

Improving our visitors' knowledge and understanding regarding wildlife and wildlife conservation is a fundamental goal for many zoo educators using program animals. A growing body of evidence supports the validity of using program animals to enhance delivery of these cognitive messages as well.

- MacMillen (1994) found that the use of live animals in a zoomobile outreach program significantly enhanced cognitive learning in a vertebrate classification unit for sixth grade students.
- Sherwood and his colleagues (1989) compared the use of live horseshoe crabs and sea stars to the use of dried specimens in an aquarium education program and demonstrated that students made the greatest cognitive gains when exposed to programs utilizing the live animals.
- Povey and Rios (2002) noted that in response to an open-ended survey question ("Before I saw this animal, I never realized that . . . "), visitors watching a presentation utilizing a program animal provided 69% cognitive responses (i.e., something they learned) versus 9% made by visitors viewing the same animal in its exhibit (who primarily responded with observations).
- Povey (2002) recorded a marked difference in learning between visitors observing animals on exhibit versus being handled during informal presentations. Visitors to demonstrations utilizing a raven and radiated tortoises were able to answer questions correctly at a rate as much as eleven times higher than visitors to the exhibits.

Enhanced Environmental Attitudes

Program animals have been clearly demonstrated to increase affective learning and attitudinal change.

- Studies by Yerke and Burns (1991) and Davison and her colleagues (1993) evaluated the effect live animal shows had on visitor attitudes. Both found their shows successfully influenced attitudes about conservation and stewardship.
- Yerke and Burns (1993) also evaluated a live bird outreach program presented to Oregon fifth-graders and recorded a significant increase in students' environmental attitudes after the presentations.
- Sherwood and his colleagues (1989) found that students who handled live invertebrates in an education program demonstrated both short and long-term attitudinal changes as compared to those who only had exposure to dried specimens.
- Povey and Rios (2002) examined the role program animals play in helping visitors develop positive feelings about the care and well-being of zoo animals.
- As observed by Wolf and Tymitz (1981), zoo visitors are deeply concerned with the welfare of zoo animals and desire evidence that they receive personalized care.

Conclusion

Creating positive impressions of aquarium and zoo animals, and wildlife in general, is crucial to the fundamental mission of zoological institutions. Although additional research will help us delve further into this area, the existing research supports the conclusion that program animals are an important tool for conveying both cognitive and affective messages regarding animals and the need to conserve wildlife and wild places.

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Appendix E: Developing an Institutional Program Animal Policy

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Rationale

Membership in AZA requires that an institution meet the AZA Accreditation Standards collectively developed by our professional colleagues. Standards guide all aspects of an institution's operations; however, the accreditation commission has asserted that ensuring that member institutions demonstrate the highest standards of animal care is a top priority. Another fundamental AZA criterion for membership is that education be affirmed as core to an institution's mission. All accredited public institutions are expected to develop a written education plan and to regularly evaluate program effectiveness.

The inclusion of animals (native, exotic and domestic) in educational presentations, when done correctly, is a powerful tool. CEC's **Program Animal Position Statement** describes the research underpinning the appropriate use of program animals as an important and powerful educational tool that provides a variety of benefits to zoo and aquarium educators seeking to convey cognitive and affective messages about conservation and wildlife.

Ongoing research, such as AZA's Multi-Institutional Research Project (MIRP) and research conducted by individual AZA institutions will help zoo educators to determine whether the use of program animals conveys intended and/or conflicting messages and to modify and improve programs accordingly and to ensure that all program animals have the best possible welfare.

When utilizing program animals our responsibility is to meet both our high standards of animal care and our educational goals. Additionally, as animal management professionals, we must critically address both the species' conservation needs and the welfare of the individual animal. Because "wild creatures differ endlessly," in their forms, needs, behavior, limitations and abilities (Conway, 1995), AZA, through its Animal Welfare Committee, has recently given the responsibility to develop taxon- and species-specific animal welfare standards and guidelines to the Taxon Advisory Groups (TAG) and Species Survival Plan® Program (SSP). Experts within each TAG or SSP, along with their education advisors, are charged with assessing all aspects of the taxons' and/or species' biological and social needs and developing Animal Care Manuals (ACMs) that include specifications concerning their use as program animals.
However, even the most exacting standards cannot address the individual choices faced by each AZA institution. Therefore, each institution is required to develop a program animal policy that articulates and evaluates program benefits. The following recommendations are offered to assist each institution in formulating its own Institutional Program Animal Policy, which incorporates the AZA Program Animal Policy and addresses the following matters.

The Policy Development Process

Within each institution, key stakeholders should be included in the development of that institution's policy, including, but not limited to representatives from:

- the Education Department
- the Animal Husbandry Department
- the Veterinary and Animal Health Department
- the Conservation & Science Department
- the Behavioral Husbandry Department
- any animal show staff (if in a separate department)
- departments that frequently request special program animal situations (e.g., special events, development, marketing, zoo or aquarium society, administration)

Additionally, staff from all levels of the organization should be involved in this development (e.g., curators, keepers, education managers, interpreters, volunteer coordinators).

To develop a comprehensive Program Animal Policy, we recommend that the following components be included:

I. Philosophy

In general, the position of the AZA is that the use of animals in up close and personal settings, including animal contact, can be extremely positive and powerful, as long as:

1. The use and setting is appropriate.
2. Animal and human welfare is considered at all times.
3. The animal is used in a respectful, safe manner and in a manner that does not misrepresent or degrade the animal.
4. A meaningful conservation message is an integral component. Read the AZA Board-approved Conservation Messages.
5. Suitable species and individual specimens are used.

Institutional program animal policies should include a philosophical statement addressing the above, and should relate the use of program animals to the institution's overall mission statement.

II. Appropriate Settings

The Program Animal Policy should include a listing of all settings both on and off site, where program animal use is permitted. This will clearly vary among institutions. Each institution's policy should include a comprehensive list of settings specific to that institution. Some institutions may have separate policies for each setting; others may address the various settings within the same policy. Examples of settings include:

I. On-site programming
   A. Informal and non-registrants:
      1. On-grounds programming with animals being brought out (demonstrations, lectures, parties, special events, and media)
      2. Children's zoos and contact yards
      3. Behind-the-scenes open houses
      4. Shows
      5. Touch pools
   B. Formal (registration involved) and controlled settings
      1. School group programs
      2. Summer Camps
      3. Overnights
      4. Birthday Parties
      5. Animal rides
      6. Public animal feeding programs

II. Offsite and Outreach
   1. PR events (TV, radio)
   2. Fundraising events
   3. Field programs involving the public
   4. School visits
   5. Library visits
   6. Nursing Home visits (therapy)
   7. Hospital visits
   8. Senior Centers
   9. Civic Group events

In some cases, policies will differ from setting to setting (e.g., on-site and off-site use with media). These settings should be addressed separately, and should reflect specific animal health issues, assessment of distress in these situations, limitations, and restrictions.

III. Compliance with Regulations

All AZA institutions housing mammals are regulated by the USDA's Animal Welfare Act. Other federal regulations, such as the Marine Mammal Protection Act, may apply. Additionally, many states, and some cities, have regulations that apply to animal contact situations. Similarly, all accredited institutions are bound by the AZA Code of Professional Ethics. It is expected that the Institution Program Animal Policy address compliance with appropriate regulations and AZA Accreditation Standards.

IV. Collection Planning

All AZA accredited institutions should have a collection planning process in place. Program animals are part of an institution's overall collection and must be included in the overall collection planning process. The AZA Guide to Accreditation contains specific requirements for the institution collection plan. For more information about collection planning in general, please see the Collection Management pages in the Members Only section.

The following recommendations apply to program animals:

1. Listing of approved program animals (to be periodically amended as collection changes). Justification of each species should be based upon criteria such as:
    - Temperament and suitability for program use
    - Husbandry requirements
    - Husbandry expertise
    - Veterinary issues and concerns
    - Ease and means of acquisition / disposition according to the AZA code of ethics
    - Educational value and intended conservation message
    - Conservation Status
    - Compliance with TAG and SSP guidelines and policies
2. General guidelines as to how each species (and, where necessary, for each individual) will be presented to the public, and in what settings
3. The collection planning section should reference the institution's acquisition and disposition policies.

V. Conservation Education Message

As noted in the AZA Accreditation Standards, if animal demonstrations are part of an institution's programs, an educational and conservation message must be an integral component. The Program Animal Policy should address the specific messages related to the use of program animals, as well as the need to be cautious about hidden or conflicting messages (e.g., "petting" an animal while stating verbally that it makes a poor pet). This section may include or reference the AZA Conservation Messages.

Although education value and messages should be part of the general collection planning process, this aspect is so critical to the use of program animals that it deserves additional attention. In addition, it is highly recommended to encourage the use of biofacts in addition to or in place of the live animals. Whenever possible, evaluation of the effectiveness of presenting program animals should be built into education programs.

VI. Human Health and Safety

The safety of our staff and the public is one of the greatest concerns in working with program animals. Although extremely valuable as educational and affective experiences, contact with animals poses certain risks to the handler and the public. Therefore, the human health and safety section of the policy should address:

1. Minimization of the possibility of disease transfer from non-human animals to humans, and vice-versa (e.g., handwashing stations, no touch policies, use of hand sanitizer)
2. Safety issues related to handlers' personal attire and behavior (e.g., discourage or prohibit use of long earrings, perfume and cologne, not eating or drinking around animals, smoking etc.)

AZA's Animal Contact Policy provides guidelines in this area; these guidelines were incorporated into accreditation standards in 1998.

VII. Animal Health and Welfare

Animal health and welfare are the highest priority of AZA accredited institutions. As a result, the Institutional Program Animal Policy should make a strong statement on the importance of animal welfare. The policy should address:

1. General housing, husbandry, and animal health concerns (e.g. that the housing and husbandry for program animals meets or exceeds general AZA standards and that the physical, social and psychological needs of the individual animal, such as adequate rest periods, provision of enrichment, visual cover, contact with conspecifics as appropriate, etc., are accommodated).
2. Where ever possible provide a choice for animal program participation, e.g., retreat areas for touch tanks or contact yards, evaluation of willingness/readiness to participate by handler, etc.)
3. The empowerment of handlers to make decisions related to animal health and welfare; such as withdrawing animals from a situation if safety or health is in danger of being compromised.
4. Requirements for supervision of contact areas and touch tanks by trained staff and volunteers.
5. Frequent evaluation of human / animal interactions to assess safety, health, welfare, etc.
6. Ensure that the level of health care for the program animals is consistent with that of other animals in the collection.
7. Whenever possible have a “cradle to grave” plan for each program animal to ensure that the animal can be taken care of properly when not used as a program animal anymore.
8. If lengthy “down” times in program animal use occur, staff should ensure that animals accustomed to regular human interactions can still maintain such contact and receive the same level of care when not used in programs.

VIII. Taxon Specific Protocols

We encourage institutions to provide taxonomically specific protocols, either at the genus or species level, or the specimen, or individual, level. Some taxon-specific guidelines may affect the use of program animals. To develop these, institutions refer to the Conservation Programs Database.

Taxon and species -specific protocols should address:

1. How to remove the individual animal from and return it to its permanent enclosure, including suggestions for operant conditioning training.
2. How to crate and transport animals.
3. Signs of stress, stress factors, distress and discomfort behaviors.

Situation specific handling protocols (e.g., whether or not animal is allowed to be touched by the public, and how to handle in such situations)

1. Guidelines for disinfecting surfaces, transport carriers, enclosures, etc. using environmentally safe chemicals and cleaners where possible.
2. Animal facts and conservation information.
3. Limitations and restrictions regarding ambient temperatures and or weather conditions.
4. Time limitations (including animal rotation and rest periods, as appropriate, duration of time each animal can participate, and restrictions on travel distances).
5. The numbers of trained personnel required to ensure the health and welfare of the animals, handlers and public.
6. The level of training and experience required for handling this species
7. Taxon/species-specific guidelines on animal health.
8. The use of hand lotions by program participants that might touch the animals

IX. Logistics: Managing the Program

The Institutional Policy should address a number of logistical issues related to program animals, including:

1. Where and how the program animal collection will be housed, including any quarantine and separation for animals used off-site.
2. Procedures for requesting animals, including the approval process and decision making process.
3. Accurate documentation and availability of records, including procedures for documenting animal usage, animal behavior, and any other concerns that arise.

X. Staff Training

Thorough training for all handling staff (keepers, educators, and volunteers, and docents) is clearly critical. Staff training is such a large issue that many institutions may have separate training protocols and procedures. Specific training protocols can be included in the Institutional Program Animal Policy or reference can be made that a separate training protocol exists.

It is recommended that the training section of the policy address:

1. Personnel authorized to handle and present animals.
2. Handling protocol during quarantine.
3. The process for training, qualifying and assessing handlers including who is authorized to train handlers.
4. The frequency of required re-training sessions for handlers.
5. Personnel authorized to train animals and training protocols.
6. The process for addressing substandard performance and noncompliance with established procedures.
7. Medical testing and vaccinations required for handlers (e.g., TB testing, tetanus shots, rabies vaccinations, routine fecal cultures, physical exams, etc.).
8. Training content (e.g., taxonomically specific protocols, natural history, relevant conservation education messages, presentation techniques, interpretive techniques, etc.).
9. Protocols to reduce disease transmission (e.g., zoonotic disease transmission, proper hygiene and hand washing requirements, as noted in AZA's Animal Contact Policy).
10. Procedures for reporting injuries to the animals, handling personnel or public.
11. Visitor management (e.g., ensuring visitors interact appropriately with animals, do not eat or drink around the animal, etc.).

XI. Review of Institutional Policies

All policies should be reviewed regularly. Accountability and ramifications of policy violations should be addressed as well (e.g., retraining, revocation of handling privileges, etc.). Institutional policies should address how frequently the Program Animal Policy will be reviewed and revised, and how accountability will be maintained.

XII. TAG and SSP Recommendations

Following development of taxon-specific recommendations from each TAG and SSP, the institution policy should include a statement regarding compliance with these recommendations. If the institution chooses not to follow these specific recommendations, a brief statement providing rationale is recommended.

Appendix F: Viverridae Species Status

Species Latin Name*	Species Common Name	CITES Listing	USFWS+ Status	IUCN Status
Chrotogale owstoni	Owston's civet***		---	Vulnerable***; High conservation priority status for Viverrids*
Cynogale bennettii	Otter civet**	Appendix II*	---	Endangered***; Viet Nam population has high conservation status*
Diplogale hosei	Hose's civet**, Hose's palm civet***		---	Vulnerable***
Hemigalus derbyanus	Banded palm civet**	Appendix II*	---	Vulnerable***
Nandinia binotata	African palm civet or tree civet**^		---	Least Concern***
Arctictis binturong	Binturong	Appendix III (India)*	---	Vulnerable***
Arctogalidia trivirgata	Small-toothed palm civet***	---	---	Least Concern***
Macrogalidia musschenbroekii	Sulawesi palm civet***	---	---	Vulnerable***
Paguma larvata	Masked palm civet**	Appendix II (India)*	---	Least Concern***
Paradoxurus hermaphroditus	Toddy cat Common palm civet	Appendix III (India)*	---	Least Concern***
P. jerdoni	Jerdon's palm civet, Brown palm civet	Appendix III (India)*	---	Least Concern***
P. zeylonensis	Golden palm civet		---	Vulnerable***
*Civettictis civetta** *Viverra civetta***	African civet*	Appendix III (Botswana)*	---	Least Concern***
Genetta abyssinica	Abyssinian genet**	---	---	Least Concern***
G. angolensis	Angolan genet** Miombo genet***	---	---	Least Concern***
G. bourloni	Bourlon's genet***			Near Threatened***
G. genetta	Small-spotted genet**	---	---	Least Concern*** Rare subspecies*
*G. cristatta****	Crested genet***	---	---	Vulnerable***

Species Latin Name*	Species Common Name	CITES Listing	USFWS+ Status	IUCN Status
G. johnstoni	Johnston's genet**	---	---	Vulnerable***
G. maculata	Rusty-spotted genet** Central African large-spotted genet	---	---	Least Concern***
G. servalina	Servaline genet**	---	---	Least Concern***
G. thierryi	Hausa genet**			Least Concern***
G. tigrina	Large-spotted genet**	---	---	Least Concern***
G. victoriae	Giant genet**	---	---	Least Concern***
G. piscivora	Aquatic genet*** (Congo water civet**)	---	---	Data Deficient***
G. poensis	King genet			Data Deficient***
Poiana richardsonii	African linsang	---	---	Least Concern***
P. leightoni	Leighton's linsang			Data Deficient***
Prionodon linsang	Banded linsang**	Appendix II**	---	Least Concern***
P. pardicolor	Spotted linsang**	Appendix I**		Least Concern***
Viverra civettina	Large-spotted civet**, Malabar civet	---	Endangered**	Critically Endangered*** (endemic to S. India)
V. megaspila	Large-spotted civet**	Appendix III (India)*	---	Vulnerable***
V. tangalunga	Malay civet**	---	---	Least Concern***
V. zibetha	Large Indian civet**	Appendix III (India)*	---	Near Threatened***
Viverricula indica	Small Indian civet**	Appendix III (India)*	---	Least Concern***

+ US Fish and Wildlife Website, Endangered and Threatened Species Listing: endangered.few.gov/wildlife.html.
* Wilson & Reeder 1992
** Corbet & Hill 1991
*** IUCN Red List of Threatened Species 2009 (www.redlist.org)
^ Now placed in the Family Nandiniidae (2009)

Appendix G: Description of Nutrients

Description of Nutrients (US National Library of Medicine)

Protein: Protein is the main building blocks of animal structure on a fat-free basis. In addition to being an important constituent of animal cell walls, protein is one of the nutrients responsible for making enzymes, hormones, lipoproteins, and other crucial elements needed for proper bodily functions. Protein also is essential for building and repairing body tissue, as well as protecting the animal from harmful bacteria and viruses. Furthermore, protein aids in the transportation of nutrients throughout the body and facilitates muscle contractions. The requirements for crude protein are effectively requirements for dietary amino acids. The requirements are based on the needs of the animal, the quality of the protein, the source of the protein, and the digestibility of the protein available.

Fat: Dietary fat plays an important role in the manufacture of certain hormones. It also plays a crucial role in a wide variety of chemical bodily functions. Also, fat functions as a concentrated energy source, serves as a carrier for fat-soluble vitamins (Vitamins A, D, E, and K), and provides essential fatty acids. The requirements for fat are effectively requirements for dietary fatty acids.

Vitamin A: Vitamin A is a fat-soluble vitamin essential for maintaining good vision and healthy mucous membranes. It contributes to the differentiation and growth of skin tissue and bone formation (including teeth), as well as bone remodeling in growing animals, and glycoprotein synthesis. Vitamin A can improve skin and hair/fur conditions, help to increase resistance to certain infections, and improve fertility in both genders. In many cases, a vitamin A requirement is effectively a requirement for carotenoids (precursors to vitamin A).

Vitamin D: Vitamin D is a fat-soluble vitamin necessary for active calcium absorption, calcium metabolism and resorption from bone. Requirements for vitamin D can be totally or partially met by exposure to sunlight or artificial UV light (vitamin D is biosynthesized in the skin of animals or in some plant cells upon exposure to the appropriate wavelength of UV light; 285-315nm).

Vitamin E: Vitamin E is a fat-soluble antioxidant that helps to maintain the structure of cellular and subcellular membranes by preventing oxidation of unsaturated fatty acids. It also protects tissues from free radicals, which are substances known to harm cells, tissues, and organs. Vitamin E is essential in the formation of red blood cells and aids the body in Vitamin K utilization.

Thiamine (B-1): Thiamine is a water-soluble vitamin, which functions as a necessary coenzyme in carbohydrate metabolism (converting carbohydrates into energy) and is hypothesized to play a role in nerve or neuromuscular impulse transmission. Thiamine also is important in the proper functioning of the heart, muscles, and the nervous system.

Riboflavin (B-2): Riboflavin is a water-soluble vitamin. It functions in two coenzymes: Flavin adenine dinucleotide or “FAD” and flavin mononucleotide. Riboflavin is important for growth and the production of red blood cells. It also helps the body to release energy from carbohydrates. Microbial synthesis of riboflavin occurs in the gastrointestinal tract of some animals, but synthesis appears to be dependent on the type of animal and the source of dietary carbohydrate.

Niacin (Nicotinic Acid): Similar to Riboflavin, niacin is a water-soluble vitamin which functions in two coenzymes: Nicotinamide adenine dinucleotide or “NAD” and nicotinamide adenine dinucleotide phosphate or “NADP”. Niacin plays a crucial role in assisting the normal functioning of the digestive, skin, and nerve systems. Like riboflavin, niacin helps the body to convert energy from food. The niacin requirement of many animals theoretically could be satisfied by synthesis of the vitamin from the amino acid tryptophan. However, removal rate of an intermediate in the pathway to create niacin is often so rapid that virtually none is produced.

Pyridoxine (B-6): Pyridoxine also known as B-6 is a water-soluble vitamin, which aids the body in the synthesis of antibodies by the immune system. It also plays a role in the formation of red blood cells and helps to promote healthy nerve functions. Pyridoxine is required to produce the chemical activity necessary for protein digestion.

Choline: Choline is an essential nutrient, which contributes to the function of nerve cells. It is a component (helps to form phosphatidylcholine, the primary phospholipid of cell membranes) of the phospholipid lecithin (found in cells throughout the body) and is critical to normal membrane structure and formation. It also functions as a “methyl donor”, but this role can be completely replaced by excess amounts of the amino acid methionine in the diet.

Folacin (Folate, Folic Acid, B-9, Pteroylglutamic Acid): Folacin, or folate, is a water-soluble vitamin, which assists the body in the formation of red blood cells. It also plays a major role in the formation of genetic material (synthesis of DNA, the hereditary and functioning blueprint of all cells) within all living cells. Folacin functions as a coenzyme, which is important at the cellular and subcellular levels in decarboxylation, oxidation-reduction, transamination, deamination, phosphorylation, and isomerization reactions. Working in conjunction with Vitamin C and B-12, Folacin assists in digestion and protein utilization and synthesis. This vitamin may be used to increase appetite and stimulate healthy digestive acids.

Vitamin B-12: Vitamin B-12 is a water-soluble vitamin, which functions as a coenzyme in single carbon and carbohydrate metabolism. In addition to playing a role in metabolism, B-12 assists in the formation of red blood cells and aids in the maintenance of the central nervous system.

Pantothenic Acid: Pantothenic acid is a water-soluble vitamin and part of the B vitamin complex. It is needed to break down and use (metabolize) food. Pantothenic acid also is needed for the synthesis of both hormones and cholesterol.

Calcium: The mineral calcium (in association with phosphorus) is a major component of the body and is largely associated with skeletal formation. It is important in blood clotting, nerve function, acid-base balance, enzyme activation, muscle contraction, and eggshell, tooth, and bone formation and maintenance. It is one of the most important minerals required for growth, maintenance, and reproduction of vertebrates.

Phosphorus: In addition to acting as a major component of the body and being largely associated with skeletal and tooth formation (in conjunction with calcium), phosphorus is involved in almost every aspect of metabolism (energy metabolism, muscle contractions, nerve function, metabolite transport, nucleic acid structure, and carbohydrate, fat, and amino acid metabolism). Phosphorus is needed to produce ATP, which is a molecule the body uses to store energy. Working with the B vitamins, this mineral also assists the kidneys in proper functioning and helps to maintain regularity in heartbeat.

Magnesium: Magnesium is a mineral, which serves several important metabolic functions. It plays a role in the production and transport of energy. It also is important for the contraction and relaxation of muscles. Magnesium is involved in the synthesis of protein, and it assists in the functioning of certain enzymes in the body.

Potassium: Potassium is a mineral that is involved in both electrical and cellular functions in the body. (In the body it is classified as an electrolyte.) It has various roles in metabolism and body functions. Potassium assists in the regulation of the acid-base balance and water balance in blood and the body tissues. It also assists in protein synthesis from amino acids and in carbohydrate metabolism. Potassium is necessary for the building of muscle and for normal body growth, as well as proper functioning of nerve cells, in the brain and throughout the body.

Sodium (salt): Sodium is an element, which the body uses to regulate blood pressure and blood volume. Sodium also is critical for the functioning of muscles and nerves.

Iron: Iron is a trace element and is the main component of hemoglobin (oxygen carrier in the blood), myoglobin in muscles (oxygen carrier with a higher affinity for oxygen than hemoglobin), and many proteins and enzymes within the body. It also functions in immune defenses against infection.

Zinc: Zinc also is a trace element that is second only to iron in terms of concentration within the body. Zinc plays an important role in the proper functioning of the immune system in the body. It is required for the enzyme activities necessary for cell division, cell growth, and wound healing. It plays a role in the acuity of the senses of smell and taste. Zinc also is involved in the metabolism of carbohydrates. Zinc is essential for synthesis of DNA, RNA, and proteins, and it is a component or cofactor of many enzyme systems.

Manganese: Manganese is essential for carbohydrate and lipid metabolism, for synthesis of one of the precursors to cartilage formation, and for proper bone formation. Manganese plays a key role in the growth and maintenance of tissues and cartilage, specifically proper bone development. It particularly aids in development at the ends of bones where new bone formation takes place. This therefore helps to reduce the risk of osteoporosis. Manganese also helps to produce certain hormones, metabolizes fat, and is part of superoxide dismutase (SOD) an antioxidant. Studies on humans have shown that manganese also may lower the frequency of epileptic seizures and enhance immune functioning.

Copper: Copper is an essential trace mineral present in all body tissues. Copper, along with iron, helps in the formation of red blood cells. It also helps in keeping the blood vessels, bones, and nervous and immune systems healthy.

Selenium: Selenium is an essential trace element. It is an integral part of enzymes, which are critical for the control of the numerous chemical reactions involved in brain and body functions. Selenium has a variety of functions. The main one is its role as an antioxidant in the enzyme selenium-glutathione-peroxidase. This enzyme neutralizes hydrogen peroxide, which is produced by some cell processes and would otherwise damage cell membranes. Selenium also seems to stimulate antibody formation in response to vaccines. It also may provide protection from the toxic effects of heavy metals and other substances. Selenium may assist in the synthesis of protein, in growth and development. In humans, selenium has been shown to improve the production of sperm and sperm motility.

Iodine: Iodine is a trace mineral and an essential nutrient. Iodine is essential for the normal metabolism of cells. It is a necessary nutrient for the production of thyroid hormones and normal thyroid function.

Appendix H: Venipuncture in Binturongs (*Arctictis binturong*)

Anneke Moresco, D.V.M., M.S. (amoresco@ucdavis.edu), SCTAG Veterinary Advisor

The following is a summary of the author's experience with a group of 35 binturongs housed at Institution I (male and female adults) that were anesthetized routinely for annual physical examinations.

In a clinical setting, sometimes a relatively large volume of blood may be needed. For example, if there is a need to perform a complete blood count, a serum biochemistry, and serology for different diseases at different labs (each generally requiring 1-2 ml of serum), test for levels of a drug in blood, and/or to archive a sample. In these cases, the jugular vein is the site of choice.

Anatomy: Several characteristics make venipuncture in the binturong challenging. They have coarse hair, thick skin, abundant subcutaneous tissue around the neck, and short, well-muscled fore legs. Binturongs are similar to ferrets in that the jugular veins course more lateral and more dorsal than in other mammals. The corner of the mandible can still be used as a landmark. However, the vein does not approach midline as it courses towards the heart like in dogs, but rather it stays more lateral. In obese animals, the veins become very difficult to palpate; the jugular is of a small diameter relative to body size, and obese animals have abundant subcutaneous fat in the neck. In addition to these challenges, the drugs used for anesthesia may make it even more difficult. In particular alpha-2 agonists, tend to make the vein more difficult to find.

The combination of ketamine (2 mg/kg, i.m), medetomidine (0.04 mg/kg, i.m.), and butorphanol (0.2 mg/kg, i.m.) (Moresco & Larsen 2003) works well from an anesthesia point of view, but it becomes significantly more challenging to locate the vein if venipuncture is attempted more than 10-20 minutes after administration of these anesthetic agents. This is possibly the result of the effects of medetomidine on vasoconstriction and changes in blood pressure.

Technique and Sites

Jugular vein: The following technique is one that worked well and enabled the author to locate the jugular vein consistently. Place the animals on their back, with the head slightly below the rest of the body (with the animal at the edge of the table with the head extending beyond the table); this facilitates localizing the vein. It is recommended that oxygenation/ventilation be monitored (e.g., with pulse oximetry, capnometry) while the animal is in this position as it is possible that animals with a subclinical respiratory problem may not oxygenate as well. Animals without disease placed in this position showed no adverse effects on their oxygenation.

Wet the site with alcohol and access the vein with a butterfly catheter; shaving is generally not necessary. If the vein is not visualized, the end of the catheter can be left open and held lower than the head of the binturong while the vein is accessed with the needle. In this manner no air will be drawn into the circulation and the blood will flow naturally when the vein is accessed. Draw blood with a syringe connected to the other end. If more than 10-12 ml are needed, this technique allows for a new syringe to be attached. Using syringes larger than 10ml is not recommended as this results in a strong vacuum that collapses the vein, and/ or in clotting of the blood before being able to place the blood in a tube with anticoagulant. Another option is to use Vacutainer® blood collection sets (vacutainer) with a 19ga 1" needle. This method can be used to fill multiple vacuum tubes directly without the need to exchange syringes.

Other sites that can be accessed, if a smaller volume of blood is needed, are the cephalic vein, the femoral vein, the saphenous vein, and the tail vein.

- Cephalic vein: In binturongs the cephalic vein courses medially, and in many of the animals it is large enough to place a 20ga ¾" or 1" catheter. The vein is visible after the hair is clipped and the site is aseptically prepared for catheter placement.

- Femoral vein: The femoral vein is not visible but is palpable on the proximal-medial aspect of the thigh (inguinal area). When palpating, the femoral artery will be more obvious, the vein can be palpated next to it, and therefore care must be exercised when accessing this vein. The vein can be accessed by using a low volume syringe (3ml) and a small gauge needle (22ga 1"). Locate the vein with two fingers and insert the syringe perpendicular to the skin between the two fingers. This site is not recommended if larger volumes of blood are needed nor for injection of i.v. drugs. Unfortunately, it is very difficult to access the femoral artery consistently enough for blood gas

analysis since blood is often admixed with venous blood. If the artery is accessed, hematomas will easily form unless pressure is put on the site for long enough.

- Saphenous vein: The saphenous vein can be accessed on the lateral aspect of the hind leg in a position similar to that in domestic dogs. However, it varied considerably in size in the binturongs examined. Shaving greatly facilitates visualization.
- Tail vein: Lastly, it is possible to obtain a blood sample from the tail vein. This is a blind stick as the vein cannot be seen or palpated. Similar to cattle, the needle is inserted midline on the ventral aspect. The highest success rate at this site is achieved when the needle is inserted about 10cm distal from the tail base and then walked slightly laterally.

Appendix I: Neonatal Examination & Monitoring Guidelines (Read & Meier 1996)

1 **Vital Signs**
- Temperature, include activity level
- Pulse, rate and character
- Respiration, rate and character

2 **Organ systems**

3 **Weight**

4 **Hydration,** skin tone and turgor

5 **Mucous membranes,** color and capillary refill

6 **Vitality,** response to stimulation, activity levels – type, frequency, duration

7 **Physical condition**

8 **Laboratory values** (optional)
- Complete blood count
- White blood cell count
- Serum chemistries, including blood glucose and blood urea nitrogen
- Urinalysis and urine specific gravity (recommended)

9 **Urination,** frequency, amount, and character

10 **Defecation,** frequency, amount, and character

11 **Condition of umbilicus**

12 **Total fluid intake,** amount in 24 hours
- Parenteral fluids, amount, frequency, and type
- Oral fluids, amount, frequency, type, nipple

13 **Housing temperature**

Appendix J: Selected Viverridae Reproduction and Development Parameters*

* From: Denver 2003; J.Reed-Smith, personal experience; Robertson et al. 2002; F.Kohn, personal communication; M.Stinner, personal experience

	Binturong *(Arctictis binturong)*	**Owston's civet** *(Chrotogale owstoni)*	**Banded linsang** *(Prionodon linsang)*	**Genet** *(Genetta genetta)*
Breeding season	Nonseasonal (indoors); Feb/Mar, May/June, Aug/Sep (outdoors)	Jan–Apr peak, possibly year-around	Nonseasonal	Nonseasonal
Estrus frequency	Polyestrous	Polyestrous; one litter per year		Polyestrous; 2 litters per year
Estrus duration	9-14 days	---	~11 days	---
Courtship	Female secretes attractive scent; becomes affectionate. Male marks & may become aggressive	Vulva swells & secretes, female scent marks more; mutual following and flank rubbing	---	Male sniffs & follows female, mutual rubbing
Copulation	Quiet/low purring, & multiple positions	May have polygynous mating system. Copulation lasts 2-3 minutes.	---	Lasts 3-5 minutes
Gestation (days)	84-99 90(Ismail et al. Undated)	75-90; shorter gestations have led to under-developed kittens	---	56-77
Number of offspring	1-6, av. 2	1-3	2-3	1-4, av. 2-3
Birth weight	319g (11.3 oz)	75-135g (2.7-4.8 oz)	~40g (1.4 oz)	61-82g (2.2-2.9 oz)
Eyes open	~2 weeks	4-15 days	---	5-12 days
First solid food	6-8 weeks	~8-10 weeks	---	1½ months
Weaned (weeks)	~6-8	12-18	---	8-18; catch own prey by 11-18 weeks
Sexual maturity (months)**	Males: 27.7 (8 has been reported) Females: 30.4	12-18	---	48

** Capable of breeding but may not be successful until older

Appendix K: Resources for Enrichment and Training

Resources for enrichment and training (S. Maher)

Enrichment

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There are also many enrichment resources available on-line and in print, including:

- "Enrichment Options" – A regular column featuring brief descriptions of ideas published monthly in the Animal Keepers' Forum. Published by the American Association of Zoo Keepers, Inc. AAZK Administrative Office, Susan Chan, Editor. 3601 S.W. 29th Street, Suite 133 Topeka, KS 66614. Phone: (785) 273-9149, Fax: (785) 273-1980. Email: akfeditor@zk.kscoxmail.com. Website: www.aazk.org.
- "The Shape of Enrichment" Newsletter – A newsletter devoted entirely to enrichment of captive wild animals. Published by The Shape of Enrichment, Inc., V. Hare & K. Worley, (eds.). 1650 Minden Drive, San Diego, CA 92111. Phone: (619) 270-4273. Fax: (619) 279-4208. E-mail: shape@enrichment.org. Website: www.enrichment.org.
- The American Association of Zoo Keepers Enrichment Committee www.aazk.org.
- Disney Animal Kingdom - www.animalenrichment.org
- AAZK Enrichment Notebook 3rd ed. 2004 ISBN1-929672-11-X, www.aazk.org/2004enrichnotebookcd.php.
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Appendix L: AAZK Enrichment Committee, Enrichment Caution List (2007)

Dietary Enrichment

- Food enrichment, if uncontrolled, can lead to obesity and tooth decay; deviation from the normal diet can cause nutritional problems. Keepers can consult with the nutritionist or commissary staff to determine the best method of introducing novel food items.
- New food items introduced without analysis may cause colic, rumenitis or metabolic acidosis in ungulates.
- Food items can spoil and cause animal illness if left in the exhibit for extended periods of time. Enrichment food items should be removed within a reasonable amount of time to prevent spoilage.
- Animals can have adverse reactions to toxic plants and chemicals. Keepers should be able to correctly discern between toxic and browse plants, ensure that browse is free of fertilizers and herbicides and wash plants to remove free ranging bird and animal feces and debris.
- Foraging or social feedings may give rise to aggression and possible injuries within the animal population.
- Competition for enrichment items may lead to social displacement of subordinate animals. These concerns can be minimized by providing enough enrichment to occupy all of the animals within the population.
- Carcass feedings for omnivores and carnivores may be hazardous if the source of the carcass is not determined and appropriate precautions taken. Diseased animals, chemically euthanized animals or those with an unknown cause of death are not appropriate for an enrichment program. Freezing the carcasses of animals that are determined to be safe to feed to exhibit animals can help minimize the risk of parasitism and disease. Providing enough carcasses in group feedings can minimize competition and aggression within an exhibit.
- Carefully introducing a group of animals to the idea of social feedings can be done by moving carcass pieces closer together at each feeding until the animals are sharing one carcass. This can allow social carnivores to exhibit normal dominance posturing while minimizing the possibility of aggression.
- Cage furniture may interrupt flight paths or entangle horns and hooves if poorly placed. Careful planning can prevent this.
- If unsecured, some items may fall on an animal or be used as a weapon and cause injuries.
- If position is not thoughtfully considered, limbs and apparatus may provide avenues for escape or may block access into exhibit safety zones, leaving subordinate animals feeling trapped and vulnerable.
- Animals that crib or chew wood should be provided with non-toxic limbs and untreated wood furniture.
- Water features should be tailored to the inhabitants to prevent drowning and ensure that animals such as box turtles can right themselves if they flip over on their backs.
- Animals can be injured in filtration systems if water intake areas are not protected.
- Substrates should provide adequate traction and not cause an intestinal impaction if ingested.
- Caution should be exercised when ropes, cables, or chains are used to hang or secure articles to prevent animals from becoming entangled. Generally, the shortest length possible is recommended. Chain can be covered with a sheath such as PVC pipe; swivels can be used to connect the chain to the enrichment item to minimize kinking.

Olfactory Enrichment

- Scents from different animals or species can lead to aggression if there is an assertion of dominant animals or subordinate animals attempting to use enrichment to advance their status in the hierarchy.
- Animal feces used for olfactory enrichment should be determined to be parasite free through fecal testing and as with other animal by-products such as feathers, sheds, wool and hair, come from only healthy animals. Many of these items can be autoclaved for sterilization.

- Perfumes can be overwhelming to some animals (and keepers) and are therefore best used in open, ventilated areas.
- Some spices may be too strong or toxic to some animals.

Auditory Enrichment

- When provided with audio enrichment, animals may be less threatened by deflected sounds rather than those directed at the animals.
- Some animals may have adverse reactions to recordings of predator calls and should be closely observed when this type of enrichment is provided.
- Providing the animals with an option for escape or the means to mobilize for confrontation when predator calls are played can lessen the stress of this type of enrichment and allow the animals to investigate the sounds and their environment over a period of time.

Manipulable Enrichment

- Individual parts or enrichment devices may be swallowed resulting in choking or asphyxiation.
- If ingested, indigestible enrichment items may cause a gut impaction or linear obstruction.
- Broken items may have sharp edges that can cut an animal. Only items that are appropriate for the species should be provided. For example, some devices will hold up to the play of a fox but not a wolf
- When building or designing enrichment items from wood, it may be wise to use dovetail cuts and glue rather than screws and nails. Rounded corners and sanded edges can prevent the animals from getting splinters.
- Many paints and other chemicals are toxic if eaten. When providing enrichment involving paint or other chemicals, only non-toxic items should be used.
- If used, destructible items such as cardboard boxes and paper bags should be free of staples, tape, wax, strings or plastic liners.

Appendix M: Contributors to Viverridae Care Manual

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Appendix N: Some Facts about the Binturong

AnAge (The Animal Ageing and Longevity Database (genomics.senescence.info/species/)

Adult weight : 12.25 kg (26.95 lb)
Maximum longevity : 27 years (Weigl 2005)
Female maturity: 925 days
Male maturity: 840 days
Gestation: 92 days
Weaning: 79 days
Litter size: 2
Litters per year: 2
Interval between litters: 348 days
Weight at birth : 0.318 kg (0.6996 lb)
Weight at weaning: 2.1 kg (4.62 lb)
Basal metabolic rate: 12.7470W
Body mass: 14.28 kg (31.416 lb)
BMR per body mass: 0.000893 W/g
Temperature: 36.7°C (98.1°F)

Appendix O: Small Carnivore TAG Necropsy Protocol and Forms

Small Carnivore TAG Necropsy Protocol

I. Recommended Fixed tissues. In addition collect a sample of any lesion. Fix in 10 parts10% neutral buffered formalin to 1 part tissues, samples should be no thicker than 1 cm, and should be fixed for at least 72hrs to ensure adequate fixation.
   1. Trachea
   2. Lung (several sections including a large airway) Skin
   3. Pulmonary/Hilar lymph node
   4. Heart (left and right ventricle, septum & atrium
   5. Aorta
   6. Thymus (if present)
   7. Esophagus (2 cm long cross section)
   8. Stomach (2 cm long portion of cardia, fundus, and pylorus)
   9. Duodenum, jejunum, & ileum (2 cm long cross section)
   10. Cecum
   11. Colon (2 cm long cross section)
   12. Rectum
   13. Liver
   14. Spleen
   15. Mesenteric lymph node
   16. Kidneys (cortex and medulla in section)
   17. Adrenal (cross section with cortex and medulla)
   18. Urinary bladder
   19. Prostate
   20. Testes (with epididymis)
   21. Female reproductive tract (fix whole - leave ovaries attached to uterus, longitudinal incisions in horns)
   22. Skeletal muscle (hindlimb)
   23. Tongue (cross section including both mucosal surfaces)
   24. Salivary gland
   25. Peripheral lymph node (popliteal or prescapular)
   26. Bone marrow (2 cm of opened rib or femur - **marrow must be exposed**)
   27. Thyroids/parathyroids
   28. Brain (if possible whole)
   29. Pituitary
   30. Both eyes

II. For neonates also collect placenta and fetal membranes and umbilicus/umbilical area. For aborted fetuses and still births, freeze stomach contents and placenta
   Necropsy Exam:
   1. Estimate stage of gestation.
   2. Measure the Crown to Rump Length: from the highest point on the skull (external occipital protuberance) to the base of the tail.
   3. Note gross appearance of placenta and if it's complete.
   4. Examine for congenital abnormalities: limb deformities, cleft palate, hernias, hydrocephalus, etc.
   5. Check if lungs were inflated: pink or dark red color; sink or float in formalin.
   6. Observe if the ductus arteriosus is contracted and if the foramen ovale is closed.
   7. Determine if suckling has occurred: check stomach for milk curds; and note amount, viscosity and color of upper and lower GI tract contents.

III. Shipping & Contact Information: Histopathology for the species managed under small carnivores should be submitted to the service the institution regularly uses (in-house, Northwest ZooPath, etc)

Small Carnivore TAG Necropsy Form

Institution\Owner

_____

Address

_____

City_____State_____Zip

Country

_____

Veterinarian

_____

Pathologist/Prosector _____

Phone# ( ) _____

Fax# ( ) _____

I. Historical Data (Attach additional sheets as needed & attach pertinent medical records.)

Species: _____

Stud Book#	ISIS#		
Age/Birth date: _____ (Circle) Actual or Estimated	Sex (Circle) M F	Weight: _____Kg (Circle) Actual or Estimated	Acquisition: (Circle) Captive Born or Wild Captured
Date & Time of Death_____ post mortem interval _____hrs Site/Enclosure_____			
1. Was animal euthanized? (Circle) Y or N If so, what method? _____ 3. Member of Group? (Circle) Y or N Number in Group_____ # Sick_____ # Dead _____ 4. Vaccinations: _____			
Additional History: (Signs, stress factors, previous disease, treatments, pertinent feed or feed additives, time period animal was on premises, clinical lab results).			

II. Gross Necropsy Examination

Under appropriate sections, use "NE" for not examined or WNL if no abnormalities are present.

1. External & General Exam (postmortem condition, nutritional status, muscling, subcutaneous fat, skin, eyes, ears, nose, body orifices).

2. Musculoskeletal Systems (bones, joints, muscling, bone marrow).

3. Body Cavities (thoracic/abdominal cavities, amount of adipose, presence of fluids/exudates, negative pressure in chest).

4. Respiratory System (pharynx, larynx, nasal passages, trachea, bronchi, lungs, hilar lymph nodes).

5. Hemic-Lymphatic System (spleen, lymph nodes, thymus)

6. Cardiovascular System (pericardium, heart: valves & chambers, aorta, large vessels

7. Digestive System (Mouth, teeth, esophagus, stomach, intestines, liver, pancreas, mesenteric lymph nodes). **Neonates**: is milk present in the stomach?).

8. Urinary System (kidneys, ureters, bladder, urethra

9. Reproductive System (ovaries, oviducts, uterus, cervix, vagina, mammary glands, placenta/fetuses, testes, penis, accessory sex glands).

10. Endocrine System (thyroids, parathyroids, adrenals, pituitary, pineal gland-if found

11. Nervous System (brain, meninges/dura mater, spinal cord, peripheral nerves

III. Summary Gross Diagnoses

IV. Ancillary Laboratory Test Results

(cytology, urinalysis, fluid/serum analysis, microbiology, parasitology, serology, toxicology, virology, or others; attach reports as necessary).

Appendix P: Sample Behaviors – Binturong

Trained behaviors for binturong Beth Schaefer – Institution K			
Behavior	**Verbal cue**	**Visual cue**	**Use**
Come	“come”	Wave hand towards you	Have animal approach trainer
Crate	“crate”	Point to crate	Used for presentations, husbandry exams, etc.
Sit	“sit”	Make fist at waist	Used for presentations, husbandry exams, etc.
Target	“target”	Present target	Touch nose to target, used to shape other behaviors, or as a redirect if she misbehaves
Hold	“hold”	Hold hand in “stop” position	Used as a “stay” command to remain where she is or hold position such as sit or stand
Stand	“stand”	Open palm toward ceiling, move hand up	Stand up on hind legs, used mainly during presentations but also for husbandry checks
Spin	“spin”	Point finger down, circle finger	Turn around in circle, used during presentations
Heel	“heel”		Used like a dog heel command to get her to walk calmly next to the trainer
Touch	“touch”		Used to let the animal she will be touched for husbandry checks or to have harness put on
Back-up	“back-up”	Point finger down, flick finger away from trainer	Get her to move back from trainer, initially used to redirect misbehavior
Down	“down”	Open palm face down, move hand down	Lay down on belly
Here	“here”	Point to spot where you want the animal to move to	Moving animal around enclosure or stage
Gloves	“gloves”		Desensitizing to gloves
Harness	“harness”		Allow harness to be put on

Trained behaviors for binturong Linda Berggren – Institution L (soft fruit used as primary reinforcer to train behaviors)		
Behavior	**Cue (Verbal & visual)**	**Use/description**
Voluntary boxing	'*In your box'* and point to box	The behaviour is maintained daily. This behaviour is used to transport the binturong to and from different areas and is invaluable husbandry behaviour.
Target	'*Touch'* Closed fist or target stick	Visually present the target paired with a verbal *'touch'* (although the verbal cue is not necessary). The binturong must touch the target with its nose. This behaviour is maintained daily and used to train new behaviours.
Follow trainer		The binturong follows the trainer on walks through the park as well as during animal presentations. Targeting was used to establish this behaviour. The binturong, known as Ezzy, responds to her name which was originally trained by pairing reinforcement with the trainer calling her name. Since the behavior was established she has been maintained on an invariable schedule of reinforcement for the correct response, which is attention to trainer, when her name is called. Taking her for walks is used for her enrichment and the animal presentations are important in educating our visitors.
Walking on harness and lead		Successive approximations were used to train her to accept the trainer to put the harness on followed by a period of desensitization. Once she was accustomed to the harness, targeting was used to teach her how to walk on the lead, behind or next to the trainer. This behaviour is used when a binturong is taken for meet and greets in locations that are less familiar as well as for enrichment (safely experiencing and exploring new environments).
Absolute recall	5 successive, short, sharp blows on a whistle are paired with jackpot reinforcement for the correct response	This behaviour is maintained regularly and invaluable back-up should we lose her attention during a presentation or park walk.
Spin	A visual cue is used	Used to get the animal to turn around.
Stand up	A visual cue is used	The animal is to stand up
Tactile	Verbal and visual clue	Allow the trainer to stroke her all over her body. This behaviour is used by the trainer to perform a daily husbandry examination.
Presentation routine		Climbing abilities (up and down trees and across ropes) are trained using successive approximations and targeting for public demonstrations.