ASSOCIATION OF ZOOS & AQUARIUMS

MONGOOSE, MEERKAT, and FOSSA (*Herpestidae/Eupleridae*) CARE MANUAL

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

Mongoose, Meerkat, & Fossa (Herpestidae/Eupleridae) Care Manual

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Introduction

Preamble

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 (http://www.aza.org) which might not be included in this manual.

Taxonomic Classification

Table 1: Taxonomic classification for *Herpestidae* and *Eupleridae*

Classification	Taxonomy	Additional information
Kingdom	Animalia	
Phylum	Chordata	
Class	Mammalia	
Order	Carnivora	
Suborder	Feliformia	
Family	*Herpestidae*/*Eupleridae*	The fossa and other Malagasy carnivores have been placed in a separate family (Wilson & Reeder, 2005)

Genus, Species, and Status

Table 2: Genus, species, and status information for *Herpestidae* and *Eupleridae*

Genus	Species	Common Name	USA Status	IUCN Status	AZA Status
Cryptoprocta	*ferox*	Fossa	Not Listed	Vulnerable	SSP
Suricata	*suricatta*	Meerkat	Not Listed	Least Concern	SSP
Helogale	*parvula*	Dwarf mongoose	Not Listed	Least Concern	SSP
Mungos	*mungo*	Banded mongoose	Not Listed	Least Concern	--

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), Studbook Programs, 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* mongoose or fossa 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 mongoose or fossa 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 Accreditation Standard 1.1.1).

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.

The ultimate goal of this ACM is to facilitate excellent mongoose and fossa management and care, which will ensure superior mongoose and fossa welfare at AZA-accredited institutions. Ultimately, success in our mongoose and fossa management and care will allow AZA-accredited institutions to

contribute to mongoose and fossa conservation, and ensure that mongooses and fossas are in our future for generations to come.

Species: (Wilson & Reeder, 2005; ITIS, 2009)
Eupleridae: *Cryptoprocta ferox* (Fossa), which has been considered by some to belong to the Viverridae (Wilson & Reeder, 1992), and by others to the Herpestidae (Nowak, 1999); the fossa was at one time considered a distinct clade in the Herpestidae (Yoder et al., 2003). Extant species include: *Eupleres goudotii* (Falanouc), *Fossa fossana* (Malagasy civet), *Galidia elegans* (Malagasy ring-tailed mongoose), *Galidictis fasciata* (Malagasy Broad-striped mongoose), *Galidictis grandidier* (giant-striped mongoose), *Mungotictis decemlineata* (Malagasy narrow-striped mongoose), and *Salanoia concolor* (Solano).

Herpestidae: Species include: *Atilax paludinosus* (Marsh, or water mongoose), *Bdeogale crassicauda* (Black-legged mongoose), *Bdeogale nigripes* (Black-legged mongoose), *Bdeogale jacksoni* (Black-legged mongoose), *Crossarchus alexandri* (Alexander's cusimanse), *C. ansorgei* (Angolan cusimanse), *C. obscures* (Long-nosed cusminase), *C. platycephalus* (Flat-headed cusimanse), *Cynictis penicillata* (Yellow mongoose), *Dologale dybowskii* (African tropical savannah mongoose), *Fossa fossana* (Malagasy civet), *Galerella flavescens* (black slender mongoose), *Galerella ochracea* (Somalian slender mongoose), *Galerella pulverulenta* (Cape gray mongoose), *Galerella sanguinea* (Slender mongoose), *Helogale hirtula* (dwarf mongoose, more northern species), *H. parvula* (Dwarf mongoose), *Herpestes brachyurus* (Short-tailed mongoose), *Herpestes edwardsi* (Indian grey mongoose), *Herpestes fuscus* (Indian brown mongoose), *H. ichneumon* (Egyptian mongoose), *H. naso* (Long-nosed mongoose), *H. semitorquatus* (Collared mongoose), *H. smithii* (Ruddy mongoose), *H. vitticollis* (Stripe-necked mongoose), *Herpestes javanicus* (Small Asian/Javan mongoose), *Herpestes urva* (Crab-eating mongoose), *Ichneumia albicauda* (White-tailed mongoose), *Liberiictis kuhni* (Liberian mongoose), *Mungo gambianus* (Gambian mongoose), *Mungo mungo* (Banded mongoose), *Paracynictis selousi* (Gray meerkat/Selous's mongoose), *Rhynchogale melleri* (Meller's mongoose), and *Suricata suricatta* (Slender-tailed meerkat).

Taxonomic Note: These species have been placed in several different families, including Viverridae and 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. When work began on this document in 2003, the taxonomic classification was under review. Based on new research from Yoder et al. (2003), Wilson & Reeder (2005), and Wozencraft (2005), molecular and morphological evidence suggests that these species (Eupleridae) are more closely related to each other than either the Viverridae or Herpestidae. As the fossa is the only member of the family Eupleridae recommended for management by AZA, the Eupleridae and Herpestidae are covered in one document. Future versions of the Animal Care Manuals may separate the Eupleridae. The Eupleridae are now split into two subfamilies: Euplerinae, which includes the fossa, falanouc, Malagasy civet, and Galidiinae, which includes the five species of Malagasy mongooses.

Introduction

The Eupleridae consists of seven genera and eight species all found on Madagascar. The *Herpestidae* consists of 14 genera and 33 species found in southern Asia, the East Indies, and Africa. One genus (*Herpestes*) occurs in Spain and Portugal, probably brought there by people in ancient times; this genus also has been introduced on many islands around the world and into other portions of Europe (Nowak, 1999).

The Herpestidae and Eupleridae resemble the Viverridae in general appearance, size, distribution, and many aspects of natural history. These species are on average somewhat smaller than the viverrids, excluding *Cryptoprocta* (fossa); the head and body length ranges from 180 mm (7.1 in.) to 710 mm (28 in.), tail lengths range from 120–530 mm (4.7–21 in.) and weights range from 230 grams (8.1 oz) to 5.2 kg (11.5 lbs). *Cryptoprocta* may reach a head and body length of 800 mm (31.5 in.), and weights up to 15 kg (33 lbs) have been recorded (Nowak, 1999; A. Winkler, personal communication), but Budovsky et al. (2009) reports for fossa an average of 9.5 kg (21 lbs) with a range of 7–12 kg (15.4–26.5 lbs) (Budovsky et al., 2009; from Lundrigan & Zachariah, 2000). Juvenile female fossa (*Cryptoprocta*) experience transient masculinization (Hawkins et al., 2002). Based on examination of *in situ* and *ex situ* fossa, Hawkins et al. (2002) determined that juvenile females exhibit an enlarged, spinescent clitoris supported by an os clitoridis and a pigmented secretion on the underpart fur that in adults is confined to males. These features appear to diminish in females as they age.

The pelage of Herpestidae and Eupleridae tends to be far more uniform in color than those seen in the viverrids though some genera do have stripes, or contrasting patterns of some type. Typically the body is long and the limbs are rather short (Nowak, 1999). Like viverrids, these species have scent glands in the anal region; however, these glands open into a pouch or saclike depression outside the anus proper in which the secretion is stored (Nowak, 1999).

Mongooses tend to live in more open country, be more diurnal, and form large social groups. Several genera, including *Cynictis* and *Suricata*, live in colonies in ground burrows. Some genera of mongooses associate in bands and take refuge as a group in any convenient shelter (Nowak, 1999). The fossa (*Cryptoprocta*) is cathemeral and solitary. Table 3 gives generalized information on each species:

Table 3: General ecological and behavioral information on herpestids

Species	Head-Body Length	Social System (S-solitary,P-pair, G-group)	Arboreal/ Terrestrial	Carnivore/ Omnivore	Noct/ Diurn/ Crepusc
Cusimanse	30.5 – 45 cm	P, G	B	C/O	D/N
Fossa	**61.0 – 80 cm**	**S**	**A/T**	**C**	**C/N**
Yellow mongoose	27.0 – 38 cm	G	T	C	D/C
Slender mongoose	26.8 – 42.5 cm	S, P	B	C	D/C
Dwarf mongoose	**18.0 – 26 cm**	**G**	**T**	**C**	**D**
Indian gray Mongoose	25.0 – 65 cm			C	D/C/N
Banded mongoose	**30.0 – 45 cm**	**G**	**T**	**C**	**D**
Meerkat	**24.5 – 35 cm**	**G**	**T**	**C**	**D**
Malagasy broad-striped mongoose sp.	32.0 – 40 cm	P, G	T	C	N/C
Malagasy narrow-striped mongoose	25.0 – 35 cm	G	B,W	C	D
Salano	25.0 – 30 cm	S, P	B	C/O	D
Mongoose sp. in general	25.0 – 65 cm	S, P, G	T, B	C, C/O	D/N
Liberian mongoose	42.3 – 47.8 cm	G	T	C	D
Black-legged mongoose	37.5 – 60 cm	S	T	C	N
White-tailed mongoose	47.0 – 71 cm	S	T	C	N
Marsh mongoose	44 – 62 cm	S	T,W	C	D/C/N

Social System codes indicate how they have been kept in zoos, where available, or what is known of their social system in the wild. Solitary individuals may exhibit varying degrees of tolerance for other animals, with some (e.g., white-tailed mongoose showing signs of matrilineal clans of related individuals inhabiting a common territory (Waser & Waser, 1985). 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 or, to escape from something, an A/T designates species known to be excellent climbers but may spend more than brief periods on the ground. Even terrestrial species can climb if motivated to do so by fear, etc. A 'W' indicates species that swim well or appear to enjoy water features in their exhibit. Carnivore/Omnivore – species are listed as carnivorous if they predominantly eat animal protein, however, they may eat some vegetation as well, an Omnivorous (O) listing indicates species known to eat large amounts of vegetative matter regularly. They are given a 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; Reed-Smith et al., 2003)

The AZA Small Carnivore TAG has designated one Eupleridae species, fossa (*Cryptoprocta ferox*), and three species of Herpestidae, dwarf mongoose (*Helogale parvula*), meerkat (*Suricata suricatta*) and banded mongoose (*Mungos mungo*) for management under the AZA Taxon Advisory Group 2009 Regional Collection Plan. Species denoted in bold in the above Table 3. The following guidelines are

designed specifically with these four species in mind; information on related species is included where appropriate. Consult the AZA SCTAG Chair for husbandry manual availability.

Regulatory agencies: The Herpestid species all fall under the United States Fish and Wildlife Service (USFWS) Injurious Species Act (http://www.fws.gov/species/#invasive). The USFWS web site should be consulted for latest permitting requirements before any transfers or transports are carried out.

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). Animals 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 animals normally living in warmer climates/water temperatures.

AZA Accreditation Standard

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

Temperature: Herpestidae and Eupleridae originate in warm climates and prefer temperatures between 20–25ºC (68–78ºF). When kept outdoors during warm summer months, shade and shelter should be provided. When animals are housed indoors, temperatures should remain between 22–25ºC (71–78ºF). In localities where indoor ambient temperatures fall below these temperatures, an artificial heat source should be provided (Carnio, 1996a).

Those species that experience lower evening winter temperatures in their natural habitats can tolerate cooler temperatures (as low as 13ºC (55ºF)), if they are protected from cold winds and allowed access to protected or heated dens or alcoves (M. Dulaney, personal communication, 2003).

An important factor to remember is that appropriate temperature ranges vary from individual to individual as well as species to species, and animals should be given the opportunity to select a comfortable ambient temperature. This can be accomplished using a variety of techniques including hidden heat lamps, hot rocks, shade structures, rocks, etc.

Banded mongoose: At some institutions, animals are not locked out when ambient temperature falls below 4.4°C (40°F); below 0°C (32°F) they are not allowed on exhibit. Zoo H the banded mongoose are not allowed access outside when temperatures fall below 10° C (50° F). When temperatures reach 31–32°C (80–90°F) or above, misters are turned on. The animals also can escape the temperature by going into their termite mound (K. Gilchrist, personal communication, 2010).

Meerkat: Meerkats have a slow metabolism for a carnivore their size, assisting them in tolerating consistently warm temperatures in their natural environment. However, a slow metabolism also makes them more susceptible to cooler temperatures (Dennis, 1999). During winter months, or in cold climates where temperatures of 18.3°C (65°F) or below are sustained for extended periods, warming opportunities offering temperatures from 18.3–21.1°C (65–70°F) should be provided. This can be accomplished by providing pig blankets, heat lamps, hot rocks, space heaters (these should be monitored closely), central heating, warmer burrows, and/or holding areas (K. Kimble, personal communication, 2004 & 2005).

Humidity: Little information is available on the humidity requirements for these species. However, exhibit humidity can be set to mimic what might be found in the species' natural environment, i.e., low humidity (~30%) for those species that come from relatively drier climates (e.g., dwarf mongoose, meerkat), and a higher humidity (~55-60%) for those that come from more tropical, damp ecosystems (cusimanse). The fossa is found in almost all climatic zones in Madagascar (Reed-Smith et al., 2003). If higher humidity is accompanied by cooler temperatures, then warm spots should be provided for meerkats (see Chapter 1.1) (K. Kimble, personal communication, 2004 & 2005).

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

(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.

1.2 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. Outdoor natural exhibits or indoor exhibits with natural light need no extra lighting system. Indoor exhibits should offer an 8–12h/16–12h day/night cycle, or one similar to the seasonal photoperiod of the species' natural habitats (Carnio, 1996a; M. Dulaney, personal communication, 2003). Fluorescent lighting is an efficient light source that provides full spectrum illumination (Carnio, 1996a; 1996b).

Red or blue reverse lighting can be used (Carnio, 1996a). It is recommended that red lighting be used for dens or caves; lighting in these areas should be left on 24 hours a day, or at all times when the animals have access to the area (C. Wilson, personal communication, 2005). In general, blue lighting works well for exhibit space, receiving higher aesthetic marks from the visiting public. Whatever color of lighting is used, the animals should be maintained on the same light cycle in holding and the exhibit. All cleaning should be carried out during the "day cycle" (C. Wilson, personal communication, 2005).

Mongoose: Most mongoose species prefer brightly lit exhibits that afford ample opportunity for them to bask in the sunlight or near heat sources (Carnio, 1996a). While natural sunlight is preferred, strategically placed heat lamps can accomplish the same behavioral goal.

Fossa: Studies of wild fossa behavior indicate that they are active day and night, spending approximately 70% of their time patrolling their territory, hunting for food, or searching for a mate. They may have high-activity bouts just before and after dawn and dusk; this species is highly active about 30% of the time (moving through their home range) and locally active about 30% of the time (L. Dollar, personal communication, 2005). The rest of their time, generally during the hottest part of the day and coldest part of the night, is spent sleeping or resting, either on the ground or on larger branches in the trees (Winkler, 2002; L. Dollar, personal communication, 2005).

When covering long distances, the fossa generally travels on the ground; field researchers have recorded an individual traveling 12 km (7.5 mi) in a 48-hour period (L. Dollar, personal communication, 2005). Equatorial species have not shown seasonality based on light cycle intensity or duration in zoos (M. Dulaney, personal communication, 2003). However, the AZA SCTAG recommends that light cycles match that of the native habitat. The light cycle at the center of a species' geographic range should be verified and mimicked as closely as possible when building indoor exhibits.

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 exchange of 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 to the public. Cubbing dens may need higher rates of air exchange in order to maintain air quality Anon 1981 referenced in Carnio, 1996a). Indoor facilities should have five to eight air changes of non-recirculated air per hour (Carnio, 1996a).

1.4 Sound and Vibration

Consideration should be given to controlling sounds and vibrations that can be heard by animals in the care of AZA-accredited zoos and aquariums.

No information is currently available on the impact of background noise on these species; in general routine low noises do not appear to be an issue for the terrestrial species such as dwarf mongoose and meerkat. Some facilities have successfully used natural sounds to mask public noise (which has, in some

cases, appeared to cause distress to the dwarf mongoose and meerkat). As a precautionary measure, loud, unusual noises particularly close to parturition should be avoided.

Banded mongoose: Loud noises tend to startle this species.

Fossa: Public access should be restricted to two sides of the enclosure, so that animals can retreat from public disturbance (AZA Small Carnivore TAG, 2004). All noise should be kept to a minimum close to parturition, particularly for primaparous females.

Chapter 2. Habitat Design and Containment

2.1 Space and Complexity

> **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.

Careful consideration should be given to exhibit design so that all areas meet the physical, social, behavioral, and psychological needs of the species. Animals 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).

The AZA SCTAG has consulted with several experts and professional resources to develop our exhibit size recommendations. The table below is included to illustrate elements considered when making our recommendations, and offers the range of sizes considered or suggested. The current AZA SCTAG recommendation is marked with an asterisk (it should be noted that recommended exhibit size is continuously under review as we gain additional experience with these species). These guidelines are based on the head/body length of a typical adult of each species, the species' typical activity pattern, daily movements, and home range. It is very important when exhibiting any of these species that the exhibit be large and varied; the AZA SCTAG suggests that sizes be larger than our recommendations, particularly taking into consideration the activity level of these species. However, well-enriched exhibits that do not meet the recommendations listed here may be acceptable. All applicable state regulations should be checked early in the planning process of new exhibits as they may impact exhibit features including size (Note: these species are covered by USFWS Injurious Species regulations).

Table 4: Exhibit size recommendations for Euplerids and Herpestids (based on two animals; an extra 25% of space should be added for each additional animal)

Species	HBL*	Formula or authority	Size (*recommended)
Dwarf mongoose	10"	Rasa 1975	4 m^2/42.8 ft^2
		*Formula Ib	*6.4 m^2/69 ft^2
		Formula IIb	4.6 m^2/50 ft^2
Meerkat	14"	Formula Ib	12.6 m^2/136 ft^2
		Formula Ic	18.2 m^2/196 ft^2
		Formula IIb	6.5 m^2/70 ft^2
		Memphis	80.8 m^2/870 ft^2
		*Kimble,K.	*32.5 m^2/350 ft^2
		Oglebay	21.2 m^2/228 ft^2
Fossa	31"	*Formula IVc	*89 m^2/961 ft^2
		Formula IIc	29 m^2/310 ft^2
		San Antonio/San Diego	44.6 m^2/480 ft^2
Banded mongoose	18"	Formula 1b	21 m^2/225 ft^2
		*Kimble,K.	*32.5 m^2/350 ft^2

Size based formulas based on HBL (head and body length) given in inches (“):

Formula I: $(HBL/12 \times X)^2$ for species with a large home range/daily travel distance. For more arboreal species, 2.1–2.4 m (7–8 ft) of vertical space should be allowed. For highly terrestrial social species, go up one size group.

Animal size	Formula
a. Small animals: 10–15"	$(HBL/12 \times 6)^2$ = # $feet^2$
b. Medium animals: 15–30"	$(HBL/12 \times 10)^2$ = # $feet^2$
c. Large animals: >30"	$(HBL/12 \times 12)^2$ = # $feet^2$

Formula II: (HBL/12 x X) x given dimension for depth (for species with a small home range/daily travel distance). For more arboreal species, 2.1–2.4 m (7–8 ft) of vertical space should be allowed. For highly terrestrial social species, go up one size group.

Animal size	Formula
a. Small animals: 10–15"	(HBL x 6)/12 x 3' = # feet^2
b. Medium animals: 15–30"	(HBL x 10)/12 x 6' = # feet^2
c. Large animals: >30"	(HBL x 12)/12 x 10' = # feet^2

Formula III: A minimum of 2.4–3 m (8–10 ft) vertical useable space and Formula II floor space.

Formula IV: A minimum of 2.4–3 m (8–10 ft) vertical useable space and Formula I floor space.

Banded mongoose: Over-crowding can cause aggression in banded mongoose. They should always be given access to all pens and as much space as possible. It is best to have holding pens set up so all pens are visible to any one pen. Exhibit furniture may include large rocks or logs and hollow logs. Decomposed granite works well for a substrate since animals cannot dig burrows in it, eliminating cave-ins as a problem.

Separated mongoose should be housed on opposite sides of cage wiring so the separated mongoose can still see, smell, and hear each other. Holding areas should include several nest boxes. Rubbermaid totes with lids work well for nest boxes. Zoo H (see photos at right) uses 55 gallon totes with 2 holes drilled in the side or 20 gallon totes with one hole drilled in the side. These can be filled with a 2.5 – 5 cm (1 – 2") layer of aspen shavings. Additionally, enclosures/holding can be provided with shelves to climb on, PVC tunnels to run through or hollow logs and stumps. Mongoose are easily litter trained, so a few litter boxes filled with absorbent material (e.g. aspen shavings) can be placed in the enclosure. Litter boxes may need to be braced by other enclosure furniture such as stumps or logs so they can't be easily flipped over.

Dwarf mongoose and meerkat: Rasa (1975) found that dwarf mongooses should have at least 1–2 m^2 (10.7–21.4 ft^2) of floor space for each individual. Below this level, lethargy interspersed with bouts of fighting and a breakdown of social structure occurs; mortality is common (Rasa, 1975).

K. Kimble (personal communication, 2004 & 2005) reviewed the current management practices for meerkat and determined that adequate space is critical to the maintenance of meerkat and dwarf mongoose groups. The needs of every group will vary with their compatibility, which may change over time. Exhibit space and complexity should allow for subordinate animals to practice avoidance. It is recommended that new exhibits start with a minimum of 8 m^2 (86 ft^2) for two dwarf mongooses and 32.5 m^2 (350 ft^2) for two meerkats, adding 25% more space for each additional meerkat (K. Kimble, personal communication, 2004 & 2005). When possible, the meerkat Studbook Keeper recommends that new exhibits allow for separation of the space into at least two sections. This provides the ability to house two groups (i.e., separated individuals or groups of individuals) either temporarily or permanently while still having all individuals on exhibit in an appropriate living space (K. Kimble, personal communication, 2004 & 2005).

The dwarf mongoose Studbook Keeper recommends similar accommodations for dwarf mongoose: either the ability to divide the exhibit space or identification of additional space for housing animals separated from the group. In addition to having appropriate housing, in the event that animals have to be separated due to aggression, the space may be advisable to better manage groups for breeding. If breeding ceases due to the age of the oldest, dominant animals and the remaining animals are also

nearing the end of their ability to reproduce, removal of the oldest animals may allow for continued reproduction. See further information about reproductive suppression in Chapters 4 and 7.

In the highly social, community-dwelling dwarf mongoose and meerkat, maintaining the species' social system integrity is paramount. While physical isolation may be necessary (but not recommended) at times, it is ideal that isolated animals be able to maintain at least visual contact with conspecifics. Mongooses suffer from stress leading to apathy and emaciation if isolated for prolonged periods. Temporary removal of individuals from established groups also may result in permanent rejection, so whenever possible, medical procedures should be administered without the animal removed (Carnio, 1996a; K. Kimble, personal communication, 2004 & 2005).

Some of the social Herpestidae (e.g., dwarf mongoose, meerkat) communicate via vocalizations as well as through body language and scent marking. They are generally vocalizing (Rasa, 1975) and have one of the most complex languages of the animal kingdom. They have developed a complicated and intricate speech that ranges from warning calls, which have a high carrying power to quieter calls that the animals use between themselves to communicate mood as well as their location, what they are doing, and what they have found (Rasa, 1975).

Fossa: Studies of wild fossa behavior indicate that they are active day and night spending approximately 70% of their time patrolling their territory, hunting for food, or searching for a mate. They have bouts of activity just before and after dawn and dusk; this species is highly active about 30% of the time (moving through their home range) and locally active about 30% of the time (L. Dollar, personal communication, 2005). The rest of their time, generally during the hottest part of the day and coldest part of the night, is spent sleeping or resting, either on the ground or on larger branches in the trees (Winkler, 2002; L. Dollar, personal communication, 2005).

When covering long distances, the fossa generally travels on the ground; field researchers have recorded an individual traveling 12 km (7.5 mi) in a 48-hour period (L. Dollar, personal communication, 2005). While fossas seem to spend a great deal of time on the ground, they regularly climb into trees, particularly when marking their territory, when hunting for food, and during mating. They are agile climbers, capable of jumping from tree to tree using their long tail as a counterbalance; they are also capable of climbing down a tree headfirst, using their sharp claws to grip the bark (Winkler, 2002).

Due to their frequent use of trees and climbing structures the AZA SCTAG recommends that this species be given a minimum of 6 m (20 ft) of useable vertical space. Trees or artificial climbing structures should be provided to encourage this behavior. Artificial structures should have "limbs" secured tightly so they do not fall but can still sway with the animal's weight. Soft, artificial substrates should be provided to soften any accidental falls.

Initially, the European standards called for an outdoor exhibit space of at least 20 m^2 (215 ft^2), an exhibit height of at least 2.5 m (8.2 ft), and an indoor space of at least 10m^2 (108ft^2) (total of 30 m^2 or 322 ft^2) (Winkler, 2002). However, it has been found that fossas are prone to developing stereotypies if kept in small, un-enriched spaces and the Studbook Keeper (A. Winkler) now recommends that these dimensions are not adequate (A. Winkler, personal communication). It is particularly important that pairs or females raising young be housed in spacious exhibits (Winkler, 2002). The AZA SCTAG recommends a larger size of 50 m^2 (538 ft^2) and minimum vertical height of 6 m (20 ft.), in agreement with A. Winkler's revised recommendations. It is believed this size will allow for complex climbing structures, varied ground surface area, plantings, and ample opportunities for exploration and enrichment to minimize this species' tendency to develop stereotypies.

Enclosure furnishings: Forest species such as the cusimanse and fossa should be provided with good vertical and ground cover to mimic their natural swamp and forest habitat. Species found in dry, more open areas such as some of the mongooses and meerkats can be exhibited in more open displays, with sparse elevated vegetation, as long as shade is provided in some form. *In situ*, dwarf mongooses have a home-range size ranging from 28 to 48 hectares (.3–.5 km^2) to 160 hectares (1.6 km^2) (Rood, 1983) and will move through their entire home range about once a month.

For meerkats, care should be taken that outdoor exhibits in open areas still provide protection, or have limited access, from native aerial predators. Some elevated furnishings are recommended for sentry posts (K. Kimble, personal communication, 2004 & 2005). Elevated locations are easily created from earth mounds or rocky piles.

Nest boxes, feeding stations, waterers, and covered sleeping/hiding spots should be located in the trees, at least 1.22 m (4 ft) off the ground (Carnio, 1996a; 1996b) for the cusimanse; either on or off the

ground for the fossa; and on the ground for the mongoose species (including the meerkat), as appropriate for their species-typical behavioral pattern (i.e., arboreal or terrestrial) (M. Dulaney, personal communication, 2003). 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, PVC pieces, hollow logs, etc. should all be secured against falling, but not all should be fixed in place; they should instead be allowed to sway with the animal's weight.

Fossa: The enclosure should provide a varied environment with rocks, trees, bushes, logs, climbing facilities, ropes, pools, clumps of vegetation, etc. The enclosure should be furnished with a variety of climbing facilities, including trees, branches, ropes, and elevated resting perches. Ropes in particular stimulate play behavior, as do scent markings, which can be distributed in the exhibit. The enclosure should include shady and sunny areas, as the fossa is fond of sun-bathing (Winkler, 2002) (see Chapter 1.4.1 for additional information).

Mongoose/meerkat: Dwarf mongooses are diurnal and terrestrial, spending evenings within termite mounds. Mongooses should have communal sleeping areas with internal nesting boxes. Because marking is a very important social behavior, a wide variety of exhibit "furnishings" should be provided. These can include: hillocks, stones, thick branches, termite mounds, rocky outcroppings, etc. (Carnio, 1996a).

Mongoose and meerkat tunnels/burrows can be self-dug or made from artificial materials; a combination of the two is ideal. Subterranean complexity may be achieved by providing an appropriate substrate for meerkats to dig their own burrows, or by creating a PVC plumbing pipe burrow system. The PVC system tends to be safer than meerkat-made burrows because the formed plastic prevents cave-ins. In addition, use of this material allows the creation of tunnel systems accessible to animal care staff in case of animal injury or illness. Underground burrows are not a necessity if alternate hiding and shelter spots such as nest boxes, large tree trunks, etc. are available (K. Kimble, personal communication, 2004 & 2005). Another effective option for meerkat or mongoose is a series of small interlinking nest boxes (C. Brown, personal communication, 2006). Dwarf mongooses demonstrate an affinity for heated nest boxes; successful designs have included a box within a box, with the inner one used by the alpha pair and the rest of the group occupying the outer box (C. Brown, personal communication, 2006).

Visual barriers of some type should be provided in all enclosures. While they are particularly important in the less social species, they are also important in social species, allowing subordinates to practice avoidance. Visual barriers such as deadfall, termite mounds, etc. will allow more subordinate individuals to escape from constant monitoring by more dominant animals.

As with other scent-oriented species, exhibit "furniture" should be changed periodically (at least twice a year), but not all at the same time. These changes can include repositioning features (e.g., moving deadfall) or bringing in new ones. If nesting/sleeping/hiding areas are altered, at least one should be left the same, and scents should not be removed from those that are moved, allowing some of the scent to remain within the exhibit "territory."

Enclosure "furniture," including tunnels and nest boxes, should not be included in the daily cleaning regime because these species scent mark their territory, and a thorough cleaning of their home space may excessively disturb them. In the past, cleaning of an entire exhibit has led to excessive scent marking, which can lead to blocked scent glands (C. Brown, personal communication, 2006). 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 the total replacement that is commonly used for species which 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 be necessary (Carnio, 1996a).

Food and water containers should be cleaned and disinfected daily. A safe and effective control program for insects, ectoparasites, bird, and mammal pests should be maintained. Mongooses are extremely fastidious animals. Many species only defecate in one area, and daily cleaning of this area is sufficient to maintain good hygiene. Other species (e.g., meerkats) are latrine users, but often choose to defecate in nest boxes that may require cleaning as well. Colonies with young should not be cleaned or disturbed (Carnio, 1996a).

Substrates/bedding materials: Natural materials are preferred as substrate for all herpestids and euplerids. The highly arboreal species can be provided with artificial climbing structures and limited artificial substrates, as long as bedding material is offered; the primarily terrestrial species such as the meerkat, banded and dwarf mongoose may be kept in enclosures offering a combination of natural and limited artificial substrates. Some species will benefit from natural substrates to allow digging, others because it is easier on their feet. Substrates can be placed on concrete floors to facilitate periodic cleaning; in this case, all substrate should be removed at least once a year for cleaning and disinfecting.

When it is not possible to provide sufficient natural substrate, a digging area and long drainage pipes connected to a communal box are recommended for the terrestrial meerkat and dwarf mongoose. Hollow logs are another alternative for the terrestrial, communal species (Carnio, 1996a). Mongooses have non-retractable front claws and digging is essential to prevent them from becoming too long (Carnio, 1996a). Suitable substrates include soil, soft sand, grass, mulch, leaves, straw, hay, pine needles, etc.

Meerkats: Substrates of loose or light consistency (e.g., fine grain sand, cat litter) that will not hold together when the animals dig in them are recommended by the studbook keeper. Artificial tunnels should be provided as an alternative; this allows for access to animals hiding in tunnels and prevents injury due to tunnels collapsing.

If other substrates are used, it is important that any meerkat-dug burrows are collapse-proof and still manageable by keeper staff. It is recommended that meerkat-dug burrows be caved in on a daily basis (while animals are clear from all burrows) to prevent unwanted cave-ins and to promote digging behavior. Artificial burrows can be provided using buried PVC tubes, eliminating the possibility of cave-ins. Whichever of these approaches is taken, it is important that keeper staff have a way to access all areas of the burrow in case of injury or illness. Underground burrows are not a necessity if alternate hiding spots (e.g., nest boxes, large tree trunks, etc.) are available (K. Kimble, personal communication, 2004 & 2005).

Water features: Some of these species may benefit from a small pool or stream 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 to allow for easy cleaning. Space dedicated to pools/streams, etc. should be deducted from the usable floor space calculations (Carnio, 1996a). In general, the herpestid species exhibited in zoological facilities are not those typically associated with water (e.g., marsh mongoose, Malagasy narrow-striped mongoose), so pools or streams should not be deeper than the length of the animal's body. The fossa may benefit from small streams or shallow pools in their enclosures.

No water standards have been set for non-aquatic species. Chemical residues, bacterial counts, mineral levels, and salts should be kept as low as possible. Fecal material and food remnants should be removed daily. PH tolerance is not known but is not likely to be vitally important for these species. Turbidity, except for isolated areas, should be kept to a minimum to encourage use of the pool by those species that may approach or go in the water naturally.

The same careful consideration regarding exhibit size and complexity and its relationship to the mongoose's and fossa's overall well-being must be given to the design and size 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.

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.

2.2 Safety and Containment

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).

Animal 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

AZA Accreditation Standard

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

and particular attention must be given to shift doors, gates, keeper access doors, locking mechanisms and exhibit barrier dimensions and construction.

Herpestids are known to dig and to climb, therefore sinking perimeter fences or walls at least 80 cm (2.6 ft) is recommended. Containment walls should be non-climbable; for the terrestrial species containment walls that may be climbable should be topped with an inward overhang. Concrete containment barriers are preferred, if wire mesh is used it should be monitored for rust. Concrete or coated wire-mesh should be placed under the substrate of meerkat and mongoose exhibits to prevent the animals from digging out (K. Kimble, personal communication). The more arboreal species (fossa) should be exhibited in covered enclosures.

Fossa: The use of water moats is not recommended with this species. When using wire mesh, the size of the mesh should be smaller than 5 cm (2 in.) to prevent newborn or young fossas from slipping through the fence. Using a 2.54 x 2.54 cm (1 x 1 in.) mesh opening will keep young in and prevent adults from biting animals or people passing by. A safe distance between the fossa enclosure and zoo visitors is essential to avoid any accidental finger-biting (Winkler, 2002).

Meerkat, dwarf, and banded mongoose: Containment is an important issue, since meerkats and mongoose are listed on the U.S. Fish and Wildlife Service (USFWS) Injurious Wildlife List and these species are known for their ability to dig. Sinking perimeter fences or walls at least 80cm (2.6ft) below the enclosure surface is recommended for containment. A concrete floor or species-specific-proof [for meerkat: <5 cm (<2 in.); for dwarf mongoose <.64 cm to 1.27 cm (<1/4 to 1/2 in.); for banded mongoose ≤ 2.54 cm (≤ 1 in.)] opening coated wire-mesh should be placed under enclosure substrate.

These species also are good climbers. Primary containment walls should be non-climbable. Meerkats have been known to jump 1.2 m (3 ft) (P. Wood, personal communication, 2005). C. Brown, of the U.K. Small Mammal TAG (personal communication, 2006) recommends a containment barrier of 1 m (3.3 ft) for dwarf mongoose.

For banded mongoose (Zoo H) cautions it is important to install exhibit shift doors that can be locked in place and cannot be pushed out of the track by the mongoose. It is important to closely monitor the rock / cement along the bottom of doors, because over time it is possible for them to dig away pieces of cement. Caution should be taken with openings over 1 inch.

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.

Because of their presence on the USFWS Injurious Species List, exhibits for these species should have some form of secondary containment. Indoor exhibits should have an exhibit door, access door for animals, and a separate door leading from the building to the out of doors. Indoor exhibits with direct access to the outside should have an additional form of secondary containment (see outdoor exhibits). Secondary containment methods for outdoor exhibits include: a second layer of mesh, hot wire, a non-climbable, inward-facing overhang, and/or a moat with a substantial non-climbable barrier (Carpenter, personal communication, 2005). All new or modified enclosure containment barriers should be re-permitted by USFWS (Carpenter, personal communication, 2005) for the meerkat, banded mongoose, and dwarf mongoose.

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.

Exhibits in which the visiting public may have contact with animals 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).

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).

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 Accreditation Standard

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

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).

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.

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 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).

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.

The AZA SCTAG has no specific recommendations regarding emergency protocols for these species. It is recommended that these policies be worked out in advance by each institution based on the species held, exhibit design, weather conditions, and institutional policies. These should be readily available to all staff and reviewed annually.

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.

When transporting mongoose and fossa there 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.

Transport Crate: Crates should be able to withstand external damage from other freight and able to withstand any internal destruction that may be caused by the animal (IATA, 2009). Air kennels of the appropriate size have been used extensively to ship many of the Herpestidae species; see IATA (2009) container #78 for modification requirements. The lining of kennels with wire of any kind is not advised due to the possible injury to feet or the animal's mouth as a result of chewing (M. Dulaney, personal communication, 2003). If wire is needed for added security of the kennel doors, or windows, it is recommended that it be attached to the outside of the door or windows (M. Dulaney, personal communication, 2003). IATA states: "When constructing travel containers for these species the normal habits and movement must be considered, they must be able to stand naturally and move around freely. Multiple compartmentalized containers must have individual access doors, single bulk containers of sociable species must have a sliding door extending down the whole length of the container" (IATA, 2009).

In summary, all shipping containers should be clearly labeled on all sides as containing live animals. In general, the following crate design guidelines are true for all species: 1) Crates should be able to withstand external damage from other freight and able to withstand any internal destruction that may be caused by the animal. 2) Crate doors should not come open accidentally, but should be securely fastened. 3) All shipping crates should allow for adequate ventilation. 4) Ventilation apertures should 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. 5) Crates should be large enough to allow the animal to stand up and turn around (IATA, 2009). 6) Shipping containers should be supplied with bedding (e.g., shredded paper, shredded cardboard). Bedding choices should be cleared with the airline first.

Social Considerations: Because meerkat and mongoose species are listed on the USFWS Injurious Species List, double containment is necessary, and permits are necessary for movement from one institution to another. IATA regulations specify that social species (e.g., meerkat, dwarf mongoose) should never be separated from their group and should be shipped as a group without partitions. From a management standpoint, shipping animals as a group is considered acceptable as long as they are a cohesive group. It is also considered acceptable to crate individuals separately, placing these crates together inside a secondary form of containment (see IATA containment #79 requirements; IATA, 2009).

Another option is the use of a partitioned crate where each individual has its own compartment. If using a partitioned crate, the group should not be split into sub-groups (i.e., the entire group should be transferred in one large crate with partitions for each animal) as this may cause re-introduction challenges at the destination. The AZA SCTAG recommends that the entire group should either be separated into individual compartments/crates within a larger crate, or all individuals should stay together. If animals are shipped in separate compartments, they should all be re-introduced at about the same time.

Mesh doors or side windows (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); this will help provide a sense of security for animals being shipped.

The equipment should provide for the adequate containment, life support, comfort, temperature control, food/water, and safety of the animal(s).

Additional Supplies: All supplies should be gathered in advance; these include scales, transport crates and vehicles, food, transport labels/permits, applicable record sheets, catch-up equipment, and veterinary supplies if required.

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.

3.2 Protocols

Transport protocols should be well defined and clear to all animal care staff. In general, mongoose, meerkat, and fossa species should be trained to voluntarily enter crates. If this is not possible, mongoose and meerkat species can be hand-caught by experienced personnel (wearing gloves), trapped in PVC tubes, or netted. Fossa should be habituated to enter crates voluntarily. Animals should always be shipped individually unless they are social species (see Transport Crate in Chapter 3.1), or young animals that have always been together. Pregnant or lactating females should not be shipped.

Food and Water: While generally not required or advised, 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. All shipments should be provided with food and watering instructions. If transit will take longer than 24 hours it may be necessary to make arrangements with a zoological facility close to one of the layover points to check on the animals. A contact number for the closest zoological facility should be provided, and after 24 hours in transit the animals may be checked on by trained professionals from this facility; if necessary, water and food should be provided. These decisions should be made by the zoological institutions concerned. In general, the Herpestidae species should be fine for 24 hours without food and water (M. Dulaney, personal communication, 2003; K. Kimble, personal communication, 2004 & 2005).

On long flights, provisions should be made for feeding in transit (this may necessitate shipping food with the animal). Herpestids can be provided with dry kibble or frozen fruit pieces (e.g., apple, grape, orange) placed in shipping crates before the animal is introduced to the crate. On long journeys, it is possible to affix an animal waterer to the outside of the crate if the airline approves.

Fossa: Fossa should be provisioned with water at 18-hour intervals at a minimum. They should be not be fed within eight hours of shipping to prevent vomiting, but should be well hydrated.

Substrate and Bedding: The crate bottom should be leak-proof and bedded with an absorbent material that the animal is familiar with. Transport company regulations should be checked for any restrictions on bedding materials used in animal crates.

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

For shipments within the U.S., the AWA requires that ambient temperatures in the holding area should not be less than 7.2ºC (45ºF) or more than 29.5ºC (85ºF) 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 29.5ºC (85ºF) or less than 7.2ºC (45ºF) for more than 45 minutes, or left in direct sunlight (Ott Joslin & Collins, 1999).

These guidelines are suitable for these species, but whenever possible, shipments should be planned to avoid temperatures at either extreme, especially the lower temperatures for some of the smaller species such as the dwarf mongoose (M. Dulaney, personal communication, 2003). Exposure to temperatures at the higher end should be minimized due to the potential of overheating. 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.

Fossa: Fossas should only be shipped if the temperature is over 10°C (50°F) and below 26.7°C (80°F).

Meerkat and Mongoose: These shipments should, whenever possible, only take place when temperatures are above 15.6°C (60°F), due to their sensitivity to cooler temperatures (Dennis, 1999).

Animal Monitoring: Transport periods greater than 24 hours (18 hours for fossa) in length should be accompanied by food and water instructions specific to the species. In these cases, it may be necessary to make arrangements with a zoological facility close to the lay-over points prior to shipping, for food and water provisions. A contact number for the closest zoological facility should be provided, and after 24 hours (or less in some cases) the animals should be checked on by trained professionals from this facility; if needed, water and food should be provided.

The decision to provide food will depend on the species involved. These decisions should be made by the zoological institutions concerned. In instances where provisioning may be required while an animal is in transit, access to food and water containers from the outside, without opening the transport crate, should be accommodated and planned for. Once shipping has been completed, 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. Meerkat and dwarf mongoose group members should be released simultaneously.

Chapter 4. Social Environment

4.1 Group Structure and Size

Careful consideration should be given to ensure that animal group structures and sizes meet the social, physical, and psychological needs of these animals and facilitate species-appropriate behaviors. Multigenerational groups are the natural social structure for many herpestid species. Typically, mongoose and meerkat species should not be separated. Fossas are primarily solitary; a male fossa should be separated from the female about 6 weeks after breeding and not reintroduced to the female and young (L. Dollar, personal communication, 2005).

Banded mongoose: Banded mongoose are a gregarious species with typically 10 – 20 individuals in a colony. It is a matriarchal society. All females in a colony can get pregnant, usually do so at the same time and will communally care for the pups. Colonies with an even 50/50 male to female ratio or with more males than females appears to work best for *ex situ* colonies. The benefit of this ratio only tends to become evident if space becomes limited or over-crowding becomes an issue. Introductions into the group are possible, see section 4.3. (Information provided by Zoo H)

Dwarf mongoose: Dwarf mongooses live in small packs of related individuals and unrelated immigrants assisting the dominant breeding pair. They are diurnal, extremely social, and live in nomadic groups averaging eight to nine individuals. Age is typically a covariant to rank; the oldest animals are dominant in the group. The alpha female is the dominant animal in the pack, followed by the alpha male. Beyond subordination to the alpha pair, the literature provides conflicting information regarding hierarchy of the remaining members of the group. While early evidence suggested the youngest animals rank higher than older ones (Rasa, 1975) more recent studies indicate that rank is strongly age dependent and increases with age (Rood, 1990; Creel et al., 1992).

Dwarf mongoose emigration from the natal pack is known to occur in both sexes, with males dispersing more frequently than females. More than one animal may disperse together and dispersers typically immigrate into their new groups as subordinates. (Waser et al., 1995) There is evidence to suggest immigrants to a group are more likely to achieve alpha status, and at an earlier age, than those that remain in their natal group (Rood, 1990).

In establishing a colony of mongooses, it is recommended to start with a compatible pair, or pairs of unrelated siblings and breed to appropriate group size. Dwarf mongooses are highly cooperative breeders. Dwarf mongoose breeding pairs are more successful in rearing young if the group contains subordinates, who serve as helpers. This is in part due to the energy requirements of producing up to four litters in 6 months, each averaging 22% of the female's body mass (Creel, 1996). Small groups are not as successful in raising young as large ones. Groups of more than twenty individuals have been successfully maintained in zoos. Minimum group size is two, but due to the highly social nature of the species, three or more are recommended. *Ex situ,* group size is dependent on space, social conflict, and the age of the dominant animals.

In a survey of institutions holding dwarf mongooses in 2002, aggression was reported by four out of seven. Scenarios included aggression between sexes, amongst the same sex, and dominant to subordinate. Increase in aggression during breeding is more likely in males than females. Allogrooming is an indicator of social bonds in dwarf mongoose, and is primarily mutual (>70%) and between sexes (>90%) (Rood, 1983). Prevention of subordinate reproduction is both endocrine and behavioral in female dwarf mongooses; in males, it is primarily behavioral (i.e., they are physically prevented from breeding). With females, endocrine suppression diminishes with the age of the subordinate so that older subordinates are more likely to breed successfully than younger subordinates. (Creel et al., 1992) Breeding can be controlled by contraception (Carnio, 1996a); however, in order to meet population needs, all contraception decisions should be first discussed with the AZA SSP Coordinator and AZA SCTAG reproduction advisor prior to taking any action.

Fossa: Fossas should be kept singly, possibly in pairs, or as female/offspring groups (Winkler, 2002). If a pair of fossas is to be housed together, it is very important that the exhibit is large enough and well furnished/enriched (Winkler, 2002). It has been shown that pairs can be successfully housed together if they are introduced at a young age (under 18 months) and, most importantly, kept in a large, environmentally complex exhibit. While it has not been determined definitively, it is believed that older

pairs may be successfully introduced if the exhibit is large and complex enough (Winkler, 2002), but introductions should be carried out slowly.

Introductions of some 1-year-old animals have worked, while others have not. Generally, this species is housed alone except in those cases where the introductions have been successful. It is recommended that all holding institutions have facilities with enough space that animals can be housed individually.

Young fossas are generally fully weaned in zoos at 4 to 6months of age and should be separated from their mothers when they are 7 to 12 months old, or just prior to the next breeding season. If necessary, young can be left with their mother for up to 2 years before she will begin to show aggression towards them. After being separated from their mother, young fossas can be housed together until they are sexually mature at 3 years of age; same sex young can remain together longer (Winkler, 2002). One institution reports that females and female offspring can remain together if breeding is not part of the management plan.

Meerkat: *In situ* meerkats can live in large colonies of animals (generally 12 or more; groups as large as 200+ have been reported, but are very rare), which consist of several adult breeding pairs and offspring. Young, sexually mature females are expelled from the colony, but young, sexually mature males may co-exist peaceably. These behaviors should be considered when developing groups of either species (Carnio, 1996a).

Ex situ meerkats differ from wild groups in that *ex situ* groups do not do well in extremely large numbers (30 animals in an *ex situ* group is absolute maximum) (K. Kimble, personal communication, 2004 & 2005). Minimum recommended group size is two. Optimum group size is two to three in non-breeding groups. A rule of thumb to follow is that the more individuals that are in a group, the more likely it is that social challenges will arise (K. Kimble, personal communication, 2004 & 2005).

It is unclear if there is hierarchy between sexes. Offspring should be kept with their parental group for as long as possible, since placement and introduction to others can be difficult (see Chapter 4.3 Introductions). These hierarchies can become unstable quickly, resulting in injury or even death of individuals. Also, because of these hierarchies, it is unusual to have more than one breeding male and/or female (although beta females have reproduced occasionally). Individuals are generally expelled from the group when they make unsuccessful attempts to climb the hierarchy. Natural inhibition of breeding by subordinates due to the presence of a dominant pair is not an effective method of breeding management for this species. Females may begin to challenge their mother (dominant female) when they reach sexual maturity (L. Ginman, personal communication, 2003), or they may begin to challenge more dominant individuals at any life stage (K. Kimble, personal communication, 2004 & 2005).

Several means of temporary contraception are available for female meerkats (see the AZA Contraception Advisory Group recommendations for carnivores in Chapter 7.6). Spaying is an option if permanent contraception is desired. However, it should not be used as a means of solving social conflict, because it does not seem to alter a female's place in the hierarchy. All contraception decisions should be first discussed with the AZA SSP Coordinator and AZA SCTAG reproduction advisor prior to taking any action. This is particularly true in the case of spaying to insure valuable genotypes are not removed from the *ex situ* population.

The offspring can stay with the group; the family will incorporate the young as part of the group and all will be quiet until the young become sexually mature. At 2 to 3 years of age the young may begin to challenge other animals; some daughters may try to overthrow their mother. However, unless there is an unrelated male in the group, the females will not have anyone to breed with; in general meerkats will not interbreed with their family members (L. Ginman, personal communication, 2003) but again, this should not be relied upon in zoos as a method of contraception.

The dominant female can sometimes become aggressive toward other females in the group when her young reach 3 to 6 months of age, particularly if she becomes pregnant again (L. Ginman, personal communication, 2003). Cohorts of young will remain a group as long as the hierarchy between them remains stable (K. Kimble, personal communication, 2004 & 2005). Yearlings will roughhouse together; this should not be confused with aggression. Female masculization goes away at about 18 months of age. Males can be housed in bachelor groups as long as the hierarchy between them stays stable. Two males are relatively easy to introduce to one another at any age; introducing additional males becomes more complicated (K. Kimble, personal communication, 2004 & 2005).

4.2 Influence of Others and Conspecifics

Animals cared for by AZA-accredited institutions are often found residing with conspecifics but may also be found residing with other species.

Conspecific groups:

Fossa: Individual pairs of fossa should not be housed closer than approximately 10 m (~33 ft) to one another, since close proximity to each other might inhibit breeding activities. If it is required to minimize potentially stressful situations, visual barriers between individual pairs may be erected (Winkler, 2002).

In *in situ* populations, a female will have a permanent mating tree that she will use for life. All of the males gather at the bottom, the strongest animal, or winner, will climb the tree and breed with her repeatedly over a period of 1 to 3 days). The female is receptive for up to 2 weeks. During this time she stays in or around her mating tree (L. Dollar, personal communication, 2005).

Meerkat and mongoose: Groups can be housed in adjacent exhibits as long as they are watched for signs of stress associated with the presence of the other group (K. Kimble, personal communication, 2004 & 2005).

Mixed species groups

In mixed species enclosures, it is important that appropriate sleeping structures, feeding stations, water sources, hiding places, and visual barriers be provided for each species.

Banded mongoose: This species has also been exhibited with colobus monkeys (C. Brown, personal communication, 2006) and meerkats (see above).

Dwarf mongoose: There is no record of dwarf mongoose being housed with other species.

Fossa: Fossas are not recommended as candidates for mixed-species exhibits.

Meerkat: One facility housed meerkats and rock hyrax together for several years. While there was some aggression at first (biting on the part of both species) it eventually calmed down. Important to the success of this combination was: 1) making sure that both species had their own nest boxes, 2) making the door of the meerkat box too small for the hyraxes to get in, because they would fight over the box, and 3) hanging the hyraxes' diet in areas that were too steep for the meerkats to climb to prevent them from eating the food (J. Greathouse, personal communication, 2003).

Meerkats and dik dik have been housed together with no challenges reported. Aardvark and meerkats have been exhibited together; however, meerkat aggression towards the aardvark was reported over food and space. With time, these conflicts resolved themselves when the aardvark learned to avoid the meerkats. Meerkats have also been exhibited successfully with African crested porcupines (pregnant porcupines should be removed prior to giving birth as meerkats will kill offspring) (K. Kimble, personal communication, 2004 & 2005).

Other combinations reported include: guenons and banded mongoose; meerkat, yellow mongoose, fennec fox, and Cape ground squirrel; meerkat, zebra, lechwe, and porcupine; meerkat and yellow mongoose; meerkat and giraffe (one meerkat was lost to trampling by a giraffe); and narrow striped mongoose with jumping rats (Muir, 2003; C. Brown, personal communication, 2006).

4.3 Introductions and Reintroductions

Managed care for and reproduction of animals housed in AZA-accredited institutions are dynamic processes. Animals 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.

In general, introductions should be handled as with other mammal species; first allowing the animals to become accustomed to the sound and smell of one another, progressing to visual introductions, tactile through wire mesh (care should be taken that feet, tails, noses, etc. cannot get caught in the mesh or be poked through and bitten), and ending with monitored physical introductions. Established groups of many species, particularly meerkats and mongooses, do not tolerate new individuals, and their introduction to an established group often results in injuries to the stranger (Carnio, 1996a).

Animals removed for any reason may have to go through a reintroduction process. This is particularly true with meerkats and mongooses, for whom even temporary removal of an individual from an established group may result in permanent rejection. In this species, whenever possible, medical

procedures should be administered without the animal being removed (Carnio, 1996a; K. Kimble, personal communication, 2004 & 2005).

Banded mongoose: Reintroductions after a removal for a medical procedure is best done by mixing one mongoose back at a time, starting with less dominant mongoose if possible. If any non-toxic chemicals, such as Nolvasan®, are used on the mongoose during the procedure it is best to sprinkle that scent around the enclosure first and spray on the other mongoose if possible, so the smell is familiar and neutral before mixing. Heavy scent marking on each other will occur after mixing until all are mixed back together. Aggression is not usually seen if they are not separated for more than 2 - 3 hours for the procedure.

New introductions or animals that have been separated for an extended period of time should be housed in adjacent pens so they can see, smell, hear each other, and can interact through the cage wiring for at least a month before mixing should be attempted. One method for introduction used Zoo H was to smear Vick's VapoRub® on the mongoose and around the enclosure. This method was used successfully to reintroduce two sub-colonies back together after being separated due to fighting. The procedure used was:

- A thorough cleaning of the enclosure should be done prior to introductions to remove as much of the old scent as possible.
- Put Vick's VapoRub® ointment on all the mongoose and especially on their noses so they all smell the same (they primarily identify each other by their scent).
- Smear the Vick's VapoRub® all over the enclosure and furnishings. An alternative is to make a spray solution out of the Vick's VapoRub® liquid and another one by soaking the VapoRub® Pads in water, and then we sprayed that all over the mongoose and the enclosure.
- Use a Vaporizer in the building to release the smell into the air.
- Add one mongoose at a time and monitor for aggression.
- If aggression occurs, separate and try the mixing again once they have calmed down.

Communal scent marking will occur and will end up with all mongoose in the colony smelling the same and getting along. A lot of enrichment is recommended during this process to keep the mongoose occupied and reduce fighting. The Vick's VapoRub® spray solution can also be used to spray on fighting mongoose to help break up fights.

Dwarf mongoose: Introduction of new animals or the reintroduction of those removed from the group present similar to the introduction of meerkats. Similar processes of olfactory and auditory contact progressing to visual, restricted, and eventually full contact are advised. *In situ,* emigrating animals are often from adjacent home ranges and may have olfactory cues that facilitate successful immigration into new packs. Ritualized “crouch-greeting,” described as flattening while darting head from side to side, may occur at reintroduction, indicating submission. Wild immigrant males face more same-sex aggression during integration than females, and most immigration occurs at the beginning of the breeding season (Rood, 1983). These factors provide insights into successful introduction in zoos as well.

Maintaining contact with other members of the group is important for the behavioral health of an animal that has to be removed from the group. This can be done by providing visual access throughout the recovery, or by exchanging bedding materials to maintain an olfactory presence if the animal cannot be housed near the group. In either case, using a “howdy” setup within the group’s enclosure is advisable. Isolation is extremely stressful and can hinder the animal’s ability to heal. Isolation may have physical consequences as well, including inappetance and stress-induced uremia resulting in death (Rasa, 1975). Institutions should contact the AZA SSP Coordinator for assistance if an animal is singly housed due to the loss of a mate or permanent removal from the pack.

Fossa: Fossas are solitary mammals that typically only come together in the wild to breed once per year. While some male/female pairs can be kept together year-round, these animals are usually introduced at a young age (less than 2 – 3 years old). Introducing fossas is similar to many other introduction techniques for mammals. It is recommended to give the animals visual, auditory, and olfactory access to each other. There should always be a physical divider during this “howdy” stage that will prevent contact. The wall between the two should be solid (e.g., plexiglass) or two offset layers of 2.54 x 2.54 cm (1 x 1 in.) mesh, as they will jump at each other against a common wall and attempt to bite at footpads and toes. Any space underneath this divider should also be less than 2.54 cm (1 in.) or

blocked in some way to keep tails and feet from sliding through to the other side. Animals should be introduced in as large a space as possible to allow chase and escape routes.

Each individual should be given access to the introduction area alone several times, to become familiar with the space and as a way to directly smell the other animal's markings. It can be helpful to allow the male access into the area first to scent mark furniture in order to stimulate the female during the breeding season. If the female is in heat (increased rubbing and scent-marking, increased interest in the male, swelling of the vulva), she will be receptive of the male's advances, although in some situations it may not be obvious for a few days. Because of this, animals should be placed together under close supervision for 2 to 4 hours of interaction daily until copulation occurs. Minor aggression should initially be expected (chasing, jumping at each other, rolling together on the floor), but should not amount to more than superficial scratches to the face or paws. Timing of the introduction (i.e., female is not in heat) should be reconsidered if injuries are more serious, or physical aggression lasts longer than 2 to 3 days. After fossas begin to breed, they should be allowed to stay together for the duration of the day, but should be separated at the end of the day, except in the instance of a pair that is housed together year round. Reintroduce each day until the female rejects the male or becomes aggressive toward him. Fossas prefer to breed in trees, usually on horizontal branches of at least 10.2–15.5 cm (4–6 in.) in diameter. Copulation can also occur on the ground, but preference of the female (who will lead the male into position) is usually an elevated branch. When fossas have access to seasonal changes (natural lighting through skylights, windows or an outside enclosure) they will come into heat during the spring (March–May). If they are kept together year-round, however, it has been reported that they will breed any time of the year. Without natural seasonal changes, breeding should be regulated through artificial light cycles.

Meerkat: Introduction of new individuals to a group is possible if done one individual at a time and slowly enough that new hierarchies can be established as each individual is added to the group. Basic introduction techniques are generally used for introducing meerkats. The process should begin with olfactory and auditory contact, adding visual contact, moving onto restricted tactile contact and culminating in full tactile contact (K. Kimble, personal communication, 2004 & 2005). The length of time a meerkat introduction will take is completely dependent on the behavior of the animals involved.

The same process should be followed for reintroduction of established group members following separation for medical care. If individuals are separated from the group for ongoing treatment, keeping them in a "howdy" situation within the group's physical environment is imperative to a successful reintroduction. In all cases it is helpful to know the hierarchy of the individuals in your group so more subordinate individuals can be introduced before dominant individuals (K. Kimble, personal communication, 2004 & 2005). Additional specific information on introduction techniques and a behavioral ethogram are available (K. Kimble, kkimble@sbzoo.org).

Chapter 5. Nutrition

5.1 Nutritional Requirements

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.

A formal nutrition program is recommended to meet the nutritional and behavioral needs of all mongooses and fossas (AZA Accreditation Standard 2.6.2). Diets should be developed using the recommendations of nutritionists, the Nutrition Scientific Advisory Group (NAG) feeding guidelines: (http://www.nagonline.net/Feeding%20Guidelines/feeding_guidelines.htm), and veterinarians as well as AZA Taxon Advisory Groups (TAGs), and Species Survival Plan® (SSP) Programs. 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.

Herpestid and euplerid species consume a range of food items including vertebrates, eggs, fish, invertebrates, and some plant/vegetable matter (Gould & McKay, 1998; Macdonald, 1999; Nowak, 1999; Ray & Sunquist, 2001). Cusimanse (*Crossarchus obscurus*) forage on vertebrate prey, eggs, invertebrate prey, and fruit. This species is known to break eggs utilizing their forepaws positioned back between the hind feet and a hard object (Nowak, 1999). Fossas (*Cryptoprocta ferox*) are highly opportunistic feeders with hyena-like dentition (L. Dollar, personal communication, 2005), and will consume almost any vertebrates and some invertebrates they naturally encounter. Dwarf mongooses (*Helogale parvula*) mainly forage invertebrate prey along with small vertebrates, eggs, and fruit. Meerkats (*Suricata suricatta*) primarily forage invertebrate prey but also small vertebrate prey, eggs, and vegetable matter. Banded mongooses consume small vertebrates like birds, snakes, and rats; their diet also includes invertebrates, reptile, or bird eggs, and they reportedly eat fallen fruit.

Digestive System Morphology and Physiology: Dentition in these families is highly variable, reflecting food specialization of species within the families (Schliemann, 1990). Meerkats possess dentition with well-developed molar cusps for crushing chitinous exoskeletons, while banded mongooses have more pronounced crushing dentition as seen in carnivores (Schliemann, 1990).

The gastrointestinal tract of mongoose is reported to be quite similar to that of a domestic cat; however, the cecum is very rudimentary in some and absent others (Stevens & Hume, 1995).

Nutrient Requirements: Although many of the items consumed by these species are known, the nutrient content of these items has not been completely characterized. In many cases, target nutrient levels are based on those of well-studied carnivores and, to a lesser extent, omnivores (e.g., 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, they reflect the highest values reported. 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 6). These values include cat requirements (NRC, 2006; Legrand-Defretin & Munday, 1993; AAFCO, 1994), Arctic fox/mink (NRC, 1982) requirements, and general mustelid guidelines (Maslanka et al., 1999). As additional information becomes available, these ranges should be adjusted to reflect new knowledge.

Meerkat: Taurine has been determined to be a necessary component to the diet of meerkats; lack of taurine may result in enlarged hearts and related complications. Diets should contain a form of cat food (which is rich in taurine), mice (which also contain taurine), or taurine dietary supplements (K. Kimble, personal communication, 2004 & 2005). See Appendix F for nutrient descriptions and Chapter 6: Veterinary Care for additional information.

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. Invertebrate-eating specialists in *Herpestidae* have low basal metabolic rates primarily due to their eating habits (McNab, 1989). Work done by Muñoz-Garcia & 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. Based upon this work Muñoz-Garcia and Williams (2005) concluded, "…species that eat meat have larger home ranges and higher BMR than species that eat vegetable matter."

Table 5: Basal Metabolic Rate (BMR) of Selected Herpestidae and Eupleridae Species (from: Muñoz-Garcia & Williams, 2005; citing original sources)

Species	Body Mass (g)	BMR (kJ/d)	Diet (%) Meat/Invert/Veg	Home Range (km^2)*
Herpestes sanguineus	540	194.4	36.5/63.4/0.1	Not listed
Herpestes auropunctatus	611	193.56 ± 149	50.7/25.5/22.4	Not listed
Suricata suricatta	850	148.92 ± 9	22.4/77.6/0	Not listed
Fossa fossa	2,260	435	50/50/0	Not listed

* Females only

The target nutrient values in these standard recommendations encompass the needs for maintenance of adults, reproducing animals (gestation and lactation), as well as needs for growing animals. The sample diets included herein have supported all life stages. Goal weights for individuals should be established, and body weight checked frequently, so that diet adjustments can be made in a timely fashion to avoid over or under-condition.

Table 6: Target nutrient ranges for baseline species (dry matter basis)

Nutrient	More Carnivorous[1] Fossa, Meerkat, Dwarf Mongoose, Banded Mongoose
Protein (%)	19.7–32.5
Fat (%)	9.0–30
Linoleic Acid (%)	0.5–0.55
Vitamin A (IU/g)	2.44–10
Vitamin D (IU/g)	0.25–1.0
Vitamin E (mg/kg)	27–120
Thiamin (mg/kg)	1.0–5.6
Riboflavin (mg/kg)	1.6–4.25
Pantothenic acid (mg/kg)	5.0–8.0
Niacin (mg/kg)	9.6–60
Pyridoxine (mg/kg)	1.6–4.0
Folacin (mg/kg)	0.2–1.3
Biotin (mg/kg)	0.07–0.12
Vitamin B_{12} (mg/kg)	0.02–0.035
Calcium (%)	0.29–1.0[2a]
Phosphorus (%)	0.26–0.8[2a]
Potassium (%)	0.4–0.6
Sodium (%)	0.05–0.4
Magnesium (%)	0.03–0.08
Iron (mg/kg)	80–114
Zinc (mg/kg)	50–94
Copper (mg/kg)	5.0–8.8
Iodine (mg/kg)	0.35–2.2
Selenium (mg/kg)	0.1–0.4

[1] Cat NRC (2006), Legrand-Defretin & Munday (1993), Cat AAFCO (1994); Maslanka et al. (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] Authors of this chapter would caution feeding diets with 0.29% calcium and 0.26% phosphorus as the Cat NRC 2006 suggests.

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 is remaining 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, with animals consuming more or less energy, comparatively, based on their status in the dominance hierarchy.

Nutrition for alternate life stages/conditions: In general, diets should be formulated with the individual animal in mind, even for animals housed in groups. Diet adjustments should be based on condition of the animal in question, and can be applied for a variety of reasons — growth and development, gestation or lactation status, activity level, illness, and/or seasonal changes.

Age: Feeding should be observed to insure the subordinate animals receive the correct proportions of ingredients. Often increasing the number of feeding times per day, placing the food in several locations (particularly for meerkat and mongoose species), distracting some of the animals to allow others adequate access or visually separating animals are necessary in a group of animals.

Reproductive status: Total food quantity may need to be increased during pregnancy and lactation to maintain female body weight appropriately. Some weight loss may be appropriate (adipose mobilization to support lactation), but should be monitored regularly to ensure health of the female. In some cases calcium intake may also need to increase.

It is important to note that in dwarf mongoose, females typically produce multiple litters in succession so that they can be both pregnant and lactating at the same time. Producing up to four litters in 6 months, each averaging 22% of the female's body mass, has substantial energy requirements (Creel, 1996). As a result the female will likely need increased food quantity for successful reproduction and rearing of the young, particularly if the group size is small (C. McKnight, personal communication, 2010).

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.

There is a wide range of diets that may be available to Euplerids and Herpestids (sample diets listed in Table 7). As omnivores and carnivores, diets that contain a mix of food items and groups appear most appropriate, with emphasis on vertebrate and invertebrate portions of the diet for more carnivorous members (e.g., fossa, meerkat, banded and dwarf mongoose). Ideally, a palatable, nutritionally complete food (wet or dry) may be used as the base of the diet to which other items are added as appropriate based on feeding strategy. Water should be available at all times. The nutrient profiles of these diets are listed in Table 6.

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

Species	Common Name	Institution	Food Item[1]	grams/day	% in diet
Cryptoprocta ferox	Fossa	Institution A	Natural Balance Carnivore 5%[1]	350	77.04
			IAMS weight control cat dry	100	22.01
			Mouse	4.3	0.94
			Femur Bone	-	-
			Total	454.3	100
		Institution B	Nebraska Special Beef Feline	225	64.68
			Ground Meat – beef, horse, bison	55	15.81
			Rat	42.8	12.32
			Bone	25	7.19
			Total	347.8	100
		Institution C	Nebraska Premium Beef	291	74.81
			Ground Meat - beef	61	15.66
			Rat	37	9.53
			Total	389	100
Suricata suricatta	Meerkat	Institution C	IAMS adult cat food dry	32	57.14
			Natural Balance Carnivore 10%	10	17.86
			Fruit – used apple	3	5.36
			Starch – used sweet potato	3	5.36
			Veggies – used carrot	7	12.50
			Crickets	1	1.79
			Total	56	100
		Institution D	Royal Canine Vet Diet Low Fat	15	43.23
			Fruit/Vegetable – used apple/carrot	7	20.17
			Oat cereal – Cheerios	7	20.17
			Fuzzy (6 grams) (2x/wk)	1.7	4.90
			Avocado	3	8.65
			Insects – used crickets	1	2.88
			Total	34.7	100
		Institution E	PMI Exclusive chicken dry	8.1	7.69
			PMI Exclusive chicken light dry	8.1	7.69
			Fruit – used apple	16.1	15.33
			Carrot	8.1	7.69
			Yam	8.1	7.69
			Natural Balance Carnivore 10%	32.4	30.72
			Mice	13.7	13.00
			Egg, hard-boiled	10.7	10.16
			Total	105.3	100
		Institution F	Totally Ferret, ground	5	6.39
			Fruit/Vegetable	40	51.16
			Mealworms	11	14.07
			Mouse	4.7	6.03
			Egg, hard-boiled	14.3	18.27
			Ground Meat – beef	2.8	3.65
			Calcium carbonate	0.33	0.42
			Total	78.13	100
		Institution G	IAMS less active cat dry	20	29.23
			ZuPreem Feline canned	10	14.61
			Fruit – used apple	8	11.69
			Root vegetable – sweet potato	20	29.23
			Capelin	2.3	3.34
			Mouse	2.1	3.13
			Egg, hard-boiled	4.6	6.68
			Natural Balance Carnivore 10%	1.1	1.67
			Mouse, pinkie	0.28	0.42
			Total	68.38	100

Helogale parvula	Dwarf Mongoose	Institution F	Eukanuba cat maintenance dry-chkn	7	19.92
			Crickets	3.5	9.96
			Mealworms	3.5	9.96
			Yam	5.6	15.85
			Corn	3.7	10.57
			Peas	3.7	10.57
			Mice, pinkie	1	2.85
			Egg, hard-boiled	7.1	20.33
			Total	35.1	100
		Institution A	IAMS less active cat dry	12.1	37.17
			Fruit – used apple	7.6	23.34
			Root Vegetable – used sweet potato	10.0	30.72
			Natural Balance Carnivore 5%	1.4	4.39
			Cricket	1.2	3.69
			Mealworm	0.23	0.70
			Total	32.53	100
		Institution B	EVO Feline Diet dry	4	8.51
			ZuPreem Feline canned	15	31.91
			Reliable Protein Product Insectivore	15	31.91
			Carrots – ground	2	4.26
			Sweet Potato – ground	2	4.26
			Egg, hard-boiled	6.4	13.68
			Mouse, hopper	2.6	5.47
			Total	47.0	100
Mungos mungo	Banded Mongoose	Zoo H**	Mealworms	10	13.51
			Chick	32	43.24
			Natural Balance Carnivore 5%	16	21.62
			Mazuri Insectivore dry	7	9.46
			Produce	9	12.16
			Total	74	100

[1]Natural Balance Pet Foods, Inc. Pacoima, CA 91331; P&G Pet Care (IAMS), Cincinnati, OH 45220; Marion Zoological, Plymouth, MN 55441; Central Nebraska Packing, Inc. North Platte, NE 69103; Waltham Royal Canine USA, Inc., St. Charles, MO 63301; PMI Nutrition, Henderson, CO 80640; Performance Foods, INC., Broomfield, CO 80021; ZuPreem; Shawnee, KS 66214; EVO Pet Products, Santa Clara, CA 95052; Reliable Protein Products, Phoenix, AZ 85050; Mazuri PMI Nutrition International. Brentwood, MO 63144.

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

** Also feed one medium sized mouse per individual daily.

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

Institution	Institution A	Institution B	Institution C			
Nutrient	Fossa	Fossa	Fossa			More Carnivorous
Protein (%)	46.9	48.5	49.1			19.7–32.5
Fat (%)	16.5	39.1	40.8			9.0–30
Vitamin A (IU/g)	18.8	18.4	18.3			2.44–10
Vitamin D (IU/g)	2.3	0.68	0.85			0.25–1.0
Vitamin E (mg/kg)	304	294	329			27–120
Thiamin (mg/kg)	21.6	8.1	0.49[2]			1.0–5.6
Riboflavin (mg/kg)	22.6	1.2	0.85[2]			1.6–4.25
Pantothenic acid (mg/kg)	52.1	2.3	1.8			5.0–8.0
Niacin (mg/kg)	237	26.1	16.9			9.6–60
Pyridoxine (mg/kg)	19.8	2.0	2.3			1.6–4.0
Folacin (mg/kg)	1.5	0.05[2]	0.04[2]			0.2–1.3
Biotin (mg/kg)	1.4					0.07–0.12
Vitamin B_{12} (mg/kg)	0.24	0.07	0.10			0.02–0.035
Calcium (%)	1.6	1.44	1.49			0.29–1.0
Phosphorus (%)	1.1	1.03	0.85			0.26–0.8
Potassium (%)	0.73	0.77	0.79			0.4–0.6
Sodium (%)	0.52	0.43	0.26			0.05–0.4
Magnesium (%)	0.36	0.11	0.09			0.03–0.08
Iron (mg/kg)	166	100	434			80–114
Zinc (mg/kg)	168	85.6	109			50–94
Copper (mg/kg)	21.6	7.4[2]	9.7[2]			5.0–8.8
Iodine (mg/kg)	1.9					0.35–2.39
Selenium (mg/kg)	0.58	0.42	0.49			0.1–0.4

	Institution C	Institution D	Institution E	Institution F	Institution G	
Nutrient	Meerkat	Meerkat	Meerkat	Meerkat	Meerkat	More Carnivorous
Protein (%)	36.5	19.9	35.8	36.2	29.66	19.7–32.5
Fat (%)	23.7	9.0	21.6	21.9	15.89	9.0–30
Vitamin A (IU/g)	89.5	68.4	109	108.6	151	2.44–10
Vitamin D (IU/g)	2.3	0.98	0.65	1.17	1.86	0.25–1.0
Vitamin E (mg/kg)	149	162	374	109.1	124	27–120
Thiamin (mg/kg)	29.8	15.8	11.9	15.92	20.5	1.0–5.6
Riboflavin (mg/kg)	15.9	7.2	8.7	16.42	16.2	1.6–4.25
Pantothenic acid (mg/kg)	44.9	24.7	20.1	26.95	38.4	5.0–8.0
Niacin (mg/kg)	159	64.5	58.7	51.32	121	9.6–60
Pyridoxine (mg/kg)	22.1	11.6	7.9	12.06	15.7	1.6–4.0
Folacin (mg/kg)	5.8	6.99	9.3	2.03	2.5	0.2–1.3
Biotin (mg/kg)	0.91	1.9[2]	0.59	0.18	0.65	0.07–0.12
Vitamin B_{12} (mg/kg)	0.26		0.07	0.06	0.22	0.02–0.035
Calcium (%)	1.17	0.81	1.2	2.46	0.85	0.29–1.0
Phosphorus (%)	0.98	0.83	0.72	0.59	0.68	0.26–0.8
Potassium (%)	0.78	0.74	0.52	1.22	0.73	0.4–0.6
Sodium (%)	0.39	0.59	0.42	0.69	0.23	0.05–0.4
Magnesium (%)	0.12	0.10	0.15	0.34	0.08	0.03–0.08
Iron (mg/kg)	280	94.7	110	108.6	141	80–114
Zinc (mg/kg)	223	41.4	109	110.8	181	50–94
Copper (mg/kg)	29.5	3.7	11.1	10.48	15	5.0–8.8
Iodine (mg/kg)	2.3	0.31	0.85	0.56	1.8	0.35–2.2
Selenium (mg/kg)	0.57	0.15	0.20	0.4	0.38	0.1–0.4

	Institution F	Institution A	Institution B	
Nutrient	Dwf Mongoose	Dwf Mongoose	Dwf Mongoose	More Carnivorous
Protein (%)	34.4	26.8	40.6	19.7–32.5
Fat (%)	15.9	10.5	24.2	9.0–30
Vitamin A (IU/g)	15.2	142	58.9	2.44–10
Vitamin D (IU/g)	1.3	2.1	0.73	0.25–1.0
Vitamin E (mg/kg)	80.1	126	108	27–120
Thiamin (mg/kg)	14.8	21.4	9.45	1.0–5.6
Riboflavin (mg/kg)	11.8	15.0	10.02	1.6–4.25
Pantothenic acid (mg/kg)	28.4	35.9	20.3	5.0–8.0
Niacin (mg/kg)	82.9	127	59.0	9.6–60
Pyridoxine (mg/kg)	12.2	17.1	3.7	1.6–4.0
Folacin (mg/kg)	1.8	2.2	0.97	0.2–1.3
Biotin (mg/kg)	0.41	0.68	0.27	0.07–0.12
Vitamin B_{12} (mg/kg)	0.17	0.25	0.17	0.02–0.035
Calcium (%)	0.54	0.79	0.88	0.29–1.0
Phosphorus (%)	0.67	0.66	0.64	0.26–0.8
Potassium (%)	1.0	0.79	0.37	0.4–0.6
Sodium (%)	0.24	0.23	0.22	0.05–0.4
Magnesium (%)	0.10	0.10	0.04	0.03–0.08
Iron (mg/kg)	101	131	150	80–114
Zinc (mg/kg)	149	185	98.9	50–94
Copper (mg/kg)	14.4	16.4	8.9	5.0–8.8
Iodine (mg/kg)	1.2	1.88	1.4	0.35–2.2
Selenium (mg/kg)	0.49	0.43	0.36	0.1–0.4

	Zoo H	
Nutrient	Banded Mongoose	More Carnivorous
Protein (%)	48.9	19.7–32.5
Fat (%)	20.1	9.0–30
Vitamin A (IU/g)	7.6	2.44–10
Vitamin D (IU/g)	1.4	0.25–1.0
Vitamin E (mg/kg)	182	27–120
Thiamin (mg/kg)	33.1	1.0–5.6
Riboflavin (mg/kg)	12.1	1.6–4.25
Pantothenic acid (mg/kg)	20.2	5.0–8.0
Niacin (mg/kg)	93.7	9.6–60
Pyridoxine (mg/kg)	8.8	1.6–4.0
Folacin (mg/kg)	1.3	0.2–1.3
Biotin (mg/kg)	0.51	0.07–0.12
Vitamin B_{12} (mg/kg)	0.1	0.02–0.035
Calcium (%)	1.2	0.29–1.0
Phosphorus (%)	1.0	0.26–0.8
Potassium (%)	0.36	0.4–0.6
Sodium (%)	0.24	0.05–0.4
Magnesium (%)	0.19	0.03–0.08
Iron (mg/kg)	171	80–114
Zinc (mg/kg)	111	50–94
Copper (mg/kg)	15.5	5.0–8.8
Iodine (mg/kg)	0.93	0.35–2.2
Selenium (mg/kg)	0.18	0.1–0.4

[1]Target nutrient levels listed in Table 7.
[2] Missing values in database so nutrients most likely meet targets.

General Food and Water Recommendations: Water and feeding stations should be located off the ground, in the branches or trees, for arboreal species. Water can be provided in a bowl or water bottles. All individuals should be observed to ensure that they know how to use the water bottle. Food can be

offered in a non-tippable container, placed to minimize the impact of dominance hierarchies, if group-fed. Enrichment items may be scattered to encourage foraging.

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. Some species benefit from more frequent feedings with the added bonus that this also can raise the activity level in an exhibit (meerkat exception below), and a minimum of two feedings is recommended (AZA Small Carnivore TAG). An effective method is to provide the primary diet in one or two feedings and scheduled enrichment feedings that can be scattered to encourage foraging/hunting during public hours. All food enrichment should be included when energy intake for the total diet is determined. All feeding times should be variable to minimize anticipatory behavior and stereotypies developed at feeding/enrichment times.

The provision of species appropriate enrichment items, including food, is advisable. Food items used as enrichment should be included as part of the diet, varied in terms of content when they are offered, and presented in such a way as to encourage species-typical foraging activities (e.g., on the ground, in the trees, hidden in holes, etc.). Live insects, fruit pieces, kibble, and frozen mice are just some of the food items that have been used. Consider that food-based enrichment should revolve around novel ways to present the base diet, not necessarily increasing the variety of the diet as it exists.

In general, it is recommended to offer the diet in several feedings over the course of the day (see below for meerkat exception). 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; this includes any enrichment feedings (AZA Small Carnivore TAG recommendation). Food should be offered in containers that are cleaned and sanitized after each use. Remnants of food scattered/hidden as enrichment should be removed.

Banded mongoose: Zoo H gives banded mongoose 9 grams of 3/4 inch crickets each or 9 grams of waxworms each. Each mongoose also gets 1 medium mouse in addition to the items listed previously. Banded mongoose are an omnivorous species. Food is always scattered around to help with aggression and the insect part of their diet is offered in puzzle feeders which keeps them entertained for hours.

Fossa: Fossas are strictly carnivorous and can be fed a variety of different food items approximating 0.5–1.0 kg (1.1–2.2 lbs) per animal per day (Winkler, 2002). Fossas have generally been fed once a day, but this amount can be divided into several, smaller feedings throughout the day and hidden/scattered in the exhibit to encourage foraging/hunting behavior; larger items such as rodents can be hung from branches etc. (Winkler, 2002).

In situ fossas will not eat carrion (L. Dollar, personal communication, 2005), so wild caught animals may be resistant to consuming dead food. In these cases, they will initially have to be fed live prey until they make the transition. However, in general, fossas should be fed a variety of whole carcass foods whenever possible; these can include: mice, rats, day-old chicks, chicken, and meat with bone (Winkler, 2002).

Meerkat: In stable groups, at least one feeding station should be provided for every three individuals. In non-stable groups, or groups in which food aggression has been observed there should be at least one feeding station for each individual in the group with feeding stations distributed in such a way that no one individual can monopolize more than one feeding station. Scattering diet items and/or multiple feeding stations are the most effective ways to feed a large group of meerkats. When offering enrichment items, there should be at least one item for each individual to prevent aggression, and items should be spread out as much as possible.

The primary part of the diet should be fed in the morning, allowing animals to eat throughout the day. Whole prey items (e.g., mice, ribs) and live bugs (mealworms and crickets) can be fed in the afternoon/early evening or at scattered enrichment times. Care should be taken when feeding whole prey that each individual receives an item, thereby minimizing opportunities for aggression (K. Kimble, personal communication, 2004 & 2005).

Initial introduction of food can stimulate aggression amongst meerkats; therefore, it is recommended that they be offered the majority of their diet once daily, in the morning. If a schedule of multiple, small feedings is adopted the provision of less food more often may stimulate unnecessary aggression leading to social unrest (K. Kimble, personal communication, 2004 & 2005).

Generally, meerkats will not finish all of their diet at one feeding, instead visiting feeding stations throughout the day. Dominant animals tend not to guard food locations for long periods of time, thus allowing subordinate individuals an opportunity to eat once more dominant individuals are satiated and tire of protecting feeding stations. Whole prey and insects may be fed later in the day to promote activity and foraging behavior. Again, when providing enrichment items it is important that enough individual items are offered to allow foraging participation by the entire group (K. Kimble, personal communication, 2004 & 2005).

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 should be processed following all USDA standards. The appropriate hazard analysis and critical control points (HACCP) food safety protocols for the diet ingredients, diet preparation, and diet administration should be established for the taxa or species specified. Diet preparation staff should remain current on food recalls, updates, and regulations per USDA/FDA. Remove food within a maximum of 24 hours of being offered unless state or federal regulations specify otherwise and dispose of per USDA guidelines.

AZA Accreditation Standard

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

AZA Accreditation Standard

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

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 mongoose and fossa. 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.

5.3 Nutritional Evaluations

An animal's weight should be monitored regularly, and the diet adjusted to maintain the individual at its optimum overall or seasonal weight. An individual's size should be taken into consideration when formulating a diet rather than using generic male/female body weights. Some individuals tend toward obesity, and season and activity patterns can influence consumption and subsequent body condition. For these reasons, "goal weights" should be established for individuals (in general or on a seasonal basis), and body weights checked frequently, so that diet adjustments can be made in a timely fashion to avoid over- or under-conditioning.

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.

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.

Dr. Anneke Moresco, U.C. Davis, is the AZA SCTAG Veterinary Advisor (Anneke_Moresco@hotmail.com; 530-754-2259). The following include veterinary resources recommended by the AZA SCTAG Veterinary Advisor (this should not be considered an exhaustive list):

- International Zoo Vet Forum (requires AAZV membership)
- AAZV listserv (requires AAZV membership)
- For contraception questions and issues (http://www.stlzoo.org/animals/scienceresearch/contraceptioncenter/)
- 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. Available from http://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 ed.) by James W. Carpenter. Available from www.amazon.com/Exotic-Animal- ormulary-James-arpenter/dp/0721601804/ref=sr_1_1?ie=UTF8&s=ooks&qid= 248110295&sr=8-1)
    - *Plumb's Veterinary Drug Handbook: Desk Edition* by Donald C. Plumb. Available from http://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. Available from http://www.amazon.com/Hand-Rearing-Wild-Domestic-Mammals-Laurie/dp/0813826837/ref=sr_1_1?ie=UTF8&s=books&qid=1248110366&sr=8-1w

There are no training programs that specialize in Herpestids and Euplerids. However, the residencies listed on the American College of Zoo Medicine website (http://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.

Animal recordkeeping is an important element of animal care and ensures that information about individual animals 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 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 of our managed 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.), or future AZA endorsed substitutes (ZIMS), as a universal medical record program. Many institutions already use MedARKS, making it easy to transfer information between them. The medical record should include the following information:

- Medical history
- Identification (current ARKS record, transponder numbers, tattoos, etc.)
- Clinical notes (including exam findings, diagnoses, vaccination history, etc.)
- Parasitology
- Anesthesia
- Clinical pathology
- Treatments (current medications, recent treatments, etc.)
- Pathology
- Reproductive status (contracepted, cycle details or abnormalities, etc.)
- Nutritional information (nutritional deficiencies, supplements, allergies, etc.)
- Behavioral/social group notes (social traumas, aggression, training for medical procedures, etc.)
- Any pertinent group history should be included as well, especially if there is a history of infectious disease within the group or exhibit.
- 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.

Keeper vigilance and familiarity with these species is paramount; as with most small mammals herpestids can swiftly become severely ill requiring immediate intervention. Following are some general recommendations that can be used as guidelines for a basic healthcare protocol. However, each situation is unique and the health care protocol should take into account the relative risk of each animal. The veterinary staff should design the preventive health protocol that is ultimately implemented. The design should take into consideration the weather, location, species involved, and institutional management policies.

6.2 Identification Methods

Ensuring that mongooses and fossas 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).

The AZA SCTAG recommends all animals be identified as soon as possible after birth with a transponder chip placed subcutaneously in the intrascapular area or neck. This location should be recorded in the medical record. If it is not possible to identify an animal with a transponder chip, it should be tattooed on the inside of its thigh with the studbook number or institutional identifier. However, a transponder chip should be implanted when it becomes possible.

AZA member institutions must inventory their mongoose and fossa population at least annually and document all mongoose and fossa 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).

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.

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.

6.3 Transfer Examination and Diagnostic Testing Recommendations

The transfer of animals between AZA-accredited institutions or certified related facilities due to AZA Animal Program 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.

Pre-shipment examination recommendations: All animals should receive a thorough pre-shipment physical examination as in Chapter 6.5. Also, check with the state requirements of the receiving institution as these vary by state. For more detailed information contact the appropriate state veterinarian. 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.

See Chapters 6.4 and 6.5 for testing recommended during quarantine; timing and/or repetition of these procedures should be coordinated between the shipping and receiving institutions.

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 animals (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 animals (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

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.

avoid aerosol and drainage contamination. If the receiving institution lacks appropriate facilities for quarantine, pre-shipment quarantine at an AZA or American Association for Laboratory Animal Science (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

(2.7.2) 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 animals, 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 of 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 -70ºC (-94ºF) freezer or a frost-free -20ºC (-4ºF) 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 animals 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 minimum of two weeks apart. Medical records for each animal should be accurately maintained and easily available during the quarantine period.

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.

The importance of a preventive medical program for zoo animals cannot be emphasized enough. Animals entering a collection should 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 necessitate barriers against ingress of potential vectors and vermin. Animals in quarantine should be cared for by separate keepers who are skilled at recognizing signs of stress and disease and who will carefully monitor feed intake and fecal characteristics. Quarantined animals call for specialized care during acclimation to new surroundings and diets (Aiello & Mays, 1997).

During quarantine, animals should receive species appropriate vaccinations and diagnostic testing (see Chapter 6.5 for recommended vaccination and testing schedule). A physical exam should be performed and include tests for the following; any appropriate treatment measures should be completed before release from quarantine. All procedures and results should be recorded and become part of the animal's medical record.

- Ectoparasites
- Endoparasites (fecal samples including direct examination, floatation, and sedimentation techniques)
- Hematology (Complete Blood Count)
- Serum biochemistry – samples should be frozen/banked for future research use
- Radiographs
- Diagnostic testing as required by the facility
- Titer testing and vaccinations (if required)

Mongoose: The social mongoose/meerkat species may suffer from apathy and emaciation if isolated for prolonged periods. Established groups of many species, particularly meerkats, do not tolerate new individuals and their introduction to an established group often results in the stranger being injured. Animals should not be quarantined alone for extended periods.

If a mongoose or fossa should die in quarantine, a necropsy should be performed on all it 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.

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.

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 animals (http://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.

Routine physical examinations: It is recommended that all animals have regular, routine physical examinations. Young, healthy animals can be examined biennially, while clinically healthy but geriatric animals or those with shorter lifespan may be examined more frequently, at the discretion of the attending veterinarian. Additionally, the attending veterinarian should evaluate any animal that has clinical signs of disease and if indicated, the animal should be anesthetized to obtain diagnostic samples and physiologic parameters. It is ideal to train animals to willingly cooperate as far as possible with medical procedures (e.g., blood draws, vaccinations) as this allows for closer monitoring of an animal's health without resorting to anesthesia. During the physical examination the following procedures and tests are recommended:

- Transponders and/or tattoos should be checked and reapplied if they are not readable. Location and type of chip should be recorded in the animal's record; location of any tattoos also should be recorded.
- Baseline physiological parameters, such as weight and body condition scoring, body temperature, heart rate and respiratory rate, and hydration status should be obtained and recorded.
- Oral examination: any problems should be documented and addressed if possible.
- Dental cleaning and polishing should be completed if necessary.
- Ear examination: appropriate diagnostics should be completed if there is any indication of problems. Cleaning and treatment should be performed if necessary.
- Chest and abdominal auscultation and palpation.
- Assessment of genitalia: 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 also should be checked to make sure they are in place and not causing any local irritation.
- Skin, feet, and nails checked.
- Anesthesia monitoring sheet completed.
- Radiographs should be taken and compared to previous ones if possible.

- Hematology and serum biochemistry profile should be performed. For animals that are housed outside in heartworm endemic areas, this can include monitoring for heartworm infection by performing a heartworm ELISA antigen test (will not detect all male infections nor infections with less than three female nematodes). If infection is suspected, *positively* identify the microfilaria as pathogenic before instituting treatment. Treatment is not benign, and mortality has been associated with melarsomine dihydrochloride administration to North American river otters and a red panda (Neiffer et al., 2002).
- Serum should be banked whenever possible.
- 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).
- Regular fecal examinations should be performed to check for internal parasites. The frequency may vary depending on environmental conditions and personnel but should be performed at least annually. Anthelmintics should be administered as necessary. Fecal testing should include both a direct smear examination as well as a fecal flotation, and if possible, sedimentation techniques. Baermann fecal examination techniques help identify certain parasites such as lungworms that are otherwise difficult to detect.
- Vaccines should be administered as needed (see Vaccinations below).
- Reports of disease issues, adverse drug reactions, etc. should be reported to the veterinary advisor or TAG on an annual basis, in addition to submission of necropsy reports.

The threat of zoonotic disease is not greater with these species than any other wildlife. Institutional policies regarding safeguarding against the spread of disease from animal to staff always should be followed and posted for staff.

Vaccinations: There is very little information on herpestids or euplerids, therefore information on other small carnivore species is included here as background for the veterinary staff to weigh efficacy and safety as much as possible in making decisions regarding the preventive medicine protocol that best fits the individual institution.

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 in their area. Vaccination schedules should be viewed in light of the real risk of animals contracting these diseases, keeping in mind that overly aggressive vaccination schedules may not be innocuous. Titers are useful if the assay that measures them has been validated for the species in question. However, in many (most) zoo species it is not known for certain what constitutes a protective titer. In order to address this question it is recommended that, if possible, institutions gather titer information for future evaluation and research.

Rabies: Rabies vaccination is recommended for all carnivores. The most commonly used is ImRab3® (Merial™). A new canarypox vaccine also is available and has been used without adverse effects in binturongs (A. Moresco, personal experience) but there is no information on its efficacy in herpestids.

Canine distemper: Mustelids, procyonids, and viverrids have been reported to be susceptible to canine distemper (reviewed in Deem et al., 2000) and herpestids have been suspected of contracting the disease (Coke et al., 2005). Modified live vaccines should *not* be used, as this has caused fatal vaccine-induced disease in black-footed ferrets (Carpenter et al., 1976; Pearson, 1977). The USDA-approved Fervac-D® (United Vaccines, Inc., Madison, Wisconsin 53744, USA), has induced disease in red pandas and anaphylaxis in some mustelids (notably ferrets) and viverrids (R. Montali, unpublished data), as well as post-vaccinal encephalitis in ferrets (Denver, 2003). It should not be used in these species nor, perhaps, in other exotic carnivores. The use of multivalent vaccines containing CDV, such as Galaxy-6-MPH-L® (Solvay), is discouraged, due to the risk of immunosuppression and clinical disease caused by other MLV components.

Data on maternal antibody interference with vaccination of raccoons and ferrets suggest that a final CDV vaccine should be administered at 18 to 20 weeks of age in raccoons, and after 10 weeks of age in ferrets (reviewed in Deen et al., 2000). Vaccination schedules may require modification during CD epidemics or periods of increased risk of exposure. Yearly vaccine boosters are recommended in species for which data on post-vaccination antibody persistence are lacking (most herpestids). For vaccination against canine distemper, it is recommended to use the canarypox vectored CDV vaccine (PUREVAX®

Ferret Distemper Vaccine, Merial Inc., Athens, Georgia 30601, USA) at a dose of 1 ml (IM) (Coke et al., 2005).

Feline panleukopenia: This disease is reported in procyonids and mustelids. Canine parvovirus (CPV), mink enteritis virus (MEV), and feline panleukopenia virus (FPLV) are very similar, and it has been reported that in mink vaccination against CPV protects against MEV (Langeveld, 1995). No reports were found of these diseases in herpestids.

Canine leptospirosis: In some areas where canine leptospirosis and canine hepatitis are a problem, vaccination may be considered (Carnio, 1996a). Leptospirosis has been reported in mongoose (Shotts, 1981). If canine leptospirosis vaccination is deemed necessary, vaccinate annually with multivalent Bacterin (Joslin et al. 1998).

Castro & Heuschele (1992) offer the following vaccination protocol for the *Herpestidae* (Table 9). The attending veterinarian should decide if all are needed based on the risk of exposure of the animals in their care.

Table 9: Recommended vaccine schedule for herpestids

Vaccine	Vaccine type	Frequency
Rabies	Imrab3/ Canary pox vectored	Annual
Canine distemper	Canary pox vectored	Annual
Feline panleukopenia	Killed/modified live	Annual
Canine adenovirus – 2	Killed/modified live	Annual
Leptospira Bacterin-CI	Killed/modified live	Annual

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 should also be screened for parasites before shipment and during quarantine. Fecal testing should include both a direct smear examination as well as a fecal flotation, and if possible, sedimentation techniques. Baermann fecal examination techniques help identify certain parasites such as lungworms that are otherwise difficult to detect. Heartworm antigen ELISA tests should be conducted in animals exposed to mosquitoes in heartworm endemic areas and animals housed out of doors should be routinely administered heartworm preventative in areas where this parasite is endemic (Denver, 2003). External parasites such as ear mites, fleas, ticks, etc., can be detected during a physical examination (Petrini, 1998). Small carnivores are susceptible to the same parasites as the domestic carnivores and, in general, treatment for these parasites is similar.

Internal parasites: Annual/semi-annual fecal examinations (direct smear, fecal flotation, and sedimentation or Baermann) should be performed. Pre-shipment fecal examinations should include a direct smear and flotation test. Quarantine fecal examination should entail three negative results, each separated by one week using direct smears and fecal flotation. De-worming should be done as determined by the results of regular fecal exams. As a screening test, samples from the same enclosure can be pooled. If results are positive, separate fecal examinations on each animal should be performed. However, it is likely that all animals in the enclosure will need to be treated.

Heartworm ELISA antigen tests can be conducted annually in animals exposed to mosquitoes in heartworm endemic areas. Heartworm has been reported in otters (Snyder, 1989a; Neiffer et al., 2002; Kiku et al., 2003), ferrets (Sasai et al., 2000), and raccoons (Snyder, 1989b), but has not been reported in viverrids or herpestids. Treatment of internal parasites can utilize Ivermectin (both oral and injectable solutions), Strongid, and Panacur®, and these have all been used in binturong without adverse reactions. Since herpestids are more closely related to cats than dogs (Wyss & Flynn, 1993), they also may have impaired metabolism of some drugs. Therefore, if no species-specific doses are available, it is recommended to use cat doses when extrapolating doses from domestic animals. Always monitor for signs of toxicity when using a new drug.

External parasites: Animals should be inspected for external parasites, including ear mites, during any physical examination (Petrini, 1998).

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 are caring for both quarantined and resident animals of the same class, 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.

AZA Accreditation Standard

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

Animals 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.

6.6 Capture, Restraint, and Immobilization

The need for capturing, restraining and/or immobilizing an animal 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.

Experienced keepers should be used to net these species for non-routine procedures (M. Dulaney, personal communication, 2003), or the animals should be habituated (using operant conditioning) to being locked in portable nest boxes equipped with injection portals or in squeeze cages.

Banded mongoose: Zoo H (see photo at right) uses catch-boxes that fit well into kennel crates for transport. A hole in the side of the door of the catch-box is used to insert the isoflurane hose end at the vet hospital with a garbage bag taped around the catch-box for anesthesia.

Fossa: Fossas should be immobilized via injection. This can be done with a dart or pole syringe within a crate. Ideally husbandry training should work up to giving a voluntary injection through operant conditioning. If necessary, a fossa can be netted from within the enclosure and injected through the net, but care should be taken when working with fossas without protected contact. It is not recommended to hand-grab fossa as they are extremely difficult to restrain.

Meerkats: Hand restraint can sometimes be less alarming to this species than netting, especially for procedures that do not require anesthesia (e.g., nail trims). Hand restraint of a meerkat placed inside a crate is relatively easy; the crate should be set on end with the restrainer grabbing the animal from above (Ginman, 2001; K. Kimble, personal communication, 2004 & 2005).

Meerkats can be hand restrained using bite gloves but be aware that meerkats have extremely long, sharp teeth that can puncture though gloves. If hand restraint is the chosen method, do so by grabbing the animal around the back of the neck and using the thumb and middle or ring finger placed on either side of the lower jaw lifting the head backward slightly. The restrainer's other hand should be placed under the animal's body to support its weight or, the restrainer's arm should be placed around the middle of the body and used to pin the animal against their body. The method chosen depends on the activity

level of the animal while being restrained (Ginman, 2001; K. Kimble, personal communication, 2004 & 2005).

Anesthesia can be induced in meerkats who are hand restrained with inhalant anesthesia (isoflurane) administered by facemask or by placing the animal in an induction chamber, as opposed to injectable anesthesia, which has a longer recovery period. Recovery from inhalant anesthesia is not dependent on extensive metabolism of the anesthetic (Steffey, 1996). A quick recovery can be extremely important in the success of re-introducing an individual meerkat back into its group (K. Kimble, personal communication, 2004 & 2005).

Small hoop nets can also be used for meerkats. Hoop nets are the best method if the animal has escaped from the exhibit. For animals contained within the holding yard, hoop nets are unnecessary, but if used, the procedure for capture is the same as for other species. Once the meerkat is within the net, it can be restrained by grasping the head, and treatments can be administered through the net. Nets can be of use when an animal is contained within a PVC tube. The tube can be inverted and the meerkat gently shaken into a net (Ginman, 2001).

For internal transport, individual meerkats, once captured, can be transferred into a crate/kennel. Alternatively, prior to transport, the meerkats can be conditioned to enter a kennel for mealworms. Conditioning may only take a few days and the kennel should remain inside the holding yard and be open at all times to desensitize the meerkats to it (Ginman, 2001). Meerkats that are transported within the institution should be double crated to provide USFWS double containment, and the final location also should be covered by the USFWS Injurious Wildlife permit.

Meerkat young should be handled for sexing, weighing, microchip implants, and vaccinations at 8, 12 and 16 weeks. Before 3 weeks of age, the young can be handled by separating the adults and removing the young from the nest box for weighing or sexing. Caution is advised, as some institutions report rejection of kitten after being handled when less that 6 weeks of age (C. Brown, personal communication, 2006). After 3 weeks of age, the young will spend increasing amounts of time shadowing the adults and so separation of adults from young at this time will be difficult. From 8 weeks of age onwards, young meerkats should be restrained in the same way as the adults. Thick leather gloves should be used while retrieving the young from the nest box if adults are also present as the adult may attempt to bite. Due to the small size of meerkats at 8 and 12 weeks of age, the thick leather gloves can be removed once the young animal has been removed from the nest box. Care should always be taken, as young meerkats still have a strong bite (Ginman, 2001).

Table 10: Anesthetic combinations and dosages used for Herpestids (from: Denver 2003)

Drug	Dosage
Ketamine	Not recommended alone
Ketamine + diazepam	10mg/kg + 0.5mg/kg
Ketamine + midazolam	10mg/kg + 0.25-0.5mg/kg
Ketamine + xylazine	10mg/kg + 1-2mg/kg
Ketamine + medetomidine	2.5-5mg/kg + 25-50µg/kg
Tiletamine/zolazepan	3-5mg/kg
Isoflurane[1]	-

[1] Isoflurane chamber induction can be used; it also should be used as a supplement, or for maintenance, during long procedures.

Combinations that include opioids may result in some respiratory depression. Ketamine/midazolam and ketamine/medetomidine are less likely to have respiratory depressant effects. Opioids, alpha$_2$ agonists, and benzodiazepines have the advantage of being reversible. Combinations that include ketamine and medetomidine have been shown to produce hypertension in other carnivores (Larsen et al., 2002). When using anesthetic combinations that include ketamine, the reversible components should not be reversed before 35 – 40 minutes post ketamine administration to minimize the effects of straight ketamine.

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.

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

AZA-accredited institutions should have an extensive veterinary program that manages animal diseases, disorders, or injuries and has the ability to isolate these animals in a hospital setting for treatment if necessary. Mongoose and fossa keepers 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 if their health becomes compromised (AZA Accreditation Standard 2.4.2). Protocols should be established for reporting these observations to the veterinary department. Mongoose and fossa 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

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

AZA Accreditation Standard

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

AZA-accredited institutions must have a clear process for identifying and addressing mongoose and fossa 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-accredited zoos and aquariums provide superior daily care and husbandry routines, high quality diets, and regular veterinary care, to support mongoose and fossa longevity; In the occurrence of death however, information obtained from necropsies is added to a database of information that assists researchers and veterinarians in zoos and aquariums to enhance the lives of the mongoose or fossa both in their care and in the wild. As stated in Chapter 6.4, necropsies should be conducted on the deceased mongoose or fossa to determine their cause of death, and the subsequent disposal of the body must be done in accordance with 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 from the body organs should be submitted for histopathological examination. The AZA and American Association of Zoo Veterinarians (AAZV) website should be checked for any AZA mongoose or fossa SSP Program approved active research requests that could be filled from a necropsy.

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.

After it has been decided by authorized staff that euthanasia is indicated, these species can be anesthetized (see Chapter 6.6 Capture, Restraint, and Immobilization). 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. The 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: http://www.avma.org/issues/animal_welfare/euthanasia.pdf.

Useful Veterinary Resource:

Alexander, K.A., Pleydell, E., Williams, M.C., Lane, E.P., Nyange, J.F.C. & Michel, A.L. (2002). Mycobacterium tuberculosis: An emerging disease of free-ranging wildlife. *Emerging Infectious Diseases, 8*(6), 598–601.

"Expansion of ecotourism-based industries, changes in land-use practices, and escalating competition for resources have increased contact between free-ranging wildlife and humans. Although human presence in wildlife areas may provide an important economic benefit through ecotourism, exposure to human pathogens may represent a health risk for wildlife. This report is the first to document introduction of a primary human pathogen into free-ranging wildlife. We describe outbreaks of Mycobacterium tuberculosis, a human pathogen, in free-ranging banded mongooses (Mungos mungo) in Botswana and suricates (Suricata suricatta) in South Africa. Wildlife managers and scientists must address the potential threat that humans pose to the health of free-ranging wildlife."

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.

Banded mongoose: This highly gregarious species forms the largest packs of all mongooses. These may include 35 or more adult and subadult animals and typically includes three to four breeding females and, "…perhaps as many males" (Estes, 1991). Reproduction is synchronized within but not between packs. Typically, several females come into estrus at once, usually within 1 week after littering, and mate with several different males. During courtship, males secrete copious amounts of fluid from enlarged anal glands. Between mounting attempts, this secretion is used to mark the female while circling, nuzzling, and pushing with his head. Females also mark the males courting them (Estes, 1991).

The banded mongoose dens mainly in old termite mounds (within thickets or in the open), but also in such places as erosion gullies, abandoned aardvark holes, and hollow logs. Most dens are used only for a few days, but some favorite sites may be occupied for as long as 2 months. Groups may produce as many as four litters per year but it is unknown if any given female produces that many litters in a year (C. Bickel, personal communication, 2010; Estes, 1991).

Kits are kept together and raised commonly by the group; they will suckle indiscriminately from any lactating female and are usually guarded by one or two adult males while the rest of the group forages. Kits will begin to travel with the others at about one month. Females attain sexual maturity at 9 to10 months (C. Bickel, personal communication, 2010).

Often, females remain in their natal pack, but males typically emigrate and join or attempt to take over other packs (Estes, 1991); some studies have shown no immigration for a period of three years (Estes, 1991).

Dwarf mongoose: *In situ* populations of dwarf mongooses live in highly related packs in which the oldest male and female dominate reproduction, while subordinate reproduction is suppressed; subordinates assist in the care of the dominant animals' offspring. *In situ* breeding is associated with seasonal rains. There is evidence to suggest that dwarf mongooses may be induced ovulators (Creel et al., 1992). Females come into estrus in synchrony (Rood, 1990) with most individuals of both sexes mating during a period lasting 1 to 7 days. The alpha female can produce two to four litters during the rainy season (Oct–May), with a mean litter size of 2.9 (1–6) young. Estrus can occur 1 to 4 weeks postpartum such that a female may be pregnant and nursing at the same time.

In situ, dwarf mongooses are obligate cooperative breeders and cannot raise young in unaided pairs, likely due to the energetic requirements for the alpha female (Creel, 1996). Subordinates, both related and unrelated to the dominant pair, contribute significantly to the care of the young, performing most of the parental care including protecting, feeding, grooming and carrying young between dens. When present, both pregnant and pseudopregnant subordinates nurse the dominant female's young. Because these pseudopregnancies are synchronized with the dominant's pregnancy, the subordinates are hormonally conditioned to lactate. Spontaneous lactation can also occur in non-pregnant females; in cases where this has occurred, the females were more closely related to the dominant (Creel, 1996).

Subordinates of both sexes do mate. High-ranking mongooses tend to mate with other high-ranking mongooses, with the dominant pair accounting for most reproductive behavior. Female reproductive suppression occurs through rank-dependent dominance effects on ovarian function and reproductive behavior resulting in a failure to establish pregnancy rather than failure to maintain it. For males the primary mechanism for suppression is behavioral. Suppression is not absolute. One study suggests that subordinate males account for 24% of pack offspring, while subordinate females account for 15%. Although the alpha male guards the alpha female during mating, opportunistic breeding by subordinates can occur leading to multiple paternity within a single litter (Keane et al., 1994). Reproductive suppression in females diminishes with the age of the subordinate and limited subordinate reproduction is tolerated by the alpha female, likely as incentive against emigration (Creel, 1996).

Table 11: Selected Herpestidae/Eupleridae Reproduction/Development Parameters (From: Hayssen et al. 1993*; Denver, 2003; Estes, 1991+; C. Bickel, personal communication, 2010 **; Reed-Smith et al. 2003; L. Dollar, personal communication, 2005; Budovsky et al., 2009, Zoo H°)

Parameter	**Dwarf Mongoose** *(Helogale parvula)*	**Meerkat** *(Suricata suricatta)*	**Banded Mongoose** *(Mungos mungo)*	**Fossa** *(Cryptoprocta ferox)*	**Cusimanse** *(Crossarchus obscurus)*
Breeding season	Associated with seasonal rains (Nov-May); births occur year-round in zoos but most Apr-Oct	October–April; doesn't seem to be synchronized Year-around in zoos and aquariums	Most births occur during the rains. Oct–January*; year-round in some parts of range**	Sept–Nov (wild) March–May in the northern hemisphere	Year-around
Estrous frequency	Polyestrous, 1–4 litters in succession, conceiving 1–2 weeks postpartum	At least some females have two estrus per year and a postpartum estrus	1 litter/year* Several litters per year**	Annually until bred, every other year when successful breeding is ongoing (L.Dollar)	Polyestrous. Can have several litters per year.
Estrus duration	1–7 days; labia swells	-	~6 days	Up to 2 weeks, generally breed with first signs in zoos and aquariums (L.Dollar)	-
Courtship	Males sniff, lick, mark more often; testes enlarge	At times, semi-serious fighting, face-nipping	Chasing & play mark early courtship+	Both mew and growl	-
Copulation	Lasts about 5–11 minutes	Male clasps female around the middle	Lasts about 10 minutes; male claps female's waist touching nape with open mouth+	Lasts ¼ to 1 ½ days or more; breeding locks broken *ex situ* (unnecessarily) after 18 hours (L. Dollar)	While standing
Gestation (days)	49–56 days	~77 days	~60 days	90 days reported (L.Dollar, AnAge 2009) others report 52 – 60 days (Institution B, 2004 International Fossa Studbook)	58–70 days
No. of offspring	1–7, mean 3	1–6, mean 4	2–6, mean2.5	2–6, usually 2–3	2–4, usually 4
Birth weight	-	25–36g	20–22g+	60–100g; ave. 100g (AnAge 2009)	-
Eyes open	~2 weeks	10–14 days	~ 9 days*	12–15 days	12 days
First solid food	7–10 days	21–30 days		~ 3 months	3 weeks
Weaned	~45 days	7–9 weeks		~6–12 months, ~4.3 months (AnAge 2009)	-
Sexual maturity[1]	107 days[1]	9–12 months; 6 months in zoos and aquariums	~11 months for females+; 9–10 mos.*,** Males at 4 months°	3–4 years; ave. 4.1 years (AnAge 2009)	9 months

[1] Animals can breed, but are often unsuccessful until older

Fossa: Fossas are seasonal breeders; the beginning of the season is marked by swelling of the male's testes and of the female's vulva. Estrus typically lasts 14 days; extended copulatory bouts may occur throughout this period, within the first few days (generally the case in zoos and aquariums), or only during the last 4 to 6 days. Both the male and the female will regularly mark prominent objects in their enclosures by rubbing their bodies across them. Additionally, both male and female will mew regularly during the daytime hours, become more restless, and frequently exhibit a decrease in appetite (Winkler, 2002).

Breeding typically occurs off the ground, on a variety of substrates. Several secure arboreal options, which can be successfully gripped with claws, should be provided as possible copulatory sites. Tree trunks and sturdy limbs such as those found on Tamarind or white oaks are good choices.

By the end of the estrus period the female will become increasingly intolerant of the male and may begin to exhibit some aggression towards him. At this point the male should be removed, as he does not participate in the care of the young (Winkler, 2002).

If fossas are kept singly, it is advisable to pair the two animals in the exhibit of the female. The female is familiar with her own exhibit, and thus less likely to suffer from stress once the male is introduced. The male should be allowed into the outdoor exhibit of the female at the beginning of the breeding season for a few hours each day to get to know this exhibit. The female should be shut away during that time. The male usually marks the exhibit by rubbing his body along branches and by urinating against prominent posts. Once the male appears familiar with the outdoor exhibit of the female, both sexes can be allowed together within the exhibit. This approach has proven to sexually stimulate both the male and the female (Winkler, 2002).

The male commonly chases the female vigorously at first while she tries to get away; soon the male will catch the female and grasp her from behind. Typically both animals will continue to try and bite each other until they gradually settle down into the mating posture; minor injuries are common during breeding. Copulation can take 15 minutes to 1½ hours, but they may remain in the mating posture for up to three hours (Winkler, 2002).

Hawkins & Racey (2009) observed that males competed for mating opportunities at a traditional site monopolized by a female, high in a tree. The female mated with multiple males, repeatedly mated with some individuals and appeared to express mate choice. We observed three females thus, one replacing another on the site after each was seen to mate with four to five males over a period of 1–6 days. Copulations were prolonged (up to 3 hr 8 min), involving a weak copulatory tie, and males appeared to guard females briefly after mating.

Meerkat: Meerkats, another social species, live in colonies made up of two to three families; each family breeds once a year (Denver, 2003). Managed meerkats living in one family group do not seem to have any seasonality to their breeding. Females in these groups experience a post-partum estrus, and are capable of producing up to six pups every 77 days. There is at least one record of a female in a zoo becoming pregnant as early as 6 months old and one male siring offspring as early as 6 months of age; while this is not typical, it is possible (K. Kimble, personal communication, 2004 & 2005). Wet-nursing is also reported in this species.

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

7.2 Artificial Insemination

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 have been achieved with a variety of, but not all, taxa and should be investigated further. At this time, AI is not used in these species.

7.3 Pregnancy, Parturition

It is extremely important to understand the physiological and behavioral changes that occur throughout an animal's pregnancy.

See Chapter 7.1 for gestation, kit development, and management recommendations.

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 "baby-proofed."

Management and facilities for parturition: Females should be given at least two nest boxes well bedded down to allow for choice; it is not advisable to lock them into small areas to which they are not accustomed. It is always better to give them denning and whelping box choices. The social herpestid species should not be isolated from the rest of the pack.

Dwarf and banded mongoose: Females and pups should be left undisturbed following parturition unless a problem is suspected. Enclosures should offer several possible denning sites, and noise or other disruption should be kept to a minimum around the exhibit until staff is confident the female is successfully caring for the kits.

Fossa: If the fossa is maintained as a pair, the male may have to be separated prior to litter birth (Winkler, 2002). In general it is advisable to remove the male fossa from the exhibit about six weeks after breeding (L. Dollar, personal communication, 2005).

Public access should be restricted to two sides of the enclosure, so that animals can retreat from public disturbance, this is particularly true for parturient and nursing females as they become increasingly sensitive to disturbance. If possible, public access to exhibits of nursing females should be restricted or blocked, particularly initially (Winkler, 2002). Pregnant females should be provided with at least two denning boxes, preferably more.

Typically, the female will give birth in a sleeping or denning box (Winkler, 2002). As previously stated, during the first few days after birth the females are very susceptible to outside disturbances. All disturbances should be kept to a minimum and the pupping den/box should not be cleaned for the first 4 to 5 weeks after birth. Any excess disturbance of the lactating mother during this period can lead to the female neglecting, killing, or even eating their young (Winkler, 2002).

Evidence suggests (L. Dollar, personal communication, 2005) that *in situ* females may utilize multiple den sites as "parking" stations for young. Therefore, the AZA SCTAG recommends that females be provided with two or more denning boxes. Fossa females are known to park their young for hours. Caution should be exercised before deciding to pull any apparently abandoned young to ensure that is in fact the case. If possible, young should be monitored for hydration.

Young left alone for up to 12 hours may be acceptable; by 24 hours, action should be considered if this is part of the institutional management protocol, which should be determined in advance (L. Dollar, personal communication, 2005).

Meerkat: Females should be left undisturbed for at least 48 hours following parturition. Females with pups who are disturbed may move the pups, causing stress to them and the rest of the group, or may kill and possibly consume pups (K. Kimble, personal communication, 2004 & 2005).

Typically, new mothers are highly sensitive to disturbances to the den. Usually, normal routines can continue in and around the enclosure but the den itself should not be disturbed unless the health of the animals is in question. Disturbance may result in either movement of the pups, which could compromise their health and safety, or infanticide. There are some females that may need more privacy and are more sensitive to activity in and around the enclosure. In these cases, keepers may need to refrain from entering the exhibit and the area around the enclosure closed to guests for a few days. Appropriate management practices should be determined by the animal care staff after taking into account the female involved. Separation of the dam and pups from the rest of the group is *not recommended* unless previous aggression, infanticide, or other behavioral challenges have been experienced in the past. While there have been instances where dam and pups were separated and later successfully reintroduced to the

group, it is always dangerous to separate individuals from their group due to possible re-introduction challenges. It is important for the other group members to be able to interact with the pups and perform species-typical behaviors such as babysitting. Furthermore, a dam that does not have other individuals to help with the care of the pups may not leave the pups in the den to fulfill her own basic needs such as eating and drinking.

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.

There has not been much experience in hand-raising these species because if hand-raised, the social herpestids seldom breed (Carnio, 1996a; 1996b). Hand-rearing protocols, including when and if abandoned or failing young should be pulled, should be established in advance. This plan also should establish who will care for the young, formula to be fed, and how the young will be socialized with conspecifics.

Banded mongoose: This species has been successfully hand-reared. The following guidelines were provided by C. Bickel:

Formula: Esbilac®, puppy milk replacer (used pre mixed liquid 8 oz cans).
To avoid complications with diarrhea caused by a change in milk, start with a dilute formula.

- First 24 hours fed 1/4 strength formula: 1 part liquid Esbilac® - 3 parts sterile water
- Day 2 fed 1/2 strength formula: 2 parts liquid Esbilac® - 2 parts filtered water
- Day 3 fed 3/4 strength formula: 3 parts liquid Esbilac® - 1 part filtered water
- Day 4 fed full strength formula: full strength Esbilac®
- Additives: Lactace, lactobilcillus blend, vitamin E
- First day pups may need to feed more frequently because of the diluted formula, as formula concentration increases pups will feed less frequently.

Amount fed: 20–25 % body weight per day, divided into eight feedings, Fed ad-lib or every 2 hours. This was done to avoid diarrhea from over feeding, Over loading of the gut can cause diarrhea, bloat, gut stasis and possibly death.

Feeding apparatus: "CATAC" nursing nipple

- Small-straight with 3 cc syringe until 8 days of age then switch to:
- "CATAC" medium-tapered (they are growing fast), (UPCO 1-800-254-8726, item number 391 small-straight nipple and item number 392 medium-tapered).

Weaning:

- 19 days of age: hand fed waxworms.
- 21 days of age: introduced solid food. Gerber's Tender Harvest Chicken + Wild Rice, licked from tip of nipple.
- 26 days of age: eating canned kitten food/chicken, Nutro Natural Choice, Complete Care.
- 36 days of age: Insectivore kibble added to milk and canine diet mixture.
- Weaned from nipple or syringe feeding at 31 days of age, but Esbilac formula was mixed with canine diet and eating from bowls.
- 32 days of age: drinking water from bowl, canned cat food discontinued and switched to Nebraska Brand Canine Diet mixed with Esbilac formula.

Medical problems: Bite wounds, pimples mostly around head, although there are pimples on other parts of their body and juvenile Diabetes Mellitus. Wounds were treated with “Animax” and A + D ointment applied to dry skin. Toenails were clipped at 9 days of age to prevent scratches.

Physical development:

- 7 days of age: eyes open.
- 10 days of age: defecating on own and using a litter pan at 29 days of age.
- 11 days of age: can see. Ears starting to open.
- 14 days of age: canines erupted and cheek teeth at 18 days of age.
- 15 days of age: perching on tail, a bit unstable.

- 16 days of age: following caretaker around on the floor, exercised for 5 minutes before returned them to the incubator, they were easily chilled. Playful, wrestling at this age.
- 28 days of age: Sleeping through the night, may no longer need night feedings. Moved out of incubator and onto floor of nursery room. Furnished with hay, litter pan, blankets, fuzzies, and heat lamp for added warmth.
- 31 days of age: discontinued nipples, and the animals eating from bowls.
- 32 days of age: grooming themselves.
- 36 days of age: eating crickets, mealworms, and waxworms.
- 38 days of age: scent marking everything.

Dwarf mongoose: Staff have successfully been hand-reared this species and reintroduced the young to a group; in one case one of the hand-reared females became the dominant female and produced her own pups which were raised successfully (C. Brown, personal communication, 2006).

Fossa: Fossas have been hand-raised several times primarily due to inappropriate mother behavior. First-time mothers have a high incidence of cannibalism and should have a quiet, secure place to raise their offspring. Any disturbances can cause the female to become increasingly anxious and may result in loss of the pups. Even when it appears that everything needed has been offered, the mother may still exhibit behaviors including frantically relocating pups over and over, abandoning, or even consuming the pups. If hand-rearing is necessary, Esbilac with Taurine and Lactase enzyme added has been used successfully as a milk replacer. The formula can be delivered in a 4 oz Petag nurser bottle with 22-gauge needle hole in the nipple. The Program Leader can be contacted directly for specific information on a successful hand-rearing protocol.

Meerkat: Due to the extremely social nature of this species, it is not recommended that individuals be hand-reared (AZA Small Carnivore TAG recommendation). Hand-reared pups may become aggressive toward caregivers as they get older, and do not make good ambassador animals. In one case, 26-day-old pups in need of medical treatment were successfully given supplemental feedings. During this period the pups were left with the group, indicating that this method may be an alternative to hand-rearing compromised pups without removing them from the group (K. Kimble, personal communication, 2004 & 2005).

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 addition to reversible contraception, reproduction can be prevented by separating the sexes or by permanent sterilization. In general, reversible contraception is preferable because it allows natural social groups to be maintained while managing the genetic health of the population. Permanent sterilization may be considered for individuals that are genetically well-represented or for whom reproduction would pose health risks. The contraceptive methods most suitable for herpestids are outlined below. More details on products, application, and ordering information can be found on the AZA Wildlife Contraception Center (WCC) webpage: http://www.stlzoo.org/contraception.

The progestin-based melengestrol acetate (MGA) implant, previously the most widely used contraceptive in zoos, has been associated with uterine and mammary pathology in felids and suspected in other carnivore species (Munson, 2006). 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 and has been used successfully in meerkats and banded mongoose.

Gonadotropin releasing hormone (GnRH) agonists: GnRH agonists (e.g., 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). Depo-Provera should not be used in combination with deslorelin as it may mask the effects by blocking down-regulation.

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 herpestids has been conducted.

A drawback of these products is that time of reversal cannot be controlled. Depot injections such as Lupron® cannot be removed to shorten the duration of efficacy to time reversals. Suprelorin implants are very difficult to find and recover after placement and in most cases cannot be removed. The most widely used formulations for Suprelorin are designed to be effective either 6 or 12 months, but those are minimum durations, and can be longer in some individuals.

Although GnRH agonists can also be an effective contraceptive in males, they are more commonly used in females, because 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) are 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 herpestids, 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.

Vasectomy: 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 herpestids.

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.

As far as possible, all animals should routinely shift into a holding area/crate and readily separate into specific holding areas/crates 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; it is a stress-free way to capture and transport the animal (Wooster, 1998). The crate training behavior may have to take the place of stationing in holding for animals housed outside without holding facilities. Weighing can be done routinely by placing the animal in a crate and weighing both. Generally the animal will stay in the crate if acclimated to it. Training for the reading of transponder chips also is recommended. An AAZK Animal Training Committee 2002 survey reports that facilities are training meerkats for the following behaviors: target, station, separate, and stand on a scale. See Appendix H for additional training resources.

Table 12: Sample behaviors and training cues for Herpestids (Institution F^, Institution I*, Institution J**, Institution N+, Institution B>)

Species	Behavior	Verbal Cue	Visual Cue	Criteria for reinforcement
Meerkat^**	Station	Station	---	Each animal has a specific color placemat they go to when given verbal cue
Meerkat^**	Target	Target	Present target	Target stick presented with the verbal cue and animal touches it with nose
Meerkat^**	Up	Up	Closed fist	Meerkat stands upright on hind legs
Meerkat^**	Go in to crate, etc.	In^, Crate**	Hand points to what they are to go in to	Animal enters box or crate and stands calmly
Meerkat*&**	Stand on a scale	Here*, Scale**	Point	Animals stands on scale
Meerkat**	Hold at station	Hold	---	Remains at station
Meerkat**	Syringe drink	Drink	---	Take fluid from syringe
Banded mongoose+	Desensitization		Chip reader	Desensitizing to having the microchip reader placed next to them; in process
Banded mongoose+	Desensitization		Catch-box	Accustoming the banded mongoose to entering the catch-box; in process
Fossa>	Crate	Crate		Enter and stand in crate
Fossa>	Stand on scale	Scale		Stand stationary on scale
Fossa>	Up	Up		Stand on hind paws at cage front presenting belly
Fossa>	Paw	Paw	Hold up hand opposite	Animal holds up mirroring paw so underside and nails can be inspected
Fossa>	Down	Down	Hand is lowered to lying flat on floor	Animal lays down on floor

Banded mongoose: This species is highly food motivated and very curious and can be easily taught to climb into tubs placed on scales (Zoo H – see picture at right). They also can be desensitized to scales, chip readers, and being locked into catch-boxes.

Fossa: can be stubborn but learn quickly. Rewards often should be changed to keep them from becoming bored; items used with most success include pinkies cut in half, horsemeat, and pork. Keepers should avoid use of aversive stimuli in the daily management of *Herpestidae*/*Eupleridae*. Profound aversive stimuli such as squirting with hoses, loud noises, harsh words, and long-term withholding of food are inappropriate unless serious injury of keeper or animal is imminent (e.g., serious fight). Many animals respond to profound aversive stimuli with fear and/or aggression, or simply by hiding from the keeper for extended periods. 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). Only positive reinforcement should be used.

In general, it is recommended that herpestid and euplerid species be trained in a protected contact situation if possible (i.e., keeper and animal should be separated by a mesh barrier) (see exception below). However, because many of these species are kept in outdoor, open enclosures with no protected holding facility attached (herpestids), keepers may need to conduct free-contact training. Husbandry training should occur anywhere the individual animal seems to feel comfortable and where the keeper can safely access them. Care should be given not to encroach upon the animal's flight distance and the

keepers/animals safety should always be paramount. Managers and caretakers should decide if food rewards can be hand fed or if a meat stick should be used to deliver the food.

Meerkat: Free contact training is the preferred method due to its greater flexibility and perceived increase in the animal's comfort level. Protected contact training should be used only in those situations where it is deemed necessary due to aggression towards staff and/or animal safety.

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 mongoose and fossa 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.

Enrichment programs for the mongoose and fossa should take into account the natural history of the species, individual needs of the animals, and facility constraints. The mongoose and fossa enrichment plan should include the following elements: goal-setting, planning and approval process, implementation, documentation/record-keeping, evaluation, and subsequent program refinement. The mongoose and fossa enrichment program should ensure that all environmental enrichment devices (EEDs) are "mongoose and fossa" safe and are presented on a variable schedule to prevent habituation AZA-accredited institutions must have a formal written enrichment program that promotes mongoose and fossa-appropriate behavioral opportunities (AZA Accreditation Standard 1.6.1).

AZA Accreditation Standard

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

Mongoose and fossa 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).

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.

As with all species a well thought out enrichment program is beneficial and should be an established part of the husbandry protocol for these species. Items used should be checked for safety and toxicity. See Appendix G for AAZK, Inc. Enrichment Committee caution list for enrichment items. The herpestid species should benefit from stimulation of any of the senses.

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* 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."

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

- Can the animals get caught in it or become trapped by it?
- Can it be used as a weapon?
- Can an animal be cut or otherwise injured by it?
- Can it fall on an animal?
- Can the animal ingest the object or piece of it? Is any part of it toxic, including paint or epoxy?
- Can it be choked on or cause asphyxiation or strangulation?
- Can it become lodged in the digestive system and cause gut impaction or linear obstruction?
- 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?
- Can it destroy an exhibit?
- If fecal material is used for enrichment, has it been determined to be free from harmful parasites?
- Is food enrichment included as part of the animals' regular diet in a manner that will reduce the risk of obesity?
- When introducing animals to conspecifics or in a multi-species exhibit, are there sufficient areas for them to escape undesirable interactions?
- Can the manner of enrichment presentation (i.e., one item or items placed in a small area) promote aggression or harmful competition?
- Has browse been determined to be non-toxic?
- Do the animals show signs of allergies to new items (food, browse, substrates, etc.)?
- Does the enrichment cause abnormally high stress levels?
- 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 less frequent 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 also should be evaluated to see if it is achieving its goals.

Tables 13 and 14 list some enrichment items that have been used successfully with meerkats and dwarf mongoose, respectively. Table 15 provides examples of enrichment items approved for fossa. Appendix H has additional enrichment resources. All enrichment items should be approved by the appropriate management staff, including the veterinarian, curator, horticulturist, and/or nutritionist.

Table 13: Sample enrichment items used by zoos* for meerkats

Sensory	Foods/feeding	Manipulative	Physical environment
• Animal scent • Feather • Noise make • Electronic bird call • Spices, herb • Animal urine • Animal fur • Animal sounds CD • Scents from other animals • Snake sheds • Mirrors • Perfume • Wind chimes • Perfumed pages • Diluted essential oils • Squirrel call • Hides (specific protocol in place) • Non-toxic bubbles • Camel hair • Catnip spray • Lemon balm	• Acrylic sheet feeder • Foraging pan • Boomer ball feeder • Covering cup • Insects (live & frozen), to include crickets, super worms, wax worms & mealworms • Frozen meat balls • Scatter feed • Puzzle feeders • Fruit (apple, grapes, peaches) • Squashes and pumpkins • Melons and berries • Shrimp • Oatmeal, cereal • Lettuce ends • Peanuts • Whole mice • Hard-boiled eggs • Coconut shell with insects • Live fish in black tub • Pinecones with peanut butter and insects • Pinkies, pinkie rats	• Straw, hay, leaves, pine needles • Rattle • Antlers • Small durable balls • Insect dispenser • Browse • Frozen water bottles • Paper bags, cardboard boxes, tubes, shredded paper • Ice cubes • Ostrich eggs, sea shells • Egg cartons • Whiffle balls • Wobble bone dog toy • Burlap sacks with hay or straw • Piñatas • Ferret balls, tennis balls • Burlap bag pillows with straw or hay • Hanging triangle with bell • Traffic cones • Newspaper, paper towels • Feathers • Snow	• Look-out mounds • Tree stumps • Branches, browse, logs • Artificial animals/decoys • Rock pile, sand castle • Remote control car • Children's climbing plastic structure • Bamboo, grass clumps, gourds • Soil, mulch, shavings • Gravel • PVC tubes • Pine cones • Milk crates • Bed-a-cob • Tissue, wrapping, and newspaper • Astroturf mats • Disco ball (outside of exhibit) • Pinwheels (outside exhibit) • Furniture from other meerkat exhibits • Window treatments (on outside, stickers, paint, paper, etc.) • Misters, kiddie pool • Cornstalks • Mist the exhibit (*Many of the above items may be provided on the ground, in boxes, bags or tubs)

* Institution F; Institution K; Institution J. Information also taken from Institution L's Enrichment Online (www.enrichmentonline.org), and K. Kimble's Meerkat Survey.

Table 14: Sample enrichment items used by zoos* for dwarf mongoose

Sensory	Foods/feeding	Manipulative	Physical environment
• Animal scents • Feathers • Spices, fresh herbs • Animal fur, fake fur • Animal sounds CD • Snake sheds • Mirrors • Perfume • Perfumed pages • Non-toxic bubbles • Mouth wash (for olfactory enrichment) • Lemon/lime juice (for olfactory enrichment)	• Insects (live & frozen): hissing cockroaches, crickets, earthworms, super worms, wax worms & mealworms • Frozen blood • Pinkie, fuzzy mice (frozen/thawed & live) • Live fish (minnows, goldfish) • Hard-boiled eggs • Cooked catfish • Puzzle/insect feeders (tubes, Tupperware, bamboo, rock feeder) • Vary presentation: scatter, smear, whole, hidden • Fruits & veggies • Raisins • Pumpkins (carved) • Fresh greens • Peanuts • Peanut butter • Honey • Air-popped popcorn • Frozen beef bouillon • Rib bones • Food items in gelatin • Ice cubes	• Straw, hay, leaves, pine needles • Small durable balls (boomer, golf) • Whiffle balls • Paper bags, cardboard boxes, tubes, shredded paper • Phone book • Egg cartons • Browse • Piñatas • Stuffed animal • Newspaper, craft paper, paper towels • Feathers • Pinecones • Shoes • Plastic gourd • Parrot toys • Mop head • Kongs • Dried corn cobs • Cat toys • Rawhides • Hollow bones • Burlap bags • Cornhusks • Plastic containers/watering cans	• Look-out mounds • Fabricated termite mounds • Live plants • Pine trees • Branches, browse, logs • Sand, mulch, wood shavings, hay, woodwool • PVC/Acrylic tubes • Milk crates • Tupperware • Baskets • Broom brush (scratching post) • Cardboard box, tubes • Sod • Astroturf mat • Tubs

* Institutions F, G, and M; Dwarf mongoose Survey 2002; additional ideas can be found at www.enrichmentonline.org

Table 15: Sample approved enrichment items at Zoo B for fossa (M. Krebs, personal communication, 2010)

Sensory	Foods/Feeding	Manipulative	Physical Environmental
• Spices • Extracts • Perfume • Urine-soaked hay • Fresh Herbs • Radio • Nature CD/sounds	• Scatter feeding • Hide food • Rodents • Chickens/Chicks • Pheasant Wings • Horse Steaks • Bones • Horsetails • Live Insects • Beef Bouillon • Ice treats	• Lg. Cardboard Box • Sm. Cardboard Box • Cardboard Tube • Shredded Paper • Newspaper • Magazine • Phonebook • Plant Paper • Paper Bag • Grain Bag • Bleach Bucket • Diet Bucket • Plastic Ball • Lg. Plastic Tube • Brown Boomer Toy • Brown Wobbly Toy • Plastic Barrel • Egg Cartons • Seasonal Item • Browse • Tire • Antlers • Palm Frond	• Mulch • Hay • Straw • Alfalfa • Topsoil • Sand • Snow • Leaves • Grass Sod • Wood chips • Logs • Furniture Change

Table 16: Sample of approved enrichment items at Zoo H for banded mongoose (N. Hutchinson, personal communication, 2011)

Sensory	Foods/Feeding	Manipulative	Physical Environmental
• Flowers • Bird feathers • Mirrors • Rocks • Scents (perfumes, spices, extracts, bouillon) • Feather pie • Frozen spice balls	• Popcorn • Enrichment bucket • Coconut milk • Whole fruits or vegetables • Various nuts • Pumpkins/gourds • Frozen treats (bouillon, blood, or fish juice) • Peanut butter, honey • Insect parfait • Scatter feed	• Rubber snakes • Paper mache items • Snake sheds • Roll-a-treat ball • Hard plastic boomer balls • Tennis balls • PVC rattles • Puzzle feeders • Kongs	• Tires • PVC tunnels • Grass/alfalfa hay • Straw • Leaf litter • Shavings, woodchips, mulch, fiber • Browse, logs, stumps, sticks, brush piles • Rubbermaid tote nest boxes • Hammocks • Substrate tub/worms

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.

Animal management staff should be encouraged to form a trusting relationship with the animals in their care; this does not mean a relationship in which the animals are treated as pets. All animals should be treated with respect; and keeper staff should learn the behavioral profiles of each individual and structure their working routine to maximize the animal's comfort. Behavioral management in the form of training for husbandry procedures, both routine and non-routine, is encouraged. Interactions with herpestid species while the public is present should be for educational purposes, medical emergency, or routine husbandry purposes only; if any of these activities are carried out while the public is present it is suggested that an interpreter be present to explain what is happening and why.

The AZA SCTAG recommends that whenever possible all animals be shifted before staff enters an exhibit (AZA Small Carnivore TAG recommendation). For meerkat, dwarf, and banded mongoose exhibits where this is not possible, exhibits can be cleaned with the animals in them so long as there are adequate numbers of hiding spots or sleeping boxes for all individuals to use. Care should be taken by the keepers to know where all animals are located at all times to avoid animals injuring themselves with tools, and to prevent animals biting or scratching keepers' hands. Other species (e.g., fossa) should be shifted out of the exhibit for cleaning.

8.4 Staff Skills and Training

Mongoose and fossa staff members should be trained in all areas of mongoose and fossa 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 technical skills will equip animal care staff with the tools more managing and meeting the needs of herpestids and euplerids in zoos and aquariums:

- Keepers and managers should have an in-depth understanding of the species natural history and the individual's 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 herpestid 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-prep area.
- Keepers should have the skills to safely capture or restrain the herpestid 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 consistently enhance the environments of the species in their care.
- 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 http://www.animaltraining.org for 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'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 1.5.4). 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.

AZA Accreditation Standard

(1.5.4) 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.

Education animals: The herpestid and euplerid species do not make good education animals due to their highly social nature (e.g., meerkat, mongoose), or solitary nature (e.g., fossa). If the former are used for any education programs they should be housed in groups, not singly; and fossa should not be used as education animals (AZA Small Carnivore TAG recommendation, 2004).

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:

- Animal and human health, safety, and welfare are never compromised.
- Education and a meaningful conservation message are integral components of the presentation.
- The individual animals involved are consistently maintained in a manner that meets their social, physical, behavioral, and nutritional needs.

AZA-accredited institutions that 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).

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.

Conservation Messages: Small carnivores are among the least known and understood carnivores. Few have been seen by biologists, and new subspecies and occasionally species are still being discovered. (In 1986 a new Herpestid species, the giant striped mongoose, *Galidictis grandidieri,* was discovered in Madagascar.) Good resources for information on small carnivores include: IUCN Small Carnivore Specialist Group (http://www.smallcarnivores.org) and the IUCN Red List of Threatened Species (www.iucnredlist.org).

Fossa: This species is managed as an SSP by the AZA SCTAG and is not considered a candidate for education programs. However, the stationing of "talking signs" at exhibits can help interpret the species to the visiting public. The IUCN lists this species are Vulnerable for the following reasons, "…it is feasible that over the course of the last 21 years (three generations), there has been population reduction exceeding 30% (and possibly much higher) mainly due to habitat loss (given the species' need for intact forest) and in combination with widespread hunting and persecution and the effects of feral carnivores." The listing for this species has changed over the years: in 1986 it was listed as "Vulnerable;" from 1988 through 1994 it was listed as Insufficiently Known; relisted as Vulnerable in 1996; as Endangered in 2000; and down-listed to "Vulnerable" in 2008 (Hawkins & Dollar, 2008; IUCN Red List, 2009). Hawkins & Dollar observe:

> "The major threat to this species is loss and fragmentation of forest habitat, largely caused by the conversion of forested areas to agricultural land and pasture, and selective logging. It also preys on domestic fowl and is consequently killed as a pest species by local people. It is very susceptible to hunting, and is often targeted by groups engaged in collective group hunting (e.g. in the Makira forests) specifically for the purpose of eradication. Parts of this species are also used for medicinal purposes. Competition with feral carnivores also occurs, including predation by feral dog packs."

Dwarf mongoose: This species is managed as an SSP by the AZA SCTAG and is not considered a candidate for education programs. However, the stationing of "talking signs" at exhibits can help interpret the species to the visiting public. For example:

> "Reported as the most abundant small carnivore in areas of open woodland or wooded savanna, with densities as high as 8 individuals/km² (though more typically around 5 individuals/km²); (Waser et al*.,* 1995)" (Creel & Hoffman, 2008).

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).

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.

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

(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.

Animal transportation must be conducted in a manner that is lawful, safe, well-planned, and coordinated, and minimizes risk to the animal(s), employees, and general public (1.5.11).

9.3 Program Evaluation

AZA-accredited institutions which have 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.

Chapter 10. Research

10.1 Known Methodologies

> **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.

AZA believes that contemporary mongoose and fossa 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 (TAG) or Species Survival Plan® (SSP) Program sponsored research, conducting original research projects, affiliating with local universities, and/or employing staff with scientific credentials (AZA Accreditation Standard 5.3).

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.

The following covers a variety of the types of studies that have been conducted on Herpestidae and Eupleridae to date. This list is not exhaustive and those interested in conducting research should perform a thorough literature review prior to beginning studies.

Behavioral

- Bell, M.B.V. (2008). Receiver identity modifies begging intensity and independent of need in banded mongoose (*Mungos mungo*) pups. *Behavioral Ecology, 19*(6), 1087–1094.
- Gilchrist, J.S., & Russell, A.F. (2007). Who cares? Individual contributions to pup care by breeders vs. non-breeders in the cooperatively breeding banded mongoose (Mungos mungo). *Behavioral Ecology & Sociobiology, 61*(7), 1053–1060.
- Gilchrist, J.S. (2006). Female eviction, abortion, and infanticide in banded mongooses (*Mungos mungo*): implications for social control of reproduction and synchronized parturition. *Behavioral Ecology, 17*(4), 664–669.
- Mueller, C.A., & M.B. Manser. (2008*). The information* banded mongooses extract from heterospecifics alarms. *Animal Behaviour, 75*(3), 897–904.
- Winkler, A. (2003). Latest findings on the biology, keeping, and raising of fossa (*Cryptoprocta ferox*). *Zoologische Garten, 73*(5), 296–311.
- Hawkins, C.E., & Racey, P.A. (2009). A novel mating system in a solitary carnivore: the fossa. *Journal of Zoology, 277*(3), 196–204.
- Drewe, J.A., Madden, J.R., & Pearce, G.P. (2009). The social network structure of a wild meerkat population: 1. Inter-group interactions. *Behavioral Ecology & Sociobiology, 63*(9), 1295–1306.
- Madden, J.R., Kunc, H.P., English, S., Manser, M.B., & T.H. Clutton-Brock. (2009). Do meerkat (*Suricata suricatta*) pups exhibit strategic begging behaviour and so exploit adults that feed at relatively high rates? *Behavioral Ecology & Sociobiology, 63*(9), 1259-1268.
- Thornton, A. *(2008). Social learni*ng about novel foods in young meerkats. *Animal Behaviour, 76*(4), 1411–1421.
- Hodge, S.J., Flower, T.P., & Clutton-Brock, T.H. (2007). Offspring competition and helper associations in cooperative meerkats. *Animal Behaviour, 74*(4), 957–964.

Diet

- Hawkins, C.E., & P.A. Racey. (2008) Food habits of an endangered carnivore, *Cryptoprocta ferox*, in the dry deciduous forests of western Madagascar. *Journal of Mammalogy, 89*(1), 64–74.

Endocrinology

- Young, K.M., Walker, S.L., Lanthier, C., Waddell, W.T., Monfort, S.L., & Brown, J.L. (2004). Noninvasive monitoring of adrenocoritcal activity in carnivores by fecal glucocorticold analyses. *General & Comparative Endocrinology, 137*(2), 148–165.
- Young, A.J., Monfort, S.L., & Clutton-Brock, T.H. (2008). The causes of physiological suppression among female meerkats: A role for subordinate restraint due to the threat of infanticide? *Hormones & Behavior, 53*(1), 131–139.

Molecular Ecology

- Waldick, R.C., Johnson, P., & Pemberton, J. (2003). Identification and characterization of 14 polymorphic microsatellite loci for a member of the Herpestidae (Mungos mungo). *Molecular Ecology Notes, 3*(2), 236–238.
- Piertney, S.B., Dallas, J.F., Hawkins, C.E., & Racey, P.A. (2000). Microsatellite markers for the fossa (Cryptoprocta ferox). *Molecular Ecology, 9*(4), 489–490.
- Spong, G.F., Hodge, S.J., Young, A.J., & Clutton-Brock, T.H. (2008). Factors affecting the reproductive success of dominant male meerkats. *Molecular Ecology, 17*(9), 2287–2299.

Veterinary

- Gyimesi, Z.S., & Burns, R.B. (2009). Presumptive benzocaine-induced methemoglobinemia in a slender-tailed meerkat (Suricata suricatta). *Journal of Zoo & Wildlife Medicine, 40*(2), 389–392.

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 (TAGs) or Species Survival Plans® (SSP) Programs.

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.

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.

Chapter 1. Ambient Environment

Section 1.1. Temperature and Humidity:

- Little information is available on the humidity requirements for these species.

Section 1.4. Sound and Vibration:

- No information is currently available on the impact of background noise on these species; some facilities have successfully used natural sounds to mask public noise (which has, in some cases, appeared to cause distress to the dwarf mongoose and meerkat).

Chapter 4. Social Environment

Section 4.1. Group Structure and Size:

- It is unclear if there is social hierarchy between sexes in meerkats.

Chapter 5. Nutrition

Section 5.1. Nutritional Requirements:

- Although many of the items consumed by these species are known, the nutrient content of these items has not been completely characterized. In many cases, target nutrient levels are based on

those of well-studied carnivores and, to a lesser extent, omnivores (e.g., Arctic fox/mink and cats).

Chapter 6. Veterinary Care

Section 6.5. Preventive Medicine:

- There is very little information on vaccination for herpestids or euplerids.
- Titers are useful if the assay that measures them has been validated for the species in question. However, in many (most) zoo species it is not known for certain what constitutes a protective titer. In order to address this question it is recommended that, if possible, institutions gather titer information for future evaluation and research.
- There is no available information on the efficacy of the ImRab3® rabies vaccination in herpestids.

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Appendix A: Accreditation Standards by Chapter

The following specific standards of care relevant to the mongoose and fossa 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 captive 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 captive 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 American Association for Laboratory Animal Science (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 mongoose and fossa:

Mongoose and fossa*:*

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 Position Statement

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 and wildlife. 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 & 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 (Wolf & Tymitz, 1981; Bitgood, Patterson & Benefield, 1986; 1988). In addition, the provocative nature of a handled animal likely plays an important role in captivating a visitor. In two studies (Povey & Rios 2002; Povey, 2002), 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 is 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 (2002) 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 et al. (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 & Burns (1991) and Davison et al. (1993) evaluated the effect live animal shows had on visitor attitudes. Both found their shows successfully influenced attitudes about conservation and stewardship.
- Yerke & 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 et al. (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 & 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 & 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.

Appendix E: Developing an Institutional Program Animal Policy

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 (Appendix D) 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 conflicting messages and to modify and improve programs accordingly.

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-specific animal welfare standards 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' biological and social needs and developing animal care standards 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.

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
- 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:

- The use and setting is appropriate.
- Animal and human welfare is considered at all times.
- The animal is used in a respectful, safe manner and in a manner that does not misrepresent or degrade the animal.
- A meaningful conservation message is an integral component. Read the AZA Board-approved Conservation Messages.
- 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:

On-site programming

Informal and non-registrants:

- On-grounds programming with animals being brought out (demonstrations, lectures, parties, special events, and media)
- Children's zoos and contact yards
- Behind-the-scenes open houses
- Shows
- Touch pools

Formal (registration involved) and controlled settings:

- School group programs
- Summer Camps
- Overnights
- Birthday parties

Offsite and outreach:

- PR events (TV, radio)
- Fundraising events
- Field programs involving the public
- School visits
- Library visits
- Nursing Home visits (therapy)
- Hospital visits
- Senior Centers
- 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 stress 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 of the AZA website (http://www.aza.org). 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
    - 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:

- Minimization of the possibility of disease transfer from non-human animals to humans, and vice-versa (e.g., hand washing stations, no touch policies, use of hand sanitizer).
- 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:

- General housing, husbandry, and animal health concerns (e.g., that the housing and husbandry for program animals meets or exceeds general standards and that the needs of the individual animal, such as enrichment and visual cover, are accommodated).
- 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.
- Requirements for supervision of contact areas and touch tanks by trained staff and volunteers.
- Frequent evaluation of human/animal interactions to assess safety, health, welfare, etc.
- Ensure that the level of health care for the program animals is consistent with that of other animals in the collection.

VIII. Taxon specific protocols: The AZA encourages 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-specific protocols should address:

- How to remove the individual animal from and return it to its permanent enclosure.
- How to crate and transport animals.
- Signs of stress, stress factors 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)
- Guidelines for disinfecting surfaces, transport carriers, enclosures, etc.
- Animal facts and conservation information.
- Limitations and restrictions regarding ambient temperatures and or weather conditions.

- Time limitations (including animal rotation and rest periods, as appropriate, duration of time each animal can participate, and restrictions on travel distances).
- The numbers of trained personnel required to ensure the health and welfare of the animals and public.
- Taxon-specific guidelines on animal health.

IX. Logistics, and managing the program: The Institutional Policy should address a number of logistical issues related to program animals, including:

- Where and how the program animal collection will be housed, including any quarantine and separation for animals used off-site.
- Procedures for requesting animals, including the approval process.
- 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:

- Personnel authorized to handle and present animals.
- Handling protocol during quarantine.
- The process for training, qualifying and assessing handlers including who is authorized to train handlers.
- The frequency of required re-training sessions for handlers.
- Personnel authorized to train animals and training protocols.
- The process for addressing substandard performance and noncompliance with established procedures.
- Medical testing and vaccinations required for handlers (e.g., TB testing, tetanus shots, rabies vaccinations, routine fecal cultures, physical exams, etc.).
- Training content (e.g., taxonomically specific protocols, natural history, relevant conservation education messages, presentation techniques, interpretive techniques).
- Protocols to reduce disease transmission (e.g., zoonotic disease transmission, proper hygiene and hand washing requirements, as noted in AZA's Animal Contact Policy).
- Procedures for reporting injuries to the animals, handling personnel or public.
- 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: Description of Nutrients (U.S. National Library of Medicine)

Protein: Protein is the main building block 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 is also 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. Fat also 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 sexes. In many cases, a Vitamin A requirement is effectively a requirement for carotenoids (precursors to Vitamin A).

Vitamin C (Ascorbic Acid): Vitamin C is a water-soluble antioxidant, which plays an important role in biochemical oxidation-reduction reactions, as well as in the formation of collagen, an important protein needed for the formation of skin, scar tissue, tendons, ligaments, and blood vessels. Because of this, Vitamin C is crucial to an animal's ability to heal wounds and repair and or maintain cartilage, teeth, and bones. It also may reduce infection by increasing immunity.

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; 285-315 nm; Bernard, 1997).

Vitamin E: Vitamin E is a fat-soluble antioxidant which helps to maintain the structure of cellular and sub-cellular 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 carbohydrate in the diet.

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 convert energy from food. The niacin requirement of many animals could theoretically 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 is also necessary 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 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 defense against infection.

Zinc: Zinc is also 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 is also involved in the metabolism of carbohydrates. Zinc is essential for synthesis of DNA, RNA, and proteins, and 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 helps reduce the risk of osteoporosis. Manganese also helps produce certain hormones, metabolizes fat, and is part of superoxide dismutase (SOD), an antioxidant. Studies on humans have shown that manganese may also lower the frequency of epileptic seizures and enhance immune function.

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 keep 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. Its main role is 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 may also 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 G:
AAZK, Inc. Enrichment Committee, Enrichment Caution List

Dietary Enrichment

- Food enrichment, if uncontrolled, can lead to obesity, 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.
- Destructible items such as cardboard boxes and paper bags should be free of staples, tape, wax, strings, or plastic liners.

Appendix H: Resources for Enrichment and Training

Prepared by: S. Maher, for AZA 2004 Otter Keeper Workshop

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: http://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, http://www.aazk.org/2004enrichnotebookcd.php.
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Appendix I: AZA Small Carnivore TAG Necropsy Protocol and Forms

AZA Small Carnivore TAG Necropsy Protocol

I. Recommended Fixed tissues. In addition collect a sample of any lesion. Fix in 10 parts 10% neutral buffered formalin to 1 part tissues, samples should be no thicker than 1 cm, and should be fixed for at least 72 hrs 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).

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