ASSOCIATION OF ZOOS & AQUARIUMS

TIGER
(*Panthera tigris*)
CARE MANUAL

CREATED BY THE
AZA Tiger Species Survival Plan®
IN ASSOCIATION WITH THE
AZA Felid Taxon Advisory Group

Tiger (*Panthera tigris*) Care Manual

Published by the Association of Zoos and Aquariums in association with the AZA Animal Welfare Committee

Formal Citation:

AZA Tiger Species Survival Plan® (2016). Tiger Care Manual. Association of Zoos and Aquariums, Silver Spring, MD.

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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 Tiger.

Classification	Taxonomy
Kingdom	Animalia
Phylum	Chordata
Class	Mammalia
Order	Carnivora
Suborder	Feliformia
Family	Felidae

Genus, Species, and Status

Table 2: Genus, species, and AZA status for Tiger (IUCN, 2015)

.Genus	Species	Common Name	IUCN Status	AZA Status
Panthera	*tigris*	Tiger	Endangered	SSP

Table 3: Tiger subspecies and status (IUCN, 2011)

Subspecies	Common Name	IUCN Status	AZA Tiger Status
P. t. tigris	Bengal tiger	Endangered	Not Managed
P. t. altaica	Amur tiger	Endangered	SSP
P. t. corbetti	Indochinese tiger	Endangered	Not Managed
P. t. jacksonii	Malayan tiger	Critically Endangered	SSP
P. t. sumatrae	Sumatran tiger	Critically Endangered	SSP
P. t. amoyensis	South China tiger	Critically Endangered	Not Managed

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* tiger populations. This ACM is considered a living document that is updated as new information becomes available and at a minimum of every 5 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 tigers must comply with all relevant

AZA Accreditation Standard

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

local, state/provincial, and federal wildlife laws and/or regulations; AZA accreditation standards that are more stringent than these laws and/or regulations must be met (AZA Accreditation Standard 1.1.1).

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

Introduction: Tigers (*Panthera tigris*) are the largest of the wild cats and were historically found throughout much of Asia, from Turkey in the west to China in the east, and from eastern Russia in the north, to Indonesia in the south. Three subspecies of tiger went extinct in the 1900s: Javan (*P. t. sondaica*), Caspian (*P. t. virgata*), and Balinese (*P. t. balica*). There are currently six remaining subspecies and a 2008 population estimate placed the global tiger population at between 3,600 and 4,600 individuals (Seidensticker, Gratwicke & Shresthe, 2010).

Natural history: The Bengal tiger (*P. t. tigris*) is the most numerous subspecies of tiger and is found in India, Nepal, Bhutan, Myanmar, and Bangladesh. Amur tigers (*P. t. altaica*) recovered from a population bottleneck in the first half of the 20th century and are now thought to number approximately 500 or fewer individuals. Indochinese tigers (*P. t. corbetti*) occur in several Southeast Asian countries and number fewer than 350. Malayan tigers (*P. t. jacksonii*; formerly classified as *P. t. corbetti*) are restricted to a portion of Malaysia, south of the Isthmus of Kra, and are thought to number fewer than 500. The most isolated subspecies is the Sumatran tiger (*P. t. sumatrae*), while the most endangered living subspecies is the South China tiger (*P. t. amoyensis*), which is represented only by relatively inbred individuals in Chinese zoos (Tilson, Nyhus & Muntifering, 2010).

In the wild, tigers live in surprisingly varied habitats, including dry thorn forests, mangrove swamps, tropical rain forests, and seasonally snow-covered woodlands (Sunquist, 2010). Tropical subspecies tend to be somewhat smaller in body size (e.g., adult males living in tropical areas weigh between 100–140 kg [220–308 lb], compared to 180–225 kg [396–496 lb] for Bengal or Amur tigers). It is hypothesized that this is an adaptation for dissipating heat.

With the exception of mothers and their cubs, tigers are essentially solitary animals. Tiger home ranges and densities vary dramatically from site to site, largely due to differences in prey densities. For example, Amur tigers in the Russian Far East exist at densities of 0.3–0.7 animals per 100 km^2 (38.61 mi^2) with prey biomass approaching 400 kg/km^2 (881 lb/mi^2), whereas Bengal tigers in Kaziranga, India exist at densities of ~16.8 animals per 100 km^2 (38.61 mi^2), with a prey biomass of ~4200 kg/km^2 (9,259 lb/mi^2). Adult females inhabit exclusive territories that remain stable long-term. Although smaller than those of males, female territories range from 20 km^2 (7.72 mi^2) in Nepal's Chitwan National Park to 400 km^2 (154.44 mi^2) in the Russian Far East, where prey densities are much lower (Sunquist, 2010). Male territories overlap one or more female territories and there is strong male-male competition for access to breeding females. Many male tigers are "floaters," and do not maintain strict territories, gaining relatively little access to females.

Tigers reinforce their territories using scent marks, including urine sprayed on bushes and trees, feces and urine left in prominent places, scratch marks on trees, and scrapes made by backwards raking with the hind feet. Both sexes remark sites routinely with the frequency of marking higher in zones where contact with neighboring tigers is likely. A tiger can tell whether a scent mark belongs to a familiar local resident or a stranger, a male or a female, and if a females, whether or not that female is in estrus. Their loud vocalizations, called "roars," are thought to aid in long-distance communication.

Much of what is known about mating and reproduction in wild tigers comes from only a few studies. A long-term study of tigers in Royal Chitwan National Park found that most cubs were sired by a very small proportion of the adult males in the population (Smith et al., 2010). The two largest males they studied each fathered over fifty cubs, whereas some adult males sired no offspring at all. On average, males began reproducing at 4.8 years of age, but their reproductive lives were short, averaging 2.8 years at Chitwan. To speed females' resumption of ovarian cycles, males often commit infanticide when they take over a territory. Reproductive success of females is less skewed than for males, but some females at Chitwan also failed to produce surviving offspring. The mean age at first reproduction for females was 3.4 years, the mean interbirth interval was 21.6 months, and the mean litter size was 3.0. Similar findings have been reported for wild Amur tigers. While births tend to occur during most months of the year, there

were concentrations of births from May–August in Chitwan tigers and from May–October in Amur tigers in Russia.

A female tiger requires approximately one large prey item per week to feed herself and her cubs. Prey species usually consist of deer and wild pigs. Small prey is often killed by biting the back of the neck while large prey is killed by biting the throat. Tigers typically stalk their prey at close range and feed only once they have hauled their kill into dense cover. Small prey is often consumed in a single feeding, whereas larger prey may be consumed over several days.

Habitat destruction/conversion and fragmentation, poaching of tigers and their prey species, and retribution by farmers (usually by poisoning) following tiger attacks on their livestock or family members have contributed to the dramatic declines in wild tiger numbers. Analyses indicate that wild tigers now occupy only 6% of their historic range (reviewed in Seidensticker *et al.*, 2010). More tigers now exist in human care (an estimated 13,000 worldwide) than in the wild (Nyhus, Tilson & Hutchins, 2010). The future of this magnificent cat is uncertain and will depend not only on the concerted efforts of conservation biologists to save it, but also on the priorities of the states containing tiger ranges, and the prevalence of the pressures tigers face.

Federal laws and amendments: *[note: this information was derived from Nyhus et al. 2009, except where noted; please check for changes to relevant laws]* An international treaty and three federal laws indirectly regulate ownership of tigers in US zoos, however, none strictly forbids the private possession of tigers and other large carnivores in the United States (Nyhus et. al, 2009). The US is a signatory of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), an international treaty that establishes a system of import and export regulations for the purpose of preventing the overexploitation of animals and plants. Tigers are covered by this treaty, and therefore, their import and export is controlled by the CITES regulations. International regulation and cooperation is necessary to ensure the future survival of many species because trade in wild animals and plants crosses the borders of many countries.

The US national counterpart to CITES is the Endangered Species Act (ESA). The ESA, enacted in 1973, regulates the interstate and international trade or taking of species officially listed as “Endangered” or “Threatened.” It is the first federal law to protect tigers, a species listed in the first version of the Act. Specifically, the ESA regulates interstate commerce involving tigers, the importation and exportation of tigers, and the unauthorized “taking” of tigers within the US. The US Fish and Wildlife Service (FWS), the primary agency responsible for permitting activities related to listed terrestrial species, does not issue permits to possess or breed endangered or threatened animals as pets (USFWS, 2002).

For conservation purposes, FWS issues Captive-bred Wildlife permits that allow permit holders to buy and sell in interstate commerce any living Endangered or Threatened species held within the US. These permits are issued to zoos and individuals breeding listed species born in the US for the enhancement of species propagation, provided the people or institutions involved in the transaction are both registered for the same species. Under this system, otherwise prohibited activities (e.g., ‘take’, interstate commerce, and export) can occur if they enhance propagation or survival of the affected species and assist *ex situ* breeding programs (USFWS, 1999). In 1998, FWS created an exemption to the Captive-bred Wildlife Permit, which eliminates permit requirements for certain listed species. At the time, the exemption included “generic tigers” – i.e., inter-subspecific crossed tigers or tigers whose ancestry cannot be traced back to wild-caught founders and that are not registered in international tiger studbooks. In 2016, FWS amended the regulation, removing generic tigers from the list of species that are exempt from registration under the Captive-bred Wildlife regulations.

The Animal Welfare Act (AWA) of 1966 is regulated and enforced by the Animal Plant and Health Inspection Service (APHIS) under the US Department of Agriculture (USDA). The main purpose of the AWA is to “ensure minimum standards of care and treatment be provided for certain animals bred for commercial sale, used in research, transported commercial, or exhibited to the public.” Under the AWA, all individuals or businesses involved with animals covered under the law are required to be licensed or registered with APHIS. “Commercial activity” is a prerequisite for licensing; pet owners are not eligible to apply for a license from APHIS. Some states grant exemptions to individuals, entities, and organizations that are licensed or permitted by USDA.

An APHIS position statement on the private ownership of large cats recognizes that large wild and exotic cats, are dangerous animals, and only qualified trained professionals should keep these animals “even if they are only to be pets” (APHIS, 2000). In the same statement APHIS notes that it does not

regulate the ownership and care of large wild and exotic cats as pets, but that state and local laws may apply in some situations.

Under the Lacey Act Amendments of 1981, regulated and enforced by FWS, it is unlawful to import, export, transport, sell, purchase, receive or acquire wildlife taken, possessed, transported, or sold in violation of federal, state, foreign or Native American tribal laws, treaties or regulations. The Act applies to those fish, wildlife, and plants, including their parts or products, which are indigenous to the US and included in the appendices to CITES or listed under state conservation laws.

In late 2003, Congress passed the Captive Wildlife Safety Act (CWSA) that amends The Lacey Act, making it illegal to import, export, buy, sell, transport, receive or acquire, in interstate or foreign commerce, live tigers and other large cats, including any hybrid combination of any of listed large cats, unless certain exceptions are met. Exemptions under the CWSA include: individuals licensed or registered by APHIS, state colleges, universities, or agencies (e.g., state-licensed rehabilitators or veterinarians), and accredited wildlife sanctuaries.

FWS's stringent permitting process is widely considered a reasonably effective deterrent to uncontrolled trafficking. Despite criticism from conservationists that the ESA is not strong enough, and opponents that it is too strong, the ESA (and the Lacey Act Amendments) have dramatically reduced the importation of tigers into the US. From the perspective of tiger conservation, it is difficult to import or export live tigers, even for zoos accredited by the Association of Zoos and Aquariums (AZA).

The effectiveness of APHIS to enforce the AWA is much less obvious. The core mission of APHIS is to protect the health and value of American agriculture and natural resources. While APHIS is charged with determining standards of humane care and treatment of animals, its role in enforcing animal welfare laws is more recent. Inspecting and permitting commercial exhibitors is a small component of its overall mission. In addition, exotic pet owners may become "exhibitors" under the AWA and receive a license, which allows them to circumvent state laws that prohibit private possession of large cats.

Supporters of the CWSA hoped the law would help to reduce the number of large cats in private ownership. It has made transporting tigers and other large cats from one state to another more difficult, but individuals wanting to own pets can still circumvent these restrictions by obtaining an APHIS exhibitor's license.

State laws and regulations: State regulations of tigers and other large cats are typically categorized as bans, licensing and permitting systems, or more general certification requirements. As of 2011, for tigers specifically, 32 states have bans, 12 have license or permit requirements, six have general regulations, and two have no form of regulation.

Chapter 1. Ambient Environment

1.1 Temperature and Humidity

Animal collections within AZA-accredited institutions must be protected or provided accommodation from weather and any adverse conditions detrimental to their health or welfare (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 institutions with exhibits which rely on climate control must have critical life-support systems for the animal collection and emergency backup systems available. Warning mechanisms and backup systems must be tested periodically (AZA Accreditation Standard 10.2.1).

Although species of large felids originate from widely varying climates, most are tolerant of fluctuating temperature extremes, at least during daylight hours. Individuals of all species can be housed outside, though opportunities for the animals to regulate their own temperatures should be provided.

AZA Accreditation Standard

(1.5.7) The animals must be protected or provided accommodation from weather or other conditions clearly known to be detrimental to their health or welfare.

AZA Accreditation Standard

(10.2.1) Critical life-support systems for the animals, 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. Warning mechanisms and emergency backup systems must be tested periodically.

Hot conditions: Animals kept outside should always have access to shade, especially during the warmer months of the year. Shade covered perches and air-conditioned fans blowing into the exhibit but mounted outside of the fence can be provided within the exhibit. Where multiple tigers are housed within the same exhibit, it is recommended that there be more suitable shady areas than there are tigers, so that each animal has the opportunity to utilize shade without having to be in close proximity to a conspecific. Tigers should be routinely monitored during temperature extremes. Tropical tigers such as Sumatran and Malayan subspecies live in environments where temperatures can exceed 90^{o} F (32^{o} C), while the Amur subspecies lives in climates that regularly drop below -29**°C** (20^{o}F), so the best management practice is to closely monitor individual tigers and make adjustments accordingly.

Cold conditions: It is recommended that institutions in northern climates consider providing access to indoor enclosures, or provide supplemental heat in temperatures below freezing (particularly for tropical tiger subspecies). Providing underground forced water heated areas (e.g., "hot rocks"), which can be operated either manually or automatically, will provide the animals with opportunities to use a greater proportion of the exhibit during colder conditions. Northern subspecies (e.g., Amur tigers) without young require only minimal unheated shelter at night, although management needs may dictate that they be brought into heated nighttime housing.

Humidity: There appear to be no ill effects to large cats that result from any particular relative humidity. However, the relative humidity of indoor exhibits should range between 30–50%, because higher levels of humidity may cause condensation on glass surfaces.

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. Because of their large size and activity patterns, large felids should be maintained in outdoor enclosures with access to natural light. In the wild, most species of large felids tend to be more active at dawn, dusk, and nighttime, and less active during daylight hours. In zoos, they adapt to the schedule of care, being active when allowed to shift into their outdoor exhibit, and later in the afternoon when they expect to return inside for feeding. Optimally, lighting should be a combination of natural and artificial illumination. Indoor lighting should mimic the normal level of natural lighting. Fluorescent lighting is an efficient light source, providing broad-spectrum illumination. Lighting should be sufficient to evaluate the health of the animal, determine the safety of the exhibit, and for sufficient cleaning, however, lower light levels might be advantageous for exhibition purposes. Lighting also should be sufficient for safety reasons, such as for monitoring by keepers. The use of skylights to provide natural light in holding areas is recommended where feasible.

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 fish, marine mammals, and other aquatic animals. A written record must be maintained to document long-term water quality results and chemical additions.

Water: Pools and moats should to be designed for maintaining high water quality through filtration or draining, and for ease of cleaning and sanitizing, as tigers tend to defecate in water. Although no special filtration systems are recommended, all water provided to the animals must be potable, and changed as appropriate to remain fresh and uncontaminated as per USDA guidelines. Each enclosure should provide a water source that can be cleaned and disinfected, that is accessible to both the tigers and keepers, and that can be shut off and drained. Drains should be of sufficient size to accommodate cleaning. Non-reservoir watering systems (such as self-waterers used in animal laboratories) are not recommended, as these can malfunction and inadvertently deprive the cat of water if not checked daily, which may be difficult from outside the enclosure.

Air: For indoor enclosures, the number of air changes per hour of non-re-circulated air needed to control odors and to maintain a healthy condition for the animals and public will vary based on both the numbers of animals in the enclosure and the size/volume of the enclosure. The initial design should be for the maximum number of animals that could be housed in that particular enclosure. The recommended standardized rate of exchange for non-re-circulated air for a pet shop is 1.0 cubic feet of non-recirculated air/minute/ft^2 of floor space, to keep odors and humidity at a level satisfactory to the public (Anonymous, 1981). Another useful recommendation is to follow Laboratory Animal Standards which are 15 air exchanges per hour. In the winter, lower air changes and increased air re-circulation conserves heat, and in summer, systems operate with 15 full air changes (J. Aquilina, Personal communication). Glass barriers and separate ventilation systems between exhibit and visitor areas will help reduce the potential of disease transmission from the public as well as complaints about odor.

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. Tigers have excellent hearing, and staff should pay special attention when there is unusual or excessive noise around the enclosure, as this may cause stress or aggression. This is even more important when there is a pregnant female on site.

Chapter 2. Habitat Design and Containment

2.1 Space and Complexity

Careful consideration should be given to exhibit design so that all areas meet the physical, social, behavioral, and psychological needs of the species. Animals must be well cared for and presented in a manner reflecting modern zoological practices in exhibit design (AZA Accreditation Standard 1.5.1). All animals must be housed in safe enclosures that meet their physical and psychological needs, as well as their social needs. (AZA Accreditation Standards 1.5.2, 1.5.2.1, 1.5.2.2).

AZA Accreditation Standard

(1.5.1) All animals must be well cared for and presented in a manner reflecting modern zoological practices in exhibit design, balancing animals' welfare requirements with aesthetic and educational considerations.

All tiger exhibits should include the following features:

- Relatively large, complex outdoor space;
- Water pools, moats, and/or running streams;
- Natural vegetation;
- Trees or other natural substrate objects to allow nail grooming
- Reduced exposure of bars or concrete from the public viewing side.

AZA Accreditation Standard

(1.5.2) All animals must be housed in enclosures which are safe for the animals and meet their physical and psychological needs.

AZA Accreditation Standard

(1.5.2.1) All animals must be kept in appropriate groupings which meet their social and welfare needs.

Regardless of the enclosure use, the design should avoid a situation in which an animal cannot be fully viewed for monitoring, or reached and shifted for potential treatment or immobilization. Opportunities should be provided for natural behaviors such as scratching, running, jumping, climbing, scent marking, swimming, and resting.

AZA Accreditation Standard

(1.5.2.2) All animals should be provided the opportunity to choose among a variety of conditions within their environment.

The same careful consideration regarding exhibit size and complexity and its relationship to the tiger's overall well-being must be given to the design and size of all enclosures, including those used in exhibits, holding areas, hospital, and quarantine/isolation (AZA Accreditation Standard 10.3.3). Sufficient shade must be provided by natural or artificial means when sunlight is likely to cause overheating or discomfort to the animals (AZA Accreditation Standard 10.3.4).

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. AZA housing guidelines outlined in the Animal Care Manuals should be followed.

AZA Accreditation Standard

(10.3.4) When sunlight is likely to cause overheating of or discomfort to the animals, sufficient shade (in addition to shelter structures) must be provided by natural or artificial means to allow all animals kept outdoors to protect themselves from direct sunlight.

Exhibit design: Newer exhibits in AZA-accredited zoos have progressed toward the use of open-air enclosures with live vegetation and natural soil substrates. Each exhibit should have enough elevated platform(s) to accommodate all animals simultaneously, if multiple tigers are exhibited together.

The recommended enclosure design includes the addition of "furniture" that provides the tiger(s) with a variety of sites to stimulate species-appropriate behaviors. The use of the 3-dimensional space within the enclosure, including the placement of trees, deadfalls, and other furniture of varying heights, can effectively promote a wide range of locomotion and resting behaviors. Providing logs or timbers promotes natural behaviors such as territory marking and scratching, which helps with claw wear and maintenance (i.e., to help reduce ingrown claws and resultant problems). *Please note*: Tree height and placement within the enclosure needs to be carefully evaluated; tigers have been observed to climb trees in several institutions, and trees placed too close to the barrier fences could result in a tiger escape. Also, high winds can break large overhead branches that may fall and break or bridge fence lines, allowing a tiger access out of an exhibit.

A raised platform 1 m (3 ft) high in each enclosure (also placed away from fences) allows the animal to be off the floor on a comfortable surface and gives adults relief from young cubs. The addition of a concrete pool is key in tiger exhibits. Pools can be placed on the ground within the exhibit, or can be built

into the enclosure floor. Veterinarian-approved plants in the enclosure are recommended to provide shade and environmental complexity. Care should be taken to avoid toxic species and species that need to be replaced frequently. All enclosures should allow each animal the ability to retreat from conspecifics through the use of visual barriers such as rock outcroppings, hills, and foliage, without limiting an animal's access to food, water, heat, or shade.

It is recommended that facilities provide the ability to shift tigers from one area of the unit to another without the need of crating or immobilization. An effective operant conditioning program is also important (see Chapter 9.1). The design of the exhibit should provide easy shifting during normal daily management routines, and especially during manipulative procedures for medical treatment. The design should include the ability to see the tiger at all times. The facility should also include provisions to encourage or promote a reluctant animal to a desired location by use of narrow chutes subdivided by several doors. The addition of a scale to these chutes can allow for routine weights to be taken from the tigers as they shift from one enclosure to another.

Spatial recommendations

Exhibit enclosure sizes must meet or exceed federal, state, or local regulations. It is recommended that exhibit enclosures measure at least 40 ft. (12 m) wide x 40 ft. (12 m) deep (1,600 sq ft/144 sq m); enclosures should be 50 percent larger per additional animal. All enclosures should have smaller shift facilities to permit safe cleaning, exhibit maintenance, or other separations. It is recommended that shift and/or holding area enclosures measure at least 8 ft. (2.4 m) wide x 8 ft. (2.4 m) deep (64 sq ft/5.8 sq m). Whenever possible, tigers should be given access to multiple enclosures to increase their living space and exceed the minimum recommendations. Also, it is highly recommended that institutions planning new tiger exhibits design them to exceed the minimum recommendations. The typical exhibit size in AZA tiger-holding institutions (as of 2012) is 2,500 sq. ft. – 10,000 sq. ft. (average 5,500 sq. ft.). The average holding enclosure size is greater than 100 sq. ft. It is recommended that institutions with multiple adult tigers, regardless of their sex, have the ability to physically separate individuals long-term.

For institutions wishing to breed, a minimum of four dedicated holding spaces are recommended for separating adult male and female tigers and male and female cubs. Multiple exhibits are also recommended for better rotation sequence.

Substrates: In general, natural outdoor dirt substrates are recommended for tiger exhibits (AZA Felid TAG recommendation, 2006). Since dirt substrates can become contaminated with high concentrations of microorganisms and parasites over time, care should be taken to remove and replace substrates on a regular basis.

For indoor enclosure areas that have non-dirt substrates, the choices of flooring are extensive. The most common material is concrete, which by itself is not recommended due to its porosity, abrasiveness, and hardness. Coatings over concrete, such as asphalt compounds, epoxy coatings, etc., provide a more acceptable surface by sealing, smoothing, and softening the floor. These surfaces can be easily cleaned, disinfected, rapidly dried, and are non-porous to prevent accumulation of organic debris and contamination. Any surface used should provide good traction for tigers, especially when wet, but should not be abrasive so as to cause footpad trauma during normal movement or exaggerated pacing. If the surface is too hard (e.g., concrete), trauma to bony prominences in normal resting or sleeping positions can result. Although rubberized flooring is soft, it can be easily damaged and ingested by tigers, and thus, is not recommended.

Bedding materials: Under normal circumstances, tigers do not require bedding materials, however, they should be provided with sleeping ledges or wooden platforms (see Chapter 1.4). In situations where a pregnant female is being housed, denning boxes should be provided (see Chapter 8).

Water placement and presentation: In outdoor exhibits or large indoor enclosures, water features for drinking, bathing, and aesthetics can be added in the form of pools, streams, and/or waterfalls. Tigers enjoy bathing and swimming, and large concrete pools 1 m (3 ft) or more in depth can be incorporated into outside exhibits. Location and climate of the institution should be taken into consideration when planning for water moat barriers, as in colder climates, the moat water could freeze and provide a jumping surface and subsequent tiger escape. Because animals will use all water sources for drinking, any water features provided should be cleaned weekly. Auxiliary drinking water sources should be provided in addition to larger water features since large moats or ponds will not be practical to drain on a weekly

basis, especially if they have a mud bottom. In hot climates, care should be taken not to place shallow pools in direct sunlight to avoid overheating and the growth of algae.

Water depth: A portion of the pool should slope gently from level ground down into the pool, and should contain both deep (e.g., greater than 1 m [3 ft]) and shallow areas, especially when young cubs are present.

Environmental variation: Enrichment items can be hidden in the exhibit to stimulate interest, exploration, marking, and feeding behaviors (see Chapter 9.2).

Cleaning and sanitation: Food and water containers should be cleaned daily and disinfected on a regular schedule. This is not necessary for items such as logs, play objects such as Boomer Balls® and other furniture. Dirt and grass substrates in outdoor enclosures should be spot-cleaned daily. Hard surface enclosures, both inside and out, should be cleaned daily and disinfected routinely. Large felids should not be given access to wet concrete floors, as slipping can lead to injury and endanger footpad health. The slope of man-made floors within enclosures should promote drainage from the tiger's enclosure. The tiger's floor should be above drain level so that a clogged drain will not flood or spill into the enclosure.

Tigers scent mark their territories, however, typical spot-cleaning of outdoor enclosures on natural substrate will not adversely affect this behavior. Walls and other raised surfaces should not be cleaned more than once or twice a week in order to maintain the animals' scent marks.

Natural dirt substrates can become contaminated over time with microorganisms and parasites, thereby exposing the cats to potentially dangerous concentrations of pathogens. Provisions should be made so that the contaminated substrate can be removed periodically and replaced with clean materials. Housing animals that have been properly quarantined and treated helps to reduce the potential contamination load on the substrate, especially the parasitic load.

Disinfection: For effective cleaning, hot water and a detergent should be used to remove organic debris followed by or coupled with the use of a disinfectant. Disinfecting agents should be selected on the basis of effectiveness and should have low toxicity to tigers. Disinfecting agents should not be used in concentrations that exceed the manufacturer's recommended effective dilution. Phenolic compounds should be avoided due to the susceptibility of felids to these chemicals. All detergents and disinfectants should be completely washed off, as per the manufacturer's directions, before the animal is returned to the enclosure. All cleaning compounds, disinfectants and other chemicals along with their Material Safety Data Sheets (MSDS) and/or Occupational Safety and Health Administration (OSHA) sheets, or other warning labels should be reviewed and approved by the zoo veterinarian prior to use.

Footbaths containing appropriate disinfectants should be used prior to entering and exiting all felid enclosures and service or quarantine areas. Their use should be strictly adhered to by all personnel. Footbaths should be changed out daily, or more frequently if noticeably soiled.

Pest management: An active and aggressive pest control program should be followed. Pest management should be done by appropriately licensed individuals or companies and in accordance with state and local laws. In addition to the aesthetic reasons for eliminating pests, their elimination is important in order to eliminate potential diseases found in feral mammals, birds, rodents, and insects. Fleas, ticks, and mites from feral mammals can be transmitted to tigers as can internal parasites. Feral animals serve as potential sources of pathogens such as the feline viral diseases, rabies, yersiniosis, leptospirosis, salmonellosis, toxoplasmosis, feline infectious peritonitis, etc.

The design of a tiger enclosure should be purposed to reduce exposure to feral animals. Well-maintained perimeter fencing provides an initial deterrent to larger feral animals, particularly dogs. However, climbing animals, such as feral cats, can easily defeat such barriers, thus areas around tiger enclosures should be monitored regularly for feral animal activity. Live trapping provides a method of removing feral animals that is acceptable to the public and humane animal interest groups, though trapping does not provide a total eradication of pests.

Rodents: Rodent pests should be handled through a well-planned, supervised, continuous pest control program. Safe rodenticides are available for use around tigers when they are applied according to their directions. Care should be taken in choosing compounds that are effective, yet not highly toxic, especially when considering secondary toxicities from the ingestion of treated rodents. A number of anticoagulant

rodenticides are available that are effective and have little or no secondary toxicity potential (e.g., warfarin, diphacinone, cholecalciferol, brodifacoum). These are the backbone of most vermin control programs. When rodent populations become unmanageable or resistant to anticoagulants, other more toxic compounds, such as zinc phosphide may be needed, requiring extra care in their application. It should be emphasized that at no time should tigers have primary access to any rodenticide. In addition, the program should be designed to minimize secondary exposure (i.e., consuming rodents that have fed on poisonous baits).

Insects: Good sanitation aids in reducing insect populations, but all zoological situations experience insect pests, particularly cockroaches. Insecticide applications can be made around tiger enclosures with chemicals that are safe when applied in a proper manner. There are many chemicals available, both primary insecticides (e.g., diazinon, piperonyl butoxide, natural and synthetic pyrethrins, carbamates, chlorpyrifos), and newer growth regulator compounds that have low toxicity potential when used correctly. Enclosures should be treated by removing the tigers, applying chemicals that have been deemed safe for use in primary enclosures, and then cleaning the enclosure to avoid exposure to the returning tigers. The residual chemicals in cracks and crevices should be minimal if contacted by tigers.

All personnel involved with tiger husbandry should participate in the planning stage of the pest control program, and be aware of the location, proper application, and safe handling of the compounds being used. Animal safety is a priority in any program. Inadvertent use or misuse of insecticides (and herbicides and miscellaneous toxic compounds not intended for use around animals) can lead to accidental exposure to tigers and possibly fatal results.

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).

AZA Accreditation Standard

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

Tigers are large, dangerous animals that can easily cause injury or death to other animals or humans, and great care should be used when in their proximity. All staff working with tigers should receive thorough training from managers and coworkers. It is important that tiger keepers understand the natural history as well as the individual history of the cats they work with. Operation of doors and other exhibit features should be thoroughly covered, as well as all safety guidelines and emergency procedures. A good tiger keeper will be safety conscious, attentive to protocols, and able to make decisions in an emergency.

Ensuring that doors, gates, and guillotines are secure is critical, as is regular checking of locks to ensure animals cannot escape. Keepers should perform routine morning checks of the exhibit perimeter to confirm the integrity of the enclosure/fence and to locate any damage that may have been caused from fallen branches/trees due to inclement weather. It is highly recommended that tigers be brought indoors whenever severe weather is predicted, night or day. Performing an accurate count of animals is recommended before entering any tiger space or enclosure. A system of keeper labels on entrances and shift doors will help ensure that staff does not enter animal enclosures while animals are present. However, staff should still double check animal and staff locations before shifting animals, and never depend solely on signs, "lock-out" tags, or other mechanical safety measures. It is also important when feeding or interacting with tigers for keepers to be cognizant of their surroundings, to avoid falling or leaning against caging, or entering fingers, arms, or extremities into the tiger cage.

Establishing a culture of safety consciousness in the area and throughout the institution is critical to maintaining a safe environment for staff, guests, and animals. Safety concerns should be taken seriously at all levels of the organization and violations of safety protocols should be considered serious disciplinary issues. Double-checking locks and maintaining open communication is critical. Staff should recognize in themselves, as well as their coworkers, when personal issues such as illness or stress may cause a distraction and remove themselves from potentially dangerous parts of the routine. Simple safety guidelines for working with tigers:

- Count your cats;
- Assume nothing;

- Trust no one;
- Employ "hands off management," with possible exceptions for operant conditioning (see Chapter 9).

Some institutions have instituted a two-person rule in large cat areas, requiring that a second person be present for shifting, feeding, and other potentially dangerous activities. This procedure provides a backup to check locks and a way to hopefully catch a mistake before it becomes a problem. In the event of an injury or escape, this second person is also available to call for help. There are potential drawbacks to this procedure as well, the most obvious being the burden on a small staff. A second person can also be a distraction if both people are engaged in conversation and do not have their full focus on the task at hand. In an effort to be more efficient, two keepers in a large building may split up to complete their work, thereby negating the benefit of having the second person present. This can also create another potential hazard if the two keepers do not communicate carefully about their locations when cats are being moved around. Individual institutions should evaluate their staff and facility, considering all of these factors when deciding whether to implement this procedure.

All large cat keepers should carry a radio at all times and ideally the holding facility should also be equipped with a phone. The decision to allow staff to carry cell phones with them should be considered carefully. Cell phones can provide a keeper with another critical means of communication if the radio fails. However, the phone can also be a distraction, particularly if the keeper is receiving text messages or calls while working. Even if they are ignored, they still cause a distraction that can dangerously interrupt a train of thought during shifting, feeding, or training. Turning off all ring and vibration notifications is a potential solution to this problem.

Many institutions also provide pepper spray (marketed as a "bear deterrent") for large cat keepers, which have been proven to be effective in deterring large cats. Pepper spray should only be used in an emergency situation when a keeper finds him/herself in the same space and close proximity to a large cat. It may provide the keeper a few moments to escape the immediate area and will have no long-term effect on the cat. Staff should be carefully trained in how to use the spray and informed of the potential risks to other people and animals if it is accidentally discharged. In areas where pepper spray has not been allowed, marine flares have also been used as a potential deterrent in emergency situations.

If non-animal staff (e.g., maintenance, IT, horticulture, etc.) are working in tiger areas, staff should provide close supervision if animals are present. This includes careful tracking of the number of people entering and leaving the area and strict instructions as to where they are allowed to go and what they are allowed to do. Non-zoo staff (e.g., contractors, guests, etc.) should be escorted at all times and provided careful instruction before entering the area. Depending upon the facility design, lines may be painted on the floor to indicate safe distance from cages.

Acceptable forms of human/animal interaction: Successful husbandry and reproduction (if desired) depends on stable, long-term relationships between large cats and their keepers. Most animals quickly adapt to daily routines, shifting readily as well as accepting training to allow routine and non-routine veterinary tasks (see Chapter 9). They also quickly recognize familiar keepers by their voice, sounds of their steps, and other behaviors, and may respond aggressively (e.g., hissing, growling, charging cage fronts) under routine circumstances. Keeper interaction can include imitating a chuffing/prusten vocalization made by tigers as a form of greeting, which will be returned by the animal toward familiar staff. Free contact with tigers is very dangerous, and is not recommended (AZA Felid TAG recommendation), except when hand-rearing abandoned cubs (see Chapter 8.5).

AZA Accreditation Standard

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

AZA Accreditation Standard

(1.5.15) All animal exhibit and holding area air and water inflows and outflows must be securely protected to prevent animal injury or egress.

Animal exhibits and holding areas in all AZA-accredited institutions must be secured to prevent unintentional animal egress (AZA Accreditation Standard 11.3.1). All animal exhibit and holding area air and water inflows and outflows must also be securely protected to prevent animal injury or egress (AZA Accreditation standard 1.5.15). Pest control methods must be administered so there is no threat to the animals, staff, public, and wildlife (AZA Accreditation Standard 2.8.1). Exhibit design must be considered carefully to ensure that all areas are secure and particular attention must be given to shift doors, gates, keeper access doors, locking mechanisms, and exhibit barrier dimensions and construction.

AZA Accreditation Standard

(2.8.1) Pest control management programs must be administered in such a manner that the animals, paid and unpaid staff, the public, and wildlife are not threatened by the pests, contamination from pests, or the control methods used.

Types of containment: The size, nature, and abilities of the tiger require secure containment that will both contain the animal and protect the public and keepers. Various types of containment barriers and materials can be used. In general, metal bars provide the greatest strength and the least maintenance. However, bars can also lead to tiger trauma through biting or attacking, trapping of limbs or heads due to inadequate spacing, or permitting physical aggression from adjacent cats due to improperly designed barriers. Wire is not as strong as metal bars, and can be vulnerable to destruction. Welded wire mesh of sufficient gauge is acceptable for tiger enclosures, however, if improperly installed or constructed of inadequate material, the barrier may trap limbs, heads, or teeth, especially in young animals. Glass provides greater visibility, but is vulnerable to fracture, and requires greater maintenance. For the various types of primary barriers listed below, all materials which compose or coat said barriers should be non-toxic, non-irritating, and should not be expected to induce any sort of trauma.

Moats and solid walls: If housed outside, enclosures with dry or wet moats measuring a minimum of 7.6 m (25 ft) wide will contain tigers. Dry moats and exterior walls should be smooth and at least 4.2 m (14 ft) high topped with a 1 m (3 ft) inward facing overhang of wire mesh (6-gauge composition) on the tiger's side, creating a total height of 4.8 m (16 ft). Zoos in cold environments must guard against water (e.g., in moats, waterfalls) freezing, which would permit possible escape of the tiger. Dry moats should have a large drain capable of carrying away rain, seepage, and wash water.

Fencing: All fences should be 4.8 m (16 ft) high and stand vertical except for the topmost 1 m (3 ft), which should be turned inward toward the exhibit at a 45° angle. Cantilevered supports with mesh or fencing material are recommended for open-top fenced exhibits. Zoos with outdoor enclosures using wire fence perimeters should consider the nature of the soils that comprise the substrate. If soft soils are present, chain link fencing that makes contact with a natural substrate should be to a depth of 91 cm (36 in.) along that perimeter, with a 91 cm (36 in.) apron at the bottom extending into the exhibit as a dig barrier, in order to prevent digging or bending of the fencing at the bottom from pushing. Chain link fencing can also be attached to a concrete footing. Fencing on hard surfaces with horizontally supported fencing or metal panels are adequate without burial. Fence or mesh material should be no less than 6-gauge composition, with mesh opening dimensions of either 5 x 10 cm (2 x 4 in.), 7.6 x 7.6 cm (3 x 3 in.), or 10 x 10 cm (4 x 4 in.). However, a mesh measuring no more than 5 x 5 cm (2 x 2 in.) is recommended in keeper work areas to prevent injury resulting from a cat reaching through the mesh openings. Lightweight mesh is not appropriate for tigers. Also, the use of a flexible mesh increases the potential for damage to teeth or the mesh itself, because tigers will often bite or pull on mesh.

Care should be taken to ensure that there are no large trees close to the perimeter fence that if climbed by tigers would allow any access to the top of the fence. There are no reports of tigers regularly climbing trees in the wild, but there are several European and Australian zoos that train adult Sumatran tigers to scale 20-30 ft (7-9 m) tree trunks as part of their daily public presentations, and both Amur and Sumatran tigers in AZA-accredited zoos have been reported to climb trees. Though most adult tigers do not climb trees, there is enough evidence of tree climbing to indicate that tree trunks and/or tree branches close to fence lines could be used for escaping. Do not provide this opportunity. In addition, care should also be taken to ensure that high winds or tree diseases cannot topple the tree onto the fence, or cause a heavy branch to break and fall onto it. Any perimeter fence around the exhibit should be checked every day before animals enter the exhibit to be sure that the fence has not been damaged.

Glass: Large glass panels provide greater visibility for keepers and visitors, but require greater maintenance due to the need to keep the glass clear of smudges and dirt resulting from tigers pawing and rubbing against the glass. Laminated safety glass 3.8 cm (1.5 in.) thick, properly secured using manufacture's specifications, is recommended when glass is used as a barrier.

Hotwire: Fence chargers and electric fences by themselves have no place in the primary containment of tigers, and are not recommended as types of primary containment. The use of "hot wires" to keep tigers away from some areas of the enclosure is an institutional decision.

Doors: All doors, including the keeper access and shift doors, should provide the ability to be locked. The design should provide safe access to animal areas for zoo staff. Animal access to the exhibit should be

by remotely operated shift doors; sliding or guillotine types are preferred with a secure and easily checked locking mechanism reinforced with padlocks. Signage on the door or near the exhibit that alerts keepers as to whether there are animals in the exhibit, if it is being serviced, etc., should be considered as an additional safety mechanism. Door handles and controls should also be clearly labeled or color-coded as to which door they operate and whether they are in the open or closed position. All doors to tiger exhibits should have a secondary containment to serve as a safety measure against escape.

AZA Accreditation Standard

(11.3.6) There must be barriers in place (for example, guardrails, fences, walls, etc.) of sufficient strength and/or design to deter public entry into animal exhibits or holding areas, and to deter public contact with animals in all areas where such contact is not intended.

Secondary containment: Exhibits in which the visiting public is not intended to have contact with animals must have a barrier of sufficient strength and/or design to deter such contact (AZA Accreditation Standard 11.3.6).

Secondary guardrails should be utilized wherever the potential exists for public contact with primary containment fencing or mesh materials. Designers should consult state or local regulations and guidelines for public barriers to exhibit contact. The public should be protected from unauthorized contact with tigers. Public viewing points composed of tempered glass are commonly used, and these do not require the use of secondary guardrails. Moated exhibits do not necessarily require guardrails, but guardrails do tend to discourage the public from climbing onto or placing children on the containment wall. On the public side, a guardrail or barrier of a height that meets or exceeds building codes [commonly 106.68 cm (42 in.) or greater] is recommended, and the vertical surface should lack footholds that would allow guests, particularly children to climb. Ensuring that children can view the exhibit while standing on the ground will help reduce the temptation to climb walls and fences.

Due to the aggressive and dangerous nature of tigers, exhibits and service areas should also have a secondary door system to maximize safety through keeper error. Convex mirrors can be used in areas where keepers cannot see down a hallway without entering the service area. Small, secure windows in exterior doors can also provide a safe way to view an area without entering.

AZA Accreditation Standard

(11.2.4) All emergency procedures must be written and provided to appropriate paid and unpaid staff. Appropriate emergency procedures must be readily available for reference in the event of an actual emergency.

AZA Accreditation Standard

(11.6.2) Security personnel, whether employed by 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 procedures: All emergency safety procedures must be clearly written, provided to appropriate paid and unpaid staff, and readily available for reference in the event of an actual emergency (AZA Accreditation Standard 11.2.4).

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

(11.2.5) Live-action emergency drills (functional exercises) must be conducted at least once annually for each of the four basic types of emergency (fire; weather or other environmental emergency appropriate to the region; injury to visitor or paid/unpaid staff; and animal escape). Four separate drills are required. These drills must be recorded and results evaluated for compliance with emergency procedures, efficacy of paid/unpaid staff training, aspects of the emergency response that are deemed adequate are reinforced, and those requiring improvement are identified and modified. (See 11.7.4 for other required drills).

Emergency drills must 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 must be recorded and results evaluated for compliance with emergency procedures, efficacy of paid/unpaid staff training, aspects of the emergency response that are deemed adequate are reinforced, and those requiring improvement are identified and modified (AZA Accreditation Standard 11.2.5). AZA-accredited institutions must have a communication system that can be quickly accessed in case of an emergency (AZA Accreditation Standard 11.2.6). A paid staff member or a committee must be

AZA Accreditation Standard

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

designated as responsible for ensuring that all required emergency drills are conducted, recorded, and evaluated in accordance with AZA accreditation standards (AZA Accreditation Standard 11.2.0).

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 11.2.7)

AZA-accredited institutions which care for potentially dangerous animals must have appropriate safety procedures in place to prevent attacks and injuries by these animals. Animal attack emergency response procedures must be defined and personnel must be trained for these protocols (AZA Accreditation Standard 11.5.3).

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

Recommended tiger escape protocol: Personnel authorized to utilize firearms for emergency containment of tigers should have professional training and regular practice. Stored firearms must be in a locked cabinet that will impede unauthorized entry and located in a secure area that is accessible only to authorized personnel trained in their use (AZA Accreditation Standard 11.6.3). Additionally it is suggested to have other types of devices readily available in staff areas near tiger exhibits to distract tigers in an emergency (e.g., noise making devices such as fog horns, CO_2 fire extinguishers, and marine flares).

AZA Accreditation Standard

(11.2.0) A paid staff member or a committee must be designated as responsible for ensuring that all required emergency drills are conducted, recorded, and evaluated in accordance with AZA accreditation standards (see 11.2.5, 11.5.2, and 11.7.4).

AZA Accreditation Standard

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

AZA Accreditation Standard

(11.5.3) Institutions maintaining potentially dangerous animals 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.

AZA Accreditation Standard

(11.6.3) Stored firearms must be in a locked cabinet of sufficient construction and design to impede unauthorized entry, and located in a secure area and accessible only to authorized personnel trained in their use.

Security personnel must be trained to handle all emergencies in full accordance with the policies and procedures of the institution. In some cases, security personnel may be in charge of the respective emergency (AZA Accreditation Standard 11.6.2). See Chapter 9.4 for more information on staff training.

AZA-accredited institutions must have a communication system that can be quickly accessed in case of an emergency (AZA Accreditation Standard 11.2.6), and must 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).

Tigers are large, dangerous animals and each institution should develop their own safety protocols applicable to their facility design, staffing responsibilities, and area operating procedures. These protocols should specifically address animal containment monitoring when tigers are provided with 24/7 access to outdoor areas (e.g., the need for trained animal care staff to be present at all times during any 24-hour period, and after-hour response protocols for gun teams, etc.), but such protocols should be in place whether the animals have 24-hour access to the exhibit or not. For facilities that use hot wire as part of their containment system, back-up emergency generators should be considered. Safety protocols should address animal escapes as well as natural disasters relevant to the location of the zoo or aquarium.

Protocols should address moving animals at any time of the year, if needed, and include crate and transportation availability, as well as an agreement with other zoos and aquariums in the local/extended area in regards to housing displaced tigers on a temporary basis, if necessary.

All emergency protocols should address the role that veterinary teams play in animal immobilization, as well as the role of the gun team in an escape. Inclusion of local law enforcement personal in the development of these safety/emergency protocols is recommended, and notification of emergency agencies of existing protocols will also be beneficial.

The strength, speed, and carnivorous nature of tigers make them dangerous animals to work with and the AZA Tiger SSP recommends that all institutions include tigers as one of the key species in any animal attack emergency drills. They also recommend that appropriate training be provided to animal caretakers involved in any aspect of tiger management and care. Given the wide range of institutional staff and facility set-ups, no specific emergency response recommendations can be provided to individual zoos and aquariums. When an institution houses tigers, keeping firearms for emergency situations in which no other option remains to protect the public, staff, and/or other animals, should be given serious consideration. This choice carries substantial obligations in staff training and proficiency, drilling, record-keeping and preparation of policy and procedure, and is as much the institution's responsibility as the decision to manage potentially lethal animals in its collection. It is recommended that all relevant staff members at institutions housing tigers be involved in the process of developing safety procedures, staff training protocols, effective documentation procedures, and documentation templates, which make the most sense for the individual institution, its staff, equipment, and local conditions.

No matter how well designed a tiger facility is for containing tigers, either through accidents or unforeseen reasons, there is a possibility of a tiger escaping its enclosure. It is important to respond immediately in a calm and professional manner in order to protect zoo staff and visiting public. A tiger that escapes from its enclosure is to be responded to immediately. Tigers are housed in a variety of areas which include exhibits, cages (large and small), and holding areas. When a tiger escapes from one of these areas into a service or public area or into an animal exhibit, an emergency protocol must be in place. A zoo employee should be instructed to call Police, Fire Department, or Ambulance if needed. Designate a person to meet and direct assistance where needed.

Chapter 3. Records

3.1 Definitions

In the zoo and aquarium world, animal records are defined as "data, regardless of physical form or medium, providing information about individual animals, samples or parts thereof, or groups of animals". Most animals in zoo and aquarium collections are recorded and referred to as individuals, and this applies to tigers. Tigers should be recorded as individuals.

3.2 Types of Records

There are many types of records kept for the animals in our care, including but not limited to, veterinary, husbandry, behavior, enrichment, nutrition and collection management. These types of records may be kept as separate records as logs in separate locations or as part of the collection records and some may be required by regulating agencies or per AZA Accreditation Standards (e.g., emergency drill records).

Recordkeeping is an important element of animal care and ensures that information about individual animals is always available. The institution must show evidence of having a zoological records management program for managing animal records, veterinary records, and other relevant information (AZA Accreditation Standard 1.4.0). These records contain important information about an individual animal, including but not limited to taxonomic name, transaction history, parentage, identifiers, gender, weights, enclosure locations and moves, and reproductive status (see Appendix B for Guidelines for Creating and Sharing Animal and Collection Records). Many zoos utilize the Zoological Information Management System (ZIMS), or software such as Tracks®.

A designated staff member must be responsible for maintaining the 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 current (AZA Accreditation Standard 1.4.7). Complete and up-to-date animal records must be duplicated and stored at a separate location (AZA Accreditation Standard 1.4.4) and at least one set of historical records safely stored and protected (AZA Accreditation Standard 1.4.5).

AZA member institutions must inventory their tiger population at least annually and document all tiger acquisitions, transfers, euthanasias, releases, and reintroductions (AZA Accreditation Standard 1.4.1). All tigers 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). All AZA-accredited institutions must abide by the AZA Policy on Responsible Population Management (Appendix C) and the long-term welfare of animals should be considered in all acquisition, transfer, and transition decisions. Studbook-registered tigers should be recorded to the subspecies level. Generic tigers (i.e., subspecies hybrids or tigers whose pedigrees cannot be traced to the wild-caught founders) should be recorded to the species level.

The Tiger SSP does not have its own forms for data collection, acquisition/disposition, or breeding loans. Rather, such forms are the responsibility of the individual institutions. Most of the Tiger SSP-

AZA Accreditation Standard

(1.4.0) The institution must show evidence of having a zoological records management program for managing animal records, veterinary records, and other relevant information.

AZA Accreditation Standard

(1.4.6) A paid or unpaid 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 paid and unpaid animal care staff members apprised of relevant laws and regulations regarding the institution's animals.

AZA Accreditation Standard

(1.4.7) Animal and veterinary records must be kept current.

AZA Accreditation Standard

(1.4.4) Animal records, whether in electronic or paper form, must be duplicated and stored in a separate location. Animal records are defined as data, regardless of physical form or medium, providing information about individual animals, or samples or parts thereof, or groups of animals.

AZA Accreditation Standard

(1.4.1) An animal inventory must be compiled at least once a year and include data regarding acquisition, transfer, euthanasia, release, and reintroduction.

AZA Accreditation Standard

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

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.

participating institutions are members of Species 360 (formerly International Species Information System) and use ZIMS for animal and veterinary records.

3.3 Permit Considerations

The tiger is regulated by federal and state governments. Therefore, possession and/or specific activities involving these species usually require a permit (or permits) issued by a regulating agency, granting permission for possession and/or the specific activities. Depending on the agency involved, the application and approval process may take a few days to many months. These permits must be received by the applicant before the proposed possession or activity can occur. All tiger species (*P. tigris*) are listed as Endangered under the U.S. Endangered Species Act (ESA), and the importation of live tigers, parts and products into the U.S. is prohibited, except under certain conditions. (http://www.fws.gov/international/animals/tigers.html). The normal time for permit processing is at least 90 days, but may take considerably longer. Also, local laws that govern tiger possession and movement should be checked state-by-state.

3.4 Government Ownership

It is incumbent on all zoos and aquariums to accurately record ownership and follow the established record-keeping protocols. While no tigers are currently claimed as being owned by a range state's government, if this changes AZA's Institutional Data Management Advisory Group's Government Ownership Working Group (IDMAG GOWG) should be consulted.

3.5 Identification

Ensuring that animals are identifiable through various means increases the ability to care for individuals more effectively. All tigers held at AZA facilities must be individually identifiable whenever practical, and have corresponding identification (ID) numbers. These IDs should be included in specimen, collection and/or transaction records and veterinary records. Types of identifiers include:

AZA Accreditation Standard

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

Physical identifier:

It is recommended that each tiger be individually identified with a subcutaneous microchip (transponder) and a tattoo of its studbook number (AZA Felid TAG recommendation, 2006). The recommended placement of the transponder and the location of the tattoo (see below) may undergo review.

Transponders: The use of a standard system and transponder location simplifies the identification of tigers transferred between institutions Glass encapsulated microchip transponders placed subcutaneously behind the left ear or between the scapula provides a primary permanent identification method. The brand, the placement and the number must be recorded in the specimen's record.. At the present time, transponders are available from Trovan®, Avid® and Home Again®. All these transponder brands can be read by a universal reader. A microchip should be implanted at the time of neo-natal vaccinations, during quarantine or when the opportunity otherwise arises.

Tattoos: Tattoos may be placed in various locations. The medial (inside) surface of the upper rear leg is recommended for many exotic felids. This location is large enough to permit large, legible tattoos to be placed, while not normally being visible when the cat is on public display. The tattoo must be an identification number unique to that individual animal; the animal's permanent studbook number is recommended (AZA Felid TAG recommendation, 2006). The placement and the number must be recorded in the specimen's record.

Photographs: Pictures of the faces and specific markings of each individual animal can also be utilized to identify the individuals in the collection.

A unique feature, such as a scar or permanent limp, might also be an identifier.

Intangible identifiers:

These include, but are not limited to, institutional accession number, house name, public name, studbook number, and ZIMS Global Accession Number.

Chapter 4. Transport

4.1 Preparations

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). All temporary, seasonal, and traveling live animal exhibits must meet the same accreditation standards as the institution's permanent resident animals, with foremost attention to animal welfare considerations (AZA Accreditation Standard 1.5.10). Safe animal transport requires the use of appropriate conveyance and equipment that is in good working order.

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.

AZA Accreditation Standard

(1.5.10) Temporary, seasonal and traveling live animal exhibits, programs, or presentations (regardless of ownership or contractual arrangements) must be maintained at the same level of care as the institution's permanent resident animals, with foremost attention to animal welfare considerations, both onsite and at the location where the animals are permanently housed.

The long-term management of the health of tigers begins before the arrival of the animal, with appropriate planning of the management program and with arrangements to transfer and receive the animal that protect the tiger's health. Shipment procedures for tigers require good organization to minimize stress to the animal. Prior to shipment, the health status of the tiger should be evaluated by a pre-shipment examination (see Chapter 7.2). If possible, the animal should have access to its shipping crate for 2 weeks prior to shipment to become familiar with the crate. The tiger should also be fed within its crate to build an association between the crate and a positive experience. In the United States, the design of the crate must meet the US Department of Agriculture (USDA) requirements and be strong enough to safely hold the tiger. International Air Transport Association (IATA) requirements must be met for international shipments and provide reasonable guidelines for most tiger transfers. IATA publishes animal transportation guidelines annually, which are available for a fee. Airlines in the United States utilize these guidelines to determine the suitability of any animal crate for use in transport.

Husbandry, dietary and medical records should be transmitted to the receiving institution prior to shipment, and complete copies of these records should accompany the tiger during shipment. It is important that any tiger tranquilized for shipment be completely awake and standing before it travels.

Documentation: Health certificates, transaction paperwork, air-bills, and all other relevant documents should be attached to the crate and shipped along with animals. A document outlining details of the sending institution's husbandry procedures, diet, and behavior notes is an important component of this paperwork. The Animal Data Transfer sheet (ADT), a form printed by the American Association of Zoo Keepers (AAZK), is a convenient method.

Pre-shipment preparations: Training a tiger to enter a shipment crate in advance of actual transport is highly recommended, and can be accomplished using standard training techniques (see Chapter 9.1). Crate training helps to eliminate the need for general anesthesia. For information on pre-shipment medical evaluations that are recommended, see Chapter 7.2.

Transport container: Care must be taken that transport crates have no spaces that allow tigers to reach out with their claws. Padlocks should be on every door, and the keys should be included with the shipment paperwork that is attached to the crate. An extra key may be sent to the recipient ahead of time in case the paperwork attached to the crate comes off during shipment.

Crates for large felids are heavy, durable containers made of hardwood, metal, welded mesh, and/or iron bars. The frame should be made from metal bolted or screwed together and should include a spacer bar 2.5 cm (1 in.) deep along the side for air circulation. The interior should be metal lined.

Ventilation openings should be placed at heights that will provide ventilation at all levels, particularly when the animal is lying down. Exterior mesh ventilation openings, with a minimum diameter of 2.5 cm (1 in), should be open on all sides, entry door, and roof. The crate design should include an access area for use by a pole syringe. Many functional tiger crates have the ability to be opened from either end. One end, typically the one closest to the tiger's head, can be equipped with narrowly spaced bars (2.5 cm [1 in] between each bar) to visualize or feed the animal if necessary. This can then be covered for transport by a wooden door with appropriate ventilation holes. This end can also be equipped with a tray to hold

water that can be accessed from outside. The best doors for transport containers are those that slide vertically in a track (guillotine type), and are secured with screws into the crate and then padlocked as an additional measure. Additionally, handles should be positioned around the crate if manual unloading is necessary. Spacer bars on the bottom will aid in unloading with machinery.

The height of the container should allow the animal to stand erect with its head extended; the length of the container should permit the animal to lie in the prone position, and should be of a width to prevent the animal from turning around. There should be at least 10 cm (4 in) of clearance around the animal when standing in a normal position. See Figure 1 for more details.

Figure 1: An example of a shipping container from The International Air Transport Association (www.iata.com).

CONTAINER REQUIREMENT 72

The illustrations shown in this Container Requirement are examples only. Containers that conform to the principle of written guidelines for the species but look slightly different will still meet the IATA standards.

Applicable to:

Bear species	Lion species
Binturong	Panther species
Cheetah	Puma species
Jaguar	Tasmanian devil
Leopard species	Tiger

Note:
The above species must be provided with space to lie comfortably but not turn around, except for bear species and binturong which must have space to turn around. There must be at least a 10 cm (4 in) clearance around the animal when standing in a normal position.

Note:
Should a veterinary certificate be provided stating that the large cat being shipped is suitable to be transported in a container which permits it to turn around, that container may be accepted for shipment.

STATE VARIATIONS: GBG-01/02/03/04, USG Variations

OPERATOR VARIATIONS: CO-04/05/09, QF-01, SV-01

1. CONTAINER CONSTRUCTION

Materials

Hardwood, metal, 1.3 cm minimum (½ in) plywood or similar material, welded mesh, iron bars.

Principles of Design

The following principles of design must be met in addition to the General Container Requirements outlined at the beginning of this chapter.

Dimension

The height of the container must allow the animal to stand erect with its head extended and the length must permit it to lie in the prone position. The measurements will vary with the species involved.

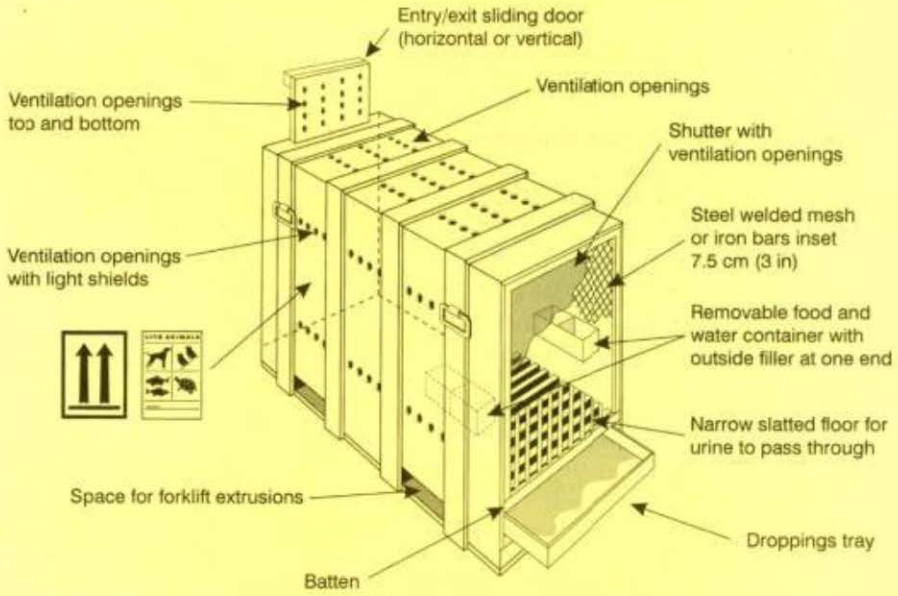
Frame

The frame must be made from solid wood or metal bolted or screwed together. The frame must provide the spacer bar requirement of 2.5 cm (1 in) depth to the sides for air circulation. When the weight of the container plus animal exceeds 60 kg (132 lb), or the animal is very aggressive the frame must have additional metal re-enforcing braces.

Sides

Suitable plywood or similar material must line the frame to give a smooth and strong interior.

EXAMPLE



Appropriate size of transport container: Note the principles of design in the International Animal Transport Association (IATA) standards.

Tiger Size	Inside Dimensions Length/Width/Height	Outside Dimensions Length/Width/Height
Large: adult male	183 cm (72 in)/56 cm (22 in)/76 cm (30 in)	198 cm (78 in)/74 cm (29 in)/97 cm (38 in)
Med: adult female	152 cm (60 in) /51 cm (20 in)/66 cm (26 in)	168 cm (66 in)/69 cm (27 in)/86 cm (34 in)
Small: sub-adults	122 cm (48 in)/46 cm (18 in)/61 cm (24 in)	137cm (54in)/64cm (25in)/81 cm (32 in)
X-small: cubs	91 cm (36 in) /41 cm (16 in)/56 cm (22 in)	107 cm (42 in)/58 cm (23 in)/76 cm (30 in)

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

4.2 Protocols

Transport protocols should be well defined and clear to all animal care staff.

Food and water: Food intake should be reduced 2–3 days prior to transport, and a light feeding may be given just before shipment. According to the Animal Welfare Act of 2005, potable water must be provided within 4 hours prior to transport and must be provided at least every 12 hours after transportation is initiated. Water containers must be positioned at the front of the crate and fixed off the floor to prevent soiling. Safe outside access should be provided for filling in an emergency. Tigers are unlikely to feed during transport, but the Animal Welfare Act of 2005 specifies that food must be provided at least once in each 24-hour period during transportation. In such a case, large felids may be fed 453.5 g (1lb) of meat per 9.97 kg (22 lb) of live weight. If the tiger is being offered for transport to a carrier or intermediate handler, written instructions concerning food and water requirements should be affixed to the outside of the tiger's primary enclosure. Ideally, some of the tiger's diet should be shipped with the cat (if a different brand from the receiving institution) to ease any transition to a new diet.

Bedding/Substrate: Straw or an absorptive material should be included in the container for comfort and absorption of excreta, but care should be taken if international shipments are involved to ensure that plant material is acceptable to receiving countries.

Separating animal from urine and feces: The crate should be well ventilated, should drain well and have absorbent bedding used to prevent the tiger from lying in urine. The floor should either be constructed in a narrow slatted form over a liquid proof tray in such a manner that all feces fall onto the tray, or it should be leak proof and covered with sufficient absorbent material to prevent any excreta from escaping.

Temperature: General temperatures recommended by airlines for live animal transport 7.2 – 29 °C (45-85 °F) are adequate for large felids. Animals being transported in unheated vehicles should not be exposed to temperatures below 4.4 °C (40 °F) unless protected from the wind and previously acclimated to such temperatures.

The Animal Welfare Act specifies that a temperature range of 7.2 – 23.9 °C (45 – 75 °F) is normally acceptable for transport. A temperature range of 23.9 – 29.5 °C (75 – 85 °F) is only acceptable for a time period less than 4 hours. Animals being moved between the animal holding areas in cargo terminals and planes on the ramp may be subjected to temperatures exceeding 29.5 °C (85 °F) or below 7.2 °C (45 °F) for no more than 45 minutes.

Light and noise: Tigers should be kept in darkened containers to avoid stimulus from their surroundings. Ventilation openings should be covered with burlap or shade cloth to provide the animal with privacy, but still allow airflow circulation. Crate doors should be secure to prevent rattling. Tigers tend to become aggressive under stress from outside noises and activity. When shipping via air, animals may be placed in temperature controlled quiet rooms at the airport if available. During transport, containers should be located away from people, loud equipment, and other sources of potential stress.

Provisions for shipping multiple animals: Due to their large size and aggressive nature, all tigers should be shipped individually regardless of age, with the exception of young cubs from the same litter (this is rarely recommended by the AZA Tiger SSP).

Responsibility for care in transit: According to the Animal Welfare Act of 2005, it is the responsibility of the driver or other employee to visually observe the animal being transported at least once every four hours, to ensure that it is receiving sufficient air for normal breathing, ambient temperatures are within prescribed limits, all other applicable standards are being complied with, to determine whether it is in obvious physical distress, and to provide any needed veterinary care as soon as possible. If the animal is being transported by air, it should be visually observed by the carrier at least once every four hours if the animal cargo space is accessible during flight. If not accessible, the carrier should visually observe the animal whenever loaded and unloaded. No animal in obvious physical distress should be transported. The animal cargo space in the transportation vehicle should have a supply of air sufficient for normal breathing for the animal in transport, and should be designed and maintained in a manner to prevent engine exhaust fumes and gases from entering the cargo area during transport.

Veterinary access: When a tiger is moved, one of its keepers should accompany it to care for it during transit if 1) the transport involves more than one transfer en route; 2) the travel time from airport drop-off to airport pick-up is more than 12 hours; and/or 3) the animal involved is a very young cub. A familiar keeper may help the tiger adjust to its new environment. Under normal circumstances, large felids may be shipped by air without specialized staff accompanying the animal(s). If transported by truck, animals should be visually checked when making routine stops. Due to the aggressive nature of large felids, animals should not be released from their transport containers during transit under any circumstances.

Transport duration: Large felids can be transported in their shipping crate for multiple days if food and water are offered daily. All transports should be carefully planned to ensure that the fastest route is taken, with the fewest number of stops and transfers. It can be helpful to contact zoos along the route, prior to transport, in case assistance is needed along the way.

Due to the decreasing size of many commercial airplanes, air transportation of adult large felids is becoming increasingly difficult unless transport only involves metropolitan areas with large airports. Increasingly, specialized truck or van transportation is often the only means of transferring large felids.

Release at transport destination: The tiger should be released as quickly and safely as possible upon reaching the transport destination. Unloading may be made easier with the use of equipment such as a “skid steer,” provided it is properly secured and will not topple over or fall off. Before releasing, the crate should be secured to the cage by means of chain, canvas strapping, etc. The crate can also be held in place by the skid steer. This is to prevent the crate from being pushed away from the cage as the animal is released, creating a potential escape gap. After the door to the release cage is closed and secured, the crate can be removed. The tiger then enters quarantine (see Chapter 7.3).

Chapter 5. Social Environment

5.1 Group Structure and Size

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

Group compositions: Even though they are known to occasionally socialize with each other, wild tigers are essentially solitary animals. This asocial nature of tigers dictates the philosophy behind exhibiting only solitary tigers in AZA-zoos probably more than any other natural history characteristic of the species. Thus, the AZA Tiger SSP recommends that tigers be managed as solitary individuals, with a few exceptions, such as same-sex littermate cubs that can be kept together or with their mother. Litter mates (cubs) can typically be kept together and with the mother up to the time they reach sexual maturity (as early as 1.5 years). Separation of opposite sex litter mates upon sexual maturity is necessary so as to avoid sexual contact. Brothers can be kept together as long as they are tolerant of each other. Sisters can also be kept together until they begin to show aggression to one another, which often occurs at sexual maturity. Older, unrelated males sometimes can be kept together if they are tolerant of each other, but the AZA Tiger SSP does not recommend this social grouping.

After recommended breeding has been completed, most male/female pairs that are retired from reproduction (i.e., contracepted or neutered) can be maintained together for the rest of their lives if they are tolerant of one another; however, individual tiger personalities and potential aggression should be taken into consideration.

5.2 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 animals of other species. Tigers can generally be housed near other large felids, but since they are large predators, tigers are not recommended for mixing with other species.

5.3 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. It is recommended to have a veterinarian on-site or on-call during introductions.

The only time tigers should be introduced to each other is because of the institution's participation in the AZA Tiger SSP and they receive a sanctioned breeding recommendation. Introductions are typically characterized by moderate to extreme levels of excitable or violent behavior, depending on the tigers' "personalities," sexual experience, age, and the experience of the animal care staff. Because of the potential for quickly inflicted, serious, or fatal injuries, all introductions should be well planned, not rushed, and intensely monitored. Basic steps for introducing large felids include the following:

1. Animal care staff working with cats should remain on a familiar feeding and cleaning schedule to make the animals comfortable in their surroundings.
2. The area used for introductions should have minimum outside disturbance and, as recommended by the AZA Tiger SSP, have remote video camera capabilities installed. Other animals not part of the introduction should be removed as far from the area as possible.
3. Sufficient time should be allowed for each new tiger to adjust to its new surroundings before beginning the introduction process. This period can take a month or more, depending upon the individuals involved. Once the tigers are calm and seemingly at ease with their surroundings (e.g., not pacing constantly, growling at keepers or other tigers, or startled by new noises), and eating well, limited visual introductions can begin.
4. Tigers should be housed in adjacent caging of adequate size. Solid walls between the cages should have two shift doors, one of which may be solid and the other of wire mesh to allow visual and olfactory access.

5. Each cage should have cage props such as sleeping boards, tree limbs, cargo nets, den sites, etc. to allow multi-level use of the enclosure, visual barriers, and areas to retreat to or defend.
6. For easily stressed individuals, initial visual introductions should be for short periods of time (5–10 minutes), and only with experienced, familiar staff present. Behavioral cues such as postures, vocalizations, etc. should be monitored. The number and length of exposures can be increased over the next several days, but always while visually monitored.
7. Tactile introduction through a common wall is important. Such walls should be constructed of wire or similar materials with only small openings [1.27 cm (.5 in) or less] to prevent injury to either cat. Shift doors between adjacent enclosures may be modified to facilitate this stage. At this point, potential pairs may show aggressive behavior such as growling, hissing or spitting. This may be shown initially and pass within a short period, but introductions should not progress until these behaviors pass. Another behavior is one of disregard for one another, characterized by cats spending little time in close proximity, and usually looking different directions. This sort of indifference often soon passes. A third set of behaviors finds the female is in estrus, as demonstrated by prusten (a greeting call that sounds like air expelled softly through the nostrils), cheek rubbing, cage rubbing, rolling on her sides, then completely over, vocalizing softly, and lordosis (crouching in a sternal position with the hips slightly elevated). In some cases, females who previously have shown no signs of estrus when isolated may act differently when put in close proximity to a male. Tigers may be physically introduced if either rolling or lordosis is evident. For more information about the length and character of females' estrous cycles, see Chapter 8.1.
8. When the pair appears to be at ease with each other at the tactile access point, as demonstrated by lying side by side or one animal presenting itself in a vulnerable position while the other animal reacts non-aggressively, they are ready for supervised physical introductions – preferably when a female is in estrus. Both cats should be fully aware of each other's presence before they are physically put together. Once this has been achieved, the door can be opened a few inches at a time until the animals have full access to one another. All parts of the enclosure should be clearly visible to both animals. Ample/multiple escape routes should exist for both cats so that neither can be trapped or cornered by the other. This full access should only be done with staff member(s) present to separate the tigers if necessary. Fighting or aggressive tigers can be separated with water hoses, CO_2 fire extinguishers, or any object that makes a loud noise.
9. Periods of supervised access can be increased in duration as long as the tigers continue to appear comfortable with each other. This increase should be slow, and careful attention should be paid to the pair's behavior during this time. During this period, changes in their environment should be kept to a minimum. Tigers should not be left together unsupervised during introductions. The use of remote monitoring equipment (recommended for pregnant females by the AZA Tiger SSP) will provide valuable insight to the pair's behavior when alone, as some felids react differently when keepers are not present. There may be many attempted mountings/copulations when animals are first introduced to one another. Actual copulation can be characterized with the female producing a strong guttural vocalization, lunging forward, turning around and defensively swatting at the male and then rapidly rolling back and forth.
10. If the area is large enough, it is recommended that introductions take place in off-exhibit areas (AZA Felid TAG recommendation, 2006). It is critical that staff know the behavior of their individual tigers. Once the pair has been introduced (off-exhibit), the process of introducing the pair to the exhibit can begin, if desired. The female should be allowed access to the exhibit first. After she has had time to explore her surroundings, the male can be reintroduced to her on exhibit.

Once it has been determined that the introduction is going well, as described above, the tigers can be given access to a larger area so that the male has space to back away after copulation; a minor confrontation can more easily escalate into a full blown fight in a restricted space with fewer opportunities for escape. It is not recommended that tigers be put together in outdoor enclosures for breeding for multiple reasons. It makes it more difficult to separate them if they become aggressive, it is difficult to tell whether they are relating well to each other, and it is often particularly difficult to determine if they have actually copulated. Other problems include greater probability of distraction either from staff or other

events and particularly multiple scents from different tigers, possibly even different males, which can confuse or disrupt the introduction process. Under no circumstances should breeding tigers be left together without staff supervision.

The choice of staff present during breeding is critical. At any one time, the staff that the tigers are familiar with (and vice-versa) should be in charge and present during the introduction process. A keeper familiar with the tigers can probably anticipate a problem by observing their behavior, and separate them by loud noises and by closing the shift door.

Chapter 6. Nutrition

6.1 Nutritional Requirements

A formal nutrition program is required to meet the nutritional and behavioral needs of all tigers (AZA Accreditation Standard 2.6.2). Diets should be developed using the recommendations of nutritionists, the AZA Nutrition Scientific Advisory Group (NAG) feeding guidelines (http://www.aza.org/nutrition-advisory-group/), 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.

AZA Accreditation Standard

(2.6.2) The institution must follow a written nutrition program that meets the behavioral and nutritional needs of all species, individuals, and colonies/groups in the institution. Animal diets must be of a quality and quantity suitable for each animal's nutritional and psychological needs.

Ecological data including geographical habitat locations and prey selection have provided clues to nutrient requirements and ability to utilize different types of foods of many of the exotic felid species. Wild pigs, cattle, and several species of deer are major prey of tigers. All prey are forest or grassland ungulates that range in size from small hog deer at 30 kg (65 lb), to sambar deer at 180 kg (400 lb), up to large gaur at over 900 kg (2,000 lb). Typically, wild tigers gorge themselves on fresh kills. The carcass is consumed over several days, and then a period of fasting generally occurs. One important feeding behavior that may relate to nutrient requirements of large felids is the initial consumption of the viscera, or internal organs. This behavior provides fat and vitamins, as well as fiber contained within the visceral contents. Skeletal muscle, bone, and cartilage are then consumed, providing protein and minerals. As the carcass is eaten after several days, daily food consumption decreases, thereby, the average amount of food consumed over the entire period is similar to what a tiger in a zoological institution may consume on average per day (Sunquist, 2010).

Diets: There are currently a multitude of diet options available for large felids from multiple commercial suppliers. Typical feeding methods include whole carcass feeding, skeletal muscle feeding with a vitamin and mineral supplement, commercially prepared raw diets, and commercially prepared extruded kibble or canned diets. When feeding skeletal muscle as the only diet item, a properly formulated vitamin and mineral supplement is critical for nutrient balance. Feeding a commercially prepared diet should eliminate the potential for either nutrient excess or deficiency. Feeding carcasses, skeletal muscle, bones, and supplements should be discussed with a professional nutritionist or veterinarian to ensure a complete diet is properly formulated and fed. Commercially prepared diets, however, may contain ingredients that would not be in a wild animal's diet and minimizes species typical behaviors regarding feeding, if fed exclusively.

Diets for tigers can include whole body prey and carcasses. The Nutrition Advisory Group (NAG) has provided a statement regarding the use of whole body prey and carcasses in nutrition programs for carnivores (http://nagonline.net/guidelines-aza-institutions/nag-carcass-feeding-statement/). The NAG defines whole body prey as the intact animal complete with entrails, fur and/or feathers while carcass refers to the body of an animal with hide and viscera removed. All whole body prey items fed to tigers should be humanely killed prior to feeding. Whole animal carcasses (rodents, rabbits, fish or fowl) or chunk meat and organs may be substituted upon occasion to vary the diet and provide dietary enrichment. Providing humanely killed whole body prey or carcasses to tigers may promote a wide range of species-appropriate hunting, food manipulation, and feeding behaviors. Whole body prey (e.g., rats, mice), partially cleaned (i.e., defeathered, eviscerated) or intact carcasses (e.g., chickens, rabbits), or carcass fragments (e.g., shanks of sheep or calf) can be provided. Carcass feeding may promote physical health, such as improved dental hygiene, as well as psychological well-being. Feeding road kill is not recommended due to possible transfer of parasites, disease, as well as high microbial loads, and the USDA highly discourages this practice (USDA, 2001).

Ideally, bones and whole prey items should be offered on fast days, or as a replacement to normal daily diets, in order to provide the gastrointestinal tract ample time to digest, pass, and process bones, hides, fur, and undigestible components that comprise whole carcasses. Feeding bones and whole prey items separately from other diet components may reduce risks of impaction. Care should be taken that whole prey animals euthanized with barbiturates are not fed to tigers, as this is the most common type of

poisoning in large felids exhibited in zoological institutions. Felids feeding on such carcasses may show varying signs from mild ataxia to general anesthesia that may last for days. The livers from such carcasses are especially high in barbiturate levels, and consumption causes more severe signs (Bush et al., 1987).

Feeding schedule: Tigers are typically fed once daily, but may be fed more often to facilitate shifting or other management needs. Number of daily feedings should be at the discretion of the facility. Due to the fact that tigers often fast in the wild, many facilities institute fasting days into feeding schedules of tigers. While this is not an exact replication of fasting behavior in the wild, this strategy may be useful for animal management and control of body condition and weight. No known nutritional implications are available regarding implementation of fasting to felid feeding routines. Bones or whole prey items are often offered in place of the regular diet on these days; therefore, animals are not under strict fasting metabolism.

Water: Fresh, potable water should be provided at all times. Regardless of size, portable water containers should be cleaned and disinfected daily; built-in streams and pools should be cleaned and disinfected at least weekly. In cold climates, installation of means to prevent pipes freezing are an important consideration.

Special considerations: Because tigers consume raw meat, which is prone to bacterial contamination, extra care should be taken in cleaning after preparing or handling meats. All equipment, receptacles, or areas that maintain contact with raw meat items should be cleaned and sanitized daily. To accomplish sanitation, all surfaces should first be cleaned with a detergent. Once cleaned, the following methods can be used to sanitize.

- Contact with a solution of 100 ppm available chlorine solution for 20 seconds, or 50 ppm for at least a minute.
- Contact with a solution of 25 ppm available iodine for 1 minute.
- Contact with 200 ppm quaternary ammonium for 1 minute.
- Use of a dishwashing machine with approved sanitizing methods (chemical or hot water).
- Applying a safe and effective disinfectant after cleaning.

Tigers may be given their food on the enclosure floor, in stainless steel pans, or in enrichment devices. Providing food in enrichment devices may allow for species appropriate behaviors (more information on the types and benefits of enrichment items can be found in Chapter 9.2). Care should be taken when providing any type of bowl to the enclosure as the animal may try to destroy or consume the item.

Seasonal changes: The diet of tigers may need adjustment due to weather conditions, particularly in the extreme cold. If animals are kept outside during long periods of extreme cold, additional food may be necessary to maintain body condition. Conversely, less food may be needed during periods of extreme heat. Changes in the quantity of food offered, however, should only be made as necessary. Depending on the normal ambient temperature and enclosure type (indoor versus outdoor) of the climate the animal is housed in, this could moderately influence the energy requirement of the animal. It is recommended to monitor and record body condition and body weights during seasonal changes in order to determine if appropriate increases or decreases in diet are warranted (Dierenfeld, 1987).

Nutrient requirements: Nutrient requirements have not been determined for tigers; the domestic cat is used as a model species. Based on ecological data indicating wild felids consume all parts of a carcass including bones, fat, viscera, and skeletal muscle, it is presumed that whole prey meet the nutrient needs of tigers and maintain good oral hygiene (Dierenfeld et al., 2002). The order Carnivora, including felids, have a characteristically simple gastrointestinal tract. Cats have a large, non-compartmentalized stomach in comparison to the rest of their gastrointestinal tract, which allows for gorging behavior typically noted in large felid species. Conversely, their small and large intestines are short in comparison to other species. Cats have short unsacculated colons, which allow for less fiber utilization than omnivorous and herbivorous species, and fast passage rates to accommodate high bacteria exposure and passage of large diet components including bones, hide, and fur.

As is the case with all cats, skeletal muscle and commercially-produced raw meat diets are relatively well digested by tigers. Protein digestion is generally greater than 85% and fat digestion greater than 90% (Barbiers, Vosbiurgh & Ku, 1982; Iske et al., 2015; Vester et al., 2008; Vester et al., 2010). Many commercial diets contain a processed carbohydrate source, which cats are able to readily utilize as an

energy source. One notable difference among cat species is that digestibility, while still high in tigers, is generally lower compared to smaller cats such as cheetahs, and domestic cats (Vester, et al., 2008; Vester et al., 2010). This may account for the differences in energy requirements in tigers as compared to other felid species as is discussed below.

Estimated nutrient guidelines for tigers and other exotic felids are based on the recommended nutrient requirements of the domestic cat as reviewed by the National Research Council (NRC). Diets may also be formulated to meet current Association of American Feed Officials (AAFCO) requirements for domestic cat diets. All values reported herein are the recommended nutrient profiles on a dry matter basis (DMB) for cats as determined by the AAFCO (2005) and NRC (2006).

Table 4: Recommended nutrient requirements of the domestic cat as reviewed by the National Research Council (NRC).

Nutrient	Unit	Growth & Reproduction	Maintenance	Maximum
Protein	%	30.0	26.0	
Taurine	%	0.1	0.1	
Fat	%	9.0	9.0	
Arachidonic acid	%	0.02	0.02	
Vitamin A	IU/kg	9000	5000	750000
Vitamin D3	IU/kg	750	500	10000
Vitamin E	IU/kg	30	30	
Thiamin	mg/kg	5.0	5.0	
Riboflavin	mg/kg	4.0	4.0	
Pyridoxine	mg/kg	4.0	4.0	
Niacin	mg/kg	60	60	
Pantothenic acid	mg/kg	5.0	5.0	
Folic acid	mg/kg	0.8	0.8	
Biotin	mg/kg	0.07	0.07	
Vitamin B12	mg/kg	0.02	0.02	
Choline	mg/kg	2400	2400	
Calcium	%	1.0	0.6	
Phosphorus	%	0.8	0.5	
Potassium	%	0.6	0.6	
Sodium	%	0.2	0.2	
Chloride	%	0.3	0.3	
Magnesium	%	0.08	0.04	
Iron	mg/kg	80	80	
Copper (extruded)	mg/kg	15	5.0	
Manganese	mg/kg	7.5	7.5	
Zinc	mg/kg	75	75	2000
Iodine	mg/kg	0.35	0.35	
Selenium	mg/kg	0.1	0.1	

Energy requirements: Energy is not a nutrient, but nutrient concentrations are balanced relative to dietary energy content. Energy is derived from the macronutrient components of the diet, including fat, protein, and carbohydrates. Metabolizable energy (ME) is the energy of the diet minus the energy from the feces, urine, and gases. Estimated ME should be determined for each animal as well as each diet. Energy requirements should be determined using metabolic body weight ($BW^{0.75}$). Maintenance energy requirements for exotic cats vary by species, but are listed between 55–200 kcal x kg $BW^{0.75}$ (Clauss et al., 2010; NRC, 2006).

Adult tigers are fed to maintain body condition, with general maintenance energy requirements estimated to be equal to 140 kcal x kg $BW^{0.75}$ (Kleiber, 1964). Thus a female averaging 123 kg (217 lb) requires 5170 kcal/day, whereas a 160 kg (353 lb) male requires 6300 kcal. Metabolizable energy requirements can be met by feeding 3.1 kg (3.8 lb) (for females) and 4.1 kg (9 lb) (for males) of commercial diets containing approximately 2000 kcal/kg (on an as-fed basis) daily, with a digestibility coefficient of 0.84 (84%). If significant amounts of enrichment foods, animal feet, carcasses, skins, etc., are offered, their caloric content should be factored into the overall diet.

These energy estimations should be used as a starting point for energy requirements of tigers. Animals should be weighed as often as the facility is capable, and should be assessed for body condition

on a regular basis. Food should be adjusted accordingly. Differences may exist not only between individual animals but also by sub-species of tigers that may require more energy than would be determined through extrapolation from domestic cat energy requirements (Allen et al., 1995).

These values are simply starting points and amount of food adjusted per day should be adjusted based on body weight, body condition changes, and physiological state. Growing or lactating animals can require up to 100% more energy than animals at weight maintenance. Fast days should not be used for lactating and growing animals. The number of cubs that a female nurses will impact energy requirements. Body weight and body condition of nursing females should be carefully monitored throughout lactation in order to assess and adjust caloric intake.

Metabolizable energy content of the diet should be determined in order to accurately establish feeding amounts. Dietary ME can be determined with good accuracy in all carnivores using "Atwater" factors of 4.0 kcal/g protein, 4.0 kcal/g carbohydrate, and 9.0 kcal/g fat (NRC, 2006; Clauss et al., 2010). The amount of dietary fiber should be subtracted from the carbohydrate fraction prior to determining ME, if available.

Nutritional peculiarities of cats and tigers: The unique nutritional requirements of felids must be recognized in feeding tigers, including the need for high protein and fat diets, and the inclusion of dietary vitamin A (as retinol), arachadonic acid, taurine, and niacin. Specifically:

- Cats require a large amount of total protein compared to other species. When faced with starvation or low protein diets, cats do not have the ability to conserve nitrogen and they are sensitive to arginine deficiency, a required amino acid for both maintenance and growth (Morris & Rogers, 1983).
- Cats require linoleic and linolenic acids, as essential fatty acids, but also require arachidonic acid (NRC, 2006). Cats have low activity of enzymes critical to conversion of fatty acids to arachidonic acid.
- Cats require preformed Vitamin A such as retinol as they lack enzymes to convert provitamin compounds such as beta-carotene. Retinol, retinyl acetate, or retinyl palmitate is required in the diet, as is niacin as the cat has low levels of enzymes that convert tryptophan to niacin (NRC, 2006).
- Fiber is often not considered an important nutrient for cats, but as tigers live longer in zoos compared to nature, providing a fiber source in the diet may allow for improved gut health. Beneficial fiber sources may also lead to better stool quality and reduced fecal odor. Care should be taken when using a fiber source and attention paid to the amount of fiber added. Tigers fed a diet with cellulose, a non-fermentable fiber source had better stool quality than tigers fed a diet with beet pulp, a fermentable fiber source (Vester, et al., 2010). This same effect was not true in domestic cats and may speak to differences among the species of felids, and/or difference in gut microbial populations.

General reviews of felid nutrition (Scott, 1968; MacDonald et al., 1984), a more specific review applying these data to tiger management (Dierenfeld, 1987), and a summary of digestion studies conducted on tigers in zoos (Hackenberger et al., 1987) provide evidence that the domestic cat remains the best model for establishing dietary composition parameters for the tiger. These data allow for appropriate formulation of diets for tigers based on domestic cats and can prevent nutrition related problems and concerns.

6.2 Diets

The formulation, preparation, and delivery of all diets must be of a quality and quantity suitable to meet the animal's nutritional and psychological needs (AZA Accreditation Standard 2.6.2). Food should be purchased from reliable, sustainable, and well-managed sources. The nutritional analysis of the food should be regularly tested and recorded.

Ingredients and nutrient profiles: Commercial raw meat diet formulations for exotic carnivores are manufactured and available from several suppliers including, but not limited to (listed alphabetically): Central Nebraska Packing, Inc. (North Platte, NE, USA); Milliken Meat Products, Ltd. (Scarborough, Ontario, Canada); and Triple A Brand Meat Company (Burlington, CO, USA). Ingredients of these raw meat formulations may consist of pork, beef and/or horsemeat (main ingredients), organ meats (may be listed as by-products), non-meat protein sources (soybean meal, corn gluten meal, egg protein, etc.), cereal grains, cellulose (Solka Floc®), beet pulp, vitamins, and minerals. These formulations are recommended as the main dietary ingredient for tigers because they meet or exceed the nutrient

requirements presented in Chapter 6.1. The above-mentioned products are successfully used throughout AZA institutions for a wide range of felids including tigers.

Due to extreme variability of potential ingredients, in-house mixtures and formulations are not recommended unless professional nutritionists are consulted regarding correct formulations. Muscle and organ meats are deficient in calcium, and low in other required nutrients such as taurine and some B-vitamins and minerals. Without careful consideration and proper formulation and mixing, improper diet mixtures can cause several clinical conditions or even result in animal death.

The meat source utilized in most commercial raw meat diet formulations is typically beef and/or horse. While not common, pork may be utilized as a meat source. Protein concentrations are similar between horse, beef, and pork, though fat concentrations may be as much as 65% lower in horse compared with beef or pork. The fatty acid profile of horse muscle meat is significantly different than either beef or pork. In particular, linolenic acid is higher in horse muscle (1.4%) compared with beef (0.1%) or pork (0.6%). Palmitoleic acid concentrations also are higher in horse muscle (8.2%) compared with beef (4.4%) or pork (3.3%) (Lee, et al., 2007).

While the inclusion of raw pork has not been common in the past, recent data suggests that pork is a viable and useful option in carnivore diets. A raw pork-based diet was found to be as, or more, digestible than other beef or horse-based diets on the market. Additionally, no adverse effects were seen in cats consuming the raw pork diet and the diet was shown to be palatable to a variety of felid species, including tigers (Iske et al., 2015).

Nutrient profiles of commercial raw diets and whole prey vary in macronutrient profiles; however, they meet or exceed nutrient requirements as presented in Chapter 6.1. Below are examples of commercial raw diet nutrient profiles from commonly fed zoological formulas including horse, beef and pork, compared to reported whole prey values, expressed on a dry matter basis.

Table 5: Nutrient profile comparison of example commercial raw meat diet to common whole prey.

Component	Commercial Raw Diets	Whole prey - rabbit	Whole prey – chicken[1]
Moisture, %	61.0 - 71.3	79.2	59.5
Crude protein, %	46.7 – 65.7	68.7	45.0
Crude fat, %	29.0 - 38.5	14.4	51.0
Ash, %	5.4 – 9.6	9.2	6.2
Ca, %	0.72 - 1.7	5.9	1.7
P, %	0.57 - 1.4	3.4	1.3
Vitamin A, IU/Kg	10,512 – 308,000	6,200	35,600

[1] Data for whole prey rabbit and chicken were compiled from Dierenfeld *et al.*, 2002.

Bones and/or whole prey items are recommended as dietary ingredients for their impact on oral health and behavior as discussed in Chapter 6.1. A ground meat diet alone may have negative effects on long-term oral health, and a significant reduction in plaque and calculus can be achieved by offering raw bones up to twice a week (Fagan, 1980; Haberstroh et al., 1984; Kapoor et al., 2016. Although often considered "enrichment" foods, bones and whole prey items offered weekly should be considered ingredients of diets. These items have potential to contribute substantial calories and additional nutrients to tiger diets and should be assessed appropriately.

AZA Accreditation Standard

(2.6.1) Animal food preparations and storage must meet all applicable laws and/or regulations.

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

Food preparation and safety: In 2001, USDA published a manual (*USDA Manual of Standard Operating Procedures for Handling Frozen/Thawed Meat and Prey Items Fed to Captive Exotic Animals* available at: www.nal.usda.gov/awic/pubs/meatprey.pdf). It is recommended that institutions utilize this document as a routine process of nutrition management. Because tigers are consuming raw meat

products that have typically not undergone processing to eliminate bacterial contamination, extreme care should be taken when handling, storing, and transporting these meat items.

Under no circumstances should these raw meat items (including bones and whole prey) be thawed at room temperature. All items fed to tigers should be properly frozen and thawed under refrigeration. It is recommended that institutions assess and establish protocols of delivery in order to minimize time that raw meat products are exposed to ambient temperatures in order to prevent excessive bacterial growth prior to consumption.

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 must be assigned to at least one qualified individual (AZA Accreditation Standard 2.6.3). 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 tigers. If animals have access to plants in and around their exhibits, there should be a staff member responsible for ensuring that toxic plants are not available.

AZA Accreditation Standard

(2.6.3) The institution must assign at least one paid or unpaid staff member to oversee appropriate browse material for the animals (including aquatic animals).

6.3 Nutritional Evaluations

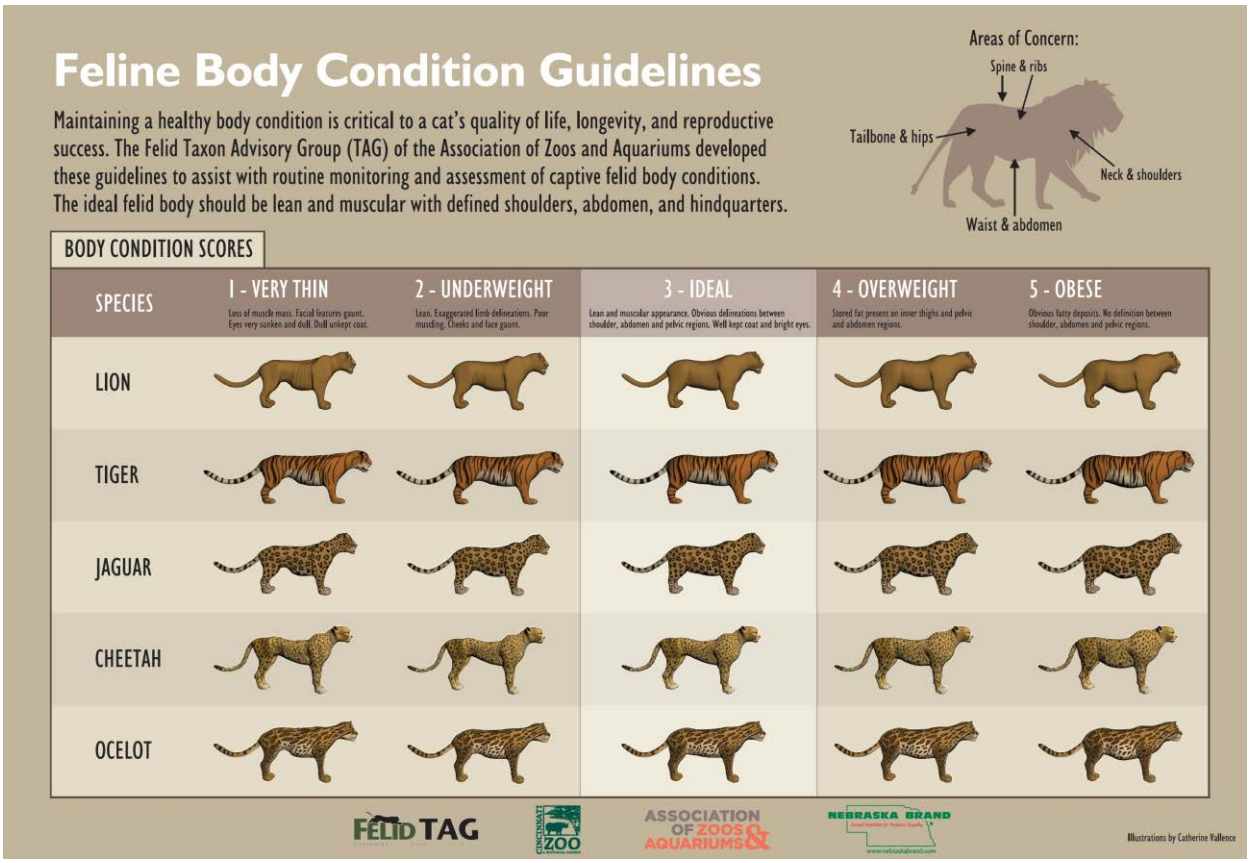
Health problems linked to diet: When feeding commercially prepared diets or mixtures approved by professional nutritionists that meet or exceed nutrient requirements, as described in Chapters 6.1 and 6.2, diet-related health concerns in normal tigers are not expected. In addition, if appropriate food safety standards and protocols are implemented, few bacterial contamination and exposure concerns exist for tigers consuming raw meat diets.

The largest health concern related to diet of tigers is body condition and body weight. Tigers exhibited in zoos do not exert the degree of physical effort as their wild-counterparts; therefore, management of diet in regard to body weight should be a major focus of tiger nutrition standards. It is recommended that professional nutritionists and veterinarians be consulted when clinical formulations are mandated based on diagnosis. Disease conditions observed in tigers that may require dietary manipulation or the formulation of clinical diets include, but are not limited to, renal disease, colitis, pancreatitis and digestive disorders, may enhance other prescribed treatments and prolong quality of life.

Tools for nutritional evaluation: When possible, tigers should be weighed and body condition scored routinely to assess need for dietary adjustment. Although weight ranges may exist for each tiger species, physiological stage, age, and overall body structure may also differ such that animals within an ideal weight range may be over or under-condition. Consequently, it is important to not only weigh, but also visually assess individual tigers.

To monitor condition, all animals should be weighed regularly, at least once or twice annually, and body condition scored a minimum of four times annually. Institutional standardization of a tiger body condition assessment tool is highly recommended as body condition assessment is subjective and may vary based on the individual conducting the assessment and by institution. It is also important to consider public display perception of body condition when developing standardized scales within institutions. Both 5-point and 9-point scales can be utilized effectively when animal management, nutrition and veterinary staff agree on appropriate assessment and objectives.

Body condition is a subjective assessment that should be standardized by the institution and by species. Several published body condition scales exist for domestic cats including Purina, WSAVA and Royal Canin that can easily be accessed free via the web. The Felid TAG also has developed the following body condition guidelines (also available on the Felid TAG website):



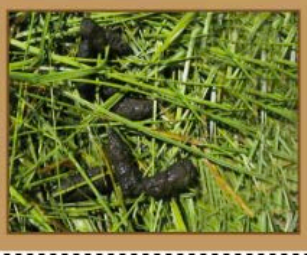
In addition to body weight and body condition, fecal consistency can provide insight into dietary management. Fecal inconsistency can be attributed to improper nutrient profiles and formulations (extreme variations in fat concentrations, improper concentrations and types of dietary fiber, etc.) and/or other health concerns (bacterial infections, disorders of the digestive tract, etc.) that should be brought to the immediate attention of both veterinary and nutrition staff. Tiger keeper staff can record fecal consistency by implementing the use of standardized fecal scoring systems such as those developed by the Felid TAG in 2014 and accessed for free via the Felid TAG website and included below.

Additionally, the Felid TAG developed a visual fecal assessment for felids following enrichment, bone and whole prey feeding, also shown below. The utilization fecal scoring systems is important for animal managers, as fecal inconsistency is common for up to 48 hours following enrichment and whole prey items. Both fecal scoring charts are available as downloadable PDF's from the Felid TAG website.

BASIC FECAL SCALE - FELIDS

1.
Hard, dry, multiple pellets that are easy to crumble or break apart into pieces. No fecal residue remains on the ground after collection.

2.
Very firm, with some moisture. Segmentation is apparent and likely occurs as more than one fecal unit. Minimal moisture residue may remain on the ground collected and form is maintained.



3. *considered ideal for most felids*
Moist, surface that is pliable and formed. Moisture on surface appears as shine. Fecal unit or units maintain shape, and only moisture residue remains on the ground after collection.

4.
Very moist, has some texture, and occurs in piles or spots. Loses form when collected and leaves fecal residue on the ground after collection.

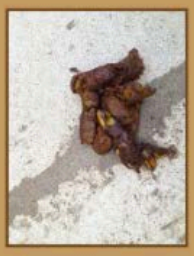
5.
Watery liquid, that can be poured and occurs in puddles and flattens and may occur with splatter marks. Has minimal texture and leaves significant residue on the ground after collection.

Considerations:
While a basic fecal scale of 1-5 provides an initial opportunity for documentation of fecal consistency, animal mangers also should describe and document the occurrence of blood, mucous, foreign bodies, off color, or off odor in relation to felid fecal excrement. Presence of those characteristics or inconsistencies in individual fecal scores over consecutive days may be indicative of serious gastrointestinal tract disturbance and should be reported to staff veterinarians and nutritionists as soon as possible.

Dietary Enrichment Considerations
Whole prey, bones and other dietary enrichment items provide valuable stimulation and variety to managed felids; however, animal managers should monitor these dietary enrichment activities carefully. Changes in fecal consistency are likely to occur for up to 48 hours following ingestion of enrichment items including bones and whole prey.

Fecal Consistency Following Bone Ingestion
Fecal excrement following ingestion of bones will likely occur as hard dry pellets (usually scores of 1 or 2) and appear white and may crumble into powder or may include small undigested bone fragments.



Fecal Consistency Following Whole Prey Ingestion
Following whole prey consumption, fecal consistency may vary from normal to dry, or include mucous and undigested fur, hair or bones. Enrichment days should be documented on fecal score sheets in order to account for observed variation among animals.




2014 Produced by Felid TAG with funding from Sustainable Swine Resources

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Chapter 7. Veterinary Care

7.1 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 necessary, a consulting/part-time veterinarian must be under contract to make at least twice monthly inspections of the animal collection and to attend 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), available at the AAZV website under "Publications", at http://www.aazv.org/displaycommon.cfm?an=1&subarticlenbr=839 (AZA Accreditation Standard 2.0.1).

A physical examination should be done yearly. It should include body weight, temperature, pulse, respiration, careful nail and footpad evaluation, dental examinations with particular attention to fractured canines, and whole body exam for abscesses and lacerations. Quarterly fecal examinations are also recommended to check for parasites. Dental scaling and polishing should be performed during the examination. Blood samples should be drawn for CBC, chemical panel, heartworm antigen testing, thyroid screen, and serology tests for FIP, FIV, FeLV, canine distemper and Toxoplasmosis. A rectal culture for enteric pathogens and urinalysis is recommended. Implanted microchips should be verified for accuracy against veterinary records.

A list of current AZA SSP/TAG Veterinary Advisors for tigers is presented at the beginning of this document and also at the AZA Tiger SSP website http://www.mnzoo.com/tigerSSP/sspContacts.html.

Protocols for the use and security of drugs used for veterinary purposes must be formally written and available to paid and unpaid 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.

AZA Accreditation Standard

(2.1.1) A full-time staff veterinarian is recommended. In cases where such is not necessary because of the number and/or nature of the animals residing there, a consulting/part-time veterinarian must be under written contract to make at least twice monthly inspections of the animals and to respond as soon as possible to any emergencies.

AZA Accreditation Standard

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

AZA Accreditation Standard

(2.0.1) The institution should adopt the *Guidelines for Zoo and Aquarium Veterinary Medical Programs and Veterinary Hospitals,* and policies developed or supported by the American Association of Zoo Veterinarians (AAZV). The most recent edition of the medical programs and hospitals booklet is available at the AAZV website, under "Publications", at http://www.aazv.org/displaycommon.cfm?an=1&subarticlenbr=839, and can also be obtained in PDF format by contacting AZA staff.

AZA Accreditation Standard

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

Veterinary 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 must 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 and veterinary records must be stored and protected (AZA Accreditation Standard 1.4.5) as well as be duplicated and stored at a separate location (AZA Accreditation Standard 1.4.4).

7.2 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 preparations: The services of a veterinarian familiar with large felids should be available prior to the arrival of new animals. The entire medical record for the new animals should be sent well before the actual shipment. An animal should not be sent to a new collection without its medical history. These data will alert the clinician to previous and potential problems and document past vaccinations, anesthetic doses, medical procedures, identification methods, fecal examinations, and blood values. **The shipping institution has an incumbent responsibility to directly inform the receiving institution of any known, significant medical problems independent of the transfer of medical records or other information.** Prior to receiving new felids, the shipping institution should provide the following:

- The result of a recent physical examination (within 3 months);
- CBC;
- Chemistry panel;
- Rectal culture for enteric pathogens;
- Two negative fecals within 30 days;
- Viral serology for FeLV, FIV, FIP, canine distemper and toxoplasmosis.

7.3 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. Quarantine duration should be assessed and determined by the pathogen risk and best practice for animal welfare (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 D). All quarantine procedures should be supervised by a veterinarian, formally written and available to paid and unpaid 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 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

(2.7.1) 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. Quarantine duration should be assessed and determined by the pathogen risk and best practice for animal welfare.

AZA Accreditation Standard

(2.7.3) Quarantine, hospital, and isolation areas should be in compliance with standards/guidelines contained within the *Guidelines for Zoo and Aquarium Veterinary Medical Programs and Veterinary Hospitals* developed by the American Association of Zoo Veterinarians (AAZV), which can be obtained at: http://www.aazv.org/displaycommon.cfm?an=1&subarticlenbr=839.

Holding space requirements can be used as a guideline for quarantine space, with the same enrichment requirements as would be utilized in holding. Each enclosure should provide a water source that can be cleaned and disinfected, that is accessible to both the tigers and keepers, and that can be shut off and drained. This allows for monitoring of water intake and water deprivation in certain clinical situations, such as pre or post-immobilization. The non-reservoir watering systems (such as lab animal design self-waterers) can malfunction and inadvertently deprive the cat of water if not checked daily which may be difficult from outside the enclosure.

AZA Accreditation Standard

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

Ideally, newly arrived felids should be quarantined separately from other species of carnivores, particularly felids, and cared for by keepers that do not care for other felids. This helps prevent the spread of disease from the arriving animal. Where this is not completely possible, the new cat should be separated from other cats as much as possible, and keepers should work with it after they have finished all work with the existing collection. Personnel working with or near a quarantined cat should wear coveralls and rubber boots designated for the quarantine area. Pregnant women are advised to wear a facemask when working with felids since they are carriers of Toxoplasmosis. A footbath going to and from the quarantine helps prevent potential contamination. The quarantine area should have drainage separate from other cat facilities. Separate cleaning tools that are not removed from the quarantine area are an absolute necessity.

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. As mentioned above, 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 should 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. A complete physical, including a dental examination if applicable, should be performed. Animals should be evaluated for ectoparasites and treated accordingly. Blood should be collected, analyzed and the sera banked in either a -70 °C (-94 °F) freezer or a frost-free -20 °C (-4 °F) freezer for retrospective evaluation. Fecal samples should be collected and analyzed for gastrointestinal parasites and the animals should be treated accordingly. Vaccinations should be updated as appropriate, and if the vaccination history is not known, the animal should be treated as immunologically naive and given the appropriate series of vaccinations.

During quarantine, felids should receive a complete physical examination halfway through the quarantine period (see Chapter 7.4), and a visual exam at the end. Because many felids nearing adult size, as well as those involved in management plans, may be transferred to other institutions, a microchip should be implanted intra-scapularly during quarantine or when the opportunity arises if one is not already present. Quarantine protocol for tigers should include a complete physical examination and preventive medical procedures such as immunizations and a dental examination. Body weights should be obtained on all tigers entering and leaving quarantine. Particular attention also should be paid to animal observations during the quarantine period; the behavior of the animal, the tiger's appetite, and subtle symptoms of potential disease problems should be recorded daily by keepers. The following medical procedures and tests are recommended for tigers held in quarantine (AZA Felid TAG recommendation, 2006):

- Three fecal examinations (direct and float). Two follow-up exams should be done post-treatment.
- Rectal culture for enteric pathogens. Due to their diet, it is not uncommon to culture *salmonella* from large felids. Only resistant strains should be treated.
- Urinalysis.
- CBC and serum chemistry panel, Blood should be collected, analyzed and the sera banked in either a -70 °C (-94 °F) freezer or a frost-free -20 °C (-4 °F) freezer for retrospective evaluation.
- Thyroid screen (T4/TSH) if animal is older than 5 years.
- Occult heartworm antigen and antibody test.
- Serology for Feline Leukemia virus (FeLV), Feline Immunodeficiency virus (FIV), Feline Infectious Peritonitis (FIP), canine distemper and toxoplasmosis.

During quarantine, tigers should be screened for internal parasites by repeated fecal examinations. If present, parasites should be eliminated, with appropriate antihelmintics, before the tiger is released into an exhibit (see Chapter 7.4 for additional information). This is extremely important in naturalistic exhibits (e.g., dirt and grass), which may become contaminated with parasite eggs. These eggs can subsequently reinfect the tigers, and are extremely difficult to eliminate from the exhibit. Screening for enteric pathogens by stool culture may also help identify tigers that are carriers of *Salmonella* spp.

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 paid and unpaid 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 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 (TB) testing/surveillance program must be established for appropriate paid and unpaid staff in order to assure the health of both the paid and unpaid staff and the animals.

Quarantine diet: When in quarantine, the tiger's diet should be gradually changed to the new diet, if different from its original. Any dietary alterations should be gradual to minimize gastrointestinal upset. It is not unusual to have a newly arrived tiger stop eating because of the environmental change. In some cases, it is advantageous to have some of the animal's previous diet accompany it if the food is not available locally. To stimulate appetite, whole carcasses of rabbits or chickens may be offered.

When a newly arrived tiger will not feed, depending on federal, state and local legislation, live-feeding of chickens or rabbits or freshly killed and still twitching animals may stimulate the cat to feed—although it may take 2–3 attempts before it does eat. Also blood or meat juices mixed with the drinking water can introduce the animal to the locally available food source.

If a tiger should die in quarantine, a necropsy should be performed on it to determine cause of death in order to strengthen the program of veterinary care and meet SSP-related requests (AZA Accreditation Standard 2.5.1). The institution should have an area dedicated to performing necropsies, and the subsequent disposal of the body must be done in accordance with any local or federal laws (AZA Accreditation Standards 2.5.2 and 2.5.3). Necropsies should include a detailed external and internal gross morphological examination and representative tissue samples from the body organs should be submitted for histopathological examination (see Chapter 7.6).

AZA Accreditation Standard

(2.5.1) Deceased animals should be necropsied to determine the cause of death for tracking morbidity and mortality trends to strengthen the program of veterinary care and meet SSP-related requests.

AZA Accreditation Standard

(2.5.2) The institution should have an area dedicated to performing necropsies.

AZA Accreditation Standard

(2.5.3) Cadavers must be kept in a dedicated storage area before and after necropsy. Remains must be disposed of in accordance with local/federal laws.

7.4 Preventive Medicine

AZA-accredited institutions should have an extensive veterinary program that must emphasize disease prevention (AZA Accreditation Standard 2.0.2). AZA institutions should be aware of and prepared for periodic disease outbreaks in other animal populations that might affect the institution's animals, and should develop plans to protect the institution's animals in these situations (AZA Accreditation Standard 2.0.3). 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 (www.aazv.org/associations/6442/files/zoo_aquarium_vet_med_guidelines.pdf).

An important element of a preventive medical approach should include routine observation of the tigers in the collection, not only by the keepers, but also by the veterinary staff. Routine rounds through the cat area should be made to remain familiar with the tigers, to evaluate their overall appearance, activity, and facility conditions, and to talk with the keepers.

AZA Accreditation Standard

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

AZA Accreditation Standard

(2.0.3) Institutions should be aware of and prepared for periodic disease outbreaks in wild or other domestic or exotic animal populations that might affect the institution's animals (ex – Avian Influenza, Eastern Equine Encephalitis Virus, etc.). Plans should be developed that outline steps to be taken to protect the institution's animals in these situations.

Table 6: Routine medical examination procedures

Procedures	Quarantine	Ongoing	Pre-shipment
Physical exam (under anesthesia)	+	+	+
Blood sample			
CBC, Chemistries	+	+	+
Serum bank	+	+	+
Radiographs if indicated	+	+	+
Fecal examination	+	+	+
Fecal culture	+		+
Vaccination			
Fel-O-Vax	+	+	+
Rabies (killed)	+	+	+
Canine distemper- only canarypox vectored	+	+	+
Dental Examination	+	+	+
Body weight	+	+	+
Transponder	+	Check	Check
Tattoo	+	Check	Check

Complete physical examination: A protocol for regular physical examination should be established in order to monitor health over time as a component of an overall preventative medical program. A complete physical examination should be performed under general anesthesia 2–3 weeks into the quarantine period (see Chapter 7.3). Complete physical examinations should subsequently be performed on an annual basis, also under anesthesia, and during times of more targeted examinations for specific health problems. These exams should include evaluation of each organ system following a regular protocol in order to assure completeness. The exam should include the following:

- Rectal body temperature;
- External examinations of eyes, ears (for ear mites), pelage (for external parasites), feet and claws;
- Examinations of the oral cavity, pharynx, gingiva and particularly the teeth for calculus or exposed root canals;
- Palpation of limbs, including movement of joints, lymph nodes, and abdomen to detect the presence of crepitation, organ enlargement, fluid, or masses;
- Auscultation of the thorax for pulmonary and cardiac assessment (rate and rhythm);
- Body weight;
- Blood samples for hematologic and clinical chemical screening and for serum banking.

A complete set of survey radiographs is also recommended to assist in the overall assessment of the tiger and as a reference set for the future (AZA Felid TAG recommendation, 2006).

Medical records: The systematic gathering and recording of medical and pathological data in a uniform manor is crucial to any medical program. These records contain information on vaccinations, diseases, surgeries, anesthetic episodes, parasite problems, weights, medications received, blood and other clinical pathology data, etc. It is vital to start this recordkeeping during the quarantine period and continue it through the existence of the animal in the collection. When the animal dies, the necropsy findings will also be included in the record. There are computer programs to compile and manage these data (e.g., MED-ARKS from ISIS and subsequently ZIMS), but if computers are not available then complete written records should be maintained. Thought should be given to developing codes that will aide in the entering these data into a computerized record system at a later date. The value of medical records cannot be overemphasized.

Dental examination: A thorough oral examination is an integral part of a physical examination. They can be either planned or done whenever anesthesia is performed. Sound, regular prophylactic dental care is important in preventing bacteremia of oral origin that can contribute to or promote systemic disease, especially as a tiger ages. The oral examination should investigate dental structures for fractures and periodontal disease. A common problem reported in exotic felids relates to wear or trauma from fighting between tigers, or contact with enclosure material. The most common dental finding is calculus

accumulation, especially along the buccal surface of the upper molars and premolars. During the examination, the teeth and the soft tissue structures of the mouth and throat should be examined for abnormalities. The subgingival sulcus, gingiva, and teeth should also be examined for evidence of gingivitis or periodontal disease. The odor from the mouth may prove to be an important indicator of a dental problem. Foreign bodies lodged between oral structures, such as bone fragments, sticks, etc., can be incidental findings, but predispose the animal to oral disease. These should be removed and infections or traumatic lesions treated as indicated.

Prophylactic dental scaling and polishing should be done at the time of the exam. Calculus accumulation should be removed from the tooth surfaces with care taken to remove material from the subgingival sulcus. If power equipment is available, the scraped surfaces should be polished to create smooth dental surfaces, which deter future calculus accumulation.

Blood baseline values: During quarantine, a blood sample should be obtained to evaluate the animal's health status and provide a baseline for future comparison. An initial blood sample can be taken prior to anesthesia by placing the tiger in a squeeze cage and bleeding it from the lateral tail vein. This will help evaluate the animal's status prior to anesthesia for a complete physical examination. It is recommended that all zoos participating in the AZA Tiger SSP have access to a squeeze cage (AZA Felid TAG recommendation, 2006). Clinical parameters of primary interest are total WBC count and differential, hematocrit, BUN, creatinine, liver enzyme values, and an examination for red blood cell parasites. The collection of blood samples for laboratory evaluation and serum banking should be a part of every immobilization or physical examination.

Serum banking: A bank of frozen serum samples stored in an ultra-low temperature freezer at -70 °C (-94 °F) should be maintained at each institution. This serum bank should contain a 5–20 ml sample of serum from each procedure in which blood samples were collected from any tiger in the collection. Samples should be stored in appropriate containers and inventoried with regard to animal identification and collection date. Low temperature storage of samples is necessary to maintain the integrity of proteins in the serum. Samples can be stored in conventional freezers but protein integrity will be maintained for shorter time.

Serum banks have proven to be a significant value in many instances. The serum bank provides the capability of performing retrospective epidemiological studies in animal collections when a disease outbreak has occurred or new disease entities have been identified that were not previously recognized. These samples are also of value in managing health care of individual animals. Serum chemistry analyses can be evaluated on banked samples to evaluate health parameters that may not have been performed when samples were initially collected. Surplus banked serum can be used as an antibody source to provide passive immunity to tiger cubs when there is a failure of passive antibody transfer from the dam of the cubs such as in hand-rearing situations. However, passive immunity transfer requires large volumes (100 ml) to be effective and extra serum should be banked for this purpose.

Vaccination: The veterinary advisor for the AZA Tiger SSP recommends the vaccination of normal healthy tigers for Feline Rhinotracheitis, Calici Virus, Panleukopenia, Feline Leukemia, Rabies, and Canine Distemper with killed or vectored vaccines only. Only killed or subunit vectored vaccines should be used in tigers, not modified live vaccines due to the potential risk of inducing disease. The following vaccination protocol is suggested for use in all AZA Tiger SSP managed animals:

- 1 ml given intramuscularly of Purevax Ferret Distemper Vaccine, (Merial, Inc., Athens, GA, USA). This recombinant canarypox vectored vaccine has been used extensively in tigers with no observed problems. Commercial killed vaccines for canine distemper are not available.
- 1 ml given intramuscularly of Fel-O-Vax LV-K, (Fort Dodge Laboratories Inc., Fort Dodge, IA, USA).
- 1 ml given intramuscularly of Purevax® Feline Rabies Vaccine, (Merial, Inc., Athens, GA, USA) or Imrab® 3 from Merial or other killed rabies vaccines.

Some institutions use 2 ml doses due to the greater body weight of tigers. Although there is no direct evidence that this is more effective, it also does not do any harm. Animals never before vaccinated should receive at least two (preferably three) booster vaccinations approximately 3 weeks apart after 6 weeks of age. Previously vaccinated animals should receive a booster every 2–3 years. There are no vaccines, including those listed above that are legally approved for use in non-domestic felids. This is particularly

relevant with rabies vaccines where human exposure through bites may occur, especially in privately owned animals. We do not know how protective these vaccines actually are or statistically how effective they might be.

It is known that most Panthera species are susceptible to canine distemper virus and the virus should be regarded as a significant potential threat to zoo populations.

Parasites: A parasite-monitoring program requires regular stool examinations to detect parasitic infections. Most internal parasites found in stool examinations are relatively common and ubiquitous in *ex situ* situations. Commonly identified species are from the orders Ascarididae and Strongyloidae (i.e., *Toxocara*, *Toxascaris*, *and Ancylostoma*). It is seldom possible to eliminate ascarids totally in the tiger, but they are controllable with periodic administration of oral anthelmintics. These agents can be more effective when the full recommended dosage is given for more than one day, such as three consecutive days, rather than as single treatments. Post-treatment fecal examinations are necessary in assessing efficacy of the initial treatment. Follow-up treatments to remove larval stages not susceptible during the initial treatment may be required. Thorough daily cleaning and disinfection of tiger housing facilities and housing tigers in quarters with sanitizable surfaces will substantially reduce reinfections.

All animals should have a fecal exam every six months. Additionally, they should have two follow-up exams at weekly intervals 1–2 weeks post-therapy. Routine monthly treatment for heartworm prevention (Ivermectin) should be performed year-round. The following anthelmintics are effective and safe when administered using appropriate dosage regimens:

- Pyrantel pamoate: 3–5 mg/kg per os. This treatment can be given at this level for 3–5 consecutive days.
- Fenbendazole: 5–10 mg/kg per os. Most commonly a single day treatment, but can be given three consecutive days at this level.
- Febantel: 6 mg/kg once a day for 3 days per os. Repeat in two weeks.
- Ivermectin: 0.2 mg/kg, subcutaneous or per os. The injectable cattle formulation has been used orally at this dose for 1–3 days. Limited use in tigers with the parenteral route.
- Praziquantel: 5.5–6.6 mg/kg. Either as the oral or parenteral form for cestodes.
- Sulfadimethoxine: 50 mg/kg, parenteral or per os, as a coccidiostat.

Not all eggs or larva observed in fecal examinations may be parasitic to the tiger. The tiger may be serving as a transport host depending on what it has been fed or any feral animals it may have consumed. *Coccidia* observed may be associated with feeding whole carcass specimens (e.g., whole rabbits). This emphasizes the need for specific identification of parasite stages seen in stool samples, and an awareness of the tiger's diet.

Neonatal care: The following information addresses the care of parent-reared and hand-reared neonates. Additional medical information can be found above, and information on hand-rearing protocols can be found in Chapter 7.3.

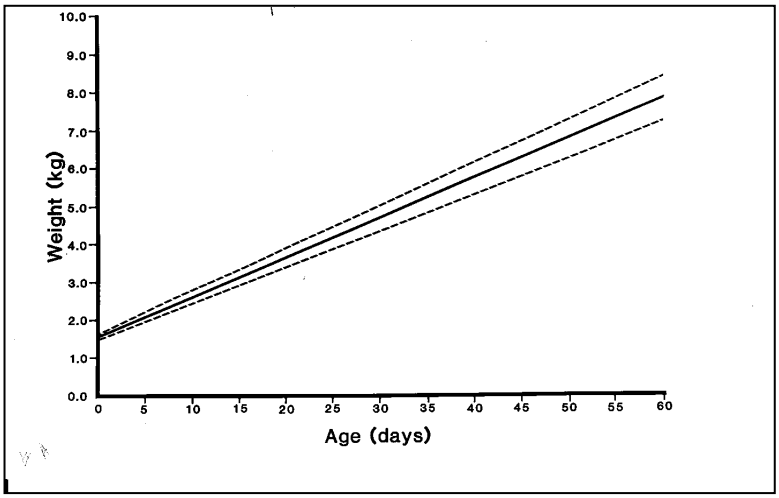
Neonatal vaccinations: Neonates should receive vaccination against feline viral diseases with a trivalent killed product at 8 weeks, 12 weeks, and 16 weeks, with a booster at one year. In collections where female tigers have very high titers due to repeated vaccination, passive immunity transferred to the cub can be high enough to delay active immunity induced by the vaccine. This is why additional vaccinations are recommended. Neonate should receive a killed rabies vaccine (e.g. Imrab®) at 4 months.

Neonatal parasite control: Fecal examinations of mother and cubs should be performed monthly. Antihelminthics (Strongid® T) should be administered every 4 weeks until 16 weeks old. If hookworms have been a problem in the collection, then the cubs should be prophylactically treated at 6-8 weeks of age.

Neonate (hand-reared) nutritional requirements: Hand-raised cubs should be weighed regularly to monitor weight gain and calculate necessary food intake. A growth chart of these animals can be compared to other published charts. Properly formulated milk replacers for felids should be used and carefully considered to ensure nutrient requirements are met. Nutrients that need careful consideration may include calcium, phosphorus, vitamin D and iron. In cases of nutrient concerns such as iron deficiency, additional supplementation should be evaluated and prescribed by nutrition and veterinary staff as over

supplementation of some nutrients can be as detrimental as deficiency. Weaning cubs to solid food should begin at 5–8 weeks of age.

Fig. 2. Neonatal (0-60 days) Amur tiger growth model based on 11 mother-reared cubs. Dashed lines delineate 95% confidence interval (Binczik, Reindl, Taylor, Seal & Tilson, 1987)



Medical management of pregnant animals: In general, particular attention should be paid primarily to the animals body condition and nutritional status during pregnancy.

Medical management of geriatric animals: Tigers may be affected by a range of disease issues as they age:

- Renal disease is very common in older cats. Routine annual physical examinations and blood samples may detect this disease in early stages and permit some degree of nutritional management to slow progression of the disease. Depending on bloodwork, tigers may benefit from lower concentrations of dietary protein and phosphorus and greater concentrations of antioxidants such as vitamin E.
- Dental disease, particularly the accumulation of calculus on the teeth and secondary gingival and subsequent systemic disease can also occur. Scheduled annual examinations and dental prophylactic cleaning procedures can significantly reduce problems associated with calculus.
- Loss of body condition is a common problem in older tigers. This may occur secondary to disease issues such as inflammatory bowel disease, renal disease or may be seen associated with muscle mass loss secondary to arthropathies. It is important to monitor the animal's body weight where ever possible and regularly utilize a body condition scoring system to monitor for both underweight and overweight animals.
- Arthropathies in older tigers may be the most common cause of general decline and eventual humane euthanasia of tigers. Degeneration of joints may occur in all limbs but is particularly frequent in the hips. Intervertebral spondylosis or bridging of the space between vertebrae by bone also occurs and may be painful. Radiographic confirmation is useful but generally symptoms the animals manifest such as lameness, stiffness and inactivity are most important in identifying arthropathies. Nutritional management such as supplementation with glucosamine/chondroitin supplements has been used, particularly in early stages of disease and appears beneficial. Non-steroidal anti-inflammatory drugs such as meloxicam or carprofen have been used at label doses in tigers to alleviate symptoms of pain and improve quality of life. Blood samples every six months to monitor liver function may be advisable when using these drugs. Quality of Life assessments should be done regularly on effected animals for the welfare of the animal.

Zoonotic concerns: As stated in the Chapter 7.3, AZA institutions must have zoonotic disease prevention procedures and training protocols established to minimize the risk of transferable diseases with all animals (AZA Accreditation

AZA Accreditation Standard

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

Standard 11.1.2).

There are relatively few zoonotic diseases associated with the Felidae including tigers. Common enteric bacterial pathogens, primarily *Salmonella* spp. and *Campylobacter* spp. pose the greatest risk with some minor risk of atypical parasite transmissions as well. Transmission is fecal- oral and usually is a result of poor sanitary practices. Animal care staff should be educated to be aware of the potential of disease transmission between animals and humans as well as from animal to animal. Each institution should establish policies and procedures for sanitation and disinfection to prevent disease transmission between animals and between humans and animals. Prevention of zoonotic disease transmission may include the use of personal protective equipment such as gloves or masks as well as fundamental sanitary practices such as frequent hand washing.

Tuberculosis can occur in Felidae but is very rarely seen in zoo animals and when it has occurred is associated with either transmission from keeper staff or a contaminated food source. AZA accreditation standard 11.1.3 recommends a tuberculin testing and surveillance program be established for animal care staff. This will substantially eliminate the risk of transmission from animal care staff and the purchase and feeding of high quality diets from reputable vendors will eliminate the other probable source. Routine or preshipment testing for tuberculosis is not recommended for this species.

AZA Accreditation Standard

(11.1.3) A tuberculin (TB) testing/surveillance program must be established for appropriate paid and unpaid staff in order to assure the health of both the paid and unpaid staff and the animals.

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 animals at the institution from exposure to infectious agents.

Off-site programs: 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).

It is unlikely that tigers would be used for off-site education programs although it is conceivable that cubs in the process of being hand reared could be used. If animals do participate in off-site programs, a veterinary risk assessment should be made and policies and protocols instituted to protect the collection animals from infectious disease.

7.5 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.

Anesthesia: Generally, large felids are too strong and dangerous for manual restraint if they are older than approximately 12 weeks of age. Chemical anesthesia, at times with gas supplementation is required.

Preanesthetic considerations: If possible the animal should receive no food for 24 hours preceding the anesthetic event. Water may be withheld for 12 hours preceding anesthesia but this is less critical and subject to environmental conditions. The animal should be confined in the smallest space possible. The space the animal will be immobilized in and will recover in should be as free as reasonably possible from potential hazards including elevated resting boards to prevent falls, water sources the animal could inadvertently drown in, enrichment items such as logs to prevent injury and elevated door sills that could obstruct the airway if laid upon in the appropriate position.

Anesthetic administration: Tigers are often highly amenable to behavioral modification and training for hand injection. Tigers trained for hand injection often remain much calmer during induction of anesthesia and anesthetic doses often seem to be relatively more effective in calm, hand injected animals. Squeeze cages where available are an effective means of restraining tigers for very brief periods for hand injection of anesthetics. In most situations where animals have not been previously trained, tigers will require darting to administer chemical anesthetics. Multiple dart systems may be used in tigers with the selection dependent on the specific circumstances of the darting and the preferences of the person administering the dart. Every effort should be made to utilize the system that will be least traumatic but still effective in

delivering the complete anesthetic dose most efficiently. System selection is influenced by volume of drug to be delivered, distance to the animal, activity of the animal, freedom of movement of the animal, available space and other considerations specific to each situation. Nearly all dart systems (Dan-inject ®, Telinject ®, Pneudart ®, Teledar ® t and others) are appropriate in various situations according to the circumstances.

Anesthetic regimens: Most anesthetic regimens used in tigers at this time utilize a combination of a disassociative anesthetic such as ketamine or tiletamine with an alpha-2 tranquilizer such as dex-medetomidine, medetomidine, or xylazine and/or a benzodiazepine tranquilizer such as midazolam or zolazepam. Combinations utilizing butorphanol as well as other drugs are also used. Selection of the combination to be used will depend on the training, experience, and preference of the veterinarian managing the anesthesia. For lengthy procedures, endotracheal intubation with administration of isoflurane or sevoflurane in O_2 is preferred over repeated supplementation with injectable agents. Information on anesthetic monitoring of tigers is also provided below.

- *Ketamine/medetomidine/midazolam:* This combination of drugs, with some variations in dose ranges, can provide safe, reversible anesthesia in tigers. The three drugs can be combined in a single dart. High concentration solutions of all 3 drugs are available commercially (Wildlife Pharmaceuticals, Fort Collins, CO, USA), significantly reducing dose delivery volume. The combination minimizes the amount of ketamine required but still provides effective control of the animal without unexpected arousals secondary to stimulation as can be seen with any alpha-2 regimen. Ketamine induced seizures are extremely rare with this combination. In general, vital signs such as heart rate and respiratory rate stay at reasonable levels. This combination provides safe, predictable anesthesia, easily transferred to gas for prolonged procedures.

  Ketamine IM- 2- 4 mg/Kg
  Medetomidine IM- 0.03- 0.05 mg/Kg
  Midazolam IM- 0.1 mg/Kg
  Supplements: Ketamine IM- 1 mg/Kg
  Reversal: Atipamezol IM or IV- 0.15- 0.25 mg/Kg (5x medetomidine dose in (mg)

- *Tilatamine/zolazepam combination:* Commercially available as Telazol or Zoletil, this drug combination can be safely used in tigers, and in some regions internationally is the preferred anesthetic for this species. The combination of drugs has the particular advantage of being supplied as a powder which can be reconstituted to high concentrations per milliliter, thereby reducing dose delivery volume. The drug has a rapid induction of anesthesia and a seemingly wide margin of safety with minimal respiratory depression or secondary cardiac effects. The primary disadvantage is that the combination cannot be effectively reversed and therefore, the duration of anesthesia may be prolonged. There has been a historic minor misunderstanding of implied high risk associated with the use of this drug combination in tigers. This issue has been discussed at length elsewhere (Kreeger and Armstrong, 2010). In brief, there have been rare occurrences of secondary, relatively minor central nervous system symptoms such as head tremors seen up to 4 days after anesthesia when this combination is used. In general these symptoms disappear within a few days. The drug combination is generally safe to use in tigers and may be the best choice in some circumstances.

  Tiletamine/zolazepam IM- 1- 4 mg/Kg

- *Ketamine and xylazine mixtures:* Historically this combination was the one used most commonly in tigers but it has largely been replaced by other combinations and is not currently being recommended. However, in some circumstances it may be the only option available. The disadvantage of the combination, as compared to combinations that use medetomidine or other drugs, is that the dose of ketamine required is higher, resulting in a larger volume of drug to deliver. In addition, seizures during anesthetic procedures were more common with this combination, although they are relatively easy to control with diazepam or midazolam. This combination is also often associated with significant but manageable respiratory depression.

  Xylazine IM- 0.4- 0.5 mg/Kg
  Ketamine IM- 4- 10 mg/Kg

Supplementation
Ketamine IM- 1.0 mg/Kg
Midazolam IV or IM- 0.01- 0.03 mg/Kg if seizures
Diazepam IV only- 0.01- 0.05 mg/Kg if seizures
Reversal of xyalazine- Yohimbine IV or IM- 0.05 mg/Kg

- *BAM- Butorphanol/Azaperone/Medetomidine*: This combination of drugs was used in a series of more than 25 big cat anesthesic procedures at one AZA institution. Initial interest in using this combination was based primarily on the extremely low dose volume that could be achieved (1-2 ml), the absence of ketamine from the combination and the reversibility of two of the components. In addition the combination had rapid induction as well as good recovery after reversal and seemed to produce less respiratory depression than other combinations. When this combination was used, quick, solitary, spontaneous movements of the limbs, tail, paws and occasionally subcutaneous musculature were observed. This movement did not appear to be reflex in response to touch or other stimulation and did not cause undue concern to the experienced animal management and veterinary personnel involved in these procedures. It was observed that the addition of small amounts of ketamine might reduce the incidence of these spontaneous movements. However, in a single instance, there was a spontaneous head movement and a bite on a veterinarian's arm, resulting in significant injury. This animal did not wake up and in fact remained in relaxed lateral recumbency throughout the incident and had to be reversed with atipamezol and naltrexone. This drug combination does offer promise for use in big cats. It may be that the addition of a small amount of ketamine routinely could eliminate these spontaneous movements.

  Experimental Doses- no peer review
  Butorphanol IM- average- 0.185 mg/Kg
  Azaperone IM- average- 0.124 mg/Kg
  Medetomidine- average- 0.092 mg/Kg
  Supplementation: Ketamine IM- 1-2 mg/Kg
  Reversal:
  Atipamezol- average- 0.46 mg/Kg (5x medetomidine dose)
  Naltrexone- average- 0.555 mg/Kg (3x butorphanol dose)
- *High Dose Alpha-2:* The use of xylazine alone as a sole immobilizing agent or very high doses of xylazine or medetomidine with very, very low doses of ketamine in tigers may be dangerous, and is not recommended. The patient may appear asleep, but when stimulated may arouse and react aggressively. If a large enough dose is used to safely handle the tiger, severe respiratory depression occurs.

Inhalation Anesthetics: For prolonged medical treatment or surgical procedures, especially in aged and/or ill patients, inhalation anesthesia is used. Intravenous ketamine (100–250 mg) will rapidly deepen anesthesia to facilitate endotracheal intubation or extend anesthesia for brief periods (15–20 minutes). The advantage of the IV verses the IM route for supplementation is the rapid onset, lower total dose, and more rapid recovery. Following initial anesthesia with injectable dissociative anesthetic, and intubation with a cuffed endotracheal tube, either sevoflurane or isoflurane can be given, depending on the preference of the clinician. Intubation of tigers is not difficult if a long laryngoscope blade is used. Topical anesthetic to the larynx is not usually necessary, and it has the disadvantage of blocking gag reflex in case the patient vomits. Most patients do well on spontaneous respiration with occasional assisted respiration, but positive pressure ventilation is sometimes indicated.

Monitoring anesthetized tigers: Physiological monitoring of the anesthetized tiger is an integral part of any anesthetic episode. Once the patient appears anesthetized, the person responsible for the anesthesia should be the first into the enclosure to evaluate the tiger's status, before allowing others access. Depth of anesthesia may be assessed using ear twitch response, palpebral reflex to stimulation, and toe pinch but, in this author's opinion, jaw tone or the lack of resistance to opening the animals mouth is the most dependable indicator of good depth of anesthesia. Other initial observations include: responsiveness to stimuli as described, respiration rate, color of mucous membranes, pulse rate and

intensity, and muscle tone (especially jaw tone). More sophisticated monitoring can include blood pressure, pulse oximetry, and electrocardiogram.

A helpful and easy parameter to measure is indirect blood pressure using a regular sphygmomanometer attached to the foreleg. There are commercially available instruments (Dinamap, Critikon, Inc., Tampa, FL 33607) that measure indirect blood pressure. These machines record data every minute, transcribing the results to a printer. Data obtained include systolic, diastolic, and mean blood pressure, and heart rate. Alarms can also be set for high or low readings. Indirect blood pressure values may not be as accurate as an intra-arterial transducer, but these values help to note trends in the pressures during the anesthesia period. Blood pressure provides a more functional evaluation of the heart than an EKG recording.

Pulse oximetry has become an indispensable physiological monitor to determine oxygen saturation of the blood and the pulse rate. The sensor, designed for humans, is modified to clip on the lip, ear, tongue, or nasal septum in a non-pigmented area.

Another parameter to measure is body temperature, especially during prolonged surgical procedures where hypothermia may occur. Elevation of temperature may be seen with convulsions, pre-anesthetic excitement, high environmental temperature, and exposure to direct sunlight. Temperatures greater than 39.4 °C (103 °F) in a patient should be an indication for cooling with water and air circulation. Severe hyperthermia (> 40.6 °C [105 °F]) requires more aggressive therapy including water immersion, cold-water enemas, IV fluids, corticosteroids, and antibiotics.

7.6 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. The owner of an animal on loan at a facility is to be consulted prior to any elective invasive procedures, including permanent contraception. Tiger care staff should be trained in meeting the animal's dietary, husbandry, and enrichment needs, as well as in restraint techniques. Staff should also be trained to assess animal welfare and recognize behavioral indicators animals may display if their health becomes compromised, however, animal care staff should not diagnose illnesses nor prescribe treatment (AZA Accreditation Standard 2.1.3). Protocols should be established for reporting these observations to the veterinary department. Tiger hospital facilities must 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

(2.1.3) Paid and unpaid animal care staff should be trained to assess welfare and recognize abnormal behavior and clinical signs 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, animal care staff (paid and unpaid) must not diagnose illnesses nor prescribe treatment.

AZA Accreditation Standard

(2.3.2) Institution facilities must have radiographic equipment or have access to radiographic services.

Signs of illness: Non-domestic felids may hide signs of illness until a disease is advanced. In zoological settings, it is important that animal care staff be astute to subtle changes in behavior or physiological signs that may suggest illness. Keepers that have daily contact with tigers are often the best persons for noting these subtle changes. Any change in appetite, urination, defecation, or general behavior should be documented. For example, changes in urine and fecal color, quantity, and consistency should be noted. Dehydration can be assessed by a visual examination that shows a tiger with dry mucous membranes and a dry hair coat. Other visual observations that can be obtained from outside the enclosure include evaluation for normal breathing patterns and rate. The following are known diseases and disorders that have been observed in tigers.

Gastrointestinal disease: Certain gastrointestinal syndromes have been placed under general categories as "general adaptation syndrome" or "tiger disease" (Seidel & Wisser, 1987). These problems are historically noted in tigers, especially Amur tigers. The proposed etiology of "tiger disease" has been reported to be a pancreatic dysfunction or disruption of gastrointestinal flora (Kloss & Lang, 1976). At the present time it appears that this syndrome may largely be recognized as chronic inflammatory bowel disease. This is a manageable but challenging problem (Travis & Carpenter, 2011). Minimal colon biopsies are indicated and in some cases more aggressive small intestine biopsies may be required. Stress was documented as the cause of these problems in one report that correlated the digestive upsets with sudden changes in the tiger's environment. Gastrointestinal upsets should be investigated as being caused by diet, infectious agents (i.e. *Salmonella* ssp., *Clostridium*), or concurrent kidney failure. The specific cause is then treated if identified or supportive care is instituted.

Kidney disease: Kidney disease is a recognized problem in aged tigers but is reported to occur at all ages (Bush, Phillips & Montail, 1987).

Bacterial diseases: Tuberculosis, caused by *Mycobacterium bovis*, has been a major disease problem historically in tigers in certain settings. However, it is not considered a problem in North America at the present time. It presents as a chronic non-responsive disease with the lungs as target organs. Localized tuberculosis lesions involving the eyes have also been reported. Ante-mortem tests are reported to be unreliable. In collections with severe problems, cubs have been vaccinated with Bacille Calmette Guérin (BCG) starting at four weeks of age, but BCG vaccinations may not be indicated in most situations.

Anthrax has been seen in large felids including tigers, causing death in 1–4 days. On post-mortem examination there are blood clots reported on the spleen that in the earlier literature were called tumors. Reported treatment includes antisera and antibiotics which have met with limited success. Anthrax is almost always contracted through the consumption of contaminated meat.

Systemic bacterial diseases have been found in tigers living in zoos such as bacterial meningitis from *Klebsiella* and *Diplococcus.* Colisepticemia, *Shigella flexneri*, *Salmonella* spp, *Corynebacterium pyogenes,* and *Clostridium perfringens,* all of which have caused fatal disease in tiger cubs (Bush, Phillips & Montail, 1987).

Salmonellosis, caused by *Salmonella typhimurium*, which occurs either sporadically or as outbreaks, is a recognized medical problem in tigers. Other species of *Salmonella* are implicated in enteric disease affecting both young and adult tigers with symptoms ranging from mild gastrointestinal upset to acute death. To prevent salmonellosis in tigers a number of precautions should be made. There should be quality control at the production source, the diet should be maintained frozen prior to feeding and the thawing process and feeding method must reduce possible contamination.

Another source of salmonellosis can be a tiger that is an asymptomatic carrier of *Salmonella* spp. These tigers serve as sources of infection for others, especially young tigers, and may break with the disease themselves if stressed.

There is a potential for zoonosis with *Salmonella* spp., as the organisms found in stool cultures from diseased tigers can also cause salmonellosis in humans. Potential zoonosis risks can occur with the diseases listed above such as, tuberculosis, rabies, and anthrax; therefore it is necessary to take routine preventative precautions when working with a sick tiger.

Viral disease: Upper respiratory viral diseases have been reported in tigers and usually have a high morbidity and low mortality. These viral diseases have similar signs in tigers as to those reported in the domesticated cat. Treatment is aimed at supportive care. Panleukopenia has been proven by viral isolation in tigers and presents in similar ways to the disease in domestic cats. Canine distemper is a virus of particular concern in large exotic felids including tigers (Nagao et al., 2011; Appel et al., 1994). Feline infectious peritonitis (FIP) has been confirmed in one Sumatran tiger, and additionally, a particularly severe strain of Feline calicivirus has been confirmed in large exotic felids including a litter of Amur tiger cubs (Harrison et al., 2007).

Fungal diseases: *Microsporum canis* is not an uncommon cause of hair loss in young tigers. Treatment is similar to that in the domestic cat with equally successful results. Griseofulvin can be given orally at 20 mg/kg every 24 hours or at 140 mg/kg once a week. A second cutaneous pathogen, *Dermatophilosis cargolensis*, has been cultured from skin lesions in polar bears and tigers. This disease has a chronic course but responds to topical and systemic antibiotics. Coccidioidomycosis was reported in two Bengal tigers with concurrent liver problems living in endemic areas.

Nervous system disorder: Tigers seem prone to exhibiting signs of central nervous systems issues with a wide variety of disease conditions.

Congenital problems: Congenital problems have been reported, and in some instances, may be related to inbreeding.

Lacerations and abscesses: A potential surgical problem is lacerations from fight wounds. Usually lesions are small and are left to drain and granulate in. It is common procedure to give antibiotics orally for 7–10 days after such fights to minimize local infection and bacteremia that may shower to other organs. A common isolate from the mouths of tigers has been *Pasteurella multocida* with *Staphylococcus aureus* and *Streptococcus viridens* as potential problems in tiger bites. *Pasteurella multocida* usually shows good sensitivity to a wide range of antibiotics with cephalosporins being the drug of choice.

Abscesses should be clipped and prepped for a sterile culture in order to determine the etiology and guide the choice of antibiotic therapy. The abscess should then be opened and drained. Flushing of the lesion with hydrogen peroxide and a disinfectant is recommended. The tiger should be treated with systemic broad-spectrum antibiotics for 7–10 days.

Parasites: A parasite-monitoring program provides periodic, regular stool examinations to detect parasitic infections. Most internal parasites found in stool examinations are relatively common and ubiquitous in *ex situ* situations, with some less frequent infections reported (Bush, Phillips & Montail, 1987). Commonly identified species are from the orders Ascarididae and Strongyloidae (e.g., *Toxocara, Toxascaris, Ancylostoma*). It is seldom possible to eliminate ascarids totally in tigers, but they are controllable with periodic administration of an oral anthelminthic. These agents can be more effective when the full recommended dosage is given for more than one day, such as three consecutive days, rather than as

single treatments. Post-treatment fecal examinations are necessary in assessing efficacy of the initial treatment. Follow-up treatments to remove larval stages not susceptible during the initial treatment may be required.

Anthelmintic programs: In this author's experience, they have found the following anthelmintics effective and safe when administered using appropriate dosage regimens:

- Pyrantel pamoate (Strongid-T, Pfizer Inc., New York, NY 10017) 3–5 mg/kg per os. Can be given at this level for 3–5 consecutive days;
- Fenbendazole (Panacur, American Hoescht, Somerville, NJ 08876) 5–l0 mg/kg per os. Most commonly single day treatment, but can be given 3 consecutive days at this level;
- Ivermectin (Ivomec, Merck & Co., Rahway, NJ 07065) 0.2 mg/kg, subcutaneous or per os. We have used injectable cattle formulation orally at this dose for 1–3 days. Limited use in tigers with the parenteral route;
- Praziquantel (Droncit, Haver-Lockhart, Shawnee, KS 66201) 5.5–6.6 mg/kg. Either as the oral or parenteral form for cestodes;
- Sulfadimethoxine (Albon, Roche Chemical Div., Nutley, NJ 07110) 50 mg/kg, parenteral or per os, as a coccidiostat.

Not all eggs or larva observed in fecal examinations may be parasitic to the tiger. The tiger may be serving as a transport host depending on what it has been fed or what feral animals it may have consumed. Coccidia observed may be associated with feeding whole carcass specimens (e.g., whole rabbits). This emphasizes the need for specific identification of parasite stages seen in stool and an awareness of the tiger's diet.

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

AZA Accreditation Standard

(1.5.8) The institution must develop and implement a clear and transparent process for identifying, communicating, and addressing animal welfare concerns from paid or unpaid staff within the institution in a timely manner, and without retribution.

AZA-accredited zoos and aquariums provide superior daily care and husbandry routines, high quality diets, and regular veterinary care, to support tiger 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 tigers both in their care and in the wild. As stated in Chapter 7.3, necropsies should be conducted on deceased tigers 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 Standards 2.5.1 and 2.5.3). If the animal is on loan from another facility, the loan agreement should be consulted as to the owner's wishes for disposition of the carcass; if nothing is stated, the owner should be consulted. Necropsies should include a detailed external and internal gross morphological examination and representative tissue samples form the body organs should be submitted for histopathological examination. Many institutions utilize private labs, partner with Universities, or have their own in-house pathology department to analyze these samples. The AZA and American Association of Zoo Veterinarians (AAZV) website should be checked for any AZA Tiger SSP Program approved active research requests that could be filled from a necropsy. For euthanasia protocols, it is recommended that institutions follow their own and AAZV guidelines. Standard institutional protocols should be used for necropsy.

AZA Accreditation Standard

(2.5.1) Deceased animals should be necropsied to determine the cause of death for tracking morbidity and mortality trends to strengthen the program of veterinary care and meet SSP-related requests.

Tiger pathology review: The necropsy records of 165 Siberian tigers (*Panthera tigris altaica*) submitted to the AZA Amur Tiger Species Survival Plan® (SSP) by participating institutions were reviewed to

determine causes of morbidity and mortality from 1915–2000. Further review was reported in 2011 (Escalante, Nguyen & Lewandowski, 2011). The mean age at death for these necropsied tigers was 12.1 (+/- 5.9) years, with females living longer than males (12.8 vs.11.3 yrs). The most common diagnosis was neoplasm (25.5%) with mammary adenocarcinoma the primary neoplasm in females (51.9%). Degenerative problems were noted in a majority of tigers (79%). Musculoskeletal abnormalities, including arthritis, spondylitis, and dysplasia, occurred in 21.8% of the cases. Renal disease was noted frequently (27.3%). Trauma was occasionally noted as the primary cause of death (12%), most frequently in neonates. Anesthetic related deaths (7%) were associated with systemic abnormalities and were infrequently the primary insult. Infectious processes of all types were reported at 18% and developmental problems were evident at 14%. Differences in the pathologic examinations, especially early on, as well as reporting bias are a significant concern in the analysis of the data (Lewandowski 2003).

Post-mortem examination: Preventive medical programs also depend on complete post-mortem examination of animals that have died in a zoological collection. This service should provide rapid tentative diagnosis from the gross pathological examination to allow immediate medical care of the remaining collection if indicated. Histopathological examination of tissues is mandatory and should be done in a timely manner to make those findings relevant to the health care of the collection. Concurrent cultures may be indicated for bacteria, fungi, and viruses. Appropriate tissues not formalin fixed may be frozen for viral, toxicology, and genetic studies. Besides determining the cause of death, a complete post-mortem examination allows review of anatomical structure, assessment of nutritional status and parasitic burden of the animal.

Guidelines for AZA Tiger SSP Necropsies: The following are the recommended procedures and records that should be a part of all tiger necropsies.

The Complete Tiger Necropsy Protocol
Notification and Reporting

Time critical gamete and genome collection- Prior to or immediately upon death, contact a reproductive physiology program to discuss gamete collection and preservation. The Omaha Zoo Center for Conservation and Research (contact below) has done the majority of tiger gamete preservation post mortem but most zoo reproductive programs and veterinary school theriogenology programs are doing or can do this. Semen preservation is most successful although oocyte may be preserved as well. Ovaries or testicles need to be collected within minutes if at all feasible. A protocol for initial testicle or ovary collection is provided at the end of this protocol if you are unable to make contact with a reproductive program immediately. However recommended procedures change so it would be useful to talk to the person who will be doing the work to determine their current recommendations.

Programs preserving genome cell lines are also in place although less common as of this writing. Preservation of this material also requires quick action. Contact the San Diego Zoo Institute for Conservation Research (contact below) for the most current instructions for this procedure.

Routine reporting- Any time a tiger managed by a Species Survival Plan dies, please notify the Tiger SSP Chair, the Subspecies Vice-Chair and the North American and International Tiger Studbook Keepers by email within 48 hours of the event. If the death has been recorded in ZIMS or other relevant record-keeping software, a specimen report should be sent. Otherwise, please send the following information:

- Institution and local contact
- Subspecies
- Studbook number
- Local accession or GAN number and house name
- Date of Death

When all work has been done and the report is complete, please submit the gross necropsy report, histopathology report and any ancillary work such as cultures, electron microscopy, special stains, virus isolation and other diagnostic procedures as a single report to the Tiger Species Survival Plan Veterinary Advisor. The report should include the above identifying information in so all records are well correlated.

Necropsy Protocol

This protocol is written as a “complete” necropsy protocol. However the author fully recognizes resources and time constraints do not always allow for as thorough a necropsy and tissue collection as

might be preferred. At a minimum we need everyone to do a "basic" necropsy and tissue collection. Please complete as much of the more thorough "complete" protocol as possible.

There are some population disease concerns that require additional special tissue collections, processing or submission. At this time these include Inflammatory Bowel Disease, Reproductive tract disease and old tiger senescence. Prior to or during necropsy if possible please contact the following people to get the most current requests for tissue collection or handling.

Contact information provided below is current as of May 2015.

Reproductive Tract Disease:
Complete tracts from all tigers needed, male and female, whether diseased or not, implanted or not. Entire tract in formalin.

Dalen Agnew,
Michigan State University
Diagnostic Center for Population and Animal Health
Lansing, Michigan 48910-8104

Phone: (517) 432-5806
Fax: (517) 353-5096

Inflammatory Bowel Disease:
Currently routine histopath on all sections of GI tract.
Erika Crook, DVM, Dipl. ACZM
Associate Veterinarian
Utah's Hogle Zoo
Phone: 801 584 4545
Fax: 801 584 1793
etravis@hoglezoo.org

Old Tiger Senescence
Brain and spinal cord, ½ in formalin, ½ frozen
Michael M. Garner, DVM, DACVP
Northwest ZooPath
654 W. Main St.
Monroe, WA 98272
Phone: 360-794-0630
Fax: 360-794-4312
www.zoopath.com; zoopath1@gmail.com

The following pathologists all have particular interest in and expertise in cats and may be willing to advise you on tissue collection and handling. Contact information provided below is current as of May 2015.

D. McAloose, VMD, Dipl ACVP
Wildlife Conservation Society
Zoological Health Program
Head of Pathology
2300 Southern Blvd
Bronx, NY 10460
phone: 718-220-7105
fax: 718-220-7126
email: dmcaloose@wcs.org

Karen A. Terio DVM, PhD, DACVP
Zoological Pathology Program
University of Illinois
LUMC Bldg 101 Rm 0745

2160 S First St
Maywood, IL 60153
Phone: 708-216-6183
Fax 708-216-5934
kterio@illinois.edu

Michael M. Garner, DVM, DACVP
Northwest ZooPath
654 W. Main St.
Monroe, WA 98272
Phone: 360-794-0630
Fax: 360-794-4312
www.zoopath.com
zoopath1@gmail.com

Complete Procedure: The necropsy should be thorough, two sets of formalin tissue should be collected and a liberal set of frozen tissue should be collected. Gross photos of everything possible should be collected and stored where they can be retrieved. Lesions should be measured, and if possible, some tissues should be weighed, such as heart. Remember the common sense part: for instance, if the cat has CNS disease, then a serious effort to get the whole brain and cord out would be a good thing. If it has heart disease, measure the walls, the luminal diameter, photo the valves and so forth. Holding the carcass until histology has been completed is also a good thing if possible.

Record the following information
Institution: _____
Address: _____
_____
_____
_____
Pathologist or person completing the necropsy_____
Species/subspecies: _____
Studbook No: _____ In house or ISIS number: _____
In-house identity: _____ Sex: _____
Date of birth: _____ Weight: _____
Date of death: _____ Date of necropsy: _____
Necropsy number: _____

STANDARD FROZEN (-70^{o}C IF POSSIBLE) TISSUE CHECK LIST: From Karen Terio
Please hold samples at your institution for future toxicological or nutritional analysis if necessary.
____ **Liver**
____ **Kidney**
____ **Brain (portion of cerebral cortex)**

STANDARD FIXED TISSUE CHECK LIST:
Preserve the following tissues in 10 % buffered formalin at a ratio of 1 part tissue to 10 parts formalin. Tissues should be no thicker than 1 cm. Include sections of all lesions and samples of all tissues on the tissue list. Photograph and measure lesions. Weigh organs that are larger or smaller than expected.

SSP SURVEILLANCE TISSUES and recommended tissue sampling procedures:
__ **Liver** - sections from 3 lobes, including gall bladder
__ **Spleen** - Cross section including capsule.
__ **GI Tract** - 3 cm long sections of:
Esophagus
Stomach - multiple sections from cardia, fundus (body), and antrum of pylorus
Small intestines - duodenum, jejunum, ileum

Large intestines - cecum, colon

__ **Omentum** - ~3 cm square

__ **Pancreas** - representative sections from two areas including central ducts

__ **Adrenal** - entire gland with transverse incision.

__ **Kidney** -cortex and medulla from each kidney

__ **Urinary bladder, ureters, urethra** - cross section of bladder and 2 cm sections of ureter & urethra.

__ **Reproductive tract** - Entire uterus and ovaries with longitudinal cuts into lumens of uterine horns. Both testes (transversely cut) with epididymis. Entire prostate, transversely cut.

__ **Salivary gland**

__ **Oral/pharyngeal mucosa and**

__ **Tongue** - cross section near tip including both mucosal surfaces.

__ **Lung** - sections from several lobes including a major bronchus

__ **Trachea**

__ **Thyroid/parathyroids** - leave intact.

__ **Lymph nodes** - cervical, mediastinal, bronchial, mesenteric and lumbar. Cut transversely.

__ **Thymus**

__ **Heart** - longitudinal sections including atrium, ventricle and valves from right and left sides.

__ **Eye** - both eyes intact. Remove extraocular muscles and periorbital tissues.

__ **Brain** - cut longitudinally along midline. Submit entire brain and **pituitary gland.**

__ **Spinal cord** (if neurologic disease) - sections from cervical, thoracic and lumbar cord.

__ **Diaphragm and Skeletal muscle** - cross section of thigh muscles

__ **Opened rib or longitudinally sectioned ½ femur** - marrow ***must*** be exposed for proper fixation

__ **Skin** - full thickness of abdominal skin, lip and ear pinna.

__ **Neonates: umbilical stump** - include surrounding tissues.

The following checklist is also provided as an aid in being thorough and keeping track of tissues, photos, etc.

Tissue examination and collection checklist (Dee MacAloose)

TISSUE	Gross	Histo	FF	FP	-20, -80	Photo	TISSUE	Gross	Histo	FF	FP	-20, -80	Photo
GENERAL-external							**ABDOMEN**						
Oral cavity & teeth							Diaphragm						
Tonsils							Stomach						
Skin and nails							Small intestines						
Subcutis							Large intestines						
Skeletal muscle							Pancreas						
Peripheral nerves							Spleen						
Mammary gland							Liver & gall bladder						
Umbilicus							Lymph nodes						
BONES & JOINTS							Aorta & vessels						
Bone marrow (femur)							Kidneys						
Bones							Ureters						
Hips							Urinary bladder						
Knees							Urethra						
Tarsi							Adrenal glands						
Shoulders							Ovaries						
Carpi							Oviduct/Uterus						
Atlantooccipital							Vagina/vulva						
CAVITIES							Testes						
Thoracic cavity							Access sex gland						
Abdominal cavity							Penis/prepuce						
PLUCK							**HEAD**						
Tongue							Eyes						
Thyroids/parathyroids							Ears & bullae						
Esophagus							Skull/nasal cavity						
Trachea & Lungs							Brain/Meninges						
Heart/Pericardial sac							Pituitary gland						
Aorta & other vessels							**SPINE**						
Thymus/lymph nodes							Vertebral column						
							Spinal cord						

Gross = Gross appearance: N=normal/no gross lesions; AB=abnormal; NE=not examined; NF=not found; NP=not present

FF = Tissue fixed in formalin: + = yes

Histo = Tissue submitted for histology: + = yes

PHOTO = Photograph: + = yes

-20/-80 + = Frozen tissue temperature: list storage temp as – 20, -80 or other

FP = Filter paper sample: + = yes

If ancillary diagnostics, please include list and results with report

Collection and Processing of Testicles or Ovaries Post-Mortem for Shipment

Testicles

As soon as possible after death, remove testicles enclosed within the scrotal sac and place them into a clean plastic bag or specimen container with some saline-soaked gauze at room temperature and seal tightly. Place ice packs or ice sealed in a plastic bag on the bottom of a small styrofoam box or other insulated container. **DO NOT USE DRY ICE**. Cover the ice with several layers of newspaper or paper towels, then place the testicles on top and seal the box. Note: it is very important that the testicles cool very slowly to 4-7^{o}C (refrigeration temperature); therefore, be sure to not place them in direct contact with the ice (or the sperm will die of cold shock).

Testicles may be sent by overnight priority delivery service, but you should expect a reduction in sperm survival – particularly from aged or chronically ill animals. Ideally – and for very valuable animals – counter-to-counter airfreight service is preferable (e.g., American Airlines or United Airlines offer such services). Current technology in assisted reproduction has demonstrated the potential of producing live offspring from embryos derived from in vitro fertilization as well as sperm injection of either motile or non-motile sperm collected from testicles. Therefore, sperm samples should be salvaged and cryobanked as part of a conservation program for any species.

Ovaries

For unexpected deaths: To avoid any loss in egg survival, ovaries must be received within 8 hours of death; therefore, they must be shipped by counter-to-counter airfreight service. Before removing ovaries, pre-warm physiological saline and several warm packs (to physiological temperature). Using sterile technique, cut the end of the oviducts (Fallopian tubes) at the utero-tubal junction, and remove the ovaries. Place them directly into a sterile specimen container or sealable, leak-proof plastic bag containing the physiological saline pre-warmed to body temperature. Pack the specimen cup in a thick styrofoam box containing several warm packs. Use cloth towels to ensure that the ovaries are properly insulated.

For anticipated deaths or euthanasia: Ideally, oocytes should be recovered from the ovaries as soon as possible after the death of the animal. If a minimum of 24 hours is anticipated before the death of the animal – call the Center for Conservation and Research (CCR) at the Henry Doorly Zoo (see below) and request a kit for recovering and maturing the ovarian oocytes. You will be sent media (Hepes-TL Solution containing heparin and antibiotics) for processing the ovaries and recovering the oocytes. The solution should be warmed to physiological temperature before beginning. Small ovaries should be sliced in approximately 5 mm sections using a sterile scalpel blade, then the follicles punctured using 25-20 gauge needles. The oocytes can then be collected (using an embryo handing device provided in the kit or, alternatively, any type of micropipette with sterile tips) and placed directly into tubes of media containing oocyte maturation medium (TCM 199 containing hormones, serum, energy substrates and antibiotics). These tubes should be placed into the transportable incubator (provided) which should be then sent by overnight courier to the Henry Doorly Zoo CCR. Once liberated from the ovarian follicles, the oocytes will resume meiosis and mature to metaphase of meiosis 2 in approximately 24 hours at which time they will be prepared for in vitro fertilization by staff at the CCR.

For any shipment, please notify someone at the reproductive biology laboratory at Omaha's Henry Doorly Zoo & Aquarium CCR as soon as possible as to what is being shipped as well as any pertinent tracking information. Telephone: 402-733-8401, ext. 5055; fax: 402-733-0490; E-mail: repro@omahazoo.com. Send tissues in care of:

Reproductive Physiology
Center for Conservation and Research
Henry Doorly Zoo
3701 South 10th Street
Omaha, NE 68107-2200
402-733-8401, ext. 5055
Or Zoo Hospital
402-738-2080

Participation in this is voluntary, but highly encouraged for the benefit of the species. The long-term storage of the gametes and the processing costs will be the responsibility of Omaha's Henry Doorly Zoo. We ask that institutions budget for overnight courier (testicles) or counter-to-counter (ovaries) shipping costs. If you are unable to fund these costs, please contact us in advance to discuss alternatives.

*The SSP will authorize the use of any rescued gamete material, according to value, genetics, and banked quantity. In the event of successful propagation, institutions will be contacted and breeding loan agreements and documentation will be drafted at that time.

Guidelines for AZA Tiger SSP neonatal necropsies: The following list includes additional information that should be obtained in the event of a neonatal death (including aborted fetuses, stillbirths, and neonates). Examine all specimens submitted including partially consumed carcasses. Use this in conjunction with the AZA Tiger SSP Necropsy Protocol for collecting all samples.

- Obtain weight, sex, and age or stage of development.
- Examine the skin, pelage (texture, color and amount of fur—if any), and nails.
- Examine for external malformations (cleft lip and palate, other facial/skull, trunk, or limb abnormalities).
- Assess state of hydration (subcutaneous and serosal surfaces dry or moist) and nutritional status (record subcutaneous and body cavity fat stores as none, minimal, moderate, or abundant).
- Examine for internal malformations (diaphragmatic hernia, cardiac anomalies, etc.).
- Determine if breathing occurred. Place a piece of lung tissue in buffered formalin. If it floats (contains air), the animal probably breathed. If it sinks (contains fluid) the animal probably did not breathe (if the lung is not pneumonic).
- Verify sex by examining gonads.
- Determine nursing activity by looking for and estimating amount of milk curd (white, cottage-cheese like mass) present in the stomach and presence of milk stool (yellow-white semisolid material in the colon) with absence of meconium (greenish-brown pasty material throughout GI tract).
- Document degree of trauma induced by mother.
- Proceed with the standard AZA Tiger SSP Necropsy Protocol. Be sure to fix any "placental/membrane material" if available.

Tiger carcass disposition: Upon the death of any tiger (*Panthera tigris*) that is registered within an AZA Tiger Studbook (Amur, Sumatran, and Malayan), the following protocol is recommended:

- Blood samples taken and stored.
- Carcass put in cooler (do not destroy).
- AZA Tiger SSP Coordinator contacted for specific instructions regarding tissues and carcass disposition.
- Report death to the Regional and International Studbook Keeper.
- Owner of the tiger should be notified of the death.
- Depending on the region, condition of the carcass and state/federal permitting, general disposition routes are: Hide, skull and skeleton used for zoo education/volunteers, donated to local museum or local university's anatomy department.

Chapter 8. Reproduction

8.1 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.

Seasonal changes: Tigers have a distribution that ranges from the hot and humid tropics of Indonesia and Malaysia, to the seasonally dry yet hot evergreen forests of India across Myanmar and Thailand, to the frozen oak and pine forests of northern China, Korea, and southeastern Russia. This broad distribution over different climatic regimes affects seasonal reproductive patterns of both wild tigers and those in human care, but an analysis of births across the subspecies needs to be performed to define what these effects are.

The Amur tiger appears to be a seasonally polyestrous breeder and an induced ovulator whose breeding season may be synchronized by photoperiod (Seal 1985). Analysis of 1,239 *ex situ* births of Amur tigers in collections throughout the Northern Hemisphere revealed a peak in births in April–June. Amur tigresses show behavioral estrous cycles and ovarian follicular phase cycles beginning in late January and ending in early June. The duration of anestrus is typically 7–8 months (Seal 1985). These findings correlate with the observed pattern of births for tigers in the Northern Hemisphere.

One animal exposed to “long day” photoperiods (16 hours of light, 8 hours of dark) in the late fall exhibited a shortened anestrus interval (Seal et al., 1985), suggesting that seasonal cycles in these tigers may be synchronized by photoperiod. This might also account for some of the off-season births in zoo animals that are exposed to artificially extended photoperiods as a part of exhibit or management practices.

Hormonal tracking: Numerous studies have been conducted that document estrous cycles in female tigers and provide useful information in helping to determine correlation of behavioral estrus and ovarian cyclicity (Seal et al., 1987; Brown, 2006; Graham et al., 2006; Putranto et al., 2007). The AZA Tiger SSP recommends that institutions housing females with breeding recommendations (particularly older females, females whose endocrine cycles have not been characterized previously, or females that display no or limited estrous behaviors) collect fecal samples every other day from these individuals for a period of at least 3 months and have these samples analyzed for steroid hormones to evaluate the reproductive potential/estrous cycles of these females. The AZA Tiger SSP Reproductive Advisor can be contacted for the latest information on protocol, methodology, and costs of such analyses.

Seal et al. (1987) conducted a study to develop a quantitative behavioral profile, based upon daily observations of female Amur tigers during the breeding season in order to identify the stage of estrus in individual animals as a prelude to ovulation induction and artificial insemination. Blood samples were collected and physical examinations conducted at least once a week to provide endocrine and physiological correlates of the estrous cycle for comparison with behavioral data. The behavioral indicators of estrus chosen for inclusion in this study were vocalizing (calling or moaning), prustening (a greeting call that sounds like air expelled softly through the nostrils), rubbing the cheek, forehead or flank against the walls/bars of the enclosure, rolling over and writhing on the back, and the exhibition of lordosis or semi-lordosis (postures assumed just prior to copulation). Other estrous behaviors in tigers include exhibiting flehmen (an exaggerated open mouth yawn used to discern the reproductive status of a female from pheremones found in her urine) and pacing. Although the frequencies of occurrence of some behaviors showed significant correlations with the endocrine profiles of the females (Seal et al., 1985), total scores of observed estrous behaviors with no weighting of individual behaviors were most indicative of the females’ estrous cycles.

The following physiological data were collected on the changes in concentrations of estradiol, progesterone, and testosterone associated with reproduction (Seal et al., 1985; Seal et al., 1987):

- Estradiol: Peaks of estradiol concentration occurred from Feb–Jun, with low values from Jun–Jan. Baseline serum immunoreactive estradiol-17ß values ranged from < 5–115 pg/ml. Values greater than 20 pg/ml of immunoreactive estradiol were more than three standard deviations greater than the mean of the remaining values or the anestrous values and were considered indicative of a

peak and of an active ovarian follicular phase. During anestrus, estradiol levels averaged 4.2 pg/ml, ranging from 0.5–9.3 pg/ml. Mean peak estradiol concentrations were 47.6 pg/ml, ranging from 21–115 pg/ml. The duration of elevated estradiol values was 6–10 days. The interval between peaks averaged 24.9 days.

- Progesterone: Serum progesterone concentrations ranged from 0.5–12 ng/ml. Progesterone values were less than 1 ng/ml in 145 of the baseline samples, and 18 values were between 1 and 2 ng/ml. Excluding values greater than 2 ng/ml, serum progesterone concentration was 1.2 ng/ml in the samples collected Feb–Jun. Eleven of 17 estradiol peaks were not associated with elevations of progesterone, and none of the elevated progesterone levels persisted more than 2 weeks.
- Testosterone: Serum testosterone concentrations in the baseline samples ranged from 10–100 ng/dl. During anestrus, testosterone concentrations averaged 23.4 ng/dl. Peak testosterone levels averaged 73.9 ng/dl. All of the 54 estradiol peaks greater than 20 pg/ml were accompanied by testosterone peaks. Androstenedione concentrations were correlated with estradiol during the estrous season, as were testosterone values. The correlation of serum testosterone and androstenedione levels with estradiol, their lack of correlation with progesterone, and their increase after pregnant mare's serum gonadotropin (PMSG) treatment suggest an ovarian rather than adrenal origin for these hormones in these tigers.

Estrous behavioral profiles were significantly correlated with the endocrine profiles of estradiol and testosterone concentrations. Clear peaks, showing a steady increase and subsequent decrease in expression of behaviors, were apparent in each cycle the tigers exhibited. Also, the peak expressions of each female's estrus profile were relatively constant, showing more variation between different females' cycles than among the various cycles of any individual female. Behavioral observations of 10 estrus cycles in three tigers yielded an average estrus length of 5.3 + 0.2 days.

Endocrine data from fecal hormone analysis indicate that fecal estrogens for tigers (regardless of subspecies) generally are in the range of 100–200 ng/g feces for an estrual female. If a female ovulates, fecal progestin values rise to above 1000 ng/g feces 3–4 days after the last day of breeding and remain elevated for a period of approximately 60–66 days if conception did not occur. If conception did occur, fecal progestin will remain elevated throughout gestation. Similar fecal hormone values have been reported in Amur tigers by Putranto *et al.* (2007) and Graham *et al.* (2006). Both papers report a psudedopregnancy length of approximately 34 days and a gestation length of 108 days (from the rise in fecal progestagens to parturition). It should be noted that endocrine profiles as a diagnostic tool for pregnancy can be subject to error, depending on the frequency of sampling, the amount of pre-breeding baseline data and hormonal fluctuations during a pregnancy/pseudopregnancy. Stationing of a female for ultrasound examination without anesthesia can provide unequivocal proof of pregnancy and has been used successfully on at least one occasion.

On average, the inter-estrous interval for Amur tiger females is 24.9 + 1.3 days (N = 10), an interval in agreement with the inter-estrous endocrine peaks (Seal et al., 1985). This 25-day interval has been confirmed from studies based upon both the behavioral and hormonal data derived from nine animals of different genetic lineages over four seasons of observations. In three other studies, inter-estrous intervals for tigers have been reported to range from 6 to 40 days, but generally fall in the range of 18–28 days (Graham et al., 2006; Putranto et al., 2007; Saunders et al. 2014). One behavioral feature of the inter-estrous period is the complete apathy females display during anestrus. In contrast to the constant vocalizing, pacing, rubbing, and rolling that is indicative of estrus, anestrus is characterized by resting quietly, even though measurable (but low) concentrations of estradiol and testosterone are evident.

The value of using behavioral indicators of an estrous cycle is that they allow a relatively accurate prediction of when the next cycle will occur (approximately 25 days in Amur tigers), and thus allow for more accurate timing for placing females with males for natural breeding or for assisted reproductive manipulations. Combining behavioral indicators with hormonal values provides even more precise timing/predictors as to when the female will be sexually receptive.

An AZA Tiger SSP study of ovarian cyclicity and breeding success (Saunders et al., 2014) examined the hormonal profiles of 38 non-contracepted female Amur, Malayan, and Sumatran tigers from numerous institutions. It found that 82% of females showed evidence of ovarian cyclicity over sampling periods

ranging from 63-217 days. Neither mean cycle length nor the frequency of ovarian cyclicity were influenced by female age or parity (i.e., whether the female had reproduced previously).

Ovulation: Tigers generally are presumed to ovulate only after multiple copulations and generally over a period of a few days (i.e., induced ovulation). However, there are instances of females undergoing spontaneous ovulation in which a prolonged rise in fecal progestins follows elevations in estrogen with no male present (Durrant, unpublished data).

Timing of introductions: The introduction of tigers for breeding is typically characterized by moderate to extreme levels of excitable or violent behavior, but this can depend on the personalities of the tigers and the experience of the animal care staff. There is no magic formula for introducing tigers, but there are some general guidelines that have proven to be successful for most institutions (see Chapter 5.3 for more information).

Initiating breeding pairs: In general, once a breeding recommendation is made by the AZA Tiger SSP, preparations to move the recommended tigers to a mutual location for the breeding should begin immediately. Once breeding and transfer recommendations have been approved and all logistics for the transfer have been addressed, the tigers should be transported as soon as possible, avoiding extreme weather conditions of summer and winter. Because of inter-individual differences between tigers, a calm tiger can settle into a new facility and probably be adapted for breeding within a minimum of 2 months; a more excitable tiger may be adaptable in three months, and some may take even longer than that.

Animal care staff can determine when a female tiger is ready to be introduced to a male by observing her behavioral cues. Female tigers will begin to react in a more positive fashion to staff by showing increased rates in greeting, vocalizing with the "prusten," rubbing up against bars, becoming more active, or even showing lordosis or rolling on the floor, etc. The female's appetite will either fall off slightly, dramatically, or she may even stop eating altogether for a day or two. The male will not show a similar decrease in appetite. Hand-reared tigers tend to continually react positively to animal care staff on a more frequent basis, and this can make it difficult to distinguish when they are in estrus versus when they are in anestrus.

Maintaining breeding pairs: Once the initial stages of introduction have been completed (visual, auditory, and olfactory contact), depending on the pairs' experience level, an estrual female should be placed with the recommended male multiple times each day for durations of 15-30 minutes. These short durations minimize the impact on staff time, and tigers often breed well during these brief periods. Tigers require numerous copulations to induce ovulation, and as many as 100 over an estrus period have been observed. As long as the female is reacting positively to the presence of the male, and as long as the two are copulating or not fighting, the pairing process should continue for a full 7 days. Breeding intensity reaches a maximum between days 3 and 6, and then tapers off to no interactions.

Once a female stops showing interest in a male and ignores him completely, this implies that she is probably in anestrus. At this point, the pair should be separated until the next cycle begins, if she is not considered pregnant. If the animals are separated and the female has not ovulated, the female should cycle again within 30 days. If she does, a second reintroduction can begin. If the female does not recycle and continues not showing interest up through 50 days, she is either pregnant or going through a false pregnancy. If the female is pregnant, she will start showing an increase appetite as she proceeds in her pregnancy. Gestation in Amur tigers is considered to be 104 days from the midpoint between the first and last day of copulation.

Seasonal separation of the sexes: Tigers are solitary animals, and it is not recommended that male/female pairs be housed together throughout the year. In many cases, male and female tigers are only compatible during estrus, and should be managed separately for the benefit of those individuals.

Predictors of breeding success: An AZA Tiger SSP study (Saunders et al., 2014) used the SSP's long-term database to investigate biological and management-related factors influencing breeding success in tigers (Amur, Malayan, and Sumatran, considered together). Female age and prior breeding experience had the largest impact on whether a female became pregnant or gave birth within one year of the issuance of a breeding recommendation. Breeding success declined starting at female age 5, with the steepest declines occurring between approximately ages 10-14. Male age and experience did not significantly impact breeding success. Zoos that had tiger litters within the past five years of a breeding

recommendation were more likely to be successful. Also, breeding success was more likely within one year of the issuance of a breeding recommendation if the tiger pair was already housed at the same zoo.

8.2 Assisted Reproductive Technology

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

In some wildlife species, 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, urine and fecal hormone measurements and ultrasound evaluations. Techniques used to preserve and freeze semen has been achieved with a variety, but not all, taxa and should be investigated further.

Besides physical issues, AI procedures also bring issues of ownership of semen and/or the animal being inseminated. Sometimes, semen from multiple animals may be used. As with any natural (physical) breeding, the rights of the owners of all materials and animals involved must be considered. Appropriate transaction documents (and loan agreements, if appropriate) must be fully completed before AI is attempted.

In tigers, methods for semen collection by electroejaculation are described by Byers *et al.* (1989); Byers *et al.* (1990) and Wildt *et al.* (1988). Byers *et al.* (1990) demonstrated that there are no effects of season on ejaculate traits in the Amur tiger. Ejaculate values range considerably among males, but generally fall within the parameters of 6-11 ml of seminal fluid, 20-100 x 10^6/ml and 60-80% motility. Byers *et al.* (1989) studied the ability of fresh and frozen tiger semen to capacitate and penetrate zona-free hamster eggs. Results indicated that a 2-hour pre-incubation time at 37 ºC resulted in higher penetration rates. This study also demonstrated that tiger sperm must be removed from the extender used to freeze semen for the cells to be capable of fertilization.

As of 2014, four litters of tigers cubs have been produced following artificial insemination - two by laparoscopic intra-uterine insemination (Donoghue et al., 1996; Armstrong, 2004), one by trans-vaginal insemination (Chagas e Silva et al., 2000), and most recently, one by laparoscopic intra-oviductal insemination (see below). In three pregnancies, follicular activity and ovulation were induced by treatment with equine chorionic gonadotropin (eCG) followed by human chorionic gonadotropin (hCG) or porcine luteinizing hormone (pLH), whereas the fourth pregnancy was produced in a naturally-estrual female induced to ovulate with a gonadotropin releasing hormone (deslorelin). Donoghue *et al.* (1996) demonstrated that timing of anesthesia for artificial insemination critically influences ovulation. Anesthesia conducted too early (39-42 hours after hCG) compromised both the number of females and the number of follicles ovulating, whereas, anesthesia 46-55 hours post hCG resulted in greater proportions of females and follicles ovulating.

In vitro fertilization (IVF) and embryo transfer (ET) also have been used to produce tiger cubs. A single litter of three tiger cubs was born following aspiration of oocytes from hormonally treated females, IVF and transfer of 86 embryos to three females (Donoghue et al., 1990). Further research demonstrated high fertilization percentages (~70%) using frozen-thawed semen for IVF, but additional ET studies have not been reported. In females treated with exogenous gonadotrophins (porcine follicle stimulating hormone, pFSH; porcine luteinizing hormone, pLH), and subjected to oocyte collection, ultrastructural examination of embryos produced following IVF and subsequent culture demonstrated high rates of developmental aberrations (Gjørre et al., 2002; Crichton et al., 2003). Cryopreservation of tiger embryos also has been attempted, with vitrification proving more successful than conventional slow-rate freezing for embryo survival, but transfer of vitrified embryos has not been reported (Crichton et al., 2003).

To improve the success of assisted reproduction in tigers, efforts have begun to adapt the alternative gonadotropin regimen (eCG/pLH) for ovarian stimulation and oviductal AI approach by scientists for successful application in tigers. These methods were used to produce pregnancies in four small cat

species in 2011 and 2012, but applicability to tigers and other large cat species had not been assessed. One tiger pregnancy with a single cub was produced by oviductal AI in 2013 (Lambo, unpublished). At present, assisted reproduction in tigers still must be considered experimental and not a proven approach for use with population management.

8.3 Pregnancy and Parturition

It is extremely important to understand the physiological and behavioral changes that occur throughout an animal's pregnancy. Gestation in tigers is approximately 104 days (Seal et al., 1987). Pregnant female tigers should be provided with access to an outdoor enclosure and an indoor den that is quiet and secure from disturbances, other animals, unfamiliar staff, and noise. This area should be equipped with a video monitor that provides remote viewing, so the female can be closely monitored. This access should be provided at the earliest indication that the female may be pregnant, rather than waiting until the last few weeks before she is ready to parturate. This helps to ensure that the female is comfortable with her surroundings. Females entering the last trimester of pregnancy (2–4 weeks prior to parturition) can then be contained to their indoor enclosure with the den. The female should remain there, assuming the young are mother raised, until her behavior indicates that she is comfortable being temporarily separated from the cubs. This typically occurs at around 2–3 months; at this time, the female and young can be reintroduced back onto the exhibit as appropriate.

Management of pregnant females: Diets for pregnant females should be increased slightly (5–10%) in the last trimester, with an equivalent increase post-parturition. However, no other significant changes to the management routine should be made in the four weeks prior to the anticipated parturition. It is strongly recommended that only experienced keepers with whom the female is familiar with should care for pregnant females (AZA Felid TAG recommendation, 2006). Managers may want to consider reducing the frequency of cleaning in pregnant female's enclosure. Den materials should not be changed unless soiled, and no more than 40–50% of the bedding should be changed at any given time. Remote monitoring of the den box via video camera is recommended (AZA Felid TAG recommendation, 2006). This can be accomplished by modifying the den to include a camera and low-level lighting prior to parturition.

Management of neonates and postpartum females: Within 24–48 hours before birth, many females will exhibit changes in behavior such as anorexia, increasing amounts of time spent in the den, and restlessness. It should be noted that first time females carrying only a single young may not display these signs, or may do so closer to parturition. Once birth has occurred, access to the female's den and the holding area should be strictly limited, and the female left completely alone for 24 hours. If the female is spending large amounts of time in the den, food is disappearing, and all is quiet, then the young are probably being taken care of satisfactorily. Disturbances during the early stages of rearing may cause the female to neglect or become aggressive toward the kittens. If the decision is made to hand-rear the kittens, females should be allowed to nurse the kittens for the first 12–24 hours to provide colostrum.

Females may not eat for the first few days after birth, but fresh water should be available at all times. After the initial postpartum period (7 days minimum), a gradual return to normal cleaning and activities in the area can begin. Cubs should be left undisturbed for at least the first week after birth depending on the behavior of the female. When the opportunity arises, cubs can be weighed and sexed, but this should only occur when the female is voluntarily out of the box, and when cubs are at least 2–3 weeks old. At 2–3 weeks it may also be possible for staff with whom the female is familiar to begin socializing the cubs if the dam is easily separated. This is done by playing with them for brief periods, and will be beneficial in reducing fear of humans as they mature. It is important that these encounters be kept to a minimum and occur only with the people that the female is most familiar. Cubs should initially be handled with rubber gloves that have been soiled with feces from the den. As the cubs get older it is wise to provide adequate room for the female to get away from them if she chooses.

An AZA Tiger SSP study (Saunders et al., 2014) used the SSP's long-term database to investigate the factors influencing cub survival. Litter size was the most influential factor, with singletons and cubs from very large litters (5 or 6 cubs) faring worse than those from average-sized litters. Zoos that had a previous tiger litter within the past 5 years also had higher cub survival. Female prior breeding experience did not have a significant impact on cub survival.

8.4 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 "cub-proofed."

Den: While many large felids will use a large open box as a den, it is highly recommended that females be provided with a den measuring 1.5 x 2.5 x 1 m (5 x 8.2 x 3.2 ft), with a door at each end, and fitted with a video camera to monitor the female's behavior. Dens for tigers should at least have straw added for bedding. Dens can also be bedded with grass hay, although some females will remove all of it from the den. Some tigers will not accept provided dens, and these may have to be removed if they disturb the female too much. Dens should be cleaned only when necessary, and not scrubbed with disinfectants, washed out or totally cleansed of all odors. This reinforces the female's sense of security and increases the likelihood of her rearing the cubs herself.

8.5 Assisted Rearing

In both the wild, and in *ex situ* populations, there are times when although a female is able to successfully give birth, she is not able to properly care for her offspring. Fortunately, animal care staff in AZA-accredited institutions is able to assist with the rearing of these offspring if necessary.

Cubs should be hand-raised only when parent-rearing is not possible due to maternal neglect or health reasons. Attempts should be made to determine the cause of the mother's neglect in order to attempt to eradicate the issue for the next litter.

Hand-raised females of most felid species will rear their young if raised with a sibling, or another young felid, if they are not otherwise overly imprinted on humans. In the event of a single birth, every effort should be made not to rear the young alone. In such cases, the AZA Tiger SSP Coordinator should be contacted to discuss options. Companionship is important for providing valuable play experience necessary for proper socialization and normal developmental skills, factors that are critical in the animal's later success in dealing with conspecifics.

Medical assessment: The following information is provided for a healthy animal that has not been compromised by trauma or is otherwise medically unsound. Whenever possible, the cubs should remain with the mother long enough to receive colostrums (12–24 hours). When cubs are removed, they should receive a complete physical examination, be weighed, the umbilicus checked for infection, blood collected for baseline values, and be given a prophylactic antibiotic (e.g., penicillin).

While conducting initial physical exams, problems such as cleft palate, wounds, herniated umbilical cord and physical deformities should be reviewed. Because neonates do not have a fully developed immune system, the umbilical cord site may be a major source of infection; this site can be cleaned by applying antiseptic (solution of 50% betadine and 50% water) every 4–6 hours until the cord dries out and falls off.

If vital signs are not within acceptable ranges, issues of dehydration, hypothermia, or hyperthermia may have to be addressed. Dehydration can be determined by pulling up on the skin on the back of the neck. If the skin does not retract immediately, and stays suspended, warm fluids will need to be administered by tube into the stomach or subcutaneously. To regulate temperature, young may need to be maintained in a warm or cool environment, as required.

Feeding and formulas: When hand-raising young felids, staff should pay close attention to three critical areas: volume of consumption per feeding, total daily consumption, and daily weight gain. Other important factors are stool quality, frequency of urination and general condition (e.g., alertness and responsiveness). A daily chart should be maintained for recording these factors. Initially, cubs may benefit from a 5% dextrose solution for the first two feedings and then be started on milk replacer; however, this would be evaluated by the veterinary staff only if cub health was compromised. Sugar solutions should be avoided as felids may have a limited ability to effectively utilize high glucose loads (MacDonald et al., 1984). Milk replacers for hand-rearing should simulate felid milk composition. There is wide variation reported in domestic cat milk, ranging from 27.6 – 47.6 crude fat and 35.0 – 43.8% crude protein, compared with cheetah milk composition ranging from 39.9 – 41.0 crude fat and 40.5 – 61.3% crude protein, dry matter basis (Bell et al., 2011).

The choice of milk replacer for tigers seems to be Esbilac®, KMR® (Pet-Ag, Inc., Hampshire, IL 60140), or 33/40 Zoologic Milk Matrix® (Pet-Ag). Adding the enzyme lactase (Lactaid® Fast Act; 1 caplet

(3000 FCC lactase units) crushed/one liter formula) to the milk is recommended to break down the lactose (AZA Felid TAG recommendation, 2006); addition of this enzyme results in fewer problems with gastrointestinal upsets.

- Esbilac® canine milk substitute: Esbilac® canine milk substitute from Pet Ag is one of the most common formulas. It is available in two forms - liquid and powder. The protein and fat concentrations are 33.0 and 40.0%, respectively. Although slightly different in nutrients than published data on domestic cat and exotic felid milk composition, Esbilac has been used successfully for hand-rearing. It is a formula manufactured for dogs; therefore, should contain supplemental taurine at a rate of 2 mg/ml.
- KMR® feline milk substitute: KMR® feline milk substitute (Pet Ag) is also widely used. See below.
- Pet-Ag's Zoologic 33/40 Milk Matrix: Many institutions have used Pet-Ag's Zoologic Milk Matrix 33/40 as the primary milk replacer. This formula has been successfully used to rear tiger cubs in combination with KMR at a ratio of 25% KMR to 75% Milk Matrix 33/40. All formulas should be checked to ensure they contain taurine – an essential amino acid for felids.

Feeding protocol: When starting on the bottle, only minimal amounts of formula (~ 10ml) should be attempted every 2-3 hours to establish feeding. Nipple selection is critical and may vary by cub. Successful institutions have used 4-8 oz slotted bottles with liner and 3-hole nipples or preemie nipples with no alterations to the hole. Several nipple options should be on hand in order for success of getting cubs to feed. This may be a trial and error situation. The cub should be placed in a normal sternal feeding position when taking the bottle. Cubs should be weighed every 24 hours, with the diet increased in volume to about 10% of the cub's body weight per 24 hours as a general guideline. Caloric requirements can be calculated based on extrapolations from domestic cats using Resting Energy Requirement (RER). Generally, growing kittens require approximately 2 – 2.5 x RER where RER = body weight in kg raised to the 0.75 power, multiplied by 70. For example, the RER for a 1.5 kg cub would be 95 kcal. When multiplied by 2.5 that would be approximately 237 kcal per day. This is slightly more kcal than the "10% of body weight" rule as most milk replacers will provide approximately 1 kcal per ml. In this same example, the 1.5 kg cub would be offered 150 ml if basing off the 10% rule. If the formula contained 1 kcal/ml, the cub would be receiving approximately 150 kcal per day. Because caloric requirements for growing tigers are not established, using these guidelines from domestic cats should provide a range of appropriate intakes for cubs (NRC, 2006; Gross et al., 2010). It is critical the energy density of the formula be evaluated prior to calculating volumes as each formula may be slightly different. Healthy cubs will let care-givers know when to increase feed. When cubs are consuming 100% of formula at each feeding, volumes can be increased 15 – 30 ml per bottle. Too much volume added too quickly may result in diarrhea. As cubs age and feeding rates decrease, number of feeds should be reduced but not volume of formula fed.

There are many subtleties and nuances associated with hand-rearing tigers. Large felid cubs can be managed initially on 5 daily feeds. Any questions should be directed to the AZA Tiger SSP Coordinator, who will direct questions to the appropriate resource and successful institutional representatives. Table 7 provides example feedings using the "10% body weight" rule along with the range of kcal provided by the RER method, assuming the formula contains 1.0 kcal/ml.

Table 7: Example feeding schedule for a hand-reared tiger cub assuming the formula contains 1 kcal/ml.

Age in Weeks	Feed	# Meals per 24 hr	Expected body weight (kg)	Vol. of milk per feed at 10% of body weight (ml)	kcal provided daily by "10% rule"	Daily kcal requirement range using RER*
0	Milk (bottle)	5	1.23	25.0	122.5	163 - 204
1	Milk (bottle)	5	1.55	31.0	155.0	194 - 243
2	Milk (bottle); introduce baby food	5	2.21	44.0	221.0	254 - 317
3	Milk (bottle) with baby food	5	3.10	62.0	310.0	327 – 409
4	Milk (bottle) with baby food	5	4.00	80.0	400.0	396 – 495
5	Milk (bottle) with baby food	5	4.72	95.0	472.0	448 – 560

6	Milk (bottle); introduce solids	4	5.45	137.0	545.0	499 – 624
7	Milk (bottle); bowl with solids	4	6.10	153.0	610.0	543 – 679
8	Reduce bottle; milk & solids in bowl	3	7.20	240.0	720.0	615 – 769
9	Reduce bottle; milk & solids in bowl	3	8.20	274.0	820.0	678 – 848
10	Reduce bottle; solids in bowl	2	9.20	460.0	920.0	740 – 924
11	Milk only with solids in bowl	1	10.40	1,040	1040.0	811 – 1,013
12	Weaning completed	-	-	-		

*RER method = (body weight kg $^{0.75}$ x 70) x 2.5 (or x 3) established for growing domestic cats (Hand et al., 2010).

Solid food: Older cubs should have solid feline diets added gradually to their formula – generally when the teeth begin to erupt. Introduction of human baby foods such as Gerber's® and Beech-nut® stage 1 strained chicken and turkey should be in small amounts – beginning with 1 tsp/1 liter formula and increasing this amount by 1 tsp every 3-4 days if no adverse effects are noted. Baby food should be mixed with formula in a blender, and strained as needed to facilitate good flow through the nipple. Adjustments to the nipple may be necessary at this point. Because human baby foods lack proper vitamins and calcium, they should be supplemented with additives like Poly-Visol® liquid vitamin or Neo-Calglucon® liquid calcium supplement. There is some concern that Gerber's® brands were recently reformulated and now contain onion powder. Onion powder is contra-indicated in felines in large doses, but because of the short time that kittens are fed this, it is probably not cause for alarm. Solid food would begin at ~ 5-6 weeks and should consist of the meat diet fed to adult tigers. Begin by offering small, marble sized pieces of meat diet with formula poured on it.

Infant felids are easily overfed, and their body weight should be monitored daily. Total daily consumption should be limited to no more than 30% of its total body weight. When feeding young felids, they should be placed on their stomach on a flat surface in a sternal position (e.g., a table or flat in the handler's lap). Do not allow the cub to become upright or in a head back position, which can increase the chances of aspiration and death. At first, it will tend to peddle forward, but in time it will become adjusted to this routine.

Elimination: Cubs should be stimulated to urinate and defecate after each feeding by massaging the ano-genital area with cotton or gauze moistened with warm water. Cubs should be held in a sternal position and the region extending from the belly to the anus gently stroked with the warm, moist cloth. Only slight pressure is needed to help guide the fecal material through the digestive tract and out the anal canal. After a week, this procedure can be reduced to two times a day. After the young begin eating solid food, this procedure can be reduced to one time per day. Most young will defecate on their own at 8–10 weeks, if not sooner.

If diarrhea occurs, the milk formula should be diluted with an oral electrolyte solution and total volume decreased by 20–40% for 8–12 hrs. A stool culture prior to antibiotic therapy should be obtained to check for pathogenic bacteria. If diarrhea is severe and persistent, all oral intake should be stopped for 12–18 hours and the cub should be supported with subcutaneous fluids. The cub can then be started on oral electrolytes followed by dilute formula, and returned to normal feeding over the next 12–24 hours.

Exercise and socialization: After cubs start walking, it is vital that sufficient space and time be provided to allow them to run and climb; all individuals should be provided with low climbing structures. Enrichment initiatives should be provided for stalking and pouncing.

Hand-raised cubs, especially those being hand-raised alone (which is not recommended), should be reared in a rich and varied environment. If possible, single cubs should be moved to where other same aged cubs live (contact the AZA Tiger SSP Coordinator to discuss options).

8.6 Contraception

Many animals cared for in AZA-accredited institutions breed so successfully that contraception techniques are implemented to ensure that the population remains at a healthy size. In the case of an

animal on loan from another facility, consult the loan agreement or owner regarding authority to contracept. In the case of permanent contraception, prior permission of the animal's owner must be obtained. Approval from the SSP Coordinator and Management Group should be obtained prior to permanent sterilization, and the Reproduction Management Center consulted for appropriate methods. Additionally, the following recommendation was unanimously approved at the 2010 AZA Tiger SSP meeting:

The AZA Tiger SSP recognizes that hormonal implants (e.g., deslorelin and MGA) can be an effective management tool for contraception and management of aggression. However, there is cause for concern about their effects on reproductive potential. This affects breeding recommendations and the SSP's ability to effectively manage tiger populations. Therefore, the SSP believes caution is warranted. We recommend that institutions wishing to implant studbook-registered tigers (i.e., generics excluded) request approval from the AZA Tiger SSP Management Group before chemically contracepting female or male tigers. Each request will be considered on a case-by-case basis.

The AZA Tiger SSP should be consulted if any contraception other than physical separation is considered.

Chapter 9. Behavior Management

9.1 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. Institutions should follow a formal written animal training program that facilitates husbandry, science, and veterinary procedures and enhances the health and well-being of the animals (AZA Accreditation Standard 1.6.4).

AZA Accreditation Standard

(1.6.4) The institution should follow a formal written animal training program that facilitates husbandry, science, and veterinary procedures and enhances the overall health and well-being of the animals.

Procedures and behaviors related to routine husbandry: All tigers should be trained to perform a series of foundation behaviors. The behaviors can be achieved through the use of an operant conditioning program that focuses on positive reinforcement. This foundation of behaviors will allow for ease of managing the cats in their day-to-day care. Minimum routine husbandry behaviors are: shifting on cue, entering a crate, stepping on a scale for weight collection, and coming to the mesh when called for inspection. Shifting should include shifting from one stall to another, out onto exhibit, and back into holding. Once shifting is trained and reliable, an emergency recall could be put on cue. An emergency recall is different from day to day shifting in that the response time should be much faster, the cue should be distinct from the normal shifting cue and the reward should be much larger than normal shifting. An emergency recall, once trained, should be practiced once a month to maintain reliability or more as needed, (Binney & Johannes, 2002).

Although not a necessity, conditioning a bridging stimulus or bridge, a signal that communicates to the subject that it has performed correctly and that additional reinforcement is on the way has been successful in shaping behaviors with tigers (AAZK/AZA, 2003). A bridge, which can be a clicker, whistle or any other distinct sound paired with food, can become a helpful tool for shaping behaviors and creates a clear form of communication if established and utilized appropriately. For more information on establishing and maintaining a bridging stimulus, reference *Don't shoot the dog!* (Pryor, 1984) or *Animal training: Successful animal management through positive reinforcement* (Ramirez, 1999).

Procedures and behaviors related to non-routine husbandry: Tigers have been trained very successfully to perform a series of non-routine husbandry behaviors. Some of the behaviors that have been trained are: hand injection, blood sample collection, urine collection, blood pressure monitoring, subcutaneous fluid therapy, wound management, and ultrasound. Prior to these behaviors being trained, it is helpful to train the following body positioning behaviors: sit, lie down, place side of body against mesh, lie on right or left side, and tail manipulation. A crate or other space with a protective physical barrier between animal and trainer, which allows safe access to the animal, is a necessity for many of the medical behaviors (Miller, 2002). Please see Chapter 9.4 for a list of behaviors that have successfully been trained with tigers. Partnering with your veterinarian is vital to creating a plan for an individual animal. Each animal's individual medical needs will be different and there may be some behaviors that take priority over others.

Facility design considerations: When beginning a training program, it is best to start training in an area that is safe for both the animal care staff and the animal, and where the cat is comfortable. This is usually

the night quarters or holding area. Tigers should be trained in a protected contact situation with a physical barrier of heavy gauge chain link or 2 x 2 inch (5 x 5 cm) steel mesh between animal and trainer. Training can also be done in commercial or custom designed crates with removable bars, access panels, or sliding doors that allow safe access to body parts. Because all facility designs are different, training staff will have to be creative and utilize the space available. For many of the body positioning and medical behaviors, trainers will require several feet of mesh with no obstructions, which allows for safe access to body parts. A standard transfer crate can be used for training many of the body positioning behaviors. It is important to remember that a fancy, expensive facility is not necessary to accomplish a successful training program, just a creative mind.

Training techniques: It is beneficial to start a training program by determining the overall behavioral goals (i.e., detailing the specific behaviors to be trained). During this goal development process it is important to include all parties involved with the management of the animals. This may include meeting with and seeking feedback from keepers, veterinary staff, nutritionist, behavioral husbandry staff, curators and managers. Having everyone on the same page with clearly laid out plans, assignments, and timelines helps to facilitate a smooth process. Defining roles and creating clear avenues of communication among all participants is also important. This can be accomplished through regularly scheduled team meetings, a consistent method of documentation, and continual communication among all staff involved in training.

There are several steps to creating a husbandry-training program for tigers. Set behavioral goals, identify a safe facility to work the cats, and determine the reinforcement type and how reinforcement will be delivered. The next steps include learning about the animal to be trained, building a relationship with that animal, and designing a training plan (see Chapter 9.4).

Reinforcement: A critical component to positive reinforcement training is finding a reinforcer, or reward, an animal is willing to work for. Most large cats are very food oriented. In most cases, the cat's regular diet can be utilized for training. Another option for reinforcement can include blood in a syringe or in some cases, even enrichment items. Feeding several small meals a day, or a portion of the main diet throughout the day, can provide great opportunities for many short training sessions. If the diet is prepared using meat, small meatballs can be made (~1 inch diameter) for easy use during a session. A helpful hint: the meat stays together better if it is cooler. If chunk meat is utilized, small pieces can be cut (~1 inch cubes) before a training session begins. It is helpful to wear a pouch on the hip containing the meat so that reinforcement can be easily retrieved and delivered in a timely manner and so that the cats are not distracted by a container of meat on the ground.

Delivery of reinforcement can occur by placing meat on a meat stick and passing it through the mesh barrier or by tossing meat through or under mesh. One type of meat stick that can be used is a fiberglass rod. This works well due to its durability (plastic can crack and break easily with large carnivores). Many facilities use meat sticks made from Hot Shot® brand fiberglass. These rods are also called "show sticks" or poles and are marketed to be used for moving ranch animals. These are readily available from feed stores or the Nasco® catalog (or https://www.enasco.com/). The sticks can be modified to any size by cutting with a saw and then shaping the cut end on concrete to the desired dull point (Binney, 2004). Hand feeding is not recommended as it can be a safety issue for the keeper, and can also cause cats to become aggressive towards their trainers.

Relationship: While large felids usually adapt better to new circumstances than small felids, staff consistency will make routine management much easier. It has been noted in both mother-reared and hand-reared cats that there is a tendency to bond with their primary caretakers, and many large felids form such a strong bond with a particular keeper that they are able to distinguish the keeper from other people. Moreover, many large felids react positively to meowing and prusten greetings when mimicked to them by their caretakers. This vocalizing may in some instances calm a nervous cat.

If a cat is aggressive or nervous, the trainer will make more progress in developing a relationship if they keep their distance while training. There is no need to stand directly in front of the mesh. Although the meat sticks discussed earlier can be cut shorter, they come usually 3–4 feet in length and can be used without modification of length. This gives a bit more space between trainer and cat and will often help curb aggressive behavior.

If there are multiple cats being housed together, adults should be separated from other adults prior to the start of a training session. If there are multiple trainers available and the cats are under stimulus control, cats can learn to eventually be trained in the same enclosure or on exhibit together.

9.2 Environmental Enrichment

Environmental enrichment, also called behavioral enrichment, refers to the practice of providing a variety of stimuli to an 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 tiger to interact with. Some suggestions include providing food in a variety of ways (e.g., 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 tigers should take into account the natural history of the species, individual needs of the animals, and facility constraints. The tiger enrichment plan should include the following elements: goal-setting; planning and approval process; implementation; documentation/recordkeeping; evaluation; and subsequent program refinement. The tiger enrichment program should ensure that all environmental enrichment devices (EEDs) are "tiger" safe and are presented on a variable schedule to prevent habituation. AZA-accredited institutions must have a formal written enrichment program that promotes tiger-appropriate behavioral opportunities (AZA Accreditation Standard 1.6.1). Enrichment activities must be documented and evaluated, and the program should be refined based on the results, if appropriate. Records must be kept current (AZA Accreditation Standard 1.6.3).

AZA Accreditation Standard

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

AZA Accreditation Standard

(1.6.3) Enrichment activities must be documented and evaluated, and program refinements should be made based on the results, if appropriate. Records must be kept current.

Tiger 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 a specific paid staff member(s) assigned to oversee, implement, assess, and coordinate interdepartmental enrichment programs (AZA Accreditation Standard 1.6.2).

AZA Accreditation Standard

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

Providing opportunities for felids to display species-appropriate behaviors has always been difficult to do in zoological settings (Mellen, Hayes & Shepherdson, 1998), but creative caretakers have taken innovative approaches to create opportunities for cats to display behaviors such as stalking, pouncing, running, chasing, climbing, scratching and scent marking (Shepherdson et al., 1993; Mellen & Shepherdson, 1997). Each enrichment initiative developed should have a behavioral goal in mind. Studying the natural history of tigers is a necessity in determining which behaviors you want to encourage from their behavioral repertoire. It is important to remember that enrichment should not be confined to physical objects but should also include sensory opportunities such as sights, sounds and smells (Law, 1993; Klomburg, 1996; Bogdan & Conner, 1998; Wells & Egli, 2004), husbandry training, social opportunities, or environmental changes such as dirt mounds, rocks or trees/logs being added to an exhibit (Barber, 2003). It is important to remember the overall purpose of enrichment is to ensure animals have good welfare.

The development of enrichment initiatives should focus on promoting species-appropriate behaviors in tigers and providing them with choice and control within their exhibit environment. With each of the items on the following list a natural behavior such as stalking, hunting, play or forage should be identified that is being encouraged. After managers and veterinarians have reviewed the list for appropriateness, safety and disease control, the following items may be considered as enrichment initiatives:

- Animal skins, feet, heads from pigs, deer, domestic stock
- Antlers
- Bird feathers
- Boomer ball/Spool
- Branches/wood chips from primate or small mammal exhibits
- Feline diet blood trails
- Fish
- Gelatin made with blood, Jell-O
- Ice blocks containing food
- Knuckle bones
- Logs/ stumps
- Paper feedbags
- Pine cones
- Rib bones
- Rope pulls
- Sand box (may become a defecation site)
- Snow/Ice cubes
- Straw/hay that has been used in ungulate exhibit/holding
- Telephone book/newspaper
- Whole chickens
- Browse (palm fronds, bamboo, banana leaves, grapevine)
- Cardboard box
- Cardboard tubes (smaller than head size)
- Christmas trees
- Corn stalks
- Frozen feline diet balls
- Grass flats, potted grasses
- Hard-boiled eggs
- Melons, gourds, pumpkins
- Peanut butter, jams and jellies, honey
- Perfumes
- Raccoon, deer or elk urine—commercially purchased
- Rats, mice, rabbits—live or dead
- Scratching logs
- Spices and herbs: Russian sage, mint, cumin, nutmeg, catnip, cloves, basil, oregano, Rosemary, rose hips and petals, allspice, cinnamon, pumpkin pie spice, peppermint
- Water mister

Combining items from the list above can create many behavioral opportunities. For example cardboard tubes or paper feedbags filled with food items or scents or leaf piles with scents or bones buried in them can encourage hunting, foraging and stalking. Large deadfall or stumps sprayed with scents can encourage climbing and scratching.

Enrichment should be varied frequently and novel items should not be left in the habitat lest they become habituated to them. Items should be removed when the animal is still interested/before interest wanes. Records of animal's interest levels and manifestation of goal behaviors should be kept in a log so that it is noted if behavioral goals are met or if interest is waning. If interest wanes, items should be removed from use for a month or two to rebuild novelty.

9.3 Staff and Animal Interactions

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

Acceptable types: Successful husbandry and reproduction (if desired) depends on stable, long-term relationships between large cats and their keepers. Most animals quickly adapt to daily routines, shifting readily as well as participating in training to allow routine and non-routine veterinary tasks. Operant conditioning and protected contact training, particularly if done consistently, will greatly assist veterinary examinations and procedures (see Chapter 9.1 for additional information).

Tigers also quickly recognize familiar keepers by their voice, movement and other behaviors, and can respond aggressively (e.g., hissing, growling, charging cage fronts) under routine circumstances. Keeper interactions can include imitating prusten, a greeting vocalization used by tigers, which may be returned by the animal toward familiar staff.

Animal and keeper safety: Large felids can easily cause injury or death to other felids or humans. Great care should be used when raising young felids as hand-raised individuals may become very tame toward humans, thus providing the opportunity for staff to become careless. It should not be forgotten that they

are very capable of injuring animal care staff, and staff should not enter cages of juvenile or adult individuals no matter how tame they were as cubs.

Ensuring that doors, gates and guillotines are secure is critical, as are constant checking of locks to ensure animals cannot escape. Periodic checking of holding enclosure steel mesh and/or chain link for weaknesses is also recommended. A system of keeper labels on entrances will help ensure that staff members do not enter animal enclosures while animals are present. The situation must be avoided where a tiger is out of its primary enclosure, cannot be seen, and can only be reached by directly entering the same space it occupies. For personal protection, keepers should carry pepper spray.

9.4 Staff Skills and Training

Tiger staff members should be trained in all areas of tiger behavior management. Whenever possible, funding should be provided for AZA professional development 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.

Staff will need to be well versed in operant conditioning techniques. They also need to be able and willing to communicate with fellow staff to ensure that people and cats do not enter the wrong areas. Similarly, they must fully understand that these animals, even if tame when young, are dangerous and quickly able to attack and injure them. Knowledge of the natural history and behavioral repertoire of tigers is essential for the development of effective enrichment, training, and nutritional initiatives.

Once a training and enrichment program is established it is important to have a program developed for new staff to be integrated, particularly with the training program. This can be done through the development of a new trainer integration plan or mentor program. New trainers should complete an operant conditioning class or read books on the topic to get familiar with the overall concept. Current trainers should mentor new trainers by showing them currently trained behaviors, cues and criteria during training sessions. Once the new trainer is competent with the concept of the techniques and established behaviors, they should start off by forming a relationship with the animals through free feeding sessions with the current trainer's supervision. After a relationship has been formed the new trainer can start requesting already trained behaviors under supervision. Once both trainers are comfortable with the progress, the new trainer can train on their own. New behaviors should be planned out before training begins.

Summary and resources: To review, the purpose of this chapter is to give animal care staff an idea of the type of behaviors that can be trained with tigers and how to develop a species appropriate enrichment program. This chapter provides direction on starting a behavioral management program, ideas for shaping techniques and reinforcement, and resources for additional information. This chapter is meant as a reference for basic information, and contains just a small amount of the information that is available.

The following is a list of just a few of the animal training resources that can be helpful in developing a training and enrichment program:

- Pryor, K. (1984). *Don't shoot the dog!* New York, NY: Simon & Schuster.
- Ramirez, K. (1999). *Animal training: Successful animal management through positive reinforcement*. Chicago, IL: Ken Ramirez and the Shedd Aquarium.
- *Animal's Keeper Forum,* a publication of the American Association of Zoo Keepers.
- www.animaltraining.org
- www.animalenrichment.org
- Animal Management Organizations:
    - ✓ MATA (International Marine Animal Trainers Association)
    - ✓ AAZK (American Association of Zoo Keepers)
    - ✓ IAATE (International Association of Avian Trainers and Educators)
    - ✓ ABMA (Animal Behavior Management Alliance)

Trainable behaviors: The following is a list of behaviors and their criteria that have been successfully trained with tigers. The list is in alphabetical order and is not exhaustive.
The minimum in any program, tigers should be trained to shift on and off exhibit, into a crate, and be conditioned to come up to the mesh calmly for a body inspection.

- Blood collection: Cat holds in the "down" position with tail pulled out of the holding area and into the keeper space while second person collects blood from the tail.
- Crate: Cat enters the crate on command and allows door to close.
- Down: Cat lays sternal facing trainer, and stays in position until released.
- Foot: The foot must be placed flat against the mesh until released.
- Hold: Cat stays steady in current requested position.
- IM/SQ injection: Cat holds still against the mesh in the "down" position while receiving an IM injection in the upper thigh area.
- Open Mouth: Cat opens mouth and holds mouth open. (Great care should be exercised to avoid reinforcing biting or holding teeth against the cage wire.) The cat should be close to the mesh without touching. Thoroughness of the examination will be achieved through extended duration of the behavior. Cats should be given frequent breaks due to the difficult nature of holding the mouth open for an extended period.
- Open Mouth with syringe: Cat opens mouth and holds mouth open while a syringe full of fluid (e.g., blood, water, etc.) is squirted into the mouth.
- Over (left): Cat lies on left side; head toward the trainer, feet facing to the trainer's left.
- Over (right): Cat lays on the right side; head toward trainer, feet facing to the trainer's right.
- Paw manipulation: After the cat is in the "stand" position, the keeper then manipulates paw pads and claws with dowel or swab. Cat holds position until released.
- Rectal temperature: Cat holds the "down" position in the crate while rectal temperature is taken.
- Scale: Cat steps onto scale and holds position until released.
- Shift: Cat goes into desired stall or chute with no baiting.
- Shift on/off exhibit: After receiving the cue, the cat moves on or off exhibit.
- Side (right and left): Cat lines up along cage front and presses its side to the mesh, holding the position until released.
- Sit: Cat sits with all four paws and buttocks on the ground and holds until released.
- Sit-up: Cat is sitting with forepaws on the mesh.
- Stand: Cat stands on hind legs and places front paws on the mesh in a way that allows trainers easy inspection. Cat will remain in position until released.
- Tail manipulation: Cat remains calmly in the "down" position while tail is touched until released from position.
- Target: Cat places the requested body part to the target.
- Urine Collection: Cat urinates when cued.
- Ultrasound: Cat allows ultrasound gel and probe to be applied to different body areas.

Sample Training Plans: The following are simplified, step-by-step sample behavioral training plans that keepers and trainers can use to achieve a desirable husbandry or medical behavior from a tiger, using positive reinforcement training techniques.

Crate Training Plan

Final behavior: Cue for crate is given, cat enters crate calmly, and the door is closed while cat remains calm.

1. Slowly open the door of the crate, while the cat is sitting outside of the crate. Reinforce the cat for calm behavior while the door opens and closes.
2. Reinforce the cat for any movement toward crate; use food to lure cat towards crate as needed.

3. Say “crate” as cat enters through door, and reinforce the cat heavily once its whole body is in the crate. Bait the cat into the crate as needed.
4. Slowly move the door up and down, reinforcing the cat for calm behavior.
5. Close the door for increasing lengths of time (30 seconds, 60 seconds) and reinforce cat for calm behavior.
6. Bait the cat out of crate and repeat step 3 while reducing the amount of baiting being done.
7. Cue by saying “crate.” Reinforce the cat for entering the crate calmly and close the door.

Blood Collection Training Plan

Final behavior: Cat enters crate calmly, turns around, and lies down in position while tail is manipulated and blood is collected.

1. Cat enters crate calmly. If cat does not enter crate on its own, trainer may need to bait with food.
2. Wait for cat to turn around in crate and face the opening, or use food to lure the cat in that direction.
3. Once cat is in the right position, trainer asks cat for the previously trained down behavior.
4. When cat is in the down position, have second trainer open the small sliding door on the crate.
5. Have the second trainer pull out the cat’s tail using a snake hook.
6. Once the tail is in the hand of the second trainer, the first trainer asks the cat to back up while in the down position. This can be done by baiting the cat backwards.
7. Cat should allow the second trainer to hold the tail for increasingly long periods of time.
8. Cat stays in position and is reinforced while manipulation is increased. This will include parting the fur and poking with finger.
9. Cat stays in position and reinforced while tail is wet with water or alcohol, and tail is pricked with a paper clip.
10. Cat stays in position and reinforced while hair clippers are turned on.
11. Cat holds position while hair is shaved on a small area of tail.
12. Cat holds position and is reinforced while tail is pricked with a needle to increasing levels of pressure.
13. Cat holds position and is reinforced while tail is pricked at the vein with needle.
14. Cat holds position and is reinforced while needle is inserted and blood is drawn.

Chapter 10. Ambassador Animals

10.1 Ambassador Animal Policy

AZA recognizes many public education and, ultimately, conservation benefits from ambassador animal presentations. AZA's Conservation Education Committee's Ambassador (previously called Program) Animal Position Statement (Appendix E) summarizes the value of ambassador animal presentations. For the purpose of this policy, an ambassador 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.

Ambassador 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 ambassador animal presentations to develop an institutional ambassador animal policy that clearly identifies and justifies those species and individuals approved as ambassador animals and details their long-term management plan and educational program objectives. The policy must incorporate the elements contained in AZA's "Recommendations For Developing an Institutional Ambassador Animal Policy". If an animal on loan from another facility is used as an ambassador animal, the owner's permission is to be obtained prior to program use.

AZA Accreditation Standard

(1.5.4) If ambassador animals are used, a written policy on the use of live animals in programs must be on file and incorporate the elements contained in AZA's "Recommendations For Developing an Institutional Ambassador Animal Policy" (see policy in the current edition of the *Accreditation Standards and Related Policies* booklet). An education, conservation, and welfare message must be an integral component of all programs. Animals in education programs must be maintained and cared for by paid and/or unpaid trained staff, and housing conditions must meet standards required for the remainder of the animals in the institution. While outside their primary enclosure, although the conditions may be different, animal safety and welfare need to be assured at all times.

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). All record-keeping requirements noted previously apply to ambassador animals (AZA Accreditation Standards 1.4.1, 1.4.2, 1.4.3, 1.4.4, 1.4.5, 1.4.6, and 1.4.7). In addition, providing ambassador animals with options to choose among a variety of conditions within their environment is essential to ensuring effective care, welfare, and management (AZA Accreditation Standard 1.5.2.2). 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.

Discussions regarding the use of felids as ambassador animals are ongoing among the AZA Felid TAG and Tiger SSP. At this time the AZA Tiger SSP does not recommend using any tiger as an ambassador or (public) contact animal.

10.2 Institutional Ambassador Animal Plans

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

AZA Accreditation Standard

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

- 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 ambassador animals are required to develop their own Institutional Ambassador Animal Policy that articulates and evaluates the program benefits (see Appendix F for recommendations). Ambassador 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 ambassador animal demonstration (AZA Accreditation Standard 1.5.3).

Animal care and education staff should be trained in ambassador animal-specific handling protocols, conservation, and education messaging techniques, and public interaction procedures. Paid and/or unpaid staff assigned to handle animals during demonstrations or educational programs must be trained in accordance with the institution's written animal handling protocols. Such training must take place before handling may occur (AZA Accreditation Standard 1.5.12). These staff members should be competent in recognizing stress or discomfort behaviors exhibited by the ambassador animals and be able to address any safety issues that arise. Additionally, when in operation, animal contact areas must be supervised by trained paid and/or unpaid staff (AZA Accreditation Standard 1.5.13).

AZA Accreditation Standard

(1.5.12) Paid and/or unpaid staff assigned to handle animals during demonstrations or educational programs must be trained in accordance with the institution's written animal handling protocols. Such training must take place before handling may occur.

AZA Accreditation Standard

(1.5.13) When in operation, animal contact areas (petting zoos, touch tanks, etc.) must be supervised by trained, paid and/or unpaid staff.

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

Careful consideration must be given to the design and size of all ambassador 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 Standards 10.3.3, 1.5.2, 1.5.2.1).

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 animals at the institution from exposure to infectious agents.

Similar consideration needs to be given to the means in which an animal will be transported both within the Institution's grounds, and to/from an off-grounds program. 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 (AZA Accreditation Standard 1.5.11).

10.3 Program Evaluation

AZA-accredited institutions which have Institutional Ambassador Animal Plan are required to evaluate the efficacy of the plan routinely (see Appendix F 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 11. Research

11.1 Known Methodologies

AZA believes that contemporary tiger 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 in both *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 and publishing original research projects, affiliating with local universities, and/or employing staff with scientific credentials (AZA Accreditation Standard 5.3). An AZA institution must demonstrate a commitment to scientific study that is in proportion to the size and scope of its facilities, staff, and animals (AZA Accreditation Standard 5.0).

AZA Accreditation Standard

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

AZA Accreditation Standard

(5.0) The institution must have a demonstrated commitment to scientific study that is in proportion to the size and scope of its facilities, staff (paid and unpaid), and animals.

All record-keeping requirements noted previously apply to most research animals, especially those which are part of the exhibit collection. When an animal on loan to a facility is subject to an invasive research procedure, including when done as part of a routine health exam, the owner's prior permission is to be obtained.

AZA-accredited institutions are required to have a clearly written research policy that includes a process for the evaluation of project proposals and identifies the types of research being conducted, methods used, staff involved, evaluations of the projects, animals included, and guidelines for the reporting or publication of any findings (AZA Accreditation Standard 5.2). Institutions must designate a qualified staff member or committee to oversee and direct its research program (AZA Accreditation Standard 5.1).

AZA Accreditation Standard

(5.2) The institution must follow a formal written policy that includes a process for the evaluation and approval of scientific project proposals, and outlines the type of studies it conducts, methods, staff (paid and unpaid) involvement, evaluations, animals that may be involved, and guidelines for publication of findings.

An Institutional Animal Care and Use Committee (IACUC) should be established within the institution if animals are included in research or instructional programs. The IACUC should be responsible for reviewing all research protocols and conducting evaluations of the institution's animal care and use.

AZA Accreditation Standard

(5.1) Scientific studies must be under the direction of a paid or unpaid staff member or committee qualified to make informed decisions.

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.

Institutional research policies typically reflect each institution's interest in, and ability to support research on different topics. Thus, there is no one typical format. 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.

In 1994, the Minnesota Zoo, National Zoo, and Omaha's Henry Doorly Zoo were awarded AZA's Edward H. Bean Award for the long-term propagation of tigers. This is another excellent example of institutions collaborating on tiger research—in this case, on reproduction, health, and nutrition. Another example is the Tiger SSP's breeding success and cub survival study (see below), in which numerous zoos participated by filling out the AZA Tiger SSP's annual breeding recommendation survey and

submitting female tiger fecal samples for hormone analysis. Zoos can also contribute to conservation research on wild tigers by supporting the AZA Tiger SSP's Tiger Conservation Campaign (www.mnzoo.org/tigercampaign).

Given their elusive, solitary nature, tigers are very difficult to study in the wild. Research on tigers kept in zoological institutions has thus contributed greatly to our understanding of tiger taxonomy, biology, and behavior. Such research has also improved the ability to manage and provide for the welfare of tigers in zoo environments. The AZA's Felid TAG and Tiger SSP can provide information to those seeking to conduct research on tigers in zoological settings. The AZA Tiger SSP website (www.mnzoo.org/tigerssp) also provides a bibliography that may be useful for those interested in tiger research. Other excellent resources include the IUCN/SSC Cat Specialist Group's website, www.catsg.org, and the Carnivore Ecology and Conservation website, www.carnivoreconservation.org. At these sites, users will find news, digital libraries, information about leading cat experts, and the *Cat News* publication.

A number of different methods have been used to study tigers in zoos. Research topics and associated methods are described below.

Reproduction: Much of the research on tigers living in zoos comes from studies of reproduction, both natural and "assisted." Hormone assays have been used to assess ovarian activity in female tigers, testosterone production in males, and cortisol (an indicator of stress) in both sexes. Early studies measured hormone concentrations in serum, but recent studies have moved toward noninvasive fecal sampling. Behavior sampling has often accompanied hormone studies, especially to identify estrous behaviors in female tigers associated with peak estradiol levels (e.g., Seal et al., 1987). Brown's (2006) review of felid endocrinology is a good source of information. In 2014, findings were published from the AZA Tiger SSP's study of breeding success, ovarian cyclicity, and cub survival in tigers (Saunders et al., 2014). This study incorporated long-term data collected by the SSP as well as hormone data from various institutions.

Assisted reproduction studies peaked in the late 1980's and 1990's but still continue to a lesser extent (see Chapter 8: Reproduction). These include studies of ejaculate characteristics, the ability of fresh and frozen spermatozoa to fertilize tiger eggs *in vitro*, ways to stimulate ovarian activity for oocyte retrieval in female tigers and methods for artificial insemination. See Wildt & Roth (1997) for a review of techniques and their relative success in tigers and other felids.

Limited research has been conducted on contraception in tigers and other large felids. For a review, see Munson (2006). More research is needed to understand the long term effects of contraceptive implants, with particular reference to resumption of ovarian cyclicity and the ability to conceive after receiving deslorelin.

Genetics: Starting in the late 1980's, tiger researchers have been using samples from tigers in zoological institutions of known ancestry for genetic studies. These studies have helped resolve tiger phylogeny and taxonomy, and contributed to an understanding of genetic variability in tigers (both *in situ and ex situ*). Recent research has also used genetic analysis to identify the species (e.g., tiger vs. leopard), or even subspecies, from which a sample originated. Both mitochondrial and microsatellite DNA have been targeted in recent studies. Though tiger DNA has typically been extracted from tissue samples, recent research indicates that DNA may be obtained from hair in tiger feces. See Luo *et al.* (2010) for a review of tiger genetic studies.

Nutrition: Historically, studies of nutrition in domestic cats have served as a basis for determining nutrition requirements in large felids. However, several studies have investigated the digestibility of different diets in tigers and other felids (e.g., Barbiers, Vosburgh & Ullrey, 1982; Vester et al., 2010). Such studies involve collecting fecal samples from tigers that have been fed a particular diet of known quantity. Both fecal samples and diets are dried, ground, and analyzed for various components (e.g., protein, fat, fiber) to determine digestibility. In another study (Crissey et al., 2003), blood samples were collected from tigers and other felids with known diets to determine serum nutrient concentrations. In both types of studies, comparisons across species have provided valuable information about felid digestion and nutritional requirements. Other studies have examined how different diets, or different treatments of the same diet (e.g., irradiated diets: Crissey et al., 2001), can reduce or eliminate potentially harmful bacteria.

Communication: Hearing, vocalization, and chemical communication have been a focus of study in tigers living in zoos. Often, these studies have included comparisons across various felid species (e.g.,

Peters & Tonkin-Leyhausen, 1999; Weissengruber et al., 2002). Studies of acoustic communication in tigers have typically involved recording and characterizing tigers' vocalizations, and/or studying the morphology of structures associated with vocal production and hearing (e.g., Titze et al., 2010; Klemuk et al., 2011). Digital technologies have greatly improved researchers' ability to collect and analyze data for such studies. Auditory brainstem response testing has also been conducted in tigers to examine the sound frequencies to which tigers are most sensitive (Walsh et al., 2003). Such studies are investigating whether tigers are capable of producing and perceiving infrasound: low-frequency sound not perceived by humans but thought to be involved in the communication of some animal species such as elephants.

Though chemical communication is thought to be important in tigers, few studies have been published on this topic. Studies from the 1970s and 1980s collected urine and 'marking fluid' samples from tigers and used distillation followed by chromatography to understand which chemical components contain the strong musky odor and are responsible for maintaining the scent for relatively long periods of time.

Morphology: Studies of subspecific variation in tiger morphology have largely been conducted on museum specimens because the geographic origin of these wild tigers is known. However, in some cases tiger specimens from zoos have been included in these morphological studies. For a review of morphological data, see Kitchener & Yamaguchi (2010).

Health/Mortality: A number of case studies related to health issues and mortality in tigers kept *ex situ* have been published. A wide variety of methodologies have been employed in these studies. For examples, please see the Journal of Zoo and Wildlife Medicine. The AZA Tiger SSP Pathology advisor has also conducted analyses based on necropsy reports from tigers who died *ex situ* to better understand morbidity and mortality in tigers (see Chapter 7: Tiger Pathology Review).

Behavior and enrichment: A number of studies have examined the influence of various environmental variables on *ex situ* tiger behavior. Efforts to reduce pacing behavior or increase activity levels, for example, have been the subject of several studies (e.g., Lyons, Young, & Deag, 1997; Bashaw et al., 2007). Typically these types of studies use behavioral observation of tigers to examine the effect of different treatments (e.g. enrichment types, feeding schedules, exhibit/holding area features) on targeted behaviors. Other behavioral studies that have been conducted in tigers include: the effects of transport stress on tiger physiology and behavior (Dembiec, Snider & Zanellet, 2004); long-term monitoring of female behavior (Miller & Kuhar, 2008); the effect of tiger activity on visitor interest and vice versa (Margulis, Hoyos, & Anderson, 2003); and a study of tiger and keeper personalities and behavior (Phillips & Peck, 2007).

11.2 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. Research needs identified by the AZA Tiger SSP include:

Chapter 7: Veterinary Care

7.6 Management of Diseases, Disorders, Injuries and/or Isolation: An investigation of the heritability of common tiger health conditions.

Chapter 8: Reproduction

8.1 Reproductive Physiology and Behavior: More research is needed on the seasonal reproductive patterns of various tiger subspecies.

Additionally, studies of the effect of transport and new environment stress on ovarian cycling in female tigers are necessary.

Also, research on the biological reasons for the decline in breeding success with increasing female age in tigers would be beneficial.

8.2 Artificial Insemination: Further studies of assisted reproduction in tigers as new technologies become available, and/or research on other felid species would provide valuable new information.

8.6 Contraception: An investigation of latency to resumption of ovarian cycling and estrous behaviors after expiration (according to manufacturer) of hormonal implants would assist in contraception plans.

Additionally, studies of the effectiveness and safety of alternative/new contraceptive options for tigers should be performed to evaluate all options.

Chapter 11: Research

11.1 Known Methodology: Further studies on chemical communication in tigers are needed to provide a clearer understanding of how this form of communication is utilized.

Acknowledgements

The first AZA Tiger SSP husbandry manual, 1994's *Conservation and Management of Captive Tigers*, served as an important basis for this Animal Care Manual. The Tiger SSP acknowledges the extensive research and effort that went into the creation of the original and subsequent versions of the manual, and thanks all of the people who contributed to it (see below).

This manual is dedicated to the memory of Dr. Ron Tilson, who passed away on November 16, 2013. Dr. Tilson coordinated the AZA Tiger SSP for more than two decades and was the driving force behind the writing of this Animal Care Manual. Over the course of his career at the Minnesota Zoo, Dr. Tilson initiated and coordinated the Sumatran Tiger Conservation Program, led the South China Tiger Advisory Office, created and coordinated the Tiger Information Center website, wrote/co-authored numerous articles about tigers and co-edited two editions of "Tigers of the World". He is remembered fondly as a passionate advocate for tigers in the wild and in human care, and a leader in the field of zoo-based conservation.

Thanks go to all internal reviewers of the AZA Felid TAG and Tiger SSP, AZA Animal Health Committee; AZA Nutrition SAG and the members of the Association of Zoos and Aquariums for their time and effort in creating, reviewing, and improving the Tiger Care Manual. Special thanks to the external reviewers, for taking the time to share their expertise. The development of the Tiger Care Manual is a collaborative project among a lot of special people over a number of years. Gratitude is extended to the AZA Felid TAG for their hard work developing and reviewing this manual, to the Association of Zoos and Aquariums (AZA) for their wholehearted support of the project, and to the AZA Animal Welfare Committee for their continued commitment to animal care.

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Appendix A: Accreditation Standards by Chapter

The following specific standards of care relevant to Tiger (*Panthera tigris*) are taken from the AZA Accreditation Standards and Related Policies (AZA, 2017) 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/provincial, and federal wildlife laws and/or regulations. It is understood that, in some cases, AZA accreditation standards are more stringent than existing laws and/or regulations. In these cases the AZA standard must be met.

Chapter 1

(1.5.7) The animals must be protected or provided accommodation from weather or other conditions clearly known to be detrimental to their health or welfare.

(10.2.1) Critical life-support systems for the animals, 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. Warning mechanisms and emergency backup systems must be tested periodically.

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

Chapter 2

(1.5.1) All animals must be well cared for and presented in a manner reflecting modern zoological practices in exhibit design, balancing animals' welfare requirements with aesthetic and educational considerations.

(1.5.2) All animals must be housed in enclosures which are safe for the animals and meet their physical and psychological needs.

(1.5.2.1) All animals must be kept in appropriate groupings which meet their social and welfare needs.

(1.5.2.2) All animals should be provided the opportunity to choose among a variety of conditions within their environment.

(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. AZA housing guidelines outlined in the Animal Care Manuals should be followed.

(10.3.4) When sunlight is likely to cause overheating of or discomfort to the animals, sufficient shade (in addition to shelter structures) must be provided by natural or artificial means to allow all animals kept outdoors to protect themselves from direct sunlight.

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

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

(1.5.15) All animal exhibit and holding area air and water inflows and outflows must be securely protected to prevent animal injury or egress.

(2.8.1) Pest control management programs must be administered in such a manner that the animals, paid and unpaid staff, the public, and wildlife are not threatened by the pests, contamination from pests, or the control methods used.

(11.3.6) There must be barriers in place (for example, guardrails, fences, walls, etc.) of sufficient strength and/or design to deter public entry into animal exhibits or holding areas, and to deter public contact with animals in all areas where such contact is not intended.

(11.2.4) All emergency procedures must be written and provided to appropriate paid and unpaid staff. Appropriate emergency procedures must be readily available for reference in the event of an actual emergency.

(11.2.5) Live-action emergency drills (functional exercises) must be conducted at least once annually for each of the four basic types of emergency (fire; weather or other environmental emergency appropriate to the region; injury to visitor or paid/unpaid staff; and animal escape). Four separate

drills are required. These drills must be recorded and results evaluated for compliance with emergency procedures, efficacy of paid/unpaid staff training, aspects of the emergency response that are deemed adequate are reinforced, and those requiring improvement are identified and modified. (See 11.7.4 for other required drills).

(11.6.2) Security personnel, whether employed by 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).

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

(11.2.0) A paid staff member or a committee must be designated as responsible for ensuring that all required emergency drills are conducted, recorded, and evaluated in accordance with AZA accreditation standards (see 11.2.5, 11.5.2, and 11.7.4).

(11.2.7) 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 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

(1.4.0) The institution must show evidence of having a zoological records management program for managing animal records, veterinary records, and other relevant information.

(1.4.6) A paid or unpaid 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 paid and unpaid animal care staff members apprised of relevant laws and regulations regarding the institution's animals.

(1.4.7) Animal and veterinary records must be kept current.

(1.4.4) Animal records, whether in electronic or paper form, must be duplicated and stored in a separate location. Animal records are defined as data, regardless of physical form or medium, providing information about individual animals, or samples or parts thereof, or groups of animals.

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

(1.4.1) An animal inventory must be compiled at least once a year and include data regarding acquisition, transfer, euthanasia, release, and reintroduction.

(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.

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

Chapter 4

(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.

(1.5.10) Temporary, seasonal and traveling live animal exhibits, programs, or presentations (regardless of ownership or contractual arrangements) must be maintained at the same level of care as the institution’s permanent resident animals, with foremost attention to animal welfare considerations, both onsite and at the location where the animals are permanently housed.

Chapter 6

(2.6.2) The institution must follow a written nutrition program that meets the behavioral and nutritional needs of all species, individuals, and colonies/groups in the institution. Animal diets must be of a quality and quantity suitable for each animal's nutritional and psychological needs.
(2.6.1) Animal food preparations must meet all local, state/provincial, and federal regulations.
(2.6.3) The institution must assign at least one paid or unpaid staff member to oversee appropriate browse material for the animals (including aquatic animals).

Chapter 7

(2.1.1) A full-time staff veterinarian is recommended. In cases where such is not necessary because of the number and/or nature of the animals residing there, a consulting/part-time veterinarian must be under written contract to make at least twice monthly inspections of the animals and to respond as soon as possible to any emergencies.
(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.
(2.0.1) The institution should adopt the *Guidelines for Zoo and Aquarium Veterinary Medical Programs and Veterinary Hospitals,* and policies developed or supported by the American Association of Zoo Veterinarians (AAZV). The most recent edition of the medical programs and hospitals booklet is available at the AAZV website, under "Publications", at http://www.aazv.org/displaycommon.cfm?an=1&subarticlenbr=839, and can also be obtained in PDF format by contacting AZA staff.
(2.2.1) Written, formal procedures must be available to paid and unpaid animal care staff for the use of animal drugs for veterinary purposes and appropriate security of the drugs must be provided.
(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. Quarantine duration should be assessed and determined by the pathogen risk and best practice for animal welfare.
(2.7.3) Quarantine, hospital, and isolation areas should be in compliance with standards/guidelines contained within the Guidelines for Zoo and Aquarium Veterinary Medical Programs and Veterinary Hospitals developed by the American Association of Zoo Veterinarians (AAZV), which can be obtained at: http://www.aazv.org/displaycommon.cfm?an=1&subarticlenbr=839.
(2.7.2) Written, formal procedures for quarantine must be available and familiar to all paid and unpaid staff working with quarantined animals.
(11.1.2) Training and procedures must be in place regarding zoonotic diseases.
(11.1.3) A tuberculin (TB) testing/surveillance program must be established for appropriate paid and unpaid staff in order to assure the health of both the paid and unpaid staff and the animals.
(2.5.1) Deceased animals should be necropsied to determine the cause of death for tracking morbidity and mortality trends to strengthen the program of veterinary care and meet SSP-related requests.
(2.5.2) The institution should have an area dedicated to performing necropsies.
(2.5.3) Cadavers must be kept in a dedicated storage area before and after necropsy. Remains must be disposed of in accordance with local/federal laws.
(2.0.2) The veterinary care program must emphasize disease prevention.
(2.0.3) Institutions should be aware of and prepared for periodic disease outbreaks in wild or other domestic or exotic animal populations that might affect the institution's animals (ex – Avian Influenza, Eastern Equine Encephalitis Virus, etc.). Plans should be developed that outline steps to be taken to protect the institution's animals in these situations.
(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.
(2.1.3) Paid and unpaid animal care staff should be trained to assess welfare and recognize abnormal behavior and clinical signs 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, animal care staff (paid and unpaid) must not diagnose illnesses nor prescribe treatment.
(2.3.2) Institution facilities must have radiographic equipment or have access to radiographic services.

(1.5.8) The institution must develop and implement a clear and transparent process for identifying, communicating, and addressing animal welfare concerns from paid or unpaid staff within the institution in a timely manner, and without retribution.

Chapter 9

(1.6.4) The institution should follow a formal written animal training program that facilitates husbandry, science, and veterinary procedures and enhances the overall health and well-being of the animals.

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

(1.6.3) Enrichment activities must be documented and evaluated, and program refinements should be made based on the results, if appropriate. Records must be kept current.

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

Chapter 10

(1.5.4) If ambassador animals are used, a written policy on the use of live animals in programs must be on file and incorporate the elements contained in AZA's "Recommendations For Developing an Institutional Ambassador Animal Policy" (see policy in the current edition of the *Accreditation Standards and Related Policies* booklet). An education, conservation, and welfare message must be an integral component of all programs. Animals in education programs must be maintained and cared for by paid and/or unpaid trained staff, and housing conditions must meet standards required for the remainder of the animals in the institution. While outside their primary enclosure, although the conditions may be different, animal safety and welfare need to be assured at all times.

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

(1.5.12) Paid and/or unpaid staff assigned to handle animals during demonstrations or educational programs must be trained in accordance with the institution's written animal handling protocols. Such training must take place before handling may occur.

(1.5.13) When in operation, animal contact areas (petting zoos, touch tanks, etc.) must be supervised by trained, paid and/or unpaid staff.

(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.

(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. AZA housing guidelines outlined in the Animal Care Manuals should be followed.

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

(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. Planning and coordination for animal transport requires good communication among all involved 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.

Chapter 11

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

(5.0) The institution must have a demonstrated commitment to scientific study that is in proportion to the size and scope of its facilities, staff (paid and unpaid), and animals.

(5.2) The institution must follow a formal written policy that includes a process for the evaluation and approval of scientific project proposals, and outlines the type of studies it conducts, methods, staff (paid and unpaid) involvement, evaluations, animals that may be involved, and guidelines for publication of findings.

(5.1) Scientific studies must be under the direction of a paid or unpaid staff member or committee qualified to make informed decisions.

Appendix B: Guidelines for Creating and Sharing Animal and Collection Records

Developed by the AZA Institutional Data Management Scientific Advisory Group
Original Publication Date: 5 Sept 2007
Publication Revision Date: 23 June 2014

The goal of maintaining a centralized, compiled record for each animal cared for in a zoo or aquarium is ideal, however, oftentimes, information belonging in an animal record is spread across many departments and may originate with any member of the animal care staff. Therefore, it is important for zoos and aquariums to have a formal method for collecting or linking various pieces of information into the official records and that the roles and responsibilities for each named record type are clearly defined in written protocols for the reporting, recording, distribution, storage, and retrieval processes; there should also be a stated process of review for the accuracy and completeness of these records. For example, a recording/reporting protocol would state who reports births or deaths, to whom they are reported, in what manner and in what time frame they are reported, who officially records the information, and who reviews the resulting record for accuracy and completeness. Then, the maintenance and archiving protocol would state where the record is to be filed, who may have access, and how long the record is to be maintained before being archived or disposed of.

Information contained in animal records is essential not only to the immediate care of the individual animal but also as pooled data to manage larger concerns (e.g., providing norms for species-related veterinary and population management decisions, evidence of compliance with laws and regulations, showing trends in populations on every level from institutional to global, etc.). No matter what its use, it is critical for the information contained in an animal record to be factual, clear, complete, and documented. Because zoos and aquariums vary greatly in size and organizational structure, it is impossible to set defined procedures that would be applicable to all; therefore the following guidelines for creating and sharing animal records have been developed to assist with the establishment of written policies that best fit their own internal structure and protocols.

Animal and Collection Records – Definitions and Examples

The AZA Institutional Data Management Scientific Advisory Group (IDMAG) defines an animal record as: *"data, regardless of physical form or medium, providing information about individual animals, groups of animals, or samples or parts thereof".* An animal's record may include, but is not limited to, information about its provenance, history, daily care, activities, and condition; some may originate in non-animal care departments. Some examples of animal records are:

- transaction documents (including proof of legal ownership, purchase contracts, etc.)
- identification information
- reports of collection changes (including in-house moves)
- pedigrees/lineages
- veterinary information, including images, test results, etc.
- nutrition and body condition information
- information on sampling and parts/products distribution

In addition, the IDMAG defines collection records as: *"information, evidence, rationalizations about an animal collection as a whole that may supplement or explain information contained in an animal record"*. Collection records may include, but are not limited to, documentation of collection decisions and changes, evidence of structural change at the institution, evidence of building name changes, and documentation of institution level or unit level husbandry protocols and changes. Some examples of collection records are:

- collection plans
- permits
- annual inventories (which include reconciliation with the previous year)
- area journals/notebooks (including information to/from/between other animal care staff)
- keeper reports
- animal management protocols (e.g., species hand-rearing protocols, special care or treatments, etc.)

- enclosure maps/trees
- enclosure/exhibit information (monitoring, maintenance, modifications, etc.)
- research plans and published papers

Animal and Collection Records - Development

It is recommended that each zoo and aquarium develop written policies and procedures, applicable to all staff involved with animal care, that:

- define the types of records that are required. For example, daily keeper reports might be required from the keeper staff and weekly summaries of activities might be required from the animal curator and senior veterinarian.
- define the information that is to be included in each type of record. Following the example above, the institution would state the specific types of information to be recorded on the daily keeper report and the weekly summaries.
- define the primary location where each record can be found. For example, if a zoo does not employ a nutritionist, the policy or procedures might state that animal diet information will be found in keeper daily reports, curator-developed daily diets, and/or veterinarian-prescribed treatment diets.
- assign responsibility for the generation of each record type and set time limits for the their creation. For example, keepers might be held responsible for producing daily reports by the start of the next day and curators might be held responsible for producing weekly summaries by the Tuesday of the following week.
- define a process to review the accuracy of each record type and assign responsibility for that review process. For example, the identity of who will review each type of record, the date of reviews, and the review/correction processes might be included in the policy.
- define a process to identify official records and assign responsibility for the recording of, or linking of, information into these records. For example, the identity of who will be responsible for placing information into the official records and the processes of how to identify official records might be included in the policy.
- ensure entries in official records are never erased or deleted. For example, if an entry is determined to be erroneous, rather than deleting it, the entry should be amended and an audit trail should be created that identifies what data was changed, who made the change, the date it was changed, and the reason for the change.
- ensure records relating to specific animals in the collection, including the records of non--animal care departments, are permanently archived as part of the animal's record. For example, if your zoo or aquarium's records retention schedules differ from this recommendation every attempt should be made to exempt these records from schedules requiring their destruction.

Animal and Collection Records – Sharing of Information

Each zoo and aquarium should assess the ownership of their animal and collection records and determine the rights of employees and outside entities to the information contained in them. It is recommended that each zoo and aquarium develop written policies and procedures for the distribution and/or availability of the animal and collection records that:

- identify who has access to animal and collection records and under what conditions. For example, animal care staff whose duties require a direct need for information about specific animals or collection of animals should be identified as individuals who are allowed access to any or specified records, regardless of who created them or when they were created.
- assign responsibility for the distribution, archiving and retrieval of each record type. For example, the recordkeeper or registrar might be held responsible for maintaining all past and current transaction documents and the curator might be held responsible for maintaining the daily keeper reports from his/her section.
- define a notification system that specifies what information will be provided in the notification, who will be notified, the date they will be notified by, and the mechanism that will be used to ensure the notification is communicated appropriately. For example, the shipment of an animal might require that written notice be made to the senior keeper in the animal's area, the curator, and the veterinarian at least 30 days prior to the move, and identifies the animal by group or individual identification/accession number, sex, and tag/transponder number, etc.

- define where each record type (stored or archived) is available and what format (paper or digital) it is in. For example, all original animal transaction documents might be kept in the registrar's office in fire-proof file cabinets but copies of the Animal Data Transfer Forms are kept in the appropriate keeper area.
- define a system for obtaining necessary information such that the information is available regardless of department and regardless of staffing issues. For example, keeper daily reports might be maintained in an electronic database run on the institution's network, to which all animal care staff members have at least read-only access.

Implementation of these Recommendations

Well-written, consistent data-recording protocols and clear lines of communication will increase the quality of animal records and should be implemented by all institutions, regardless of technical resources. While the best option for availability of information is an electronic database system run on a computer network (intranet) to which all animal care staff members have unrestricted access, the above recommendations may also be adopted by zoos and aquariums without full electronic connections.

Appendix C: AZA Policy on Responsible Population Management

PREAMBLE

The stringent requirements for AZA accreditation, and high ethical standards of professional conduct, are unmatched by similar organizations and far surpass the United States Department of Agriculture's Animal and Plant Health Inspection Service's requirements for licensed animal exhibitors. Every AZA member must abide by a Code of Professional Ethics (https://www.aza.org/Ethics/). In order to continue these high standards, AZA-accredited institutions and certified related facilities should make it a priority, when possible, to acquire animals from and transfer them to other AZA member institutions, or members of other regional zoo associations that have professionally recognized accreditation programs.

AZA-accredited institutions and certified related facilities cannot fulfill their important missions of conservation, education, and science without live animals. Responsible management and the long-term sustainability of living animal populations necessitates that some individuals be acquired and transferred, reintroduced or even humanely euthanized at certain times. The acquisition and transfer of animals should be prioritized by the long-term sustainability needs of the species and AZA-managed populations among AZA-accredited and certified related facilities, and between AZA member institutions and non-AZA entities with animal care and welfare standards aligned with AZA. AZA member institutions that acquire animals from the wild, directly or through commercial vendors, should perform due diligence to ensure that such activities do not have a negative impact on species in the wild. Animals should only be acquired from non-AZA entities 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.

I. INTRODUCTION

This AZA Policy on Responsible Population Management provides guidance to AZA members to:

1. Assure that animals from AZA member institutions and certified related facilities are not transferred to individuals or organizations that lack the appropriate expertise or facilities to care for them [*see taxa specific appendices (in development)*],

2. Assure that the health and conservation of wild populations and ecosystems are carefully considered as appropriate,

3. Maintain a proper standard of conduct for AZA members during acquisition and transfer/reintroduction activities, including adherence to all applicable laws and regulations,

4. Assure that the health and welfare of individual animals is a priority during acquisition and transfer/reintroduction activities, and

5. Support the goals of AZA's cooperatively managed populations and associated Animal Programs [Species Survival Plans® (SSPs), Studbooks, and Taxon Advisory Groups (TAGs)].

This AZA Policy on Responsible Population Management will serve as the default policy for AZA member institutions. Institutions should develop their own Policy on Responsible Population Management in order to address specific local concerns. Any institutional policy must incorporate and not conflict with the AZA acquisition and transfer/transition standards.

II. LAWS, AUTHORITY, RECORDKEEPING, IDENTIFICATION AND DOCUMENTATION

The following must be considered with regard to the acquisition or transfer/management of all living animals and specimens (their living and non-living parts, materials, and/or products):

1. Any acquisitions, transfers, euthanasia and reintroductions must meet the requirements of all applicable local, state, federal and international laws and regulations. Humane euthanasia must be performed in accordance with the established euthanasia policy of the institution and follow the recommendations of current AVMA Guidelines for the Euthanasia of Animals (2013 Edition https://www.avma.org/KB/Policies/Documents/euthanasia.pdf) or the AAZV's Guidelines on the Euthanasia of Non-Domestic Animals. Ownership and any applicable chain-of-custody must be documented. If such information does not exist, an explanation must be provided regarding such animals and specimens. Any acquisition of free-ranging animals must be done in accordance with all local, state, federal, and international laws and regulations and must not be detrimental to the long-term viability of the species in the wild.

2. The Director/Chief Executive Officer of the institution must have final authority for all acquisitions, transfers, and euthanasia.

3. Acquisitions or transfers/euthanasia/reintroductions must be documented through institutional recordkeeping systems. The ability to identify which animal is being transferred is very important and the method of identifying each individual animal should be documented. Any existing documentation must accompany all transfers. Institutional animal records data, records guidelines have been developed for certain species to standardize the process (https://www.aza.org/AnimalCare/detail.aspx?id=3150).

4. For some colonial, group-living, or prolific species, it may be impossible or highly impractical to identify individual animals when these individuals are maintained in a group. These species can be maintained, acquisitioned, transferred, and managed as a group or colony, or as part of a group or colony.

5. If the intended use of specimens from animals either living or non-living is to create live animal(s), their acquisition and transfer should follow the same guidelines. If germplasm is acquired or transferred with the intention of creating live animal(s), ownership of the offspring must be clearly defined in transaction documents (e.g., breeding loan agreements).

   Institutions acquiring, transferring or otherwise managing specimens should consider current and possible future uses as new technologies become available. All specimens from which nuclear DNA could be recovered should be carefully considered for preservation as these basic DNA extraction technologies already exist.

6. AZA member institutions must maintain transaction documents (e.g., confirmation forms, breeding agreements) which provide the terms and conditions of animal acquisitions, transfers and loans, including documentation for animal parts, products and materials. These documents should require the potential recipient or provider to adhere to the AZA Policy on Responsible Population Management, and the AZA Code of Professional Ethics, and must require compliance with the applicable laws and regulations of local, state, federal, and international authorities.

7. In the case of animals (living or non-living) and their parts, materials, or products (living or non-living) held on loan, the owner's written permission should be obtained prior to any transfer and documented in the institutional records.

8. AZA SSP and TAG necropsy and sampling protocols should be accommodated.

9. Some governments maintain ownership of the species naturally found within their borders. It is therefore incumbent on institutions to determine whether animals they are acquiring or transferring are owned by a government entity, foreign or domestic, and act accordingly by reviewing the government ownership policies available on the AZA website. In the case of government owned animals, proposals for and/or notifications of transfers must be sent to the species manager for the government owned species.

III. ACQUISITION REQUIREMENTS

A. General Acquisitions

1. 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 regarding the individual or species.

2. Animals (wild, feral, and domestic) may be held temporarily for reasons such as assisting governmental agencies or other institutions, rescue and/or rehabilitation, research, propagation or headstarting for reintroduction, or special exhibits.

3. Any receiving institution must have the necessary expertise and resources to support and provide for the professional care and management of the species, so that the physical, psychological, and social needs of individual animals and species are met.

4. If the acquisition involves a species managed by an AZA Animal Program, the institution should communicate with the Animal Program Leader and, in the case of Green SSP Programs, must adhere to the AZA Full Participation Policy (http://www.aza.org/full-participation-in-ssp-program-policy/).

5. AZA member institutions should consult AZA Wildlife Conservation and Management Committee (WCMC)-approved TAG Regional Collection Plans (RCPs), Animal Program Leaders, and AZA Animal Care Manuals (ACMs) when making acquisition decisions.

6. AZA member institutions that work with commercial vendors that acquire animals from the wild, must perform due diligence to assure the vendors' collection of animals is legal and using ethical practices. Commercial vendors should have conservation and animal welfare goals similar to those of AZA institutions.

7. AZA member institutions may acquire animals through public donations and other non-AZA entities when it is in the best interest of the animal and/or species.

B. Acquisitions from the Wild

Maintaining wild animal populations for exhibition, education and wildlife conservation purposes is a core function of AZA-member institutions. AZA zoos and aquariums have saving species and conservation of wildlife and wildlands as a basic part of their public mission. As such, the AZA recognizes that there are circumstances where acquisitions from the wild are needed in order to maintain healthy, diverse animal populations. Healthy, sustainable populations support the objectives of managed species programs and the core mission of AZA members. In some cases, acquiring individuals from the wild may be a viable option in addition to, or instead of, relying on breeding programs with animals already in human care.

Acquiring animals from the wild can result in socioeconomic benefit and environmental protection and therefore the AZA supports environmentally sustainable/beneficial acquisition from the wild when conservation is a positive outcome.

1. Before acquiring animals from the wild, institutions are encouraged to examine alternative sources including other AZA institutions and other regional zoological associations or other non-AZA entities.

2. When acquiring animals from the wild, both the long-term health and welfare impacts on the wild population as well as on individual animals must be considered. In crisis situations, when the survival of a population is at risk, rescue decisions will be made on a case-by-case basis by the appropriate agency and institution.

3. AZA zoos and aquariums may assist wildlife agencies by providing homes for animals born in nature if they are incapable of surviving on their own (eg in case of orphaned or injured animals) or by euthanizing the animals because they pose a risk to humans or for humane reasons.
4. Institutions should only accept animals from the wild after a risk assessment determines the zoo/aquarium can mitigate any potential adverse impacts on the health, care and maintenance of the existing animals already being housed at the zoo or aquarium, and the new animals being acquired.

IV. TRANSFER, EUTHANASIA AND REINTRODUCTION REQUIREMENTS

A. Living Animals

Successful conservation and animal management relies on the cooperation of many entities, both AZA and non-AZA. While preference is given to placing animals with AZA-accredited institutions or certified related facilities, it is important to foster a cooperative culture among those who share AZA's mission of saving species and excellence in animal care.

1. AZA members should assure that all animals in their care are transferred, humanely euthanized and/or reintroduced in a manner that meets the standards of AZA, and that animals are not transferred to those not qualified to care for them properly. Refer to IV.12, below, for further requirements regarding euthanasia.

2. If the transfer of animals or their specimens (parts, materials, and products) involves a species managed by an AZA Animal Program, the institution should communicate with that Animal Program Leader and, in the case of Green SSP Programs must adhere to the AZA Full Participation Policy (http://www.aza.org/full-participation-in-ssp-program-policy/).

3. AZA member institutions should consult WCMC-approved TAG Regional Collection Plans, Animal Program Leaders, and Animal Care Manuals when making transfer decisions.

4. Animals acquired solely as a food source for animals in the institution's care are not typically accessioned. There may be occasions, however, when it is appropriate to use accessioned animals that exceed population carrying capacity as feeder animals to support other animals. In some cases, accessioned animals may have their status changed to "feeder animal" status by the institution as part of their program for long-term sustained population management of the species.

5. In transfers to non-AZA entities, AZA members must perform due diligence and should have documented validation, including one or more letters of reference, for example from an appropriate AZA Professional Fellow or other trusted source with expertise in animal care and welfare, who is familiar with the proposed recipient and their current practices, and that the recipient has the expertise and resources required to properly care for and maintain the animals. Any recipient must have the necessary expertise and resources to support and provide for the professional care and management of the species, so that the physical, psychological, and social needs of individual animals and species are met within the parameters of modern zoological philosophy and practice. Supporting documentation must be kept at the AZA member institution (see #IV.9 below).

6. Domestic animals should be transferred in accordance with locally acceptable humane farming practices, including auctions, and must be subject to all relevant laws and regulations.

7. AZA members must not send any non-domestic animal to auction or to any organization or individual that may display or sell the animal at an animal auction. *See certain taxa-specific appendices to this Policy (in development) for information regarding exceptions*.

8. Animals must not be sent to organizations or individuals that allow the hunting of these individual animals; that is, no individual animal transferred from an AZA institution may be hunted. For purposes

of maintaining genetically healthy, sustainable zoo and aquarium populations, AZA-accredited institutions and certified related facilities may send animals to non-AZA organizations or individuals (refer to #IV.5 above). These non-AZA entities (for instance, ranching operations) should follow appropriate ranch management practices and other conservation minded practices to support population sustainability.

9. Every loaning institution must annually monitor and document the conditions of any loaned specimen(s) and the ability of the recipient(s) to provide proper care (refer to #IV.5 above). If the conditions and care of animals are in violation of the loan agreement, the loaning institution must recall the animal or assure prompt correction of the situation. Furthermore, an institution's loaning policy must not be in conflict with this AZA Policy on Responsible Population Management.

10. If living animals are sent to a non-AZA entity for research purposes, it must be a registered research facility by the U.S. Department of Agriculture and accredited by the Association for the Assessment & Accreditation of Laboratory Animal Care, International (AAALAC), if eligible. For international transactions, the receiving facility must be registered by that country's equivalent body having enforcement over animal welfare. In cases where research is conducted, but governmental oversight is not required, institutions should do due diligence to assure the welfare of the animals during the research.

11. Reintroductions and release of animals into the wild must meet all applicable local, state, and international laws and regulations. Any reintroduction requires adherence to best health and veterinary practices to ensure that non-native pathogens are not released into the environment exposing naive wild animals to danger. Reintroductions may be a part of a recovery program and must be compatible with the IUCN Reintroduction Specialist Group's Reintroduction Guidelines (http://www.iucnsscrsg.org/index.php).

12. Humane euthanasia may be employed for medical reasons to address quality of life issues for animals or to prevent the transmission of disease. AZA also recognizes that humane euthanasia may be employed for managing the demographics, genetics, and diversity of animal populations. Humane euthanasia must be performed in accordance with the established euthanasia policy of the institution and follow the recommendations of current AVMA Guidelines for the Euthanasia of Animals (2013 Edition https://www.avma.org/KB/Policies/Documents/euthanasia.pdf) or the AAZV's Guidelines on the Euthanasia of Non-Domestic Animals.

B. Non-Living Animals and Specimens

AZA members should optimize the use and recovery of animal remains. All transfers must meet the requirements of all applicable laws and regulations.

1. Optimal recovery of animal remains may include performing a complete necropsy including, if possible, histologic evaluation of tissues which should take priority over specimens' use in education/exhibits. AZA SSP and TAG necropsy and sampling protocols should be accommodated. This information should be available to SSP Programs for population management.

2. The educational use of non-living animals, parts, materials, and products should be maximized, and their use in Animal Program sponsored projects and other scientific projects that provide data for species management and/or conservation must be considered.

3. Non-living animals, if handled properly to protect the health of the recipient animals, may be utilized as feeder animals to support other animals as deemed appropriate by the institution.

4. AZA members should consult with AZA Animal Program Leaders prior to transferring or disposing of remains/samples to determine if existing projects or protocols are in place to optimize use.

5. AZA member institutions should develop agreements for the transfer or donation of non-living animals, parts, materials, products, and specimens and associated documentation, to non-AZA entities such as universities and museums. These agreements should be made with entities that have appropriate long term curation/collections capacity and research protocols, or needs for educational programs and/or exhibits.

DEFINITIONS

Acquisition: Acquisition of animals can occur through breeding (births, hatchings, cloning, and division of marine invertebrates = "fragging"), trade, donation, lease, loan, transfer (inter- and intra-institution), purchase, collection, confiscation, appearing on zoo property, or rescue and/or rehabilitation for release.

Annual monitoring and Due diligence: Due diligence for the health of animals on loan is important. Examples of annual monitoring and documentation include and are not limited to inventory records, health records, photos of the recipient's facilities, and direct inspections by AZA professionals with knowledge of animal care. The level of due diligence will depend on professional relationships.

AZA member institution: In this Policy "AZA member institutions" refers to AZA-accredited institutions and certified related facilities (zoological parks and aquariums). "AZA members" may refer to either institutions or individuals.

Data sharing: When specimens are transferred, the transferring and receiving institutions should agree on data that must be transferred with the specimen(s). Examples of associated documentation include provenance of the animal, original permits, tags and other metadata, life history data for the animal, how and when specimens were collected and conserved, etc.

Dispose: "Dispose/Disposing of" in this document is limited to complete and permanent removal of an individual via incineration, burying or other means of permanent destruction

Documentation: Examples of documentation include ZIMS records, "Breeding Loan" agreements, chain-of-custody logs, letters of reference, transfer agreements, and transaction documents. This is documentation that maximizes data sharing.

Domestic animal: Examples of domestic animals may include certain camelids, cattle, cats, dogs, ferrets, goats, pigs, reindeer, rodents, sheep, budgerigars, chickens, doves, ducks, geese, pheasants, turkeys, and goldfish or koi.

Ethics of Acquisition/Transfer/Euthanasia: Attempts by members to circumvent AZA Animal Programs in the acquisition of animals can be detrimental to the Association and its Animal Programs. Such action may also be detrimental to the species involved and may be a violation of the Association's Code of Professional Ethics. Attempts by members to circumvent AZA Animal Programs in the transfer, euthanasia or reintroduction of animals may be detrimental to the Association and its Animal Programs (unless the animal or animals are deemed extra in the Animal Program population by the Animal Program Coordinator). Such action may be detrimental to the species involved and may be a violation of the Association's Code of Professional Ethics.

"Extra" or Surplus: AZA's scientifically-managed Animal Programs, including SSPs, have successfully bred and reintroduced critically endangered species for the benefit of humankind. To accomplish these critical conservation goals, populations must be managed within "carrying capacity" limits. At times, the number of individual animals in a population exceeds carrying capacity, and while meaning no disrespect for these individual animals, we refer to these individual animals as "extra" within the managed population.

Euthanasia: Humane death. This act removes an animal from the managed population. Specimens can be maintained in museums or cryopreserved collections. Humane euthanasia must be performed in accordance with the established euthanasia policy of the institution and follow the recommendations of current AVMA Guidelines for the Euthanasia of Animals (2013 Edition https://www.avma.org/KB/Policies/Documents/euthanasia.pdf) or the AAZV's Guidelines on the Euthanasia of Non-Domestic Animals.

Feral: Feral animals are animals that have escaped from domestication or have been abandoned to the wild and have become wild, and the offspring of such animals. Feral animals may be acquired for temporary or permanent reasons.

Group: Examples of colonial, group-living, or prolific species include and are not limited to certain terrestrial and aquatic invertebrates, fish, sharks/rays, amphibians, reptiles, birds, rodents, bats, big herds, and other mammals,

Lacey act: The Lacey Act prohibits the importation, exportation, transportation, sale, receipt, acquisition or purchase of wildlife taken or possessed in violation of any law, treaty or regulation of the United States or any Indian tribal law of wildlife law. In cases when there is no documentation accompanying an acquisition, the animal(s) may not be transferred across state lines. If the animal was illegally acquired at any time then any movement across state or international borders would be a violation of the Lacey Act.

Museum: It is best practice for modern zoos and aquariums to establish relationships with nearby museums or other biorepositories, so that they can maximize the value of animals when they die (e.g., knowing who to call when they have an animal in necropsy, or specimens for cryopreservation). Natural history museums that are members of the Natural Science Collections Alliance (NSCA) and frozen biorepositories that are members of the International Society of Biological and Environmental Repositories (ISBER) are potential collaborators that could help zoos find appropriate repositories for biological specimens.

Non-AZA entity: Non – AZA entities includes facilities not accredited or certified by the AZA, facilities in other zoological regions, academic institutions, museums, research facilities, private individuals, etc.

Reintroduction: Examples of transfers outside of a living zoological population include movements of animals from zoo/aquarium populations to the wild through reintroductions or other legal means.

Specimen: Examples of specimens include animal parts, materials and products including bodily fluids, cell lines, clones, digestive content, DNA, feces, marine invertebrate (coral) fragments ("frags"), germplasm, and tissues.

Transaction documents: Transaction documents must be signed by the authorized representatives of both parties, and copies must be retained by both parties*. In the case of loans, the owner's permission for appropriate activities should be documented in the institutional records. This document(s) should be completed prior to any transfer. In the case of rescue, confiscation, and evacuation due to natural disasters, it is understood that documents may not be available until after acceptance or shipping. In this case documentation (e.g., a log) must be kept to reconcile the inventory and chain of custody after the event occurs. (*In the case of government owned animals, notification of transfers must be sent to species manager for the government owned species).

Transfer: Transfer occurs when an animal leaves the institution for any reason. Reasons for transfer or euthanasia may include cooperative population management (genetic, demographic or behavioral management), animal welfare or behavior management reasons (including sexual maturation and individual management needs). Types of transfer include withdrawal through donation, trade, lease, loan, inter- and intra-institution transfers, sale, escape, theft. Reintroduction to the wild, humane euthanasia or natural death are other possible individual animal changes in a population.

RECIPIENT PROFILE EXAMPLE

Example questions for transfers to non-AZA entities (from AZA-member Recipient Profile documents):

Has your organization, or any of its officers, been indicted, convicted, or fined by a State or Federal agency for any statute or regulation involving the care or welfare of animals housed at your facility? (If yes, please explain on a separate sheet).

Recipients agree that the specimen(s) or their offspring will not be utilized, sold or traded for any purpose contrary to the Association of Zoos and Aquariums (AZA) Code of Ethics (enclosed)

References, other than (LOCAL ZOO/AQUARIUM) employees, 2 minimum (please provide additional references on separate sheet):

Reference Name		Phone	
Facility		Fax	
Address		E-mail	
City	State		Zip
Country		AZA Member?	

Reference Name		Phone	
Facility		Fax	
Address		E-mail	
City	State		Zip
Country		AZA Member?	

Veterinary Information:

Veterinarian		Phone	
Clinic/Practice		Fax	
Address		E-mail	
City	State		Zip
Country			

How are animals identified at your facility? If animals are not identified at your facility, please provide an explanation about why they are not here:

Where do you acquire and send animals? (Select all that apply)

AZA Institutions	Non-AZA Institutions	Exotic Animal Auctions	Pet Stores
Hunting Ranches	Dealers	Private Breeders	Non-hunting Game Ranches
Entertainment Industry	Hobbyists	Research Labs	Wild
Other			

What specific criteria are used to evaluate if a facility is appropriate to receive animals from you?

Please provide all of the documents listed below:
Required:
1. Please provide a brief statement of intent for the specimens requested.
2. Resumes of primary caretakers and those who will be responsible for the husbandry and management of animals.
3. Description (including photographs) of facilities and exhibits where animals will be housed.
4. Copy of your current animal inventory.

Only if Applicable:
5. Copies of your last two USDA inspection reports (if applicable).

6. Copies of current federal and state permits.
7. Copy of your institutional acquisition/disposition policy.

(in-house use only) In-Person Inspection of this facility (Staff member/Date, attach notes):

(Local institution: provide Legal language certifying that the information contained herein is true and correct)

(Validity of this: This document and all materials associated will be valid for a period of 2 years from date of signature.)

Example agreement for Receiving institution (agrees to following condition upon signing):
RECIPIENT AGREES THAT THE ANIMAL(S) AND ITS (THEIR) OFFSPRING WILL NOT BE UTILIZED, SOLD OR TRADED FOR THE PURPOSE OF COMMERCE OR SPORT HUNTING, OR FOR USE IN ANY STRESSFUL OR TERMINAL RESEARCH OR SENT TO ANY ANIMAL AUCTION. RECIPIENT FURTHER AGREES THAT IN THE EVENT THE RECIPIENT INTENDS TO DISPOSE OF AN ANIMAL DONATED BY (INSITUTION), RECIPIENT WILL FIRST NOTIFY (INSTITUTION) OF THE IDENTITY OF THE PROPOSED TRANSFEREE AND THE TERMS AND CONDITIONS OF SUCH DISPOSITION AND WILL PROVIDE (INSTITUTION) THE OPPORTUNITY TO ACQUIRE THE ANIMAL(S) WITHOUT CHARGE. IF (INSTITUTION) ELECTS NOT TO RECLAIM THE ANIMAL WITHIN TEN (10) BUSINESS DAYS FOLLOWING SUCH NOTIFICATION, THEN, IN SUCH EVENT, (INSTITUTION) WAIVES ANY RIGHT IT MAY HAVE TO THE ANIMAL AND RECIPIENT MAY DISPOSE OF THE ANIMAL AS PROPOSED.

Institutional note: The text above is similar to the language most dog breeders use in their contracts when they sell a puppy. If people can provide that protection to the puppies they place, zoos/aquariums can provide it for animals that we place too! Some entities have been reluctant to sign it, and in that case we revert to a loan and our institution retains ownership of the animal. Either way, we are advised of the animal's eventual placement and location.

Appendix D: 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 -70° C (-94° F) frost-free freezer or a -20° C (-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 Tiger (*Panthera tigris*):

Tiger (*Panthera tigris*):

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 E: Ambassador (Program) Animal Policy and Position Statement

Ambassador (Program) Animal Policy

Originally approved by the AZA Board of Directors—2003
Updated and approved by the Board—July 2008 & June 2011

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

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

There are three main categories of Ambassador Animal interactions:

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

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

Ambassador Animal presentations bring a host of responsibilities, including the safety and welfare of the animals involved, the safety of the animal handler and public, and accountability for the take-home, educational messages received by the audience. Therefore, AZA requires all accredited institutions that make Ambassador Animal presentations to develop an institutional Ambassador Animal policy that clearly

identifies and justifies those species and individuals approved as Ambassador Animals and details their long-term management plan and educational program objectives.

AZA's accreditation standards require that education and conservation messages must be an integral component of all Ambassador Animal presentations. In addition, the accreditation standards require that the conditions and treatment of animals in education programs must meet standards set for the remainder of the animal collection, including species-appropriate shelter, exercise, appropriate environmental enrichment, access to veterinary care, nutrition, and other related standards. In addition, providing Ambassador Animals with options to choose among a variety of conditions within their environment is essential to ensuring effective care, welfare, and management. Some of these requirements can be met outside of the primary exhibit enclosure while the animal is involved in a program or is being transported. For example, free-flight birds may receive appropriate exercise during regular programs, reducing the need for additional exercise. However, the institution must ensure that in such cases, the animals participate in programs on a basis sufficient to meet these needs or provide for their needs in their home enclosures; upon return to the facility the animal should be returned to its species-appropriate housing as described above.

Ambassador Animal Position Statement

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

The Conservation Education Committee (CEC) of the Association of Zoos and Aquariums supports the appropriate use of Ambassador Animals as an important and powerful educational tool that provides a variety of benefits to zoo and aquarium educators seeking to convey cognitive and affective (emotional) messages about conservation, wildlife and animal welfare.
Utilizing these animals allows educators to strongly engage audiences. As discussed below, the use of Ambassador 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 Ambassador 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.

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

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

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

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

- MacMillen (1994) found that the use of live animals in a zoomobile outreach program significantly enhanced cognitive learning in a vertebrate classification unit for sixth grade students.
- Sherwood and his colleagues (1989) compared the use of live horseshoe crabs and sea stars to the use of dried specimens in an aquarium education program and demonstrated that students made the greatest cognitive gains when exposed to programs utilizing the live animals.
- Povey and Rios (2002) noted that in response to an open-ended survey question ("Before I saw this animal, I never realized that . . . "), visitors watching a presentation utilizing a Ambassador 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
Ambassador Animals have been clearly demonstrated to increase affective learning and attitudinal change.

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

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

Acknowledgements
The primary contributors to this paper were Karen Povey and Keith Winsten, with valuable comments provided from members of both the Conservation Education Committee and the Children's Zoo Interest Group.

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Appendix F: Developing an Institutional Ambassador Animal Policy

Last revision 2003
Re-authorized by the Board, June 2011

Rationale

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

The inclusion of animals (native, exotic, and domestic) in educational presentations, when done correctly, is a powerful tool. CEC's **Ambassador Animal Position Statement** describes the research underpinning the appropriate use of Ambassador 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 Ambassador Animals conveys intended and/or conflicting messages and to modify and improve programs accordingly and to ensure that all Ambassador Animals have the best possible welfare.

When utilizing Ambassador Animals our responsibility is to meet both our high standards of animal care and our educational goals. Additionally, as animal management professionals, we must critically address both the species' conservation needs and the welfare of the individual animal. Because "wild creatures differ endlessly," in their forms, needs, behavior, limitations and abilities (Conway, 1995), AZA, through its Animal Welfare Committee, has recently given the responsibility to develop taxon- and species-specific animal welfare standards and guidelines to the Taxon Advisory Groups (TAG) and Species Survival Plan® Program (SSP). Experts within each TAG or SSP, along with their education advisors, are charged with assessing all aspects of the taxons' and/or species' biological and social needs and developing Animal Care Manuals (ACMs) that include specifications concerning their use as Ambassador 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 Ambassador Animal policy that articulates and evaluates program benefits. The following recommendations are offered to assist each institution in formulating its own Institutional Ambassador Animal Policy, which incorporates the AZA Ambassador Animal Policy and addresses the following matters.

The Policy Development Process

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

- The Education Department
- The Animal Husbandry Department
- The Veterinary and Animal Health Department
- The Conservation & Science Department
- The Behavioral Husbandry Department
- Any animal show staff (if in a separate department)
- Departments that frequently request special Ambassador 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 Ambassador Animal Policy, we recommend that the following components be included:

I. Philosophy

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

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

Institutional Ambassador Animal policies should include a philosophical statement addressing the above, and should relate the use of Ambassador Animals to the institution's overall mission statement.

II. Appropriate Settings

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

I. On-site programming
    a. Informal and non-registrants:
        i. On-grounds programming with animals being brought out (demonstrations, lectures, parties, special events, and media)
        ii. Children's zoos and contact yards
        iii. Behind-the-scenes open houses
        iv. Shows
        v. Touch pools
    b. Formal (registration involved) and controlled settings
        i. School group programs
        i. Summer camps
        ii. Overnights
        iii. Birthday parties
        iv. Animal rides
        v. Public animal feeding programs
    c. Offsite and outreach
        i. PR events (TV, radio)
        ii. Fundraising events
        iii. Field programs involving the public
        iv. School visits
        v. Library visits
        vi. Nursing home visits (therapy)
        vii. Hospital visits
        viii. Senior centers
        ix. Civic group events

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

III. Compliance with Regulations

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

IV. Collection Planning

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

The following recommendations apply to Ambassador Animals:

1. Listing of approved Ambassador Animals (to be periodically amended as collection changes). Justification of each species should be based upon criteria such as:
    a. Temperament and suitability for program use
    b. Husbandry requirements
    c. Husbandry expertise
    d. Veterinary issues and concerns
    e. Ease and means of acquisition / disposition according to the AZA code of ethics
    f. Educational value and intended conservation message
    g. Conservation Status
    h. 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 Ambassador Animal Policy should address the specific messages related to the use of Ambassador 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 Ambassador 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 Ambassador 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 Ambassador Animals. Although extremely valuable as educational and affective experiences, contact with animals poses certain risks to the handler and the public. Therefore, the human health and safety section of the policy should address:

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

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

VII. Animal Health and Welfare

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

1. General housing, husbandry, and animal health concerns (e.g. that the housing and husbandry for Ambassador Animals meets or exceeds general AZA standards and that the physical, social

and psychological needs of the individual animal, such as adequate rest periods, provision of enrichment, visual cover, contact with conspecifics as appropriate, etc., are accommodated).

2. Where ever possible provide a choice for animal program participation, e.g., retreat areas for touch tanks or contact yards, evaluation of willingness/readiness to participate by handler, etc.)
3. The empowerment of handlers to make decisions related to animal health and welfare; such as withdrawing animals from a situation if safety or health is in danger of being compromised.
4. Requirements for supervision of contact areas and touch tanks by trained staff and volunteers.
5. Frequent evaluation of human / animal interactions to assess safety, health, welfare, etc.
6. Ensure that the level of health care for the Ambassador Animals is consistent with that of other animals in the collection.
7. Whenever possible have a "cradle to grave" plan for each Ambassador Animal to ensure that the animal can be taken care of properly when not used as a Ambassador Animal anymore.
8. If lengthy "down" times in Ambassador Animal use occur, staff should ensure that animals accustomed to regular human interactions can still maintain such contact and receive the same level of care when not used in programs.

VIII. Taxon Specific Protocols

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

Taxon and species -specific protocols should address:

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

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

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

IX. Logistics: Managing the Program

The Institutional Policy should address a number of logistical issues related to Ambassador Animals, including:

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

X. Staff Training

Thorough training for all handling staff (keepers, educators, and volunteers, and docents) is clearly critical. Staff training is such a large issue that many institutions may have separate training protocols and

procedures. Specific training protocols can be included in the Institutional Ambassador Animal Policy or reference can be made that a separate training protocol exists.
It is recommended that the training section of the policy address:

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

XI. Review of Institutional Policies

All policies should be reviewed regularly. Accountability and ramifications of policy violations should be addressed as well (e.g., retraining, revocation of handling privileges, etc.). Institutional policies should address how frequently the Ambassador 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 G: Recommended Reading

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Appendix H: Timeline of AZA Tiger SSP Based *In Situ* and *Ex Situ* Conservation Initiatives

1982: First Species Survival Plan® initiated by the AAZPA was for the Siberian (Amur) tiger by Ulysses Seal;

1986: International Symposium, World Conservation Strategies for Tigers, coordinated by the IUCN/SSC CBSG, Cat Specialist Group and Minnesota Zoo;

1987: Tigers of the World: The Biology, Biopolitics, Management, and Conservation of an Endangered Species published;

1990: First live tiger births through in vitro fertilization and embryo transfer;

1991: European Endangered Species **(**EEP) Sumatran Tiger Program established;

1991: First live tiger birth through artificial insemination;

1992: EEP Amur Tiger Program established;

1992: First meeting of the AAZPA Felid Taxon Advisory Group (TAG), during which the first Felid Action Plan was developed, classifying *P. tigris amoyensis* and P. tigris *sumatrae* as critical, and recommending that PVAs and breeding programs be developed;

1992: First IUCN/SSC CBSG Tiger Global Animal Survival Plan in Edinbourgh, Scotland, linking *in situ* and *ex situ* conservation programs for tigers on a global level, developed with the AAZPA, EEP and Indian Zoo Authority (IZF);

1992: First Population and Habitat Viability Analysis (PHVA) for Sumatran tigers in Padang, West Sumatra with the Indonesian Department of Forest Protection and Nature Conservation (PHPA);

1992: First Regional Captive Management Program for tigers in Asia (Sumatran subspecies) by the Indonesian Zoological Parks Association (PKBSI);

1993: AZA Significant Achievement Award in Conservation for the *Sumatran Tiger Conservation Strategy*;

1993: First IUCN/SSC CBSG *Genome Resource Bank (GRB) for Tigers* presented in Antwerp, Belgium;

1994: First AZA Tiger SSP husbandry manual - *Conservation and Management of Captive Tigers,* translated into Russian, Chinese, Vietnamese, Thai and Bahasa Indonesia;

1994: AZA Edward Bean Award for Long-tern Management and Conservation of Tigers;

1995: South China Tiger Studbook and Masterplan of the Chinese Association of Zoological Gardens established in Chongqing, China;

1995: Indochinese Tiger Masterplan for Thailand's Zoological Parks Organization of Thailand established;

1995: South China Tiger Studbook Analysis and Masterplan of China's Association of Zoological Parks established;

1995: First *Tiger Information Center*, a web site at http://www.5tigers.org created;

1995: Initiated the Sumatran Tiger Conservation Program, a holistic field program for tigers in Indonesia that integrates assessments of habitat and prey, tiger-human conflict, anti-poaching patrols and undercover investigation of trafficking;

1997: PKBSI Sumatran Tiger Masterplan - Masterplan Harimau Sumatera Indonesia - established;

1997: Medical, Reproductive and Management Evaluation of South China Tigers completed;

1998: Year of the Tiger Conference in Dallas, TX, largest gathering of international tiger specialists ever;

1998: AZA Significant Achievement Award in Conservation for the Sumatran Tiger Project;

1999: Facilitated Indonesian Javan Tiger Symposium in Jogakarta, Indonesia;

1999: 21st Century Tiger (UK) Conservation Prize for outstanding field work in the Sumatran Tiger Project, Way Kambas National Park, Indonesia.

1999: CITES Tiger Task Team Commendation for outstanding project design of the Sumatran Tiger Project, presented at the COP CITES meeting in Portugal;

2001: Initiated components of South China Protection Program with a field methodology workshop in collaboration with State Forestry Administration, China;

2002: Initiated the South China Tiger Field Survey in Jiangxi, Fujian, Zhejiang, Hunan and Hubei Provinces, P.R. China in collaboration with State Forestry Administration, China;

2004: AZA International Conservation Award for the Sumatran Tiger Project;

2005: China's State Forestry Administration appointed the South China Tiger Advisory Office, based at the Minnesota Zoo (USA), to provide technical and financial support for China's long-term efforts to restore tigers to wilderness areas;

2007: Identified criteria for deciding where to reintroduce South China for the State Forestry Administration, including requirements for the long-term survival of wild tigers, present status of potential South China tiger habitat where reintroduction might begin, and site selection criteria to guide the development of policy for reintroduction.

2012: Initiated the Tiger SSP's Tiger Conservation Campaign to galvanize zoo and public support for wild tiger conservation efforts

2015: Top Honors, AZA's Edward H. Bean Award for long-term management and conservation of tigers