JAGUAR
(Panthera onca)
CARE MANUAL

CREATED BY THE
AZA Jaguar Species Survival Plan®
IN ASSOCIATION WITH THE
AZA Felid Taxon Advisory Group
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Disclaimer: This manual presents a compilation of knowledge provided by recognized animal experts based on the current science, practice, and technology of animal management. The manual assembles basic requirements, best practices, and animal care recommendations to maximize capacity for excellence in animal care and welfare. The manual should be considered a work in progress, since practices continue to evolve through advances in scientific knowledge. The use of information within this manual should be in accordance with all local, state, and federal laws and regulations concerning the care of animals. While some government laws and regulations may be referenced in this manual, these
are not all-inclusive nor is this manual intended to serve as an evaluation tool for those agencies. The recommendations included are not meant to be 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. Commercial entities and media identified are not necessarily endorsed by AZA. The statements presented throughout the body of the manual do not represent AZA standards of care unless specifically identified as such in clearly marked sidebar boxes.
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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 *Panthera onca*

<table>
<thead>
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<th>Taxonomy</th>
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<tbody>
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<td>Kingdom</td>
<td>Animalia</td>
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<tr>
<td>Phylum</td>
<td>Chordata</td>
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<tr>
<td>Class</td>
<td>Mammalia</td>
</tr>
<tr>
<td>Order</td>
<td>Carnivora</td>
</tr>
<tr>
<td>Suborder</td>
<td>Feliformia</td>
</tr>
<tr>
<td>Family</td>
<td>Felidae</td>
</tr>
<tr>
<td>Subfamily</td>
<td>Pantherina</td>
</tr>
</tbody>
</table>

**Genus, Species, and Status**

Table 2. Genus, species, and status information for *Panthera onca*

<table>
<thead>
<tr>
<th>Genus</th>
<th>Species</th>
<th>Common Name</th>
<th>USA Status</th>
<th>IUCN Status</th>
<th>AZA Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panthera</td>
<td>onca</td>
<td>Jaguar</td>
<td>Endangered</td>
<td>Near Threatened</td>
<td>Green SSP</td>
</tr>
</tbody>
</table>

(United States Fish and Wildlife Service, 2016; IUCN, 2013)

**General Information**

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

Information presented is intended solely for the education and training of zoo and aquarium personnel at AZA-accredited institutions. Recommendations included in the ACM are not exclusive management approaches, diets, medical treatments, or procedures, and may require adaptation to meet the specific needs of individual animals and particular circumstances in each institution. Statements presented throughout the body of the manuals do not represent specific AZA accreditation standards of care unless specifically identified as such in clearly marked sidebar boxes. AZA-accredited institutions which care for jaguar must comply with all relevant 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 jaguar management and care, which will ensure superior jaguar welfare at AZA-accredited institutions. Ultimately, success in our jaguar management and care will allow AZA-accredited institutions to contribute to jaguar conservation, and ensure that jaguars are in our future for generations to come.

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.
The AZA Jaguar SSP endorses the concept that, to the fullest extent possible, management under human care should emulate circumstances an animal might encounter in nature. The sketch of natural history information presented here is intended both to offer considerations for exhibit design and care as well as to suggest additional reading of the cited references for additional detail.

The jaguar is the only living big cat, genus Panthera, native to the western hemisphere. A terrestrial apex predator throughout much of sub-tropical and tropical America, wherever it shares the landscape with humans, the jaguar’s cultural significance matches its importance as an indicator species for the health of ecological communities. The jaguar inhabits such a wide variety of environmental conditions that few facts about any one individual or group should be taken as absolutes for the species. As a result, it is a mistake to make broad claims about the psychology or activity of jaguars as a whole. In many ways, placing an emphasis on individuality may be the one generalization that accurately can be made.

To pre-Columbian people, the jaguar was a deity. Approximately twenty-five hundred years ago, the Olmecs first carved likenesses of the jaguar into statues of jade and stone and even carved human figures with jaguar heads. Reaching its prominence in Mesoamerica around 1200 B.C., the Olmec culture and its art were suffused with human-jaguar figures. As a symbol of royal power, a jaguar pelt was often worn by Mayan kings. Carved stone stelae depict the presentation of regalia, including helmets in the shape of a jaguar head. Elaborate verbal and visual puns created multiple layers of meaning in Maya writing. For example, the name of Xbalanque, a mythical hero whose exploits during the creation of the world explain many natural phenomena, translates as “sun’s hidden aspect.” Within his name is a pun on balam (jaguar), and his image always includes jaguar rosettes, either on his clothing or his skin itself (Coe, 1992). He well may be the personified Jaguar God of the Underworld, the agent—among other things—of the sun’s nightly passage beneath the earth. So it stands to reason that the jaguar, nocturnal, powerful, invisible but always present, could also represent the sun’s hidden aspect.

Aztec culture also featured jaguars in art, architecture, and religion. Tezcatlipoca, god of darkness and evildoers, was often disguised as a jaguar. His spotted skin represented the stars in the night sky. The two highest Aztec military orders took as their emblems the top predators of sky and earth: the Orders of the Eagle and Jaguar (Schele and Miller, 1986).

Both the common and scientific nomenclature for the species have mixed cultural histories. The name jaguar originated in Amazonia and most likely came into Brazilian Portuguese from the native Tupi word, yaguara, “beast of prey.” The genus Panthera originated from the Greek πανΘηρ, translated literally as “hunter (or predator) of all,” referring to all spotted cats. Onça is a Portuguese common name for the jaguar which may have its roots in the Latin lynx (Collins English Dictionary, 2014).

The jaguar has been under considerable pressure because of conflict with the livestock industry in Latin America for many years, yet it has long been considered one of the premier cats for zoological institutions to exhibit at their facilities. The jaguar is a charismatic and impressive species on display and an icon for conservation education. With an integrated interpretive approach utilizing multiple communications media, the public can easily be made aware of the jaguar’s—and many other species’—plight of habitat loss, fragmentation, and human persecution throughout its range.

Traditional taxonomic methods relying on morphology and geography originally divided the family Felidae into four genera (Acinonyx, Felis, Neofelis, and Panthera) (Nowak & Paradiso, 1983), but work in molecular genetics has brought to light a much more complicated relationship among groups of cats. Three major groups, the ocelot lineage, the domestic cat lineage, and the pantherine lineage, have been recognized, and these groups include more than a dozen genera (Johnson & O’Brien, 1997).

Culminating with the tenth edition of Linnaeus’ Systema Natura in 1758, classification of living organisms was based on physical characteristics and on the geographic location in which type specimens originated. This work used a downward classification scheme whereby large groups were split into smaller groups based on possession or lack of a characteristic. Identification keys, consistent and specific descriptions and standardization of synonymous names, and binomial nomenclature were the tools that set Systema Natura apart from its predecessors (Mayr & Ashlock, 1991). It defined the standard for taxonomic method for two centuries. Until the mid-Twentieth Century, organisms were classified according to similarities and differences making no direct implication of actual genetic relatedness.

After Watson and Crick deduced the structure of DNA and its role as the genetic blueprint, biologists began to classify organisms based on their genetic relationships and their places in ecosystems. Today, researchers in biosystematics focus much of their work on phylogenetic relationships among species. In
addition to physical characteristics, they use a number of techniques at the molecular level, seeking to understand how organisms are genetically connected to one another and to construct family trees that demonstrate the relationships. Systematists take into account geographic, genetic, behavioral, chronological and other circumstances that may have served as isolating mechanisms to create new species over time.

The last taxonomic revision of Panthera onca into subspecies was published in 1939 (Pocock, 1939). Pocock measured skull characters and grouped specimens according to their collection localities, revising the number of species and races of jaguar downward from 24 to eight, as follows:

Table 3: Jaguar subspecies (Pocock, 1939)

<table>
<thead>
<tr>
<th>Nomenclature</th>
<th>Taxonomist</th>
<th>Described</th>
<th>Geographic range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panthera onca onca</td>
<td>Linnaeus</td>
<td>1758</td>
<td>Venezuela, south and east to Rio Grande do Sul in Brazil</td>
</tr>
<tr>
<td>Panthera onca palustris</td>
<td>Ameghino</td>
<td>1888</td>
<td>Matto Grosso, Paraguay and northeastern Argentina</td>
</tr>
<tr>
<td>Panthera onca peruviana</td>
<td>Blainville</td>
<td>1843</td>
<td>Coastal Perú</td>
</tr>
<tr>
<td>Panthera onca centralis</td>
<td>Mearns</td>
<td>1901</td>
<td>Central America, El Salvador to Colombia</td>
</tr>
<tr>
<td>Panthera onca hernandesii</td>
<td>Gray</td>
<td>1857</td>
<td>Western México</td>
</tr>
<tr>
<td>Panthera onca arizonensis</td>
<td>Goldman</td>
<td>1932</td>
<td>Eastern Arizona to Sonora, México</td>
</tr>
<tr>
<td>Panthera onca veraecrucis</td>
<td>Nelson &amp; Goldman</td>
<td>1933</td>
<td>Southeastern México to central Texas</td>
</tr>
<tr>
<td>Panthera onca goldmani</td>
<td>Mearns</td>
<td>1901</td>
<td>Yucatán peninsula to Guatemala and Belize</td>
</tr>
</tbody>
</table>

However, he concluded that individual variation among specimens outweighed any true systematic differentiation; his subspecies were based only on the geographic origins of the study skulls at the British Museum (Pocock, 1939).

Larson’s 1997 re-evaluation of jaguar subspecific taxonomy began with Pocock’s revision based on skull morphology and then applied the same criteria and statistical analysis to a different study set of 170 skulls of known geographic origin. Her study concluded that clinal variation exists from north to south, but it emphasized that there is more variation within subspecies than between subspecies (Larson, 1997). While skull morphology is by no means the only criterion on which to base jaguar taxonomy, it was, and continues to be, a primary method used alongside molecular genetics techniques.

This was strongly reinforced by Eizirik, et al. (2001) in their analysis of mitochondrial DNA (mtDNA) differences and microsatellite location in somatic DNA. This study revealed very weak phylogeographic differentiation. While it indicates that jaguars from the southern part of the range are significantly different from those in the northern part of the range, a much less marked difference appears between populations living Central America and those from northern South America. The Amazon River and the former Darien Straits, between what is now Panama and Colombia, were posed as geographic isolators. A comparison with similar studies in other species suggested that, as a species, jaguars might be in an expansion and rapid growth phase of habitat exploitation. Under such conditions, along with the counter-pressures of habitat fragmentation and persecution, broad genetic diversity without deep geographic differentiation could be expected (Eizirik et al., 2001). Today the living jaguar is seen as monotypic: Panthera onca without subspecies.

The paleontology and historical biogeography of jaguars is complex and is a story that continues to be written. Most of the evidence is fragmentary or implied, and it is subject to frequent revision. Ecological and taxonomic conclusions have often been drawn from subtle skeletal differences among incomplete or solitary specimens, some of which are ultimately shown to result from sexual dimorphism or normal individual variation (Kurtén, 1973). Tying the DNA analyses of mutation rates to physical evidence in the form of confidently dated fossils is important when identifying a speciation event (Johnson et al., 2006), but this is not always accomplished. Meanwhile, ongoing fossil discoveries push the earliest appearance farther back in time and often spread the geographic range further afield than previously thought.

In a relatively short span of geologic time, modern big cats diversified and colonized Asia, Europe, and the Americas. It has been suggested that their speciation relied more upon ecological divergence than geographic separation (Mattern & McLennan, 2000). Many species in the genus Panthera have died out, with fairly frequent new fossil discoveries continuing to be reported. Glaciations and regional climatic changes during the past three million years alone likely opened and closed migration routes, altered regional habitats, and perhaps isolated populations of big cat species. As the jaguar’s predecessors and ancestors spread across the globe from their presumed central Asian origin, factors in their evolution
were time, space, climate fluctuation, and physical obstacles. From our present perspective, these factors also obscure the relationships among extinct and living species. They make it difficult to identify clear pathways from jaguars’ beginnings to where the species is today, and it is evident that the complete story has not yet been told (Mattern & McLennan, 2000).

The earliest identified member of the genus Panthera, described in 2013, lived more than 4.4 million years ago in Tibet. This recent discovery more than doubled the genus’ age in the fossil record and firmly establishes its geographic home in Asia. It also pushes a hypothetical origin of Panthera back to 10.7 million years before the present. This directly affects the timing of the jaguar’s appearance.

The proposed new phylogenetic tree suggests that approximately 7.7 million years ago, the clade—a group consisting of a common ancestor and all its descendants—containing the modern jaguar (Panthera onca), leopard (P. pardus), and lion (P. leo) along with the extinct American ‘lion’ (P. atrox) and cave lion (P. spelaea) diverged from the group which gave rise to the tiger (P. tigris) and snow leopard (P. uncia). It also suggests that the last common ancestor shared by jaguars and the leopard-lion group itself lived some 6 million years ago (Tseng et al., 2013).

Fossil specimens still classified as jaguars have been dated at between 1.8 and 2 million years old in both Arizona (Kurtén, 1973) and Bulgaria (O’Regan & Turner, 2004). Similar specimens tentatively dated older than 2.4 million years have also been unearthed in the Netherlands (O’Regan & Turner, 2004; Mol, van Logchem & de Vos, 2011). So, the jaguar must have arisen in Asia, expanding its range westward into Europe and east to North America through the Pleistocene, or even earlier.

Based upon geography, the Plio-Pleistocene Eurasian jaguar is referred to as Panthera onca gombaszogensis (Wagner, 2011) and the North American is called P. onca augusta (Simpson, 1941). Nevertheless, this allows us to assume a more or less contiguous ancient jaguar population across Europe, Asia, and North America (Hemmer, Kahlke & Vekua, 2001; Kurtén, 1973). Plant and animal material found in association with both subspecies indicate forest vegetation and abundant water; this is still the modern jaguar’s preferred habitat. So, while other Panthera species diversified by exploiting new niches as the cats found them or as the landscapes themselves developed (e.g. lion onto savannah, and snow leopard into high, rocky mountains), the jaguar seems to have stayed true to its original ecosystem, exploiting major watercourses as corridors for expansion—as they still do—across the northern hemisphere and, later, into South America (Rabinowitz, 2014).

Fossils indicate the paleo-jaguar being as much as 25 percent larger than today’s largest jaguars even as relatively recently as 10,000 years before the present. As a result of this and other skeletal similarities among North America’s Pleistocene felines, there has been confusion and disagreement regarding their placement. For example, Panthera atrox, perhaps the largest true cat of all time, has been variously described as a lion, a transitional species linking lions and jaguars, a jaguar ancestor, a jaguar and a sister species to the jaguar. Its first conclusive appearance in the fossil record is much later than the jaguar’s, and when it is included in recent phylogenetic trees constructed with combined physical/molecular characters, P. atrox is placed after the jaguar, making the sister species explanation appear more likely (Kurtén, 1973; Christiansen, 2008; Tseng et al., 2013).

Fossilized jaguars dated to the Pleistocene have been unearthed as far north as Pennsylvania and as far south as Paraguay, yet it disappeared from North America not long after, as did many of the other megafauna. The jaguar reappeared during recent times. DNA evidence suggests that approximately 500 generations ago, South American jaguars re-colonized the northern continent and underwent a dramatic population explosion (Eizirik et al., 2001).

Mean generation time for zoo jaguars in the United States today is just over seven years (Association of Zoos and Aquariums, 2013), permitting a rough calculation of 3,500 years ago for the re-colonization of North America. Molecular analysis of the jaguar’s evolutionary events tends to place them more recently than indicated by the admittedly sparse fossil record (Eizirik, et al., 2001; Christiansen, 2008). So, it is probably safe to say that the big paleo-jaguar declined and disappeared along with most of the Pleistocene megafauna as climatic changes reworked North American habitats; however, its smaller, ever-adaptable descendants in northern South America filled the ecological void the paleo-jaguars left. Upon the jaguars’ return, they faced pressure and competition from a relatively new arrival on the scene: humans.

Ecological information preceding 1970, when available, consists mainly of anecdotes and notes on the animal’s natural history (Humboldt, 1852 & 1853; Rengger, 1830; Azara, 1838; Roosevelt, 1914; Cherrie, 1930; Miller, 1930; Krieg, 1948; Leopold, 1959; Brock, 1963).
The modern jaguar thrived in the US Southwest and probably much further east until burgeoning human populations forced a long, slow retreat. It was essentially eliminated from the United States around 1900 and has subsequently disappeared from other parts of its range including all of Chile, El Salvador, and Uruguay. The present-day jaguar range extends from the southern border of Arizona in the United States through Central America and South America, east of the Andes, to the forests of northern Argentina. Sporadic sightings of male jaguars in Arizona beginning in the mid-1990s and subsequent field research, there and throughout the range, hint strongly that if hunting and other forms of persecution were removed, jaguar populations would rebound.

Today jaguar inhabits approximately 63 percent of its pre-Columbian range. Although most range countries recognize the intrinsic and ecological value of maintaining the integrity of ecosystems for which the jaguar serves as a key indicator, land development for agriculture and resource extraction continues inexorably to alter landscapes and isolate populations. Natural habitat corridors persist, connecting the larger patches of pristine habitat; but this is due largely to their relative inaccessibility for human activity and the jaguar’s native resilience (Sanderson et al., 2002). See Figure 1 for a map of historic versus current jaguar ranges.

At the turn of the 21st Century, 17 percent of the jaguar’s historic range remained largely unstudied. Most of that territory is in Brazil and México (about 2.3 million and 848,000 square kilometers, respectively). Of the estimated 8.75 million square kilometers that jaguars are presumed to inhabit, the largest remaining contiguous range centers in the Brazilian Amazon Basin, extending to the northeastern coastline and southward to the Cerrado, Pantanal, and Chaco in Bolivia, Brazil, and Paraguay. This comprises almost 90 percent of the species’ present range. Of the total land occupied by jaguars today, the good news is that some six million square kilometers—about 70 percent of the range—has a strong chance for long-term sustainability. In addition to the core range mentioned above, a band of forest stretching from southern Mexico Selva Maya through Guatemala and Belize and another band from northern Honduras through Panama and Colombia also have high sustainability ratings (Sanderson et al., 2002).

Another 1.6 million square kilometers (617,763 mi²)—roughly 18 percent of the total present habitat—found in the northern Cerrado, most of the Venezuelan and Colombian llanos, the Costa Rican/Panamanian highlands, and additional smaller portions of México continue have at least a medium sustainability rating (Sanderson et al., 2002).

Changes in the jaguar’s range, viewed in time-lapse over the past two centuries, bear similarity to a drying seasonal pond, shrinking from all edges to leave ever smaller and more-isolated puddles. At present, many of those puddles remain linked, but concerted and enduring action will be required to preserve the connections.

In habitat selection, jaguars require a water supply, dense cover, and sufficient prey (Mondolfi & Hoogesteijn, 1982). Within those parameters, although habitat varies widely for the species, individual animals rarely seem to move between eco-regions which include grassland, lowland tropical rainforest, montane tropical rainforest, succulent and thorn scrub, temperate broadleaf forest, tropical monsoon and...
dry forest, and tropical savannah woodland. The consistent necessary component to their habitat is available plant cover. A preference for water is also evident, and the species is an excellent and frequent swimmer. Jaguars are found from sea level up to altitudes of 2,000 meters (Emmons, 1997).

Being near water becomes imperative during the dry season when water becomes scarce and the jaguar should drink more frequently. This, as a consequence, restricts the jaguar to cover near isolated pockets of water. It has been observed on numerous occasions that jaguars are water-loving cats; they are probably the most water-loving felids in the world, notes Almeida (1976). He reports that jaguars often seek relief from the heat in rivers and details sighting one swimming across the Orinoco River during the rainy season when the river was 8–10 km (5–6.2 mi) wide. The jaguar is a very able swimmer, capable of even carrying a kill while swimming. A jaguar was sighted in the Cano Ave Maria carrying a heifer kill, which it then hauled on top of a tree that was above the flood level (Almeida, 1976).

One probable reason that the jaguar occurs over such a wide geographic range and in such a broad variety of habitats is that it is equipped to opportunistically exploit large and small prey, in water and on land. In contrast to lions and, perhaps, leopards, whose prey are often predictably concentrated and easy to find, jaguars live in rugged habitats where generally solitary prey animals are widely dispersed. As a result, the jaguar’s hunting method seems to consist of extensive walking as it seeks encounters with both prey and potential mates (Emmons, 1987).

Like many other jaguar characteristics, prey selection varies with geography and habitat. Capybara (Hydrochoerus hydrochaeris) and peccaries are usually listed as the jaguar’s major food source in South America, but crocodilians, fish, snakes, birds, and many additional species of small mammals are taken, too (Emmons, 1987). In the Brazilian Pantanal, peccaries and caiman are noted as the primary prey (Cavalcanti & Gese, 2009). Armadillos (Dasypus novemcinctus, 33.3%) and pacas (Agouti paca, 23.3%) constitute the bulk of the jaguar’s documented diet in southern Belize. Those two species, plus collared peccary (Tayassu tajacu, 23.3%), make up 80 percent of the diversity in the Belizian jaguar’s diet (Weckel et al., 2006). In a final example, near Calakmul, Mexico, biomass of the top three jaguar prey species is red brocket deer (Mazama americana, 35%), collared peccary (T. tajacu, 20%), and coati (Nasua narica, 18%) (Chávez, Ceballos & Amin, 2007).

Despite jaguars’ physical prowess, capability for stealth, and frequent proximity to human settlements, the near complete absence of unprovoked attacks on humans by jaguars is interesting to note. With extraordinarily rare exceptions, usually in self-defense, jaguars choose to retreat from direct contact with people. On those documented occasions when attacks have occurred, humans always created the circumstances which led to them. Rabinowitz (2014) concludes that virtually all cattle-killing jaguars he examined in Belize had been seriously injured by shotgun blasts (or were the offspring of such injured cats) and resorted to preying upon livestock due to resulting physical disability.

The jaguar is primarily a solitary predator. However, the advent of GPS telemetry and camera traps may redefine the species as potentially gregarious, if not social. Almeida was the first to provide any tangible observations of the jaguar in the wild in his book Jaguar Hunting in the Mato Grosso (Almeida, 1976). He notes that females had no set breeding season in the Pantanal area of the Mato Grosso. He reports hearing jaguars mating on numerous occasions and observed the tracks of pairs at varying times during different months. He also observes that females, upon coming into heat, moved about searching and calling for a mate far outside their normal territory. At other times, he notes that the jaguar tended to be solitary and that it has a designated hunting territory that it will defend against intrusion from others of the same species and sex. In the Pantanal, both males and females have been occasionally detected less than 200 meters apart, which is near enough for them to be aware of one another. Camera trap photos show adult females in contact with males before current young disperse. They also show both males and females associating and possibly mating with more than one animal of the opposite sex (Cavalcanti & Gese, 2009). Camera-trapping evidence also strongly suggests that jaguars make extensive, routine use of both game trails and human paths and roads (Silver et al., 2004).

Radio-collar tracking and camera-trapping data indicate that jaguars can be active around-the-clock, but they are mainly active in the hours near sunrise and sunset. Contradiction exists in published literature on this issue; it seems to result from some authors connecting crepuscular activity with day while others classify it as night. Unlike lions, which were shown to rest as much as 20 hours a day (Schaller, 1972), there are indications that jaguars may be active approaching 11 hours a day (Cavalcanti & Gese, 2009). See Table 4 for the activity pattern of one wild female jaguar.
Table 4. Activity trends of one wild female jaguar (Schaller and Crawshaw, 1980)

<table>
<thead>
<tr>
<th>Time of day</th>
<th>Hours</th>
<th>Active vs. Rest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predawn</td>
<td>03:30–06:00</td>
<td>Active</td>
</tr>
<tr>
<td>Late morning</td>
<td>09:30–12:00</td>
<td>Rest</td>
</tr>
<tr>
<td>After dusk</td>
<td>18:30–21:00</td>
<td>Active</td>
</tr>
<tr>
<td>Midnight hours</td>
<td>00:30–03:00</td>
<td>Rest</td>
</tr>
</tbody>
</table>

The home range size of the jaguar is almost certainly a function of relative prey availability. Where food is more accessible, ranges seem to be smaller. It would be no surprise if water availability factors in as well.

In Cockscomb Basin, Belize, females inhabit home ranges of about 10 km² (3.86 mi²). Ranges overlap somewhat, and resident males inhabit home ranges of an average 33.4 km² (12.90 mi²), patrolling through the ranges of several females at a time (Rabinowitz & Nottingham, 1986). In the Brazilian Pantanal, home ranges have been established at 28–40 km² (17.4–24.9 mi²) for males, while females moved over a minimum area of 10 km² (6.2 mi²). Their stability varies widely, shrinking in the wet season and expanding in relatively dry weather. This may occur both as a physical result of seasonal flooding and due to the concentration of prey forced into smaller areas by the same flooding. Male jaguars in the Pantanal overlap their home ranges extensively and frequently move to different areas, particularly younger animals. However, females do not share home ranges during the wet season (Cavalcanti & Gese, 2009).

Adult males typically had a home range that encompassed several females’ (two to three) territory and would defend it against all jaguars except sub-adults and females (Schaller & Crawshaw, 1980). In the event of a jaguar’s death, a jaguar that had a contiguous home range filled that vacant home range, and that range was then filled in turn by a jaguar from an outside territory (Rabinowitz, 1986b).

Identifying their presence and demarcating their ranges seems to be accomplished vocally, visually, and by scent. “Panthera” cats such as the lion (Panthera leo), tiger (Panthera tigris), and leopard (Panthera pardus) may delineate their ranges both directly by roaring and indirectly by scraping the ground with their hind paws, defecating or urinating on scrapes or at prominent locations, clawing trees, and spraying urine (Schaller, 1972). Schaller and Crawshaw (1980) report that a jaguar at Acurizal and Bela Vista seem remarkably restrained about advertising their presence by such methods. They describe spending many nights in the forest but never hearing the characteristic jaguar roar, a sequence of loud, hoarse grunts. They followed fresh jaguar tracks for a total of 39 km (24.23 mi) without noting a scrape, except once when a female had been chased by dogs. By contrast, a puma (Puma concolor) at Acurizal left 10 scrapes in 16 km (9.9 mi); two scrapes had been marked with urine and one with feces. The route of tiger can often be detected from pungent urine marks left on bushes and trees, but at Acurizal and Bela Vista, Brazil, Schaller and Crawshaw (1980) were unable to detect similar routes for jaguars. However, Rabinowitz & Nottingham (1986) had no difficulty finding feces on cattle trails used by the jaguars in Cockscomb Basin, Belize.

“Jaguar occasionally raked their claws down tree trunks, some trees being used repeatedly, but since puma showed similar behavior it was often impossible to ascertain which of the two cats had made the marks.” (Schaller & Crawshaw, 1980). Mondolfi and Hoogesteijn (1982) noted that jaguars would leave claw marks on tree trunks, and it was believed that this was more to sharpen claws than to serve as any form of communication. They mentioned Darwin’s observation in his Journal of Researches from the Beagle voyage that certain trees were marked at different ages by scratches made by jaguars.

Several authors describe jaguar vocalizations. Capstick (1981) reported that in some parts of the Mato Grosso Region they are often vocal. In Venezuela they reportedly called often in some areas (Mondolfi & Hoogesteijn, 1982). The vocalizations were described not as the true roar of a lion, but rather as being composed of a series of five to a dozen repetitions of a short, hoarse coughing. This usually starts with short guttural “uhs” that increase in volume until after several repetitions the final “uhs” have appalling power and effect. Hunters in Venezuela often refer to this as “snoring.” The male has a stronger and more resounding call when compared to the softer call of the female, although the intensity of the female call will increase when entering estrus. It was also reported that males would call more frequently at the beginning of the rainy season. A female jaguar in heat will travel at night advertising her presence for a mate with a series of five to seven grunts that can be heard late into the night or until sunrise. When answering a female, the male’s call will be far more hoarse and guttural. The jaguar’s habit of answering
a call of another individual is often taken advantage of by hunters who lure a cat by the use of a corotear, a call constructed out of a hollow gourd that is operated by either grunting into it or by pulling a piece of rawhide through it to simulate the characteristic jaguar grunt. As Capstick (1981) tells it, this is a device so effective it once called a jaguar out of the water and into a canoe, requiring the hunters to beat it out of the boat with their paddles.

Mating and birth have been documented in wild jaguars throughout the year (Mondolfi & Hoogesteijn, 1982; Line & Ricciuti, 1985), but at widely separated points in the species range. Other authors emphasize that reproduction coincides with peaks in prey availability rather than geography (Rabinowitz, 2014). Seymour (1989) cites Rabinowitz’ observations of two cubs in just over half the litters he documented, followed by singletons at 35%. He saw three cubs 13% of the time. In zoos, litters occasionally contain four cubs, as well (Association of Zoos and Aquariums, 2013).

The jaguar may utilize a characteristic Panthera killing technique which is typified by attacking with a deep bite to the throat that suffocates the prey, but, more often than not, an attack where a bite pierces the back of the skull at its weakest point is used. This bite frequently crushes the zygomatic arch with such precision as to place the canines precisely in a 7.6 cm x 7.6 cm (3 in. x 3 in.) area which, at times, correlates with canine placement into the ear and cranium of its prey. Afterward, the jaguar drags the prey to a thicket or secluded spot. The digestive tract is usually removed 2–3 m (6.56 ft–9.84 ft) away. The ventral surface of the prey (neck, chest, heart, and lungs) is eaten first, followed by the shoulders (Schaller & Vasconcelos, 1978).

When jaguars are hunting reptiles, the technique is slightly different. The jaguar pounces on the alligator or caiman from behind, immediately biting through the neck. This severs the cervical vertebrae and renders the reptile unable to lash itself into the water. When eating a turtle, the jaguar introduces its paw into the shell through the opening between the carapace and plastron and scoops out the flesh without breaking the shell. Porcupines are simply flipped onto their dorsal side, and the exposed flesh is scooped out with the paw (Mondolfi & Hoogesteijn, 1982).

In all cases, the jaguar attacks from cover, and they usually attack from a blind side with a characteristic pounce. As an ambush predator, the jaguar has few peers in the animal kingdom and is accorded a high degree of respect by not only field researchers, but by indigenous people as well. In retrospect, this comes as no surprise when considering how the jaguar as a species has effectively adapted to a variety of ecosystems and has the ability to function as an apex predator in its established range (Mondolfi & Hoogesteijn, 1982).

Median life expectancy for a zoo jaguar is 17.7 years, meaning that one-half of all cubs born reach that age. 69% of zoo-born jaguars reach one year of age, but it is presumed that wild jaguars have a much lower survivorship. After a zoo-born cub reaches the one-year mark, median life expectancy stays above 90% each year until age 15, and it does not drop down to 69% again until the jaguar is 19 years of age. On the whole, jaguars live longer in zoos than any other big cat, and the current longevity record in North America is 26 years, 10 months (Association of Zoos and Aquariums, 2013).

Interaction with humans is the most likely cause of mortality for wild jaguars, followed by young falling prey to other carnivores (e.g. other jaguars, crocodilians, and large snakes). Accidental death from injuries sustained during hunting probably also takes a toll (Seymour, 1989). Wild animal longevity is often assumed to be half that experienced under zoo care, but a field research team in Belize reported camera-trap photographs made in 2012 of jaguars that were first observed in 2000. In the original photos, the animals were mature adults, but twelve years later they still appeared vigorous and healthy (Harmsen personal communication, 2012). Thus, wild jaguars may enjoy longer lives than previously thought.

The jaguar is the largest cat in the Americas with a record weight of over 158 kg (348 lbs) (Emmons, 1997). The largest jaguars have been found in the Brazilian Pantanal region, where, in one study, the average weight of males was 100 kg (220 lbs). Head and body length without the tail may be up to 1.85 m (6 ft), and the tail can measure 75 cm (29.5 in.) long. Height at the shoulder may be up to 75 cm (29.5 in.) (Nowak & Paradiso, 1983).

The jaguar’s coat color ranges from pale yellow to reddish brown, with a much paler (often white) underbelly. It has spots on the neck, body, and limbs that form rosettes which contain black markings within them. On the head and underparts, the spots are simple black dots. Black jaguars are not uncommon, and even they possess darker rosette markings that are visible in bright light. Black jaguars are recognized as a color morph of the same species.
Compared to a leopard, the jaguar is stocky and more powerfully built. The square jaw and prominent cheeks, along with robust, muscular limbs give evidence of immense strength. It has been said that the jaguar is built for power, not speed. While true, this cat also demonstrates surprising stealth and grace in movement.

The best care for wildlife in zoological institutions stems from understanding the factors that make up and affect animals in the wild. This sketch of jaguar natural history is intended to introduce zoo managers to its unique combination of traits and requirements, and to offer literature resources which may further strengthen their awareness. Particular data from this section may be reiterated in the relevant chapters of this manual.

While sharing much in common with other members of the genus Panthera, the jaguar has a distinctive background at the species level and exhibits marked individualism in behavior and temperament. Particular consideration of those factors is more than appropriate for good care and safety; consideration of each jaguar’s individual traits is indeed the key means to maximize welfare under zoo management.
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.

**Hot weather:** Animals kept outside should always have access to shade during the warmer months of the year. Increased respiration, panting, lethargy, anorexia, diarrhea, or constipation may indicate that the jaguar is suffering from heat stress (AZA Jaguar SSP Management Group and Advisors, personal communication, 2014). Water features are recommended to be accessible year-round (see also Section 1.3). The use of pools or water features not only provides an opportunity for jaguars to thermoregulate, but water features are also used quite frequently for enrichment reasons, especially when live feeder fish are introduced. The use of misters or sprinklers for cooling is also quite satisfactory, but the option to remain warm and dry should always be available.

**Cold weather:** Zoological institutions located in northern climates are urged to consider developing indoor exhibits in addition to outdoor exhibits or provide supplemental heat for specimens when the temperature drops below 10 °C (50 °F). Heating systems used with jaguars need to be carefully considered due to the aggressive nature of these cats. Heat lamps, Fiberglas® pig boards, and other portable heat sources can and will be destroyed if the animals can gain access to them. Foresight in planning allows for the use of flexible heating hose embedded in concrete. There has been some success adding a warm rock constructed of concrete if the tubing can be adequately protected from the animals. These systems are increasing in popularity with the improvement in hose reliability and low cost hot water heater type mini-boilers (D. Morris, personal communication, 2007).

However, provided adequate shelter from wind and acclimated to conditions, jaguars can tolerate conditions down to -1.1 °C (30 °F). It is always advisable to offer multiple shelters if more than one animal is sharing an enclosure. Acclimation of all cats begins by exposing animals to changing temperatures on a consistent basis. Animals that are given access to warmer or colder temperatures on a daily basis develop the appropriate hair coat to cope with these temperatures. Heat index, humidity, wind chill, and whether individual animals are acclimatized affect tolerance of temperature variations, and animal managers should use judgment in deciding to place jaguars outdoors in cool climates. Providing sections of varying shelter and sunlight exposure in an exhibit can create temperature zones that permit the animals to select the most comfortable location. This can be accomplished through a rock or object that protects the cat from a prevailing wind while offering a sunny exposure. In northern climates, a southern exposure would be preferred. When kept indoors, specimens should be protected from temperatures exceeding 29.4 °C (85 °F) through the use of circulating fans or air conditioning. Clinical signs associated with poor ability to handle low temperatures may include huddling/shivering, increased pacing, and/or constipation (AZA Jaguar SSP Management Group and Advisors, personal communication, 2014).

**Humidity:** Jaguars can adapt to any humidity as long as adequate shade and drinking water are available. Shade is critical, and can be provided naturally with trees and bushes. Cats are notoriously rough on trees. If live trees are selected for placement inside a jaguar exhibit, their ability to tolerate damage from urine spray, bark removal (through biting as well as clawing) and broken branches is important. Extreme care should be taken with tree placement, ensuring that the trees are further from exhibit barriers than the cats’ maximum jump distance, to avoid providing an escape avenue. Exhibits with covered tops can use commercially available shade cloth to provide patches of shade. One other technique used successfully is the planting of non-toxic vines to grow on the enclosure mesh. Robust vines can survive as long as the cats do not have access to the main trunks (AZA Jaguar SSP Management Group and Advisors, personal communication, 2014).

Animals may be housed outside during warmer weather with adequate ventilation and with the opportunity to adapt to increasing humidity levels over time. When managed indoors, specimens can be
kept comfortable through the use of circulating fans or air conditioning. Indoor exhibits should maintain a relative humidity of 30–50%; this will prevent excessive condensation on glass surfaces which interferes with effective viewing of specimens on display.

Jaguars (like most felids) can acclimate to a wide range of environmental variables, except the most extreme, if given time to do so. Problems tend to arise when jaguars are suddenly presented with a large change in conditions (AZA Jaguar SSP Management Group and Advisors, personal communication, 2014).

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).

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. Due to their size, most large felids are housed in outdoor exhibits that utilize ambient lighting. Because jaguars jump and climb well, it is recommended to install cage-strength mesh barriers to prevent skylights from having to function as primary containment. Light levels should be appropriate to provide unrestricted viewing of the animals by the staff at all times, due to safety considerations, especially during night house operations. Most large felids adapt well to normal light cycles and usually do not present negative behaviors. Fluorescent lighting is acceptable, and it is commonly used as an artificial light source indoors. Full spectrum UV bulbs have been suggested to diminish aggression in some large felids held in indoor enclosures (W. Baker, personal communication, 2007).

Photoperiod has not been recognized as being critical to jaguar reproduction. Institutions using natural skylights have not reported any problems with using the natural photoperiod, regardless of latitude.

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.

Air quality: While the number of air changes per hour of non-recirculated air will be dependent on the number of animals housed and the size and volume of an enclosure, an expected rate of air exchange is 28.3 L (1.0 ft³) for non-recirculated air/minute/929 cm² (ft²) of floor space. Indoor exhibits should have a negative air pressure of 10 to 15 air changes per hour. Proper ventilation should be considered an integral facet of exhibit design to promote cooling, control odors, and reduce the risk of disease transmission among specimens. Glass barriers and separate ventilation systems between exhibit and public areas should be effective in controlling potential disease transmission and problematic odors.

Water Quality: Water features that do not incorporate filtration systems are recommended to be drained and sanitized on a regular schedule or as needed. All water systems should be clean and capable of being a drinking water source for the cat. It is not uncommon for jaguars to defecate in the water. A second, easily flushable drinking source should always be available (AZA Jaguar SSP Management Group and Advisors, personal communication, 2014).
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. Although the effects of sounds and vibrations have not been scientifically researched in relation to managing jaguars in zoos, it has been observed that loud noises and unusual activity such as nearby construction, machinery, or large vehicles may act as stressors. Even the voices and activity of unfamiliar personnel in off-exhibit or night house areas may visibly disturb jaguars. This may be seen as loss of appetite, aggression, or refusal to shift. Observations of self-trauma, stereotypic pacing, and/or vacant staring also are often indicators of environmental stress. Good communication between animal care staff and other zoo divisions can ensure that any unusual or loud noises are timed or monitored by appropriate staff, and their effects lessened. Stability and routine should be considered positive environmental modifiers (J. Becker, personal communication, 2014).

Zoo visitor density and intensity have been shown to impact jaguar behavior negatively (Sellinger & Ha, 2005). This is an area warranting further research to more clearly define both causes and effects as well as to identify differences between individual personalities.
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). Prior to designing a new jaguar habitat, institutions should consult the AZA Felid TAG to identify which AZA felid SSP populations have the greatest need for additional spaces. This will ensure that your facility is contributing to increasing the SSP’s long-term sustainability.

Species-appropriate behaviors: Jaguars, like all large cats, exhibit periods of activity (e.g., hunting) followed by usually longer periods of inactivity (Mondolfi & Hoogesteijn, 1982). The space should be designed to accommodate this. An environment with varying heights and obstructions to break up and prevent pacing patterns is recommended. Jaguars are comfortable in trees and other elevated locations as well as on the ground. As a result, enclosure designs should incorporate climbing structures of live, dead, or artificial trees. Preference should be given to natural, rather than artificial, materials to encourage claw maintenance to provide better overall comfort as resting places. The exhibit should have plenty of vertical perching for climbing with real or artificial logs, branches, or rocks and various high nesting sites. Objects such as Boomer Balls® and cardboard boxes help to promote the natural stalk and pouncing behavior. See Chapter 6 for more information on promoting species-appropriate feeding and foraging behaviors. The top of the enclosure should have plenty of natural cover for shade and security. Areas where the jaguars can dig, real wood to allow scratching, pools to allow swimming, and enrichment-minded cage furniture all help to stimulate natural behaviors. Conversely, when jaguars are at rest, they often prefer to be in a spot where they are either hidden from view or high enough to be provided a wide field of vision. Given that most people come to zoos to see animals, the latter is often the easiest compromise. Offering psychological cover is an important component of environmental enrichment, better presents a naturalistic environment, and promotes better welfare. In the wild, jaguars find shelter in the very dense, almost impenetrable understory formed by tangled tree roots, low spiny palms, and other plants. During the day, jaguars lie down and rest, always in deep shade, and usually in thick cover, sometimes in caves under boulders or in large holes in riverbanks. They have also been known to rest outstretched on thick horizontal tree limbs (Mondolfi & Hoogesteijn, 1982).

Enclosure size: No specific data are available on inter-individual distances, but providing a minimum of 50% additional space for each additional animal is recommended. This is the number used for some state licensing regulations. Trauma from a cage-mate is the most common indicator of a small exhibit, and the outcome can be fatal. Housing jaguars as singletons with constant enrichment and sufficient space to exercise or in same-gender or sibling pairings is recommended by the AZA Jaguar SSP Veterinary Advisor (S. Deem, personal communication, 2007).

The home range of wild jaguar has been established to be 25–38 km² (15.5–23.6 mi²) for females and at least double that for males (Schaller & Crawshaw, 1980). Under zoo management, it is strongly recommended to provide outdoor access for jaguars. Outdoor enclosure size should be no less than 91.4 m² (983.8 ft²) with 50% additional square footage per each specimen. Indoor enclosures should be no less than 6.1 m x 4.6 m (20 ft x 15 ft) with 50% additional square footage per specimen. Height for indoor exhibits should be at least 2.4 m (8 ft), although a height of 3.1–3.7 m (10–12 ft) is recommended.
in mind that these measurements are the recommended minimums. In 2014, using data from 34 of 47 AZA institutions holding jaguars, the average primary habitat area was more than 241.5 m² (2,600 ft²). Secondary, usually off-exhibit, space averaged 49.4 m² (531.78 ft²); this does not include individual shift cages or bedrooms, discussed in more detail below (AZA Jaguar SSP Management Group and Advisors, personal communication, 2014).

**Enclosure complexity:** As stated previously, high resting areas allow a cat to get above the head level of the visitor, a less psychologically vulnerable position. Height that has lateral pathways, such as tree branches, is more useable because it increases the total available square footage. Additional square footage beyond the base recommendation would be considered optimal to facilitate introductions and breeding pairs while reducing potential aggression. Clinical signs that would suggest that an enclosure may be too small or not complex enough include obesity, lethargy, boredom, and/or self-trauma (AZA Jaguar SSP Management Group and Advisors, personal communication, 2014).

There should be plenty of visual barriers for the animal to feel hidden from the public. Care should be taken to note behavioral changes and minimize all conditions causing the animals to display signs of stress. Loud or repetitive noises, unusual activity, and unknown personnel in off-exhibit or night house areas may act as potential triggers for aggression. Stability and routine should be considered positive environmental modifiers. Behavioral changes indicating stress may include inappetence, aggression, or refusal to shift. On a visual level, self-trauma is probably the most common indicator. The primary keeper will usually have the best awareness of any deviation from the normal behavior of each specific animal under his or her care.

Holding areas, hospital and quarantine spaces must receive the same careful consideration regarding exhibit size and complexity and its relationship to the jaguars’ overall well-being as main exhibit habitat, (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).

As a result, exhibits and night house facilities should have doorways large enough to permit the placement and removal of landscaping and furniture items (e.g., rocks, deadfall, substrates, trees, etc.).

**Water sources:** In the wild, the jaguar is very dependent on water and consequently has a marked preference for the immediate vicinity of watercourses and lagoons (Mondolfi & Hoogesteijn, 1982). Jaguars may be the most water-loving of the felids (Almeida, 1976). Jaguars will often seek relief from the heat in rivers and have been observed swimming across rivers while carrying a prey item.

Under zoo management, there should be at least one water source. Pools, ponds, waterfalls, and streams are recommended for drinking, playing, and temperature regulation. For information on other drinking water sources, see Section 2.2. Including a water feature in a jaguar exhibit is an important consideration, but care should be taken in balancing the land to water area. A good rule of thumb for water feature size would be 20% or less of the total exhibit area. Water features should contain both deep (>1 m [3.28 ft]) and shallow areas to stimulate play activity. An aerator may be added to circulate water for a variety of reasons including freeze prevention. However, care should be taken not to leave breakable portions of the equipment exposed to teeth and claws (Hall et al., personal communication, 2015).

**Enclosure substrate:** Naturalistic exhibits that utilize complex artificial or natural features that enter the vertical plane, such as connected tree branches, should be considered the optimal design to maximize available square footage and decrease animal loading in the enclosure. Exhibits should be designed to reflect the naturally occurring felid behaviors of hunting, resting, territoriality, scent marking, and the defense of home range against conspecifics.

Jaguars are comfortable on the ground as well as in the trees. As a result, enclosure designs should incorporate climbing structures of live, dead, or artificial trees. Artificial snags or ledges should be incorporated into the exhibit design to produce elevated resting sites as well as long distance viewing. At least one resting site per animal should be provided. The resting site should be large enough to comfortably allow the cat to stretch out and be stable. Artificial and natural rocks can be utilized to provide...
visual and auditory barriers which, when used in conjunction with other features, should produce multi-level, complex pathways that can help to prevent the development of stereotypic behaviors. Exhibits should be designed to minimize psychological pressure from viewers. Vegetation, rockwork, and climbing structures may help reduce stress. Landscaping should be maximized to simulate natural cover and provide walkways, escape routes, and shade. Plant toxicity should be ascertained prior to planting an enclosure with landscaping materials. Water features are highly recommended and should contain deep (>1 m [3.28 ft]) and shallow areas to stimulate play activity.

With approval from area managers and veterinarians, the exhibit components listed in Table 5 can be included within jaguar enclosures to promote species-appropriate behaviors.

Table 5. Exhibit components for indoor and outdoor jaguar exhibits

<table>
<thead>
<tr>
<th>Exhibit</th>
<th>Exhibit components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outdoor</td>
<td>Rocks, bamboo, trees (evergreen, mulberry, elm) swinging or hanging logs, shrubs, deadfall trees, tree limbs at different levels, rock den, concrete cave, timber platform, straw bed, rock ledge, brush pile, fire hose hammock, hot rock, gunite rock/trees, tree stumps, vines, plants (e.g., honey suckle, palms, butterfly bush, junipers)</td>
</tr>
<tr>
<td>Indoor</td>
<td>Wooden bench, shelves (wooden, gunite, plywood, metal, Corian®) pallets, kennel, den, vines, hide box, ropes, hanging cedar logs, hanging tire, wooden perching, pool (approximately one meter deep)</td>
</tr>
</tbody>
</table>

Exhibits should also be designed to incorporate the jaguar’s nocturnal and crepuscular activity peaks, and so provide the opportunity for animals to perform species-appropriate behaviors throughout the day and night. Studies of wild jaguars reveal peaks in activity around 0330–0600 hours and 1830–2100 hours (Law, 2009). Natural substrates such as grass and dirt are recommended as best for outdoor exhibits. Substrates such as dirt, sand, wood chips, and mulch can be utilized to cover hardscape surfaces if they are necessary. It should be noted that these materials may need to be stripped according to need, especially if they are being used as a latrine. The use of hard, artificial substrates (e.g., concrete) should be minimized, as these have been associated with footpad injuries and early symptoms of arthritis (Law, 2009). Even a thin intermittent layer of natural substrate such as sand is helpful. The use of natural logs is also helpful.

Enclosure cleaning: Recommended procedures for cleaning include daily inspections of the naturalistic exhibit to remove fecal material, waste products, and enrichment items. Cleaning/sanitation of off-display holding areas and exhibits that utilize hard surface floors in the keeper work areas, shift corridors, individual holding units, and enrichment items, should include daily removal of fecal material. It is good practice to implement a regular cleaning and sanitizing schedule incorporating detergents (e.g., lotionized soap and degreasing dish detergents) and disinfecting agents (e.g., quaternary ammonium disinfectants, chlorhexidine, and diluted bleach). Felids are potentially susceptible to toxicity from certain disinfectants including phenols. The choice of disinfectant should be veterinarian-approved. After any chemical application, surfaces should be rinsed with a high-pressure water stream. Access should not be provided until wet areas have completely dried in order to prevent injury to the animals. Many institutions place disinf ecting footbaths at exhibit and night house entry points, especially in areas where keepers service a number of exhibits containing diverse species. Steam cleaning of hard surface areas is recommended annually where practical.

Animal care staff are recommended to never enter an enclosure with adult jaguars. For the purposes of cleaning and making changes to the environment (e.g., adding enrichment), each facility should have a means to shift the animals from the exhibit/habitat space to an equally secure off-exhibit space such as a holding area or ‘night house’ (see Section 2.2 for additional information).

Holding areas: Every animal should have its own individual shift cage, or bedroom, containing a shelf or nest box which is utilized while the animals are off-exhibit during enclosure maintenance and servicing. Logs and stumps for scent marking and sharpening claws are also recommended for night holding enclosures. The minimum recommended size for shift cages used in daily operations is 2.44 m x 2.44 m x
2.44 m (8 ft x 8 ft x 8 ft). Shift cages should be designed to prevent accidental contact that would allow an appendage to enter the cage of an adjacent, incompatible cat, resulting in injury. If the shift cages are immediately adjacent to each other, a solid divider is the best option. If mesh is used, it should be no less than 4 mm (6-gauge) steel wire composition with a grid measuring no more than 5 cm x 5 cm (2 in. x 2 in.). Shift doors should be designed to prevent tail injury during transfer procedures. The easiest way to prevent this is to be sure there is a clear unobstructed view of the shift door. Optional “howdy” doors should be considered between individual holding units to facilitate introductions. Isolated birthing dens that have low-light capabilities and reduced human foot-traffic activity should be available for institutional breeding programs. Provision for a closed-circuit television monitor is suggested as well (AZA Jaguar SSP Management Group and Advisors, personal communication, 2014).

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).

The jaguar is not a candidate for any mixed species or free-range exhibits; nor is it suitable as an ambassador animal.

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.

Primary containment: Primary containment for jaguars should be designed to provide the highest level of security. If possible, institutions are recommended to completely enclose the top of any jaguar enclosure.

However, if jaguars are to be housed in an open-topped enclosure, dry moats should have a width of no less than 7.62 m (25 ft), and vertical jump walls at least 4.57 m (15 ft) high are recommended. Cantilevered supports with mesh or fencing material with an attached hot-wire is recommended for open-top fenced exhibits.

Fence or mesh material should be no less than 4 mm (6-gauge) steel wire composition, with good results achieved using 5 cm x 10 cm (2 in. x 4 in.) mesh. Custom woven stainless steel cable net is also available with a cable diameter of 2.29 mm (3/32 in.) or more in a 5 cm or 7.6 cm (2 or 3 in.) mesh. Lighter-weight mesh is not appropriate for this species. Because of the risk of jaguars’ paws reaching through, a mesh measuring no more than 5 cm x 5 cm (2 in. x 2 in.) is recommended in keeper work areas or zones in which the public may be able to reach it. In keeper work areas, good results have been achieved using woven steel wire grids of 5 cm x 5 cm (2 in. x 2 in.) composed of 6.35 mm (1/4 in.) wire stock. It should be noted that woven cable net is quite flexible and jaguars can stretch it as much as several feet outward when striking the barrier at a run.

As this species is a strong jumper and climber, an impenetrable roof, preferably no lower than 3.66 m (12 ft), should be considered in order to defeat climb-outs or a leaping ricochet off an adjacent structure or prop. Great care should be taken in placement of landscaping and exhibit furniture to avoid the possibility of their use by cats to reach areas in which public, other animals, or staff may be injured. Consideration should include prevention of a stepping stone effect by animals jumping from one.
landscaping element to another in order to reach a location otherwise out of reach. When animal care staff is unavailable to monitor them (e.g. when the zoo is closed to the public), jaguars should not remain in an open-topped habitat. Jaguars are not known to dig routinely; however, it may be prudent to include a buried 91.4 cm (36 in.) chain-link apron on the interior if concrete perimeter footers less than 61 cm (2 ft.) deep are employed.

A major risk to jaguars is the failure to use suitable materials to contain the animals. Jaguars often grasp mesh with their canine teeth, over time damaging or breaking them entirely (Rabinowitz, 1986a; Johnson, personal communication, 2014). Utilizing a mesh size too small for the animals to bite is one suggested means to avoid this situation. Effective training and environmental enrichment are potentially even more powerful tools to redirect habitual behavior (refer to Chapter 9, Behavior Management). It is also important to remember the jaguar’s immense bite force. Single strand wire mesh types like chain link or welded wire can be can be compromised by animals biting and pulling them apart.

**Secondary containment**: Secondary containment in keeper areas is recommended and can consist of a safety door constructed of a mesh type described previously. A good rule of thumb to follow is that an animal should always have at least two doors between its enclosure and potential escape. Likewise, a clear field of view should be preserved at all times for keepers to observe animals’ locations. If a safety door is not feasible, a way to look into the holding area, such as through safety glass, allows keepers to be certain everything is in order prior to entering.

In addition to the main exhibit space and bedroom(s) described in Section 2.1, additional off-exhibit outdoor holding space is useful and strongly recommended for participation in breeding programs. Because long-term housing may be occasionally required to separate a mother with cubs from the sire or incompatible animals from one another, this space should conform to the minimum guidelines also outlined above. An appropriate birthing den space should be provided for births and cub rearing. This may be set up permanently or accomplished via temporary modification of bedrooms. It is important to provide a sense of isolation and security for the animals while retaining the ability to manage and clean the area(s). A means of remote observation within the den should be incorporated, and can be as simple as a small viewing port or as advanced as closed-circuit video monitors (AZA Lion Species Survival Plan, 2012). For more information on birthing facilities, see section 8.1.

**Transfer**: Transfer doors and chutes are necessary to safely and effectively manage large carnivores, and they should be both as simple and as secure as possible. They should be designed to prevent accidental contact between jaguars or with keepers and to prevent tails being injured by closing doors during transfers. Doors may move horizontally (sliders) or vertically (guillotines), but design is often driven by available space. Each type has advantages and drawbacks. Sliders may be obstructed by debris on the track. Heavy guillotines are difficult for staff to operate and pose a risk of animal injury if they fall or are dropped. Doors operated by cable and pulley systems should be inspected regularly for wear because a door with a broken cable may move freely. Pins that go through both the door and the frame are recommended to secure the door in place, whether open or closed, increasing safety and security. These may be operated manually or designed with a spring mechanism to insert the pin automatically when the pin and the hole align. Doors may be electric, hydraulic, or manually operated. Well-designed manual doors are the most cost-effective choice and do not require as much specialized maintenance. Electric doors should have a manual or battery backup for use during power outages. Regardless of design, door controls should be in a location allowing the keeper to have a good view of the door and of animals passing through it.

For transfer chutes, size considerations may be similar to those for shipping crates. This is particularly true for chutes to which a crate may be attached when transferring jaguars and a means of securely connecting a crate to the chute’s transfer door should be included in its construction. It is recommended that squeeze/restraint chutes be incorporated into the design of the facility to provide an alternative method of handling for procedures normally necessitating anesthesia. A properly designed restraint cage allows simple close examination, collection of biological samples (e.g., blood, urine or culture), or drug injection (e.g., antibiotics, vaccinations, anthelmintics or anesthetics). The use of a cage is less stressful compared to other remote delivery methods like darts or pole syringes, especially when large volumes are required. One way to acclimate animals to a squeeze chute and prepare for its use is to place it in a location through which the animals should routinely pass (AZA Lion Species Survival Plan, 2012).
Feeding safety: Watering devices built into the exhibit/enclosure are appropriate for jaguars. These may range from simple cement bowls to commercially available waterers, such those made by Nelson®. Regardless of the choice made, it is important to remember the jaguar’s bite and body strength. The watering device should be able to withstand the attention of a determined jaguar while remaining functional and avoiding injury to the animal. Pools may be used as drinking water sources, but these should be designed to be easily emptied and cleaned. Many felids will urinate and defecate in water bowls, so frequent cleaning will be necessary.

Well-designed food chutes may be utilized to deliver meat to jaguars safely. Their advantage is that they allow keepers to deliver meat quickly; however, chutes may require covers when not in use to keep animals from reaching out or from having objects unintentionally dropped into them. The location of a food chute should be considered carefully to avoid blocking visibility into the enclosure (AZA Lion Species Survival Plan, 2012).

Thus, an effective and safe jaguar habitat often employs a combination of materials and construction methods to contain the animals securely, protect the public and employees, yet present an aesthetically pleasing and functional habitat.

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 appropriate public barriers to prevent exhibit contact. The public should be protected from unauthorized contact with zoo animals. Public viewing points composed of tempered glass are commonly used in conjunction with interpretive graphics and do not require the use of secondary guardrails. Moated exhibits do not necessarily require guardrails, but railings do tend to discourage the public from climbing onto or placing children on the containment wall. As moat walls act as a form of primary containment, a public barrier height of no less than 1.22 m (4 ft) is recommended, and the vertical surface should lack footholds.

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).

When planning for natural disasters or other emergencies, the primary concern for jaguars is the need to ensure that the animal can be secured in a place that does not allow escape. Determining that the dangerous animal is still safely confined is essential before allowing rescue workers to enter an area.

Quickly and safely relocating animals during an emergency, poses a substantial challenge in avoiding injury to staff and animals, not to mention obtaining behavioral compliance under unusual circumstances. Therefore, some portion of jaguar enclosures, such as bedroom(s), should be designed and constructed to securely shelter the animals in place during severe weather, environmental or other emergency (e.g. tornado, hurricane, flood, fire, earthquake, etc.).

Staff training for emergencies must be undertaken and records of such training maintained. Security personnel must be trained to handle all emergencies in full accordance with the policies and procedures of the institution and in some cases, may be in charge of the respective emergency (AZA Accreditation Standard 11.6.2).
Emergency drills 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 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) It is recommended to communicate institutional emergency policy, procedure, and intention with local law enforcement and emergency officials. Establishing a smooth working relationship in advance of an emergency may save lives.

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).

When an institution houses jaguars, maintaining 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, safe storage and maintenance of said firearms, record-keeping, and preparation of policy and procedure, and is as much the institution’s responsibility as is the decision to manage potentially lethal animals in its collection.

As a large predator with powerful body and bite strength and excellent jumping and ambush capability, the jaguar should be classified among an institution’s most dangerous species with respect to emergency and escape response procedures and safety training. Vigilance and adherence to best practices in large carnivore care is the best emergency preparedness, and safety procedures for jaguars are similar to those of all large cats. Jaguar keepers should receive thorough training in methods, procedures and observational skills from supervisors and co-workers in advance of working independently.

Training subject matter should include familiarization with all enclosures and service areas, equipment and features such as doors and chutes. It is important that jaguar keepers understand the species’ natural history as well as the individual histories of the cats with which they work. Detailed written protocols should be prepared, and adhered to, with respect to routine daily tasks, medical procedures and emergency response.

Safety consciousness cannot be over-emphasized with respect to guests, animals and staff. Protocols should include, but not be limited to, the following: daily checks of enclosure perimeters for cage integrity, verification of all animals’ presence in expected locations each time the keeper enters the exhibit/holding area vicinity, and double-checking doors and locks with each use. A system of labels (such as “On Exhibit,” “In Holding,” “Indoor/outdoor Access”) on entrances and shift doors to help prevent keepers entering enclosures where animals are present should also be implemented. Appropriate

AZA Accreditation Standard (11.2.8) The institution must have a communication system that can be quickly accessed in case of an emergency.

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 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.

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awareness and response to factors such as keeper illness, fatigue, stress or other potential distractions is also important. Reliance on direct observation, and avoiding making assumptions about the status of animals or the facility should be emphasized in the protocols.

Ultimately, each person who enters the area or opens a shift door should be responsible for the consequences of his or her actions, and current best practice defines two-way radios as the method of choice for optimal communication abilities. Ideally, the jaguar exhibit’s service area is also equipped with a telephone to allow flexibility in both emergency and routine communication.

When zoo employees or volunteers from outside the area are working in, or near, jaguar facilities, staff should provide close supervision and clear instructions about safety procedures. This includes careful tracking of the number of people entering and leaving the area and strict detail about where they are allowed to go and what they are allowed to do. Non-zoo employees (e.g., contractors, guests, etc.) should be accompanied at all times and also provided careful instruction before entering the area. Depending on the building design, lines may be painted on floors to indicate safe distances from cages (AZA Lion Species Survival Plan, 2012).

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).

In developing an emergency response protocol, each institution will have unique history and circumstances to address. However, four core sets of actions should be covered by the document. Firstly, the employee, or volunteer, responding to the emergency should call the institution’s communications center, providing the location and circumstances of the emergency according to the format defined by the institution. Secondly, the responding employee, or volunteer, should assess the situation, according to priorities defined by the institution, to formulate a plan of action. Parts of this plan may be pre-determined by the protocol, such as communications trees, team responses to details of the initial call, equipment to be used, and so on. Other components may be delegated to the responder’s own initiative but they should also be outlined in the response protocol. The decision to use lethal force, and under what conditions, should be specifically addressed in the protocol. Thirdly, the employee(s), or volunteer(s), assembled should secure the scene according to the plan of action. Finally, the appropriate employee(s), or volunteer(s), as defined by the institution should prepare a detailed written report and analysis to explain the actions taken and the results that were achieved (San Diego Zoo Global Academy, 2013).

Another potentially useful component of an emergency response protocol is the inclusion of advice and training on how to respond should a worker find him/herself sharing space with a jaguar.

No single protocol or methodology can cover every possible situation. Analysis of drills, or training exercises, should aid in continually improving both proficiency and the procedures themselves. Narrative reports which outline the details of drills, exercises, or training may be useful, especially if they include descriptions of the specific successes and failures of the exercises along with recommended modifications in procedure. Recording the names of participants and the scope of an exercise also provide important perspective.
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 as (referred to as) individuals, though some types of animals are recorded as (referred to as) groups or colonies of animals, particularly with invertebrates and in aquariums (see Appendix B for definitions and Recordkeeping Guidelines for Group Accessions). The decision about how to record its animals usually resides with each institution, but in certain cases, the AZA Animal Program Leader (i.e., TAG Chair, SSP Coordinator, or Studbook Keeper) may request that animals be recorded in a certain manner, whether as individuals or as groups.

Jaguars are solitary, aside from mothers with dependent offspring, rarely housed in groups larger than three animals. Thus, it is most appropriate and effective to keep separate records for each individual animal. The AZA Jaguar SSP and North American Regional Studbook manage *Panthera onca* to the species level, not splitting to sub-species. Reports requested from institutions are most frequently for individual animals’ specimen reports or histories and taxon reports which consist of summary lists of birth, death, disposition, and acquisition of all jaguars at an institution within a defined date range. These reports are utilized in updating studbook information and to create the periodic breeding and transfer plan.

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 (e.g., primate enrichment records) 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 or groups of 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 or group of animals, including but not limited to taxonomic name, transaction history, parentage, identifiers, gender, weights, enclosure locations and moves, and reproductive status (see Appendix C for Guidelines for Creating and Sharing Animal and Collection Records).

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 and veterinary 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). No additional recordkeeping beyond best professional practice, as outlined in this chapter, is required for jaguars.

Since many types of information are maintained in AZA institutions, the term collection and/or transaction records are used in this chapter to specify the main animal records.

Animal transaction confirmation documents (and breeding loan...
agreements, where applicable) should be maintained for all animals entering the collection by means other than birth or leaving the collection by means other than death. This applies not only to live animals, but to living and non-living biomaterials (other than samples for health testing) derived from those animals. These documents contain the terms and conditions of transactions, should be signed by both parties to the transaction (except invoices), and kept at the institutions as proof of legal possession or ownership and compliance with applicable laws.

AZA member institutions must inventory their jaguar population at least annually and document all jaguar acquisitions, transfers, euthanasias, and reintroductions (AZA Accreditation Standard 1.4.1). All jaguars 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 D) and the long-term welfare of animals should be considered in all acquisition, transfer, euthanasia, and reintroduction decisions.

Transaction forms should help document that potential recipients or providers of the animals adhere to the AZA Code of Professional Ethics, and all relevant AZA and member policies, procedures and guidelines. In addition, transaction forms should ensure compliance with the applicable laws and regulations of local, state, federal, and international authorities. Recordkeeping requirements apply to all jaguars at the institution, including the main collection and, if applicable, research and rehabilitation collections. See Appendix G for sample forms that are typically used with jaguars for daily reporting, acquisitions, and dispositions.

3.3 Permit Considerations

The jaguar is regulated by federal and/or state governments. Therefore, possession and/or specific activities involving this species usually requires a permit(s) issued by the 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.

The jaguar is listed in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Thus, international transport is regulated under the US Fish and Wildlife Service’s Division of Management Authority. Acquiring an import or export permit is a complex and lengthy process which also involves the CITES authority in the country of origin or destination. At least a year before a transport should be allotted to establish communication, collect data, and process any applications.

The jaguar is listed as Endangered under the U.S. Endangered Species Act. However, as a native North American species, the jaguar is not covered by the US Fish and Wildlife Service’s Captive-bred Wildlife Registration program for endangered species. Transporting or transferring jaguars within the United States does not require a federally-issued permit. Possession, management, and transportation of the species also falls under the ex situ wildlife management regulations of most state wildlife agencies. These regulations vary widely from state to state, and it is important to consult the appropriate agency law enforcement division for complete information.

Experienced members of the AZA Jaguar SSP are often able and willing to advise and support facilities through the permitting process, but it is each institution’s responsibility to obtain the necessary permits for conducting work with jaguars.

3.4 Identification

Ensuring that jaguars are identifiable through various means increases the ability to care for individuals more effectively. All animals held at AZA facilities must be individually identifiable whenever practical, and have corresponding identification (ID) numbers. For animals maintained in colonies or groups, or other animals not considered readily identifiable, institutions must have a procedure for identification of and recording information about these groups or colonies (AZA Accreditation Standard
1.4.3). These IDs should be included in specimen, collection and/or transaction records and veterinary records. Types of identifiers include:

Physical identifier: These include, but are not limited to, ear tags, tattoos, microchips/transponder and RFID devices, elastomers, and ear notches. Animals should be permanently identified. Use of microchips is widely considered to be best practice but tattoos, ear notches or their natural markings, if necessary, are other options for jaguars. Permanent physical identifiers are often required when a species is regulated by a government agency and to distinguish separate animals in studbooks.

Intangible identifiers (called 'logical identifiers' in the Zoological Information Management System [ZIMS]): These include, but are not limited to, institutional accession number, house name, public name, studbook number, and ZIMS Global Accession Number.

Every jaguar should be entered into an institution's animal records and given a local identifier at birth, even if it does not survive. All jaguars born in AZA institutions will be entered into the North American Regional Studbook for jaguars and given studbook numbers. It is useful to track the births and deaths of even those animals which are not viable for demographic analysis.

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 record keeping is maintained.
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).

Safe animal transport requires the use of appropriate conveyance and equipment that is in good working order. Include copies of appropriate permits and authorizations in transport documentation. If the animal is not owned by the shipping institution, permission is to be obtained from the owner well in advance of the move. Contact with the registrar, curator, or proprietor of the owning institution to obtain permission and initiate relevant documentation should be made at least 30 days prior to setting a shipment date.

The choice of whether jaguars should be shipped over land or by air rests on a variety of factors, including distance, season, climate, and cost. For land transportation, compliance with the wildlife regulations for each state on the itinerary is necessary. Contacting the law enforcement division of each appropriate state wildlife agency is an important first step. At the federal level, transport conditions for jaguars are regulated through the US Department of Agriculture (USDA-APHIS, 2014); these are noted in the next section of this chapter. The International Air Transport Association (IATA), (International Air Transport Association, 2013/2014) specifies details of shipping containers which are excerpted below, and all professional airlines abide by IATA’s manual in addition to USDA regulations.

The equipment must provide for the adequate containment, life support, comfort, temperature control, food/water, and safety of the animal(s). Jaguar transport crates should be constructed of hardwood, metal, plywood (or similar material) of no less than 1.3 cm (0.5 in.) in thickness, welded mesh, or iron bars. Aluminum stock of at least 4 mm (0.16 in.) thickness offers a very good strength to weight comparison, for example. The frame should be made from solid wood or metal and bolted or screwed together. Welded aluminum crates which meet or exceed the IATA requirements are commercially available, or they can be custom fabricated and their use is probably the best available option. The frame should meet a spacer bar requirement of 2.5 cm (1 in.) in depth to the sides for air circulation. When the weight of the container exceeds 60 kg (132 lb) or the animal is very aggressive, the frame should have additional metal re-enforcing braces. Suitable plywood or a similar material should line the frame to give it a smooth and strong interior. The floor should either be constructed in a narrow slatted form over a liquid-proof tray in such a manner that all the excreta fall onto the tray, or it should be leak-proof and covered by sufficient absorbent material in order to prevent any excreta from escaping. The roof should be solid, and a sliding or hinged entry/exit door should be provided. The front entry/exit door and the opposite end should be made of welded steel mesh or strong iron bars. The iron bars should be spaced in such a way that the animal cannot pass its legs between them. It is recommended that a jaguar crate have doors at both ends. Alternatively, the front entry-exit door may be made from heavy, steel-lined plywood with ventilation openings, while the other end is made of welded steel mesh or strong iron bars. When mesh or bars are used, a cover should be in place to reduce disturbance to the animal and protect handlers. This may be a sliding, ventilated shutter, burlap, or a similar material. Openings should be placed at heights that will provide through-ventilation at all levels. Exterior meshed ventilation openings with a minimum diameter of 2.5 cm (1 in.) should be made on the sides, entry door(s), and roof. However, extreme care should be taken that transport crates have no spaces that allow jaguars to reach out with their claws.

Care should be taken with the size, shape, and spacing of openings to minimize opportunities for jaguars to damage teeth and claws while inside the crate. Animals should not be able to come in contact with any edges or surfaces that can cut or abrade. It is advisable that forklift spacers be provided if the total weight of the container plus animal exceeds 60 kg (132 lb). A means of allowing a team of up to four people to carry the crate should be incorporated into the design. Careful consideration should be given to the handles or means of attaching/detaching handles to maximize their usefulness but minimize increasing the crate’s width. Figure 2 provides a visual representation of the aforementioned container design.
Food and water containers should be fixed off the floor to prevent soiling near the front of the crate. There should a safe way to access them from the outside in order to refill them. It is important that the height of the crate allow the animal to stand erect with its head extended, and the length should permit the animal to lie in the prone position. A good rule of thumb is to allow 10 cm (4 in.) clearance around the animal when standing. An interior height and width of 85 cm (33 in.) by 85 cm (33 in.) and a length of 185 cm (73 in.) should accommodate the largest jaguar.

Constructed to IATA guidelines, crates provide adequate space. However, it is important not to make them too large. Injuries may occur if space permits animals to leap or be thrown about within the crate or if the vents are large enough to encourage the animals to attempt to escape. Many aircraft cargo bays provide ample space for animal crates. However, it is extremely important to consult with the airline for the exact measurements. The dimensions of the aircraft’s cargo hatch are likely to be the limiting factor for accessibility. Padlocks are necessary on every door, and the keys should be included with the shipment paperwork that is attached to the crate.

Health certificates, transaction paperwork, air-bills, and all other relevant documents should be shipped along with animals and attached to the shipping crate. 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 Form, a form printed by the American Association of Zoo Keepers, is a convenient method to provide this information. For information on recommended pre-shipment medical evaluations, see Chapter 7.

Preparation of a checklist of tasks and timing is always of benefit with such a complex activity. In addition to transport crate(s), state and federal (as applicable) permits, transaction paperwork, health certificates and related documents, scheduling and coordination of preparation, and execution of the move are important components. Travel logistics for animals and staff, whether by land, air or water, should be organized and confirmed well in advance of shipment. Depending on the mode of transport, tools, equipment, vehicles, and backup options should be prepared and assembled. These are general considerations and are not intended to be an exhaustive list. Rather, they offer a starting point from which to begin (AZA Jaguar SSP Management Group and Advisors, personal communication, 2014).

Safe transport also requires the assignment of an adequate number of appropriately trained personnel (by institution or contractor) who are equipped and prepared to handle contingencies and/or emergencies that may occur in the course of transport. Planning and coordination for animal transport requires good communication among all affected parties, plans for a variety of emergencies and contingencies that may arise, and timely execution of the transport. At no time should the animal(s) or people be subjected to unnecessary risk or danger (AZA Accreditation Standard 1.5.11). The mode of transport, time taken, and accessibility of support services en route should determine the number of people who participate directly. The best training for animal transport is probably practice. Participating in
a secondary role on several shipments under the supervision of someone with a successful history is recommended before taking on primary responsibility for a jaguar shipment.

When going by land, two people are recommended to share driving duties and provide additional labor should the need to manipulate the crate(s), make frequent observations, or other unexpected circumstances arise. When transporting by air, at least one person should accompany the shipment for the same reasons. If anesthesia, medical testing, or procedures are planned as part of the process, a veterinarian should be part of the transport team.

Because anesthesia and sedation carry risks of negative reaction (e.g. over-heating, cardiac or respiratory arrest, injury due to impairment of coordination during recovery), transporting jaguars while they are under the influence of such drugs is discouraged (AZA Jaguar SSP Management Group and Advisors, personal communication, 2014).

Due to risk of injury to both animals and people, direct contact with jaguars during shipment should be minimized. Unless conditions become life-threatening, standard practice is to maintain focus on reaching the destination once the animals are secured in shipping crates.

4.2 Protocols

Transport protocols should be well defined and clear to all animal care staff. As part of pre-shipment preparations, training jaguars to enter a shipment crate in advance of actual transport is highly recommended, and can be accomplished using standard positive reinforcement techniques (see Chapter 9 for additional information). Crate training helps to eliminate the need for general anesthesia and the accompanying psychological and physiological stress. If the jaguar has not been trained to enter shipment crates on their own, recommendations for capture anesthesia may be found in Section 7.5.

IATA guidelines require that food and water be available during air transport. However, providing food to a jaguar during transport is not necessary if the transport takes less than 24 hours. It is recommended that water be provided at the beginning of transport and, when practical, during any stopovers. However, jaguars are likely to be agitated during transport and will refuse to consume either food or water.

Bedding is not normally required in routine jaguar housing, but IATA guidelines suggest it in transport containers primarily as a means to separate the animal from urine and feces during transport. It is not recommended to enclose any materials with the animal that are not intended to be ingested because of the agitation often caused by the stress of being transported. Thus, wood shavings, or some other absorbent material, can be placed in a removable tray beneath the floor of the transport container to absorb any urine or feces.

Environmental temperature is an important consideration in the loading process and during the actual transport. Transporting animals in the summer calls for attention to adequate water and ventilation. Ambient temperature is not as critical as avoiding a situation where the crate is sitting in the direct sunlight. Conversely, the same temperature guidelines for putting a jaguar outdoors apply to transport in the colder months. Animals may experience sudden dangerous increases in body temperature, especially if anesthesia or sedation has been utilized. Shipping animals in the cooler months of the year, or in the early morning, should be carefully considered.

The ideal temperature range under which to house jaguars is 10–29 °C (50–85 °F). Airlines in the United States will not accept animals for transport if ambient temperatures will subject them to temperatures outside the range of 7–29 °C (45–85 °F) for more than 45 minutes at any time during transit. Likewise, as specified under the Animal Welfare Act, during ground transport, temperatures may not fall outside the same range for more than four consecutive hours (United States Department of Agriculture Animal and Plant Health Inspection Service [USDA-APHIS], 2014). Some form of fabric covering (e.g., burlap, metal window screen, or shade cloth) is recommended to be placed over ventilation holes in the crate to lower light levels inside and to prevent foreign objects being introduced into the crate.

It is recommended that jaguars be shipped in separate transport crates because they are a solitary species. Crates should be constructed to provide safe visual access to the animal at all times. Animal staff traveling with the animal should have keys to crate padlocks; however, unless it will be possible to anesthetize the animal and additionally secure caging is present, physical access to a jaguar in transport should be avoided. An animal that has been tranquilized should not be transported until the animal is fully recovered from the anesthesia unless the transport is accompanied by a veterinarian. (AZA Jaguar SSP Management Group and Advisors, personal communication, 2014).
All transports should be carefully planned to ensure that the fastest route is taken with the fewest number of stops and transfers. If a transport encounters a delay, a means to provide food and water safely is critical. When shipping, it can be helpful to contact zoos along the route, prior to transport, in case assistance is needed along the way. If for some reason a delay occurs, someone can then be available to go to the airport and check on the animal or meet the transporter to assist with providing food and water. Release of the transported animal should occur as quickly after arrival as is practical, minimizing the time spent by the animal in the transport container. The jaguar should be transferred directly into the enclosure in which it will spend its quarantine period. Such an enclosure should be equivalent to the night housing described in Section 2.1, at a minimum.
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. Jaguars are generally solitary with the exception of mothers and young offspring. However, accounts of wild jaguars living, and possibly hunting, together have been documented and are mentioned in the General Information chapter of this manual. Temperaments among individuals vary a great deal in the species, and mixed-sex social groups of more than two animals have been successful. Fighting over females is not common, but it does occur among some adult males. The recommended social structure for managed jaguars is an adult pair (consisting of a male and a female) or a mother with immature offspring. Housing a single animal is perfectly acceptable, although many jaguars appear more content when they have an exhibit-mate, even if it is not a reproductive partner (S. Johnson, personal communication, 2006). The female will not tolerate the presence of the mated male after the cubs are born because the male may kill and eat them.

Following a period where successful copulations are observed or any time a pregnancy is suspected, it is always better to separate the pair. Failure of the female to come back into heat can also be an indicator of pregnancy. The female should be given as many options as possible for selecting a spot to cub. Bedding areas heavily can sometimes entice a female to cub in one area over another. As with all cats, it is advisable to give the female as much privacy as possible when giving birth. The male should be kept as far away as possible, and use of a plywood visual barrier is fine if the male cannot be removed from the immediate vicinity. Use of closed circuit camera equipment and microphones can be very useful to monitor infant progress and the female’s comfort without causing her to feel threatened. The birth of cubs is an exciting event for zoo staff and guests, but the less interference and unusual activity the better. The male should not be re-introduced to female until the cubs are weaned and separated from the female.

When wild jaguars are about one and a half years old, they have been observed to leave their mother. Two siblings may live and hunt together for a few months while searching for their own territories/home ranges, and, upon finding an appropriate area, they may establish themselves contiguously (Almeida, 1976). Zoo jaguars have been observed to be rejected by their mothers as early as six months of age, but there are also examples of offspring or introduced, unrelated animals successfully living together for many years (S. Johnson, personal communication, 2014).

There is no reason to avoid compatible, single-sex, multigenerational groups. Same-sex or neutered groups can be maintained together indefinitely as long as the individuals remain behaviorally compatible. Brothers reared together or unrelated individuals introduced as juveniles may remain compatible indefinitely. Several institutions have also maintained all-female groups of up to three animals as well. Vigilant observation of any changes in social interaction like intimidation or prevention of access to food or water is recommended to prevent injury, however. As in all jaguar groupings, loss of condition, lethargy, or anorexia by a group member may give an indication of incompatibility. Injury from an exhibit mate is the most obvious sign of incompatible animals (S. Johnson, personal communication, 2014).

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. Like other great cats, jaguars are not recommended for mixed-species exhibits. Probably the most predictable variation in social behavior comes as a result of females entering and leaving estrus. Males will likely show increased interest in the female, and possibly behave more aggressively. When they are in estrus, females also show increasing interest in males. Mutual grooming may occur, along with non-aggressive and other physical contact. Lordosis and other postures by the female inviting copulation will become more frequent during the four to five day estrus period. Brief agonistic interactions are also normal, and the female should most often emerge as being dominant.

Extreme care should be taken when housing jaguars in adjacent enclosures because the animals will attempt to interact physically with each other. No unsupervised physical contact should be possible between animals in adjacent enclosures. The ears of animals housed side-by-side have been bitten, and
one animal’s tongue was so severely injured that the animal bled to death (S. Deem, personal communication, 2007). Jaguars are very possessive, and once they are in possession of something, they are difficult to get to disengage. They are also extremely strong, and can bite through mesh as heavy as 9-gauge chain link (S. Johnson, personal communication, 2014).

Keeper interaction through safe feeding, vocalization, limited tactile behavior, and operant conditioning develops a positive exchange with a cat, and this should be considered an integral part of this relationship. Operant conditioning and protected contact training methods appropriate to many other species also work well with jaguars. Safety for animals and trainers must be paramount in any interaction. The following considerations apply to all activity conducted in proximity to jaguars. Animal managers should establish safe access to the night house prior to entry. An accurate animal count should be performed before proceeding with daily husbandry procedures. Primary containment and hot-wire inspection should be performed daily. Animal transfers may utilize shift corridors that incorporate restraint devices, scales, and holding units for daily procedures. Cleaning and sanitation procedures can then be performed on the holding areas. Maintenance repairs to the holding areas should be performed while animals are on display. Staff members should be aware of animal locations and the status of locks at all times during animal husbandry procedures.

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.

Most large felids are solitary in nature except during periods of breeding activity. As a result, extreme caution and patience is recommended during introductions to facilitate pairings. Compatibility between animals can be achieved through extended controlled introductions in a night house shift area or adjacent enclosure which allow auditory, olfactory, and visual contact but prevent actual physical contact. By utilizing such “howdy” barriers, an introduction schedule can be set up over a period of days or weeks to gradually reduce barriers until the animals are introduced into the same space. Safe measures to separate the cats such as water hoses, CO2 fire extinguishers, or air horns are recommended to be available in case of aggression.

Further olfactory contact can be provided by allowing each animal out into the exhibit on alternate days. This allows each cat to be aware and investigate the presence of another jaguar nearby through olfactory recognition of marked spots and other deposits in the exhibit. Introductions of males and females can be timed to coincide with estrus in the female. Indicators of estrus include restlessness, increased vocalizations, neck-rubbing on items within the exhibit, the female rolling on her back or pacing, and the display of the lordosis posture (Stehlik, 1971).

Multiple staff members should be present during an introduction, and at least one member of the team is strongly recommended to have previous experience introducing jaguars. Staff should be stationed around the outside of the exhibit with CO2 fire extinguishers, air horns, and water hoses in case the animals need to be separated. Keep in mind that deaths have occurred during jaguar introductions, and some aggression is normal. However, prolonged or intense physical aggression should be prevented. A time limit can be established for aggressive interactions before attempts are made to separate the cats. Aggression initiated by the female may be allowed for a longer period of time as long as no serious injuries occur to the male.

Females should be provided with access to the exhibit prior to the male being introduced. Introduced jaguars should be monitored continuously throughout their first day together on exhibit. Fire extinguishers and water hoses should also be kept in easily accessible locations for the first week thereafter. Housing the animals separately when off exhibit (e.g., at night) may be necessary for a longer period due to the smaller size of night quarters (AZA Jaguar SSP Management Group and Advisors, personal communication, 2014).
6.1 Nutritional Requirements

A formal nutrition program is required to meet the nutritional and behavioral needs of all jaguars (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://nagonline.net/guidelines-aza-institutions/feeding-guidelines/), 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. This chapter was written by the AZA Jaguar SSP Nutrition Advisors with support from the management group and other advisors.

Jaguars may be active two-thirds of the day or more if feeding. Unlike the other felids in the neotropics, jaguars utilize all areas including forest, river, and lake edges during all times of the day (Emmons, 1987). In general, they may be considered opportunistic predators. Jaguars will walk extensively until they encounter prey (Emmons, 1987). Similar to most other Felidae, they obtain prey by stalking or ambushing. Their diet is diverse and dependent on geographic location. Prey size can range from small (less than 1–2 kg [2.2–4.4 lb]) to large (greater than 10–15 kg [22–33 lb]), but most prey are greater than 1–2 kg (2.2–4.4 lb) (Emmons, 1987; Rabinowitz & Nottingham, 1986; Lopez Gonzalez & Miller, 2002; Cascelli de Azevedo, 2006). Prey species in the wild commonly include capybara (Hydrochoerus hydrochaeris), caiman (Caiman crocodilus and C. yacare), side-necked turtles (Podocnemis vogli and Podocnemis unifilis), collared peccary (Tayassu tajacu), white lipped peccary (Tayassu pecari), armadillos (Dasypus novemcinctus), paca (Agouti paca), and coati (Nasua nasua) (Guggisberg, 1975; Schaller & Vasconcelos, 1978; Mondolfi & Hoogesteijn, 1982; Novack, 2003, Polisar et al., 2003, Weckel et al., 2006; Salom-Perez et al., 2007; Cascelli de Azevedo & Murray, 2007, Polisar et al., 2003). When feeding, a jaguar may stay with a prey item one to three days, move prey items, or abandon the prey shortly after obtaining it. Depending on prey size, there may be several days between feeds. Six kills were seen in a period of 35 days for one individual. (Schaller & Crawshaw, 1980). Many items are entirely consumed. Feet, hooves, bone pieces up to 4.4 cm (1.7 in.), and armadillo and anteater (Tamandua mexicana) claws have all been observed in the feces. Exceptions include the skulls, the larger bones, digestive tracts, and the carapaces of turtles and armadillos (Emmons, 1987; Rabinowitz & Nottingham, 1986). Field biologists commonly use 34 g (1.2 oz) of prey required per kilogram body weight to assess suitability of habitat for maintaining jaguars (Novack, 2003, Polisar et al., 2003).

The jaguar has a wide variety of opportunistic prey that composes its diet. See Tables 6 and 7.
Table 6. Main prey species of jaguar identified to date (Mondolfi & Hoogesteijn, 1982; Schaller & Vasconcelos, 1978; Guggisberg, 1975).

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capybara</td>
<td>Hydrochaerus hydrochaeris</td>
</tr>
<tr>
<td>Spectacled caiman</td>
<td>Caiman crocodylus</td>
</tr>
<tr>
<td>Side-necked turtle</td>
<td>Podocnemys vogii</td>
</tr>
<tr>
<td>Tercay turtle</td>
<td>Podocnemys unifilis</td>
</tr>
<tr>
<td>Collared peccary</td>
<td>Pecari tajacu (syn. Tayassu tajacu, Dicotyles tajacu)</td>
</tr>
</tbody>
</table>

Table 7. Lesser Prey Species identified to date (Mondolfi & Hoogesteijn, 1982; Rabinowitz & Nottingham, 1986).

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armadillo*</td>
<td>Dasypus novemcinctus</td>
</tr>
<tr>
<td>Paca</td>
<td>Agouti paca</td>
</tr>
<tr>
<td>Collared anteater</td>
<td>Tamandua mexicana</td>
</tr>
<tr>
<td>Lesser anteater</td>
<td>Tamandua tetradactyla</td>
</tr>
<tr>
<td>White-tailed deer</td>
<td>Odocoleus virginianus</td>
</tr>
<tr>
<td>Land tortoise</td>
<td>Geochelone carbonaria</td>
</tr>
<tr>
<td>Iguana</td>
<td>Iguana iguana</td>
</tr>
<tr>
<td>Porcupine</td>
<td>Coendou prehensilis</td>
</tr>
<tr>
<td>Howler monkey</td>
<td>Alouatta senniculus</td>
</tr>
<tr>
<td>Arrau turtle</td>
<td>Podocnemys expansa</td>
</tr>
<tr>
<td>Sloths</td>
<td>Bradypus sp.</td>
</tr>
<tr>
<td>Giant armadillo</td>
<td>Priodontes maximus</td>
</tr>
<tr>
<td>Red brocket deer</td>
<td>Mazama americana</td>
</tr>
<tr>
<td>Agouti*</td>
<td>Dasyprocta punctata</td>
</tr>
<tr>
<td>Opossum</td>
<td>Didelphis marsupialis</td>
</tr>
<tr>
<td>Coati</td>
<td>Nasua nasua</td>
</tr>
<tr>
<td>Four-eyed opossum</td>
<td>Philander opossum</td>
</tr>
<tr>
<td>Skunk</td>
<td>Spilogale putorius or Coneatus semistriatus</td>
</tr>
<tr>
<td>Kinkajou</td>
<td>Potos flavus</td>
</tr>
</tbody>
</table>

*Primary species in Cockscomb Basin, Belize

Digestive System Morphology, and Physiology: When masticatory muscle fiber architecture is considered with bite force, jaguar dentition facilitates puncturing turtle shells and skulls of medium to large prey (Hartstone-Rose et al., 2012). Jaguars are obligate carnivores, and, therefore, may possess a simple digestive tract comparable to the digestive system of other carnivores including the domestic cat (Figure 3) and the lion. The ratio of small to large intestines is similar among these three species with the contribution of the length of each area (stomach, small intestine, large intestine, cecum, and colon) to the total length of the tract similar between the domestic cat and lion (Seymour, 1989; Stevens & Hume, 1995; Smith et al., 2006). The intestine of domestic cats (Felis domesticus) maintains bacterial colonies comparable to those in herbivorous species (Brosey et al., 2000). These can provide protection against invading bacteria, stimulate gastrointestinal function such as immunity and motility, and digest fiber sources to produce volatile fatty acids (Suchodolski, 2011). This is likely true for jaguar as well; however, due to the small relative volume of the feline tract, the contribution of volatile fatty acids to digestion is probably negligible (Suchodolski, 2011). The feline digestive tract allows for storage of large meals in the stomach and efficient digestion of vertebrate prey (Bennett et al., 2010; Clauss et al., 2010; Smith et al., 2006; Vester et al., 2010), but it may limit digestion of more complex fiber sources which omnivores and herbivores are able to utilize (Edwards et al., 2001; Figure 3. Digestive tract of Felis domesticus (Stevens & Hume, 1995)
information on nutritional evaluations, see section 6.3. which 1 g (0.04 oz) gain costs 1.9 kcal (Hendricks & Wamberg, 2000; Kienzle, 1998) is MEg kcal/d = MEm

mature weight by 13%.  An alternative equation based on energy requirements derived from nursing kittens for limited (few animals or lack of body weights), a maintenance requirement of 100–127 kcal/kgBW0.75 for managed jaguars in zoos is proposed. This is approximately 1.8 kg (4 lb) per for adult male jaguars and 1.6 kg (3.5 lb) for adult female jaguars on a diet 1.75 kcals/g. Individual feeding rates should be evaluated through extrapolation, suggested 90–110 kcal/kg BW0.75/day for managed wild felids that are similar to the domestic cat. Estimated energy intake for adult wild jaguars as proposed by Emmons (1987) is 119–139 kcal/kg BW0.75/day, assuming 1.4 kcal/g of whole prey. It is likely that higher requirements for free-ranging animals reflect increased activity associated with hunting. Considering this data for managed jaguars is limited (few animals or lack of body weights), a maintenance requirement of 100–127 kcal/kgBW0.75 for managed jaguars in zoos is proposed. This is approximately 1.8 kg (4 lb) per for adult male jaguars and 1.6 kg (3.5 lb) for adult female jaguars on a diet 1.75 kcals/g. Individual feeding rates should be evaluated and readjusted based on regular assessment of body condition score and weights.

Reproduction Nutrition: Gestation and lactation in the domestic cat are periods of increased energy demand. The maternal contribution to reproduction is dependent on the size of the litter, growth rate of the offspring, and relative size of the offspring; therefore, a comparison between the domestic cat and larger felids may not be appropriate. Energy requirements for the domestic cat during gestation are approximately 40% higher than normal and approximately twice that of maintenance energy requirements during peak lactation (NRC, 2006). However, no difference in metabolic rate was observed in a female puma (Puma concolor) during lactation (McNab, 2000). Considering known parameters in jaguars including maternal weight, weight of young, time of first solids, and litter size, the predicted increase in energy needs for early to mid-gestation and peak lactation are 0.7 kcals/kg BW0.75/day and 71 kcals/kg BW0.75/day, respectively (Oftedal & Gittleman, 1989). Optimal weight gain or weight loss during reproduction in large felids has not been studied. In domestic cats, body stores can be mobilized for gestation and lactation (Loveridge, 1986). Since extreme body condition scores are associated with multiple health risks to the mother and offspring, it is recommended that gestating and lactating jaguars be fed to maintain body condition within the moderate range (Body Condition Score [BCS] 4–6). For more information on nutritional evaluations, see section 6.3.

Growth Nutrition: Energy requirements for growth can be estimated from domestic cats (NRC, 2006) considering maintenance energy requirement and proportion of mature bodyweight as follows: MEg kcal/d = MEm + (1.3*MEm * -1.15*p) where MEm = maintenance energy requirement and p = proportion of mature bodyweight = bodyweight/mature bodyweight. The energy requirement is approximately 2.3 times the maintenance energy requirement at birth and decreases to overestimate energy requirements close to maturity by 13%. An alternative equation based on energy requirements derived from nursing kittens for which 1 g (0.04 oz) gain costs 1.9 kcal (Hendricks & Wamberg, 2000; Kienzle, 1998) is MEg kcal/d = MEm + 1.9(ADG). Average daily gain (ADG) for jaguars is predicted to be 48 g/day (1.7 oz/day) (Oftedal & Gittleman, 1989).

For the purpose of developing this manual, weight data were collated from 71.81 parent-reared, hand-reared, and unknown-reared jaguars (Figures 4 and 5) in AZA institutions during the past two decades. Weight data for parent-reared and hand-reared animals were not significantly different, thus all 3 sets were combined for each sex. Below (Table 8) are the results of the segmental linear regression. The model generated birth weights very close to actual/expected. Break points are similar to oldest age of weaning (11 weeks). Males grew faster overall, but both reached mature weight around 1.3 years old. The expected mature weight for a female is approximately 51 kg (112.44 lbs), and for a male, expected...
mature weight is approximately 61 kg (134.48 lbs). A variation of 10 kg (22.05 lbs) is typical. Managed female early ADG were more similar to the Oftedal/Gittleman prediction. Along with body condition scoring, these gains should be used as a guide when considering altering diets for growing parent and hand reared animals.

Table 8: Jaguar segmental linear regression 3-part.

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept 1/Birth weight</td>
<td>1.102 kg (2.429 lb)</td>
<td>0.9316 kg (2.054 lb)</td>
</tr>
<tr>
<td>Slope 1/Average daily gain</td>
<td>55.26 g/day (1.95 oz/day)</td>
<td>83.70 g/day (2.95 oz/day)</td>
</tr>
<tr>
<td>Breakpoint 1</td>
<td>66 days</td>
<td>72 days</td>
</tr>
<tr>
<td>Slope 2/Average daily gain</td>
<td>105.8 g/day (3.73 oz/day)</td>
<td>138.7 g/day (4.89 oz/day)</td>
</tr>
<tr>
<td>Breakpoint 2</td>
<td>506 days</td>
<td>462 days</td>
</tr>
<tr>
<td>R-value</td>
<td>0.942</td>
<td>0.919</td>
</tr>
</tbody>
</table>

Figure 4: Growth curve for ex situ male jaguars (AZA Jaguar SSP, 2015).
A subsample of the main growth period from 100–400 days was selected, and linear regressions were run for all jaguar with at least 5 weights during this period (n=19 females, n=16 males). The rate of growth of this subsample was used to describe the observed variation in growth rates for managed jaguars.

For males, the median growth rate from was 151 g/day (5.33 oz/day), which is slightly higher than the model generated. This is due to the odd distribution of the data (split) suggesting the possibility of 2 distinct populations. The inner quartile range was 117–159 g/day (4.13–5.61 oz/day). The animals that displayed a high growth rate appeared to drop in weight later on and were not outliers in the final weight. This possibly suggests a period of being overweight. One of these animals showed catch-up growth following a period of poor growth early on. The animals that displayed a low growth rate ended up being either normal size or smaller.

For females, the median growth rate was 106 g/day (3.74 oz/day), similar to the model. The inner quartile range was 74–115 g/day (2.61–4.06 oz/day). The high growth rate animals that displayed a high growth rate appeared to drop in weight later on and were not outliers in final weight. This possibly suggests a period of being overweight similar to the males, though extreme. These animals also showed an increased growth rate early on. The animals that displayed a low growth rate ended up being the smallest animals. Instead of increasing, their growth rate appeared to slow around 6 months of age. They were not reported as stunted, suggesting genetics may play a role. Ex situ animals should be managed to avoid periods of excessive gain and/or rapid catch-up growth to avoid metabolic disturbances.

**Energy of Feeds:** Several equations for estimating the energy content of typical cats feeds are available (Clauss et al., 2010; NRC, 2006), and numerous papers determining gross energy and digestible energy are available as well (Barbiers et al., 1982; Bennett et al., 2010; Vester et al., 2010). Care should be taken when making, comparing, or reporting estimates that the different terms for energy are used appropriately (i.e. gross energy (GE) * digestibility = digestible energy (DE) * metabolic efficiency = metabolizable energy (ME)). A review of literature on raw diets and whole prey as are generally offered to managed jaguars supported the following Atwater equation for estimating ME in carnivores (Clauss et al., 2010): ME kcal/kg = 39.9*(%CP+%NFE) + 90.0*(%Fat), where %CP is the percent crude protein and %NFE is the percent nitrogen free extract (which can be estimated as 100-CP-Fat-Fiber-Ash). The more specific an estimation equation is to the feed evaluated, the more accurate the estimate; therefore, estimates based on a single property (e.g. protein or fiber) should be used with caution. Feed composition
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varies between products, manufacturers, and even manufacturing lots (Allen et al., 1995), and regular quality control of feeds and assessment of managed animals for changes in weight or condition are recommended.

The nutrient content of food items consumed by jaguars has not been completely characterized. For the limited number of nutrients studied, the domestic cat remains an appropriate model (Vester et al., 2010). The nutrient levels presented below have been recommended by the National Research Council of the National Academies for the domestic cat (Table 9). As in all species, nutrient requirements vary depending on growth, activity, reproductive status, health status, environment, and group dynamics.

Table 9. Target nutrient levels for carnivores on a dry matter basis (NRC, 2006).

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Growth</th>
<th>Maintenance</th>
<th>Gestation/Lactation</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein, %</td>
<td>22.5</td>
<td>20.00</td>
<td>21.3-30.0</td>
<td>20.0-30.0</td>
</tr>
<tr>
<td>Fat, %</td>
<td>9.00</td>
<td>9.00</td>
<td>15.00</td>
<td>9.0-15.0</td>
</tr>
<tr>
<td>Linoleic acid, %</td>
<td>0.55</td>
<td>0.55</td>
<td>0.55</td>
<td>0.55</td>
</tr>
<tr>
<td>Vitamin A, IU/g</td>
<td>3.55</td>
<td>3.55</td>
<td>7.50</td>
<td>3.55-7.50</td>
</tr>
<tr>
<td>Vitamin D3, IU/g</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>Vitamin E, mg/kg</td>
<td>38.00</td>
<td>38.00</td>
<td>38.00</td>
<td>38.00</td>
</tr>
<tr>
<td>Vitamin K, mg/kg</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Thiamin, ppm</td>
<td>5.50</td>
<td>5.60</td>
<td>5.50</td>
<td>5.5-5.6</td>
</tr>
<tr>
<td>Riboflavin, ppm</td>
<td>4.25</td>
<td>4.25</td>
<td>4.25</td>
<td>4.25</td>
</tr>
<tr>
<td>Niacin, ppm</td>
<td>42.50</td>
<td>42.50</td>
<td>42.50</td>
<td>45.50</td>
</tr>
<tr>
<td>Vitamin B6, ppm</td>
<td>2.50</td>
<td>2.50</td>
<td>2.50</td>
<td>2.50</td>
</tr>
<tr>
<td>Folic acid, ppm</td>
<td>0.75</td>
<td>0.75</td>
<td>0.75</td>
<td>0.75</td>
</tr>
<tr>
<td>Biotin, ppm</td>
<td>0.08</td>
<td>0.08</td>
<td>0.08</td>
<td>0.08</td>
</tr>
<tr>
<td>Vitamin B12, ppm</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Pantothenic acid, ppm</td>
<td>6.25</td>
<td>6.25</td>
<td>6.25</td>
<td>6.25</td>
</tr>
<tr>
<td>Choline, ppm</td>
<td>2550.00</td>
<td>2550.00</td>
<td>2550.00</td>
<td>2550.00</td>
</tr>
<tr>
<td>Calcium, %</td>
<td>0.80</td>
<td>0.29&lt;sup&gt;1&lt;/sup&gt;</td>
<td>1.08</td>
<td>0.29-1.08&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Phosphorus, %</td>
<td>0.72</td>
<td>0.26&lt;sup&gt;1&lt;/sup&gt;</td>
<td>0.76</td>
<td>0.26-0.72&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Magnesium, %</td>
<td>0.04</td>
<td>0.04</td>
<td>0.06</td>
<td>0.04-0.06</td>
</tr>
<tr>
<td>Potassium, %</td>
<td>0.40</td>
<td>0.52</td>
<td>0.52</td>
<td>0.40-0.52</td>
</tr>
<tr>
<td>Sodium, %</td>
<td>0.14</td>
<td>0.07</td>
<td>0.13</td>
<td>0.07-0.14</td>
</tr>
<tr>
<td>Iron, ppm</td>
<td>80.00</td>
<td>80.00</td>
<td>80.00</td>
<td>80.00</td>
</tr>
<tr>
<td>Zinc, ppm</td>
<td>75.00</td>
<td>75.00</td>
<td>60.00</td>
<td>60-75</td>
</tr>
<tr>
<td>Copper, ppm</td>
<td>8.40</td>
<td>5.00</td>
<td>8.80</td>
<td>5.0-8.8</td>
</tr>
<tr>
<td>Manganese, ppm</td>
<td>4.80</td>
<td>4.80</td>
<td>7.20</td>
<td>4.8-7.2</td>
</tr>
<tr>
<td>Iodine, ppm</td>
<td>2.20</td>
<td>2.20</td>
<td>2.20</td>
<td>2.20</td>
</tr>
<tr>
<td>Selenium, ppm</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
</tr>
</tbody>
</table>

<sup>1</sup>Data do not exist for large maintenance level exotic felids fed 0.3% calcium and phosphorus diets.

As obligate carnivores, jaguars have unique nutrient requirements compared to omnivores. These differences are consistent with constant consumption of a high protein diet. Strict carnivores require higher levels of most essential amino acids, taurine, preformed vitamin A, niacin, and arachidonic acid (NRC, 1986). Omnivores can meet these requirements with other nutrients or possess enzymes or greater enzyme activity to up-regulate metabolic pathways to meet these requirements. Nutrient requirements are affected by physiological state and, for some animals, season/environmental affect. Estimates for energy for growth and reproduction have been presented above in Table 9. Young, parent reared jaguars may show interest in food at approximately 70 days. Diet adjustments should be monitored assessing body condition and body weights to avoid large fluctuations that can be a result of perceived needs. Many institutions feed 10–20% more food during the colder months.

6.2 Diets

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

Managed jaguars can be maintained on diets consisting of commercially available meat mixes, whole prey, bones, carcasses, and muscle meat diets balanced with supplements. Some or all of these ingredients fed in combination should meet the target nutrient ranges for domestic cats (Table 9 above).
Commercially prepared meat mixes should be formulated to meet the nutrient needs specific to cats. As such, these products have the advantage of requiring no additional supplementation. However, soft diets provide little abrasion for good dental health and thus should be fed with whole prey, bones, or carcass. Meat mixes have traditionally consisted of predominately horse or beef. More recently, pork products have become available and appear to be well digested similar to beef and horse (C. Iske, personal communication, 2014). In general, these diets are well digested by jaguars. Studies comparing digestibility of meat mixes consisting predominately of horse, beef, bison, and elk fed to large cats (lion, cheetah, tiger, jaguar) and domestic cats show high digestibility of dry matter (75–90%), organic matter (79–96%), crude protein (81–97%), and fat (87–97%) with variability attributable to level and type of fiber, collagen content, ingredients, and possibly species (Morris et al., 1974; Vester et al., 2008; Vester et al., 2010; Wynne, 1989; Kerr et al., 2013a; Kerr et al., 2013b). Domestic cats fed the same diets had similar or greater nutrient digestibilities, further supporting the domestic cat as an appropriate model for exotic carnivores. Muscle meat does not provide a complete diet. Muscle contains too little calcium, vitamins A, D, and E, and other micronutrients to support health without additional sources of these nutrients. Muscle meat can be fed in combination with other diet items which meet the target nutrient levels so that additional supplementation is not required. For example, muscle meat is often utilized as a training tool or a medication vector. If muscle meat is going to be fed at a significant level in the diet or exclusively, the following supplementation is recommended per 2 kg of muscle: 5 g calcium carbonate, 10 g dicalcium phosphate and 1.5 g (1 tablet) Centrum multi vitamin mineral tablets (Ullrey & Bernard, 1989). Commercially available supplements specifically designed to balance muscle meat like Mazuri Carnivore supplement and Nebraska Meat Complete with Taurine can also be fed. Commercial meat mixes contain little fiber (3% max, dry matter basis), and sources are typically either cellulose or beet pulp. Cellulose is considered unfermentable, insoluble, and non-viscous, while beet pulp is considered moderately fermentable with viscous and non-viscous components. Fermentable fiber has been suggested to promote intestinal health in domestic cats by supporting intestinal cells and microflora, in part due to production of short chain fatty acids (Barry et al., 2010). Small exotic felids (leopard cat, caracal) have been maintained on diets including fructo-oligosaccharides, another fermentable carbohydrate (Edwards et al., 2001). In general, in large exotic felids, beet pulp appears to increase fecal wet weight, fecal score, and fecal metabolites; however, cellulose increases fecal dry weight and dry matter. Larger species (tigers) appear to need more insoluble fiber for appropriate feces (Kerr et al., 2013b, Vester et al., 2008; Vester et al., 2010). In these studies, type of fiber also affected some macronutrient digestibilities, but the authors suggested that the impact would not be physiologically significant and that lower digestibilities could be beneficial to colon health by decreasing bacterial protein production. This in turn decreases fermentation and generation of putrefactive compounds including ammonia, branch chain amino acids, phenols, and indoles. In summary, benefits exist for both types of fiber, but the ideal mix is unknown at this time (Allen et al., 1999).

Bones are recommended to be provided for abrasion, for dental health, and for enrichment, provided abnormal deleterious wear such as loss of enamel or damage to the teeth does not occur (Briggs & Scheels, 2005). Broken and cracked teeth were the top health issue from a recent survey. Fifty-five percent of responding institutions reported this problem. It is not clear from the survey if these cases were associated with bone feeding. Providing bones twice weekly may favor more frequent plaque dislodgement and markedly reduced calculus formation and gingivitis (Haberstroh et al., 1983). As a comparative example, bones commonly fed to lions include: horse neck bones, horse tails, oxtails, knuckle bones and femurs. Rib bones are less common (AZA Lion Species Survival Plan, 2012.).

**Inspection Standards:** All meat and meat products shall originate from animals slaughtered in plants subject to the Meat and Poultry Inspection Operations regulations of the USDA Food Safety and Inspection Service (FSIS) (United States Department of Agriculture Food Safety Inspection Service, 2016), or under a system of inspection approved by FSIS. All bones, cartilage, heavy connective tissue, lymph glands, and central nervous system tissue should be removed. Likewise, meat and meat products that originate from animals or carcasses designated as 3-D or 4-D should not be used. Other (non-meat) ingredients shall conform to standards as defined by the Association of American Feed Control Officials (AAFCO) (www.aafco.org). The product should be routinely monitored for specific microbial populations. The diet should test negative for the presence of *Salmonella* and *Listeria* and within specified tolerance limits for total coliforms and *E. coli*.

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Standards for inspecting meat and whole prey items are available in the USDA Manual of Standard Operating Procedures for Handling Frozen/Thawed Meat and Prey Items Fed to Captive Exotic Animals (Crissey et al., 2001). Food items from non-domestic stock should be frozen prior to being used as food to kill any pathogens that might be present. Meat-based diets should not be allowed to warm to room temperatures or above for extended periods of time because this may result in the growth of harmful bacterial organisms.

**Whole Prey:** Whole prey is an intact animal with entrails and fur (or feathers) typically chicks, quail, rabbits, rats and mice. Whole prey is also recommended to ensure proper dental health. The hide/fur, cartilage, gut and gut contents are closer to the natural diet of jaguars than hard bones and may therefore be more appropriate for abrasion. Additionally, the fiber-type qualities of indigestible prey parts including raw bones, tendons, cartilage, skin, hair, feathers, or “animal fiber” act as either soluble or insoluble fiber (Depauw et al., 2012). Fermentation of these items in the colon has been suggested to be beneficial to gastrointestinal health of cheetahs based on changes in fermentation end products and inflammation markers compared to an all meat chunk diet (Depauw, 2013), and it would be expected to benefit jaguars as well. In addition to the beneficial effects of animal fiber on fermentation, animal fiber also provides gut fill. Similar to the plant fibers discussed above, a combination of animal fibers may be the most appropriate. Whole prey fed to jaguars includes rabbits, guinea pigs, and rats.

The diet of wild jaguars is made up of whole carcasses. Providing humanely-killed animals to jaguars according to practices outlined below can promote a wide range of species-appropriate hunting, food manipulation, and feeding behaviors. Whole animals (e.g., rats, mice), gutted carcasses (e.g., chickens, rabbits), or carcass fragments (e.g., shanks of sheep or calf) can be provided. Many felids will perform all or part of their species-appropriate ‘stalk-rush-kill’ behavioral sequence when presented with carcasses (Law, 2009). Carcass feeding may promote physical health (e.g., improved dental hygiene) as well as psychological well-being. Institutions choosing to feed carcass should be aware of potential hazards that may exist including the presence of pharmaceutical drugs, pesticides, toxic organic compounds, and pathogenic bacteria (Harrison et al., 2006). The origin and the history of the carcass should be known, and institutions should follow USDA policy #25 (USDA, 1998). This policy specifies feeding the carcass as soon as possible or processing it into smaller pieces and freezing it, avoiding the carcasses of sick animals, removing lead shot from the carcasses of animals euthanized by gunshot, and avoiding the carcasses of animals with signs of central nervous system disease or at risk of transmissible spongiform encephalopathies, including animals with scrapie, chronic wasting disease, and Johne’s disease. Feeding jaguars roadkill is not recommended due to possible transfer of parasites, disease, and high microbial loads. The USDA highly discourages this practice (United States Department of Agriculture, 1998). The AZA Nutrition Advisory Group only condones carcass feeding as part of a feeding program that assures the diet of the animal is nutritionally balanced and free of pathogens.

**Enrichment Foods:** To promote species-appropriate hunting and feeding behaviors, jaguars can be offered edible items in a way that requires the cats to work for the food. Obesity, lethargy, and self-trauma could all indicate boredom and a lack of species-specific hunting opportunities for jaguars. Providing enrichment opportunities on a randomized schedule will help to prevent the development of stereotypic behaviors and ensure that the animals do not become desensitized to the presence of the enrichment initiatives. Food items can be hidden throughout the exhibit or in specially constructed PVC tubes. Institutional enrichment coordinators can be contacted for suggestions on how to make these items. Enrichment liaisons are also available through AZA and AAZK. Bags containing food can be hung in trees or from ropes. Jaguars will catch live fish when placed in the water features. The inclusion of whole prey and bones can facilitate natural feeding behaviors as well as facilitate good dental health. The institutional nutritionist or veterinarian should be consulted prior to introducing any food item for enrichment.

Enrichment foods consumed by jaguars should be considered a part of the diet. All dietary enrichment should go through an institutional approval process including review by nutritionists and veterinarians. All new dietary items should be monitored closely when they are first provided. Ice should be used with caution because several cases of tooth damage in domestic and exotic carnivores treated by zoo dentists have been reported (Briggs & Scheels, 2005). Table 10 provides examples of enrichment items fed to managed jaguars.
Table 10. Enrichment food items fed to jaguars (Law, 2009).

<table>
<thead>
<tr>
<th>Fish</th>
<th>Meat</th>
<th>Bones &amp; other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live tilapia</td>
<td>Fetal calf</td>
<td>Venison</td>
</tr>
<tr>
<td>Tuna</td>
<td>Chunk horse meat</td>
<td>Horse</td>
</tr>
<tr>
<td>Herring</td>
<td>Rabbit</td>
<td>Cattle</td>
</tr>
<tr>
<td>Frozen salmon</td>
<td>Quail</td>
<td>Beef tail</td>
</tr>
<tr>
<td>Live goldfish</td>
<td>Frozen steaks</td>
<td>Pork neck</td>
</tr>
<tr>
<td>Trout</td>
<td>Frozen lamb</td>
<td>Horse Shank</td>
</tr>
<tr>
<td>Minnows</td>
<td>Mice</td>
<td>Horse Knuckle</td>
</tr>
<tr>
<td>Live red shiners</td>
<td>Meatballs</td>
<td>Mutton</td>
</tr>
<tr>
<td>Smelt</td>
<td>Cooked chicken (boneless chunks)</td>
<td>Cow leg</td>
</tr>
<tr>
<td>Fish ice block</td>
<td>Chicken necks, gizzards, hearts, &amp; livers</td>
<td>Blood ice block</td>
</tr>
<tr>
<td></td>
<td>Venison (ground or whole)</td>
<td>Gelatin made with blood</td>
</tr>
<tr>
<td></td>
<td>Raw beef</td>
<td>Boiled eggs</td>
</tr>
<tr>
<td></td>
<td>Pork hock</td>
<td>Fruit and vegetables</td>
</tr>
</tbody>
</table>

**Sample Diets:** Those institutions supplying detailed diet information fed diets based on commercially available nutritionally complete meat mixes using beef or horse (Table 11). Though carcass was not fed in the below diets, many large cats are offered carcass. One institution offered deer legs with fur.

Table 11. Ingredient composition as a percent of the total diet (as fed) of 6 diets offered at 4 institutions to jaguars

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Average</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat mix</td>
<td>62%</td>
<td>22-96%</td>
</tr>
<tr>
<td>Whole prey</td>
<td>20%</td>
<td>4-45%</td>
</tr>
<tr>
<td>Bones</td>
<td>13%</td>
<td>0-25%</td>
</tr>
<tr>
<td>Chunk meat</td>
<td>5%</td>
<td>0-20%</td>
</tr>
<tr>
<td>Supplements</td>
<td>0.03%</td>
<td>0-0.2%</td>
</tr>
</tbody>
</table>

1 Meat mixes: Nebraska Premium and Classic Feline diets, Nebraska Premium Beef Feline, Central Nebraska Packing, Inc. North Platte, NE; Milliken Small Carnivore Diet, Milliken Meat Products, Ltd., Markham, Ontario, Canada
2 Whole prey: rabbits, guinea pigs, rats, mice, trout, chicks
3 Bones: Horse or beef femur or knuckle bones, ox tails
4 Chunk meat: horse muscle meat, beef liver
5 Supplements: Omega Tri-V Liquid Omega EFA and Vitamin Supplement, Henry Schein, Dublin OH
Table 12. Nutrient content, energy on an as fed basis, all other nutrients on a dry matter basis, of 6 sample diets compared to target nutrient levels described in Table 9

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Average</th>
<th>Range</th>
<th>Target Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy, kcal/g AS FED</td>
<td>1.45</td>
<td>1.28-1.82</td>
<td>-</td>
</tr>
<tr>
<td>Protein, %</td>
<td>56.62</td>
<td>50.67-64.67</td>
<td>20.0-30.0</td>
</tr>
<tr>
<td>Fat, %</td>
<td>33.49</td>
<td>25.02-41.05</td>
<td>9.0-15.0</td>
</tr>
<tr>
<td>Ash, %</td>
<td>7.44</td>
<td>5.47-9.64</td>
<td>NA</td>
</tr>
<tr>
<td>Linoleic acid, %</td>
<td>NA</td>
<td>NA</td>
<td>0.55</td>
</tr>
<tr>
<td>Vitamin A, IU/g</td>
<td>22.05</td>
<td>11.84-41.63</td>
<td>3.55-7.50</td>
</tr>
<tr>
<td>Vitamin D3, IU/g</td>
<td>NA</td>
<td>NA</td>
<td>0.25</td>
</tr>
<tr>
<td>Vitamin E, mg/kg</td>
<td>277.82</td>
<td>120.61-458.36</td>
<td>38</td>
</tr>
<tr>
<td>Thiamin, ppm</td>
<td>NA</td>
<td>NA</td>
<td>5.5-5.6</td>
</tr>
<tr>
<td>Riboflavin, ppm</td>
<td>NA</td>
<td>NA</td>
<td>4.25</td>
</tr>
<tr>
<td>Niacin, ppm</td>
<td>NA</td>
<td>NA</td>
<td>45.5</td>
</tr>
<tr>
<td>Vitamin B6, ppm</td>
<td>NA</td>
<td>NA</td>
<td>2.5</td>
</tr>
<tr>
<td>Folic acid, ppm</td>
<td>NA</td>
<td>NA</td>
<td>0.75</td>
</tr>
<tr>
<td>Biotin, ppm</td>
<td>NA</td>
<td>NA</td>
<td>0.08</td>
</tr>
<tr>
<td>Vitamin B12, ppm</td>
<td>NA</td>
<td>NA</td>
<td>0.02</td>
</tr>
<tr>
<td>Pantothenic acid, ppm</td>
<td>NA</td>
<td>NA</td>
<td>6.25</td>
</tr>
<tr>
<td>Choline, ppm</td>
<td>NA</td>
<td>NA</td>
<td>2550</td>
</tr>
<tr>
<td>Calcium, %</td>
<td>1.81</td>
<td>1.33-2.14</td>
<td>0.29-1.08</td>
</tr>
<tr>
<td>Phosphorus, %</td>
<td>1.36</td>
<td>1.08-1.50</td>
<td>0.26-0.72</td>
</tr>
<tr>
<td>Magnesium, %</td>
<td>0.11</td>
<td>0.09-1.15</td>
<td>0.04-0.06</td>
</tr>
<tr>
<td>Potassium, %</td>
<td>0.89</td>
<td>0.40-1.06</td>
<td>0.40-0.52</td>
</tr>
<tr>
<td>Sodium, %</td>
<td>0.39</td>
<td>0.24-0.51</td>
<td>0.07-0.14</td>
</tr>
<tr>
<td>Iron, ppm</td>
<td>216.29</td>
<td>142.89-353.35</td>
<td>80</td>
</tr>
<tr>
<td>Zinc, ppm</td>
<td>120.37</td>
<td>133.52-125.20</td>
<td>60-75</td>
</tr>
<tr>
<td>Copper, ppm</td>
<td>13.09</td>
<td>10.55-14.59</td>
<td>5.0-8.8</td>
</tr>
<tr>
<td>Manganese, ppm</td>
<td>19.49</td>
<td>13.71-26.22</td>
<td>4.8-7.2</td>
</tr>
<tr>
<td>Iodine, ppm</td>
<td>NA</td>
<td>NA</td>
<td>2.2</td>
</tr>
<tr>
<td>Selenium, ppm</td>
<td>0.43</td>
<td>0.28-0.59</td>
<td>0.4</td>
</tr>
</tbody>
</table>

1 Target nutrient range encompassing growth, pregnancy, lactation, and maintenance from Table 9.
2 Nutrient requirement not established.
3 Missing values in database thus composition could not be calculated.

Levels of several vitamins (thiamin, riboflavin, niacin, pantothenic acid, B6, folate, choline, B12, biotin, D) have not been calculated for most whole prey items or were not provided by the manufacturer for their meat mix. Muscle meat and organs are a source of these nutrients. Deficiencies of these vitamins have not been reported in jaguars.

**Feeding Schedules**: As with most carnivores, jaguars are not recommended to be fed together in the same space. Feeding separately permits more accurate evaluation of food consumption and eliminates risk of injury from other jaguars aggressively protecting their food (S. Johnson, personal communication, 2016).

Different food items, which provide a diet meeting known nutrient needs of domestic cats when fed in combination, can be rotated and varied from day to day. The average nutrient content of items consumed for one week should meet the cat nutrient requirements. Fasting for 24 hours without access to food is part of the feeding management at some institutions. Per USDA #25 animals should not be fasted more than two days per week (United States Department of Agriculture, 1998). See Table 13 for an example of a feeding schedule that can be used for jaguars.

Table 13. Example of a possible feeding schedule for jaguars

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat mix</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Guinea pig</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rabbit</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MiscPrey (rats/mice, chicks/fish)</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shankbone</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chunk meat</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
Food preparation must be performed in accordance with all relevant federal, state, or local laws and/or 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 jaguar. 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.

6.3 Nutritional Evaluations

A retrospective study of jaguars held in AZA accredited institutions from 1982–2002 (Hope & Deem, 2006) provides an overview of disease prevalence in managed jaguars by age, sex, and body systems. Overall, the most common causes of morbidity were found to be dental, gastrointestinal, integumentary, and musculoskeletal diseases. The authors suggested hepatic lipidosis as the most frequently reported liver problem, which may be linked to obesity in managed animals. Obesity is one nutritional disease that is still commonly seen in managed jaguars. Maintaining no more than a moderate body condition would be beneficial to managing animals with musculoskeletal diseases. Additionally, hand-raised jaguar cubs are known to suffer from metabolic bone disease when not properly fed.

When possible, animals should be weighed to assess body condition and needs for diet changes. It is recommended that jaguars be weighed at least four times a year. Depending on the bone structure, even at a general ideal body weight for the species, the animal could be over or under weight. Consequently, it is important to visually assess each animal as well. The recommended method for evaluating degree of fatness for animals which cannot be readily palpated is visual body condition scoring. Body condition scoring (BCS) systems provide a spectrum of fatness usually with 1–5 or 1–9 levels (BCS points). Nine-point BCS systems are more specific and preferred in domestic cats, dog, horses, and other species and have been validated against direct and indirect objective measures of fatness (German et al., 2006; Henneke et al., 1983; LaFlamme, 1997; Laflamme, 2005; Stevenson & Woods, 2006). One advantage of a 9-point BCS system is that scores of 4 (moderate low) and 6 (moderate high) serve as warning zones where diet or management changes can be made to avoid ever reaching body conditions of increased health risk (low 1–3 and high 7–9 scores). Weight measurements can provide the most specific measure of change in fatness; however, BCS is recommended to be used in addition to weight to determine appropriate target ranges and track animals when weights alone are not indicative of BCS. During growth and gestation, BCS can be particularly useful. BCS systems also do not require special equipment or animal training, but scorer training is needed.

For this publication, a 9-point BCS scale draft for the jaguar using images collected from the internet and other institutions has been proposed (see Appendix H). In a longitudinal study comparing lions, tigers, and jaguars, mean percent body weight change per body condition score was 9 ± 1%. This is comparable to the human body mass index (BMI) assessing “overweight” and “underweight” as approximately 15% above or below the middle of the “normal” range. In this study, “high” and “low” would fall 18% above or below the “moderate” body condition (Treiber et al., 2010). It is recommended that managed animals be maintained within the range of moderate body condition scores (4–6 on a 9-point scale). More extreme body conditions are associated with increased health risks, poor reproductive performance, and reduced longevity in domestic cats and dogs (Laflamme, 2005). Palpation and transcutaneous ultrasound can provide a more accurate measure of fatness, and these should be used in conjunction with weights to calibrate visual assessment if possible.

A fecal scoring chart specific to jaguars has not been previously published. In the literature, 1–5 scales are described without a photo record. To minimize this subjective assessment, a scale with photos is highly recommended. The chart in Appendix I should be used to provide consistency between evaluators.
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).

The period between routine examinations should be based on the veterinarian’s risk [of anesthesia] vs. benefit [of gathering data on sub-clinical health concerns] evaluation, and the signalment/health status of the individual animal. Most AZA accredited zoos perform routine examinations on large felids at one- to three-year intervals. Quarterly fecal examinations are recommended to check for internal gastro-intestinal parasites.

Additional information on veterinary care for jaguars may be obtained by contacting the AZA Jaguar SSP Veterinary Advisor Sharon Deem, DVM, PhD, Dipl. ACZM, or the AZA Felid TAG Veterinary Advisor Ellen Bronson, DVM, Dipl. ACZM. This chapter was written by the AZA Jaguar SSP Veterinary Advisor with support from the SSP Management Group and other advisors.

Protocols for the use and security of drugs used for veterinary purposes must be formally written and available to animal care staff (AZA Accreditation Standard 2.2.1). Procedures should include, but are not limited to: a list of persons authorized to administer animal drugs, situations in which they are to be utilized, location of animal drugs and those persons with access to them, and emergency procedures in the event of accidental human exposure. The AZA Jaguar SSP recommends that each institution’s veterinarian(s) lead the formulation of their own institutional protocols for the storage and use of drugs to be applied in the care and management of jaguars.

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 should be responsible for maintaining accurate animal veterinary record keeping. All pertinent health information for jaguars should be recorded per institutional protocols in a currently available and recognized medical record-keeping software.

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 this 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.
Medical history should be sent to and reviewed by the receiving institution’s veterinary staff prior to shipment. Pre-shipment examination should include a complete physical examination, complete blood count (CBC), chemistry profile, fecal parasite examination, enteric pathogen screen, thyroid screening, and thoracic and abdominal radiographs. Serology to screen for calcivirus, canine distemper virus, *Dirofilaria immitis*, feline immunodeficiency virus, feline infectious peritonitis, feline leukemia virus, feline panleukopenia, herpesvirus, *Leptospira interrogans* spp., and *Toxoplasma gondii* should also be completed. If not already properly identified, the jaguar should also be permanently identified with a transponder chip. The animal should be current on all recommended vaccinations (see Section 7.4, below), which minimally should include rabies and Fel-O-Vax® (panleukopenia, rhinotracheitis, and calicivirus).

### 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 E). 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 recommendations have precedence.

AZA institutions must have zoonotic disease prevention procedures and training protocols established to minimize the risk of transferable diseases (AZA Accreditation Standard 11.1.2) with all animals, including those newly acquired in quarantine. Keepers should be designated to care only for quarantined animals if possible. If keepers must care for both quarantined and resident animals of the same class, they should care for the quarantined animals only after caring for the resident animals. Care should be taken to ensure that these keepers are “decontaminated” before caring for the healthy resident animals again. Equipment used to feed, care for, and enrich 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.

The AZA Jaguar SSP recommends that veterinarians at each institution develop their own specific disinfection protocols for animal management equipment and environmental enrichment provided in quarantine. These protocols should take into consideration the material to be disinfected, and should ensure that disinfectants are thoroughly rinsed off or neutralized before the equipment or enrichment is used again.

The quarantine period should last for a minimum of 30 days but is recommended to avoid running longer than 45 days. This range is suggested in order to accomplish quarantine goals while minimizing time the animals spend in housing that is usually not appropriate as a long-term habitat for jaguars. If additional jaguars, or other carnivores, are introduced into their corresponding quarantine areas, the
minimum quarantine period should begin over again. However, the addition of mammals of a different order will not require the re-initiation of the quarantine period.

During the quarantine period, specific diagnostic tests should be conducted with each animal if possible or from a representative sample of a larger population (e.g., birds in an aviary or frogs in a terrarium) (see Appendix E). 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.

Food provided at the sending institution may be different from that which will be fed at the receiving institution, and diets from the sending institution are recommended to accompany the animal or at least be used initially by the receiving institution. It is imperative that the jaguar’s diet not be switched immediately upon arrival at the new institution. It is better to slowly transition the jaguar to the new diet while weaning it off the old diet. This will minimize possible anorexia and gastrointestinal problems that may occur with any dietary change. Most zoos will begin to transition the diet during the quarantine period.

The AZA Jaguar SSP recommends that member institutions follow AZA and AAZV guidelines for tuberculosis testing. During the quarantine period, three fecal samples for internal parasite evaluation should be submitted and all parasites treated appropriately while in quarantine. Usually in the time period between 14–21 days of quarantine (e.g., allowing time for the jaguar to adjust to its new surroundings but also allowing enough time, prior to moving it to a permanent enclosure, to respond if a health issue is determined during the exam), the jaguar should receive a quarantine examination that includes those tests listed for the pre-shipment examination in section 7.2.

Endoparasites are relatively common and ubiquitous in managed situations. Some parasites may be acquired from the feed and not be pathogenic in jaguars. Pathogenic species commonly identified in jaguars are from the orders Ascarididae and Strongyloidae (e.g, *Toxocara*, *Toxascaris*, *Ancylostoma*). Coccidiosis can also be a problem in managed jaguars. Based on fecal results, anthelmintics should be administered to minimize the parasite load. These agents are often more effective when administered for more than one day (i.e., three consecutive days). Follow-up treatment to remove larval stages not susceptible during the initial treatment may also be required. Thorough daily cleaning and disinfection of enclosures will substantially lower the chance of re-infections. Anthelmintics that have been effective and safe in jaguars include:

- Carbaryl (0.5%) as a topical powder for flea control.
- Fenbendazole (Panacur®, American Hoescht, Somerville, NJ 08876) at 5–10 mg/kg p.o. is most commonly given as a single day treatment, but it can be given for three consecutive days at this dose.
- Ivermectin (Ivomec®, Merck and Co., Rahway, NJ 07065) at 0.2 mg/kg s.c. or p.o. is used as a single day treatment for gastrointestinal parasites. Many AZA accredited zoos administer 0.2 mg/kg ivermectin p.o. on a monthly basis as a heartworm preventative. This is strongly recommended in heartworm endemic areas.
- Praziquantel (Droncit®, Haver-Lockhart, Shawnee, KS 66201) at 5.5–6.6 mg/kg s.c. or p.o. for cestodes.
- Pyrantel pamoate (Strongid®, Pfizer Inc., New York, NY 10017) at 3–5 mg/kg p.o. can be given at this dose for three to five consecutive days.
- Pyrethrins (0.15%) plus piperonyl butoxide (1.0%) for flea control.
- Sulfadimethoxine (Albon®, Roche Chemical Div., Nutley, NJ 07110) at 50 mg/kg, s.c. or p.o. for coccidiosis.

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. Use of microchips is widely considered to be best practice but tattoos, ear notches or their natural markings, if necessary, are other options for jaguars. They can best be marked when anesthetized or restrained. 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.

Association of Zoos and Aquariums
apart. Medical records for each animal should be accurately maintained and easily available during the quarantine period.

The quarantine examination provides a good opportunity to satisfy all those requirements not met (if any) during the pre-shipment examination. The jaguar should be microchipped at this time if it is not already permanently identifiable. Release from quarantine should be contingent upon normal test results and should follow the protocols set forth by the staff veterinarian.

Jaguars are normally solitary, so social issues should not arise from isolation during quarantine. However, some stereotypic behaviors have been seen in jaguars including pacing and tail sucking; these may arise in quarantine due to stress. Providing jaguars with environmental enrichment and space that allows them to exhibit species appropriate behaviors is recommended to be part of the quarantine protocols.

If a jaguar 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).

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).

The physical examination should include body weight, temperature, pulse, respiration, careful nail and pad evaluation, dental examinations with particular attention to fractured canines, and a whole body exam for abscesses and lacerations. Species360 provides physiologic reference ranges for managed jaguars with division by sex and age (ISIS, 2002). The physiological reference ranges combined for managed jaguars of all ages and sexes from 43 member institutions can be found in Appendix J (ISIS, 2002). See Table 14 for normal parameters for adult jaguars.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Normal Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight (adult male)¹</td>
<td>50–80 kg (110–176 lb)</td>
</tr>
<tr>
<td>Body weight (adult female)¹</td>
<td>30–70 kg (66–154 lb)</td>
</tr>
<tr>
<td>Temperature</td>
<td>37–39.5 °C (98.6–103.1 °F)</td>
</tr>
<tr>
<td>Pulse</td>
<td>70–140 bpm</td>
</tr>
<tr>
<td>Respiration</td>
<td>8–24 bpm</td>
</tr>
</tbody>
</table>

¹ISIS, 2002

A thorough oral examination is an integral part of a physical examination. The teeth and soft tissue structures of the mouth and throat should be examined for abnormalities. Dental tartar and calculi are a
common problem in managed jaguars. Tooth scaling and polishing should be a routine part of any physical examination. Additionally, fractured teeth (most commonly canines) can be a serious problem in jaguars. Teeth should be carefully examined for fractures; dental films provide additional diagnostic capabilities. Root canals should be performed when deemed appropriate.

Clinical pathology is an important component of the pre-shipment, quarantine, and routine examinations. Laboratory tests that should be performed include complete blood count (CBC), chemistry profile, fecal parasite examination, enteric pathogen screen, serology for calicivirus, canine distemper virus, *Dirofilaria immitis*, feline immunodeficiency virus, feline infectious peritonitis, feline leukemia virus, feline panleukopenia, herpesvirus, *Leptospira interrogans* spp., *Toxoplasma gondii*, and thyroid screening. Thoracic and abdominal radiographs should be taken routinely with special attention to the musculoskeletal condition and internal organs. Ultrasonography may also provide information, especially for heart, abdominal, and reproductive assessments. In male jaguars, semen evaluation is also important. For a description of semen evaluation, see section 8.1.

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). Jaguars that are transported outside of the institution for testing that cannot be conducted at the home institution are recommended to undergo a quarantine period upon their return.

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 annual repetitions of diagnostic tests as determined by the veterinarian. To prevent specific disease transmission, vaccinations should be updated as appropriate for the species.

**Vaccinations:** Vaccinations have been the mainstay of preventive medicine programs for both domestic and non-domestic cats. However, in recent years vaccine-induced neoplasia (Morrison et al., 2001) has become a concern in domestic cats and may be a concern in non-domestic felids (Larsen et al., 1998). To minimize tumorigenesis associated with vaccination of cats, it is best to allow all vaccines to acclimate to room temperature before administration. Additionally, there is species variation in immunologic response to vaccines, and thus vaccines may afford protection in one species but not another. The author knows of no experimental studies on the efficacy of vaccines in jaguars. Killed or recombinant vaccines should always be used in jaguars because modified live virus vaccines may cause vaccine-induced disease.

Vaccination schedules for non-domestic felids are based on recommendations for domestic cats. For neonatal jaguars a routine vaccination series may begin under veterinary supervision at between four and six weeks of age. The number of veterinary staff and associated sensory cues (smells, sounds, etc.) should be minimized. Boosters will be given every four weeks through a series of three injections. Domestic cats that received colostrum as neonates should be vaccinated every three to four weeks between 6 and 16 weeks of age. Colostrum-deprived neonates should be given two vaccinations administered on a three to four week interval starting at two weeks of age because maternal antibodies acquired in utero should be absent by four to six weeks of age (Davis-Wurzler, 2006). Adults that were never vaccinated when young should be vaccinated twice, three to four weeks apart. Yearly vaccine boosters may be advisable in non-domestic species for which data on antibody persistence post-vaccination are lacking. However, the risk versus benefit ratio between exposure to infectious agents and the possible development of vaccine-induced neoplasia should be taken into consideration when developing long-term vaccination policies for managed jaguars. In domestic cats, the recommended interval between vaccinations of core vaccines is one year following the initial vaccination series and then no more frequently than every three years (Richards et al., 2006).
In domestic cats, core vaccines include FPV, FHV-1, FCV, and rabies virus (Richards et al., 2006), which is similar for managed jaguars. The use of other vaccines should be based on specific risk categories. There are many brands of vaccines for use in felid species (Richards et al., 2006). Clinicians should only use killed or recombinant products and should be familiar with the vaccines they administer. Any adverse reactions should be reported to the AZA Jaguar SSP veterinary advisor so that this information can be disseminated to other institutions that house jaguars. Panleukopenia (feline distemper), rhinotracheitis, and calicivirus are the most common viral infectious diseases of domestic cats. All *ex situ* jaguars should be vaccinated against these three viral diseases using the killed vaccine (e.g., Fel-O-Vax®, Fort Dodge Lab Inc.).

**Rabies** is a highly fatal member of the rhabdovirus family requiring direct contact for transmission. All warm blooded animals are susceptible to clinical rabies disease. In the Americas rabies is endemic in many regions. All managed jaguars should be vaccinated against rabies using the killed vaccine (e.g., Imrab®, Merial Ltd). This (or any) rabies vaccine is NOT licensed for non-domestic felids. However, the compendium of animal rabies prevention and control states “Zoos or research institutions may establish vaccination programs which attempt to protect valuable animals, but these should not replace appropriate public health activities that protect humans” (Centers for Disease Control and Prevention, 2011).

Canine distemper virus (CDV) has been reported in all families of terrestrial carnivores. Since 1991, CDV infections have been reported in five species of free-ranging and *ex situ* felids from at least eight discontinuous sites, and epidemics in managed lions, tigers, leopards, and jaguars have been reported in the 1990s as reviewed in Deem et al., 2000. Although the AZA Felid Taxon Advisory Group does not recommend vaccinating managed non-domestic felids at this time, the canarypox-vectored CDV vaccine (e.g., PUREVAX®, Merial) has proven safe and effective in many nondomestic species. Additionally, there is a newly available Recombitek® CDV vaccine. However, the need exists for studies that may result in a better understanding of the safety and efficacy of any of the CDV vaccines in nondomestic felid species. Some zoos are currently using this vaccine in jaguars and other non-domestic felids in the face of CDV epidemics.

**Leptospirosis**, caused by a variety of *Leptospira interrogans* serotypes, is a potential problem in all mammals. There are many reports of significant morbidity and mortality in zoo collections. However, the disease does not appear to be a major problem in felid species. A killed vaccine (e.g., Leptoferm C-I®, Smith Kline Beecham) is available and has been used in some *ex situ* situations during leptospirosis epidemics. Unfortunately, limitations to this vaccine are the lack of cross protection for one serotype when vaccinated with a different serotype and the short lived (two to three months) immunity post-vaccination.

**Feline leukemia virus** is a major pathogen in domestic cats (associated with neoplastic and non-neoplastic disease) throughout the world. However, infection and resulting disease is rare in non-domestic felids. There is a killed vaccine (e.g., Leukocell®, Pfizer Animal Health) available for use in domestic cats but it is NOT recommended for use in non-domestic felids at this time.

**Feline immunodeficiency virus** is an often fatal and serious disease of domestic cats. However there is no clear correlation between virus infection and disease in non-domestic felids. A killed vaccine (e.g., Fel-O-Vax® FIV, Fort Dodge Lab Inc.) is available for use in domestic cats but is NOT recommended for use in non-domestic felids at this time.

**Feline infectious peritonitis** is a coronavirus that causes severe disease in both domestic and non-domestic cats. There is a commercial modified live virus vaccine (Felocell FIP, Pfizer Animal Health) marketed for domestic cats. Presently, this vaccine is NOT recommended for use in non-domestic felids due to questions about its safety and efficacy.

Vaccines should be used in conjunction with other preventive measures including limiting contact that managed jaguars have with free roaming wildlife and feral carnivores (domestic cats and dogs), good hygienic standards, and maintaining adequate nutrition and overall health of jaguars to ensure strong immune systems. Vaccination for protection against panleukopenia, rhinotracheitis, calicivirus, and rabies viruses should be routinely given to jaguars housed at AZA institutions. A dose of 1 mL (standard domestic cat dose) should be used in jaguars of all ages. Currently, the AZA Felid TAG does NOT recommend the routine use of canine distemper, feline leukemia, or feline immunodeficiency virus vaccines in jaguars and other non-domestic felids.
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).

The AZA Jaguar SSP recommends that member institutions develop and implement protocols to train staff members for safe capture and restraint of jaguars. Capture and restraint may be performed through a combination of training and chemical immobilization. Training jaguars to voluntarily enter into a squeeze cage can minimize the need for using blow pipes or dart guns to chemically immobilize the animal.

Chemical immobilization is necessary when performing more invasive veterinary procedures on a jaguar. Jaguars should be fasted for at least 24 hours prior to anesthesia and water should be withheld for at least 12 hours prior to anesthesia. Similar to other felids, anesthesia of jaguars is usually uneventful if proper drugs and techniques are used. However, the clinician should always be prepared for handling emergency situations (Kreeger & Arnemo, 2012; West et al., 2007) as these can and do arise. There are a number of anesthetic protocols that have been successfully used for free-ranging and managed jaguars. A review of these protocols can be found in Deem & Karesh (2005) and West et al. (2007).

Clinicians should be familiar with the drugs they choose to use and understand the risk and benefits associated with different anesthetic options. Telazol® can be used (4–8 mg/kg i.m.). A supplemental anesthesia can be ketamine at a dose of 1–1.5 mg/kg i.v. or 1–2 mg/kg i.m., as needed to maintain an adequate level of anesthesia. Although there has been debate as to whether Telazol® is a problem for tigers (Armstrong, 1990), there are no reports of adverse reactions to Telazol® in jaguars (Kreeger and Armstrong, 2010). Regardless, adverse reactions with any anesthetic protocols should be reported to the AZA Jaguar SSP veterinary advisor if they do occur.

Ketamine (4 mg/kg) and xylazine (2 mg/kg) i.m. have also been used in conjunction. Supplemental anesthesia should be ketamine at a dose of 1–1.5 mg/kg i.v. or 1–2 mg/kg i.m., as needed to maintain an adequate level of anesthesia. Yohimbine (0.125 mg/kg) should be delivered following anesthesia to reverse the effects of the xylazine.

Ketamine (2.5–4 mg/kg) and Medetomidine (50–70 mg/kg) i.m. is another combination that can be utilized. A supplemental anesthesia should be ketamine at a dose of 1–1.5 mg/kg i.v. or 1–2 mg/kg i.m., as needed to maintain an adequate level of anesthesia. Atipamezole (5 x medetomidine dose) i.m. should be delivered following anesthesia to reverse the effects of the medetomidine.

For any of these protocols, atropine (0.04 mg/kg) or glycopyrrolate (0.01–0.02 mg/kg) can be administered as a single dose either subcutaneously or intramuscularly if the cat has excessive salivation.

Anesthesia is best maintained under zoo management (and increasingly so in the wild if longer term anesthesia is necessary) by providing isoflurane or sevoflurane via endotracheal tube. Maintenance levels usually are 0.5–3% but may need to be adjusted based on careful monitoring of the plane of anesthesia.

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.

Jaguar 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. Hospital facilities for jaguars must have radiographic equipment or access to
radiographic 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. Non-domestic felids may hide signs of illness until a disease is advanced. In managed settings, it is important that animal care staff be astute to subtle changes in behavior or physiologic signs that may suggest illness. Keepers that have daily contact with jaguars 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 jaguar 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 (normal breathing rate is 8–24 bpm). Other physiologic parameters like temperature (normal temperature is 37–39.50 °C [98.6–103.10 °F]) and pulse (normal pulse is 70–140 bpm) require handling the animal. Jaguar keepers noticing signs of illness should follow the protocol set forth by their institution for proper reporting of health concerns.

Non-infectious diseases: There are a number of diseases documented in the literature that occur in managed jaguars. A retrospective study on the morbidity and mortality of jaguars in AZA zoos from 1982–2002 (Hope & Deem, 2006) provides a good review of these diseases. Non-infectious diseases include a high incidence of neoplasia which may be species related but also associated with husbandry under zoo management and/or longevity. Dental issues including calculi and tooth fractures are also commonly seen in managed jaguars. Laceration, with or without subsequent abscess formation, can also be a problem in managed jaguars. Kidney and musculoskeletal diseases occur in jaguars, as in other large cat species, especially as they age.

Jaguars appear to be uniquely predisposed to develop gynecological cancers. A high prevalence of ovarian, endometrial, and mammary gland cancers have been identified in managed jaguars through the AZA Contraceptive Advisory Group Contraceptive Health Surveillance program. Although other felids also develop mammary gland cancer and endometrial cancer, the risk is considerably higher in jaguars. Also, jaguars are the only felid to date to have documented ovarian cancer, and it affects more than 50% of the aged population. This combination of ovarian, uterine, and mammary cancers is linked to a genetic mutation in humans, which is of concern for the AZA Jaguar SSP. Therefore, a study supported by the SSP is being conducted to better understand the role that BRCA gene mutations may have in the high prevalence of reproductive tract related neoplasias in jaguars. For these studies, the SSP requests frozen tissues from both affected and unaffected jaguars and complete (intact) formalin-fixed reproductive tracts from all jaguars that are ovariohysterectomized (spayed) or that die (see appendices for forms). Frozen tissues for genetic analyses should include small samples of any tumor, the heart, the spleen, and skeletal muscle.

Infectious diseases: Many infectious agents have been documented to cause morbidity and/or mortality in jaguars including protozoan (Cirillo et al., 1990), bacterial (Abdulla et al., 1982) and viral pathogens (i.e., canine distemper virus, feline infectious peritonitis) (Appel et al., 1994; Fransen, 1973). It is also assumed that jaguars are susceptible to the common respiratory disease agents of domestic and non-domestic cats. Additionally, there is serologic evidence of infection with canine distemper and feline immunodeficiency virus (Appel et al., 1994; Barr et al., 1989; Brown et al., 1993; Deem, 2001). Since there is insufficient data on the epidemiology and pathogenicity of FIV in jaguars, it is important to test all managed jaguars for FIV-specific antibodies, and, if possible, all sero-positive animals should be housed separately from uninfected animals.

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

AZA-accredited zoos and aquariums provide superior daily care and husbandry routines, high quality diets, and regular veterinary care, to support jaguar 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 jaguars both in their care and in the wild. As stated earlier, necropsies should be conducted on deceased jaguars to determine their cause of death, and the subsequent disposal of the body must be done in accordance with local, state, or federal laws (AZA Accreditation Standard 2.5.1). 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 from 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 Jaguar SSP Program approved active research requests that could be filled from a necropsy.

There are currently no recommended euthanasia protocols for jaguars, and the AZA Jaguar SSP recommends that member institutions work with their staff veterinarian to develop and implement institutional guidelines for the humane euthanasia of jaguars. The AVMA guidelines on euthanasia (AVMA, 2013) should be consulted for protocols that apply to non-domestic felid species.

Important diseases affecting population viability are detected or confirmed through performing a complete necropsy and comprehensive histopathology on individual animals, and consulting with the AZA Jaguar SSP Veterinary Advisor. Currently, the principal concern in jaguars is the high prevalence of cancers, particularly those of the reproductive tract and mammary gland. However, vigilance is important if emerging diseases are to be detected in the population. Currently there are no funds available for a formal pathology survey by the AZA Jaguar SSP. The SSP is recommending: 1) a complete necropsy be performed on any animal that dies, 2) a complete set of tissue samples be fixed and archived for the SSP (see Appendix K for the protocol), 3) the reproductive tract and selected frozen samples be sent to the AZA Jaguar SSP Veterinary Advisor (see Appendix K for instructions), 4) each zoo veterinarian decide what tissue samples to submit for histopathology, and 5) the final necropsy report be submitted to the AZA Jaguar SSP Veterinary Advisor.
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. Zoos have held jaguars for many years, but still relatively little is known about their reproductive characteristics. There is still a great deal to learn about reproduction and the factors that influence its success. There is information on genetic status of jaguars throughout Mexico and Latin America. Mitochondrial DNA from 44 managed individuals (mostly of wild-born origin) suggests that there is less genetic diversity than found in ocelots and margays, but nonetheless significant gene flow within the jaguar as a species (Eizirik, et al., 1998; Johnson, et al., 1998; Johnson et al., 1999; Eizirik et al., 2001). Eizirik, et al., recognized up to four phylogeographically isolated populations (Mexico and Guatemala, southern Central America, northern South America [north of the Amazon], and southern South America [south of the Amazon]). However, there was insufficient genetic distinction to designate subspeciation. There is a need to add more individuals to this database. These authors have advocated developing coordinated wild and ex situ management plans to avoid gene flow across these geographic barriers for the time-being, particularly between the southern and northern South American populations (Eizirik et al., 2001). The AZA Jaguar SSP manages the jaguar population as a monotypic species.

In zoos, females reach sexual maturity between the ages of 12–24 months. The estrus cycle is 37 days, and the estrus length is 6–17 days (Wildt, Brown & Swanson, 1998). Estrus can be detected by behavioral cues, such as lordosis, flehmen, vocalization, rolling, and increased scent marking. Hormone levels can be detected non-invasively by the collection and analysis of feces and urine for estrogen and progesterone metabolite concentrations (Brown & Lopez Gonzales, 2001). Males generally are sexually mature at the age of 24–36 months (Association of Zoos and Aquariums, 2013).

Data from the AZA North American Regional Studbook for jaguars also sheds some light on lifetime trends in reproduction. In a sample size (n) of 110 known first-time mothers, the average age at first reproduction for females under human care in North America is 4.7 years, with the youngest age for a first litter at 2 years and the oldest mother reliably recorded to deliver a first litter being 20.5 years old. The average age of the mother for all zoo-bred litters is 6.7 years (n=381). For males, the average age to sire a first litter (n=101) is 5.9 years, with the youngest and oldest first-time sires recorded at 1.6 and 21.1 years, respectively. The average sire’s age (n=339) is 5.4 years.

Births peak for jaguars in North American institutions (Canada, United States, and Mexico) in June at 14% of the annual average total, while the lowest monthly average was November, 6%. However, the median number of birth events (n=513) per month over an 88-year period was 43, but this value ranged between 33 and 70 (Figure 6) (Association of Zoos and Aquariums, 2013).
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Association of Zoos and Aquariums

Figure 6. *Ex situ* jaguar births in North America, sorted by month, from 1927 through 2013 (Association of Zoos and Aquariums, 2013).

For wild jaguars, reproductive information recorded is quite similar to what has been recorded in zoos. Across the entire geographic range, jaguar births have also been recorded in every month of the year (Ewer, 1973). Rabinowitz (1986a) reports a peak birthrate in Belize between June and August, while Quigley and Crawshaw (2001) describe them giving birth between March and June in the Southern Pantanal. In both wild cases, higher birthrate correlates to greater availability of prey at that time of year.

Males may show a slight seasonality in androgen levels throughout the year. Like the females, the reproductive hormones of wild males appear to increase during the receding of the floodwaters, and are probably linked to increased abundance of prey (Morato *et al.*, 2004).

Females reach sexual maturity at one to two and a half years of age (Tewes & Schmidly, 1987). Males reach sexual maturity at three to four years of age (Ewer, 1973). Females in estrus can exhibit behaviors including restlessness, pacing, rolling, and prolonged vocalizations (Stehlik, 1971). Once a female enters estrus, she may venture outside the normal home range and as a result be courted by several males (Nowak, 1991).

Gestation takes between 93 and 105 days, tending toward 100 days. At birth, an average jaguar cub measures approximately 40 centimeters in length and weighs between 700 and 900 grams, although this varies with the health status of the mother and the number of cubs born. In zoos, the cubs’ eyes are often open on the first day and almost always by the third. They are walking clumsily by three weeks of age and able to follow their mother outdoors by two months. At approximately 10 weeks they begin to consume some meat and are nursing infrequently, if at all, by age six months (Seymour, 1989).

Average litter size in zoos is 1.7 cubs. Singleton litters represent 45.3% of zoo births, followed by two-cub litters at 39.9%. Three cubs are produced in only 14.2% of litters; and four cubs are born 0.6% of the time. Litter sizes larger than four have not been recorded (Association of Zoos and Aquariums, 2013). This corresponds fairly closely with Rabinowitz’ observations of jaguar cubs in Belize (Seymour, 1989): in 23 sightings of mothers with offspring, there was a single cub 35% of the time, two cubs 53% of the time and three cubs 13% of the time. Also similar to zoo management experience, wild offspring have been observed traveling with their mothers for up to two years, but occasionally may become independent before one year of age.

The most accurate method of characterizing female reproductive activity is through a longitudinal assessment of ovarian hormones. This evaluation can be conducted non-invasively by analyzing steroid metabolites excreted in feces. Fecal samples can be collected, and ovarian (estrogen and progesterone), and adrenal (corticoid – as an index of stress) steroid metabolites analyzed. These data are most useful if
additional data on behavioral, environmental, and nutritional changes of the jaguar are taken throughout the evaluation period. For information on collecting, labeling, storing, and sending fecal samples to the National Zoo for analysis, see the AZA Jaguar SSP “Guidelines for Captive Management of Jaguars” (Law, 2009). Confirmation of pregnancy can be obtained by ultrasound, which requires anesthesia, or by analyzing fecal and urine levels of progesterone with radio- or enzyme-immunoassays.

Semen collection under anesthesia is an accurate method of gaining information on male fertility. As with all anesthetic events, food should be withheld for at least 24 hours and water for 12 hours before anesthesia induction. Some anesthesia protocols will increase the chances of urine contamination in semen samples due to relaxation of the bladder. The recommended anesthetic for use in jaguars for semen collection is Telazol, dosed at 6–8 mg/kg. Supplementation with ketamine is acceptable, but isoflurane increases chances of urine contamination, and its application should be delayed until after semen collection. For semen collection and evaluation, after reaching a surgical plane of anesthesia, each testis is measured as described in Howard, 1993, and a combined testicular volume calculated. The penis is extruded from its sheath and examined for the presence of spines (scale of 1-3, 3 = most prominent spines [Swanson et al., 1995; Morato et al., 2001]). Sperm is collected and evaluated by measuring: 1) semen volume, sperm count, motility, and forward progressive status; 2) proportions of normal and abnormal sperm forms, all via phase microscopy (630x) [Howard et al., 1990] and 3) acrosomal integrity using the rose bengal/fast green stain (Pope et al., 1991). Sperm can be collected by electro ejaculation (Morato et al., 1999; Morato et al., 2001). Semen is usually very dilute (~5 x 106/ml) but large volumes are generally recovered (up to 20 ml) (Swanson et al., 1995; Morato et al., 2001; Morato et al., 2003). Jaguars are normospermic (average ~65% normal) and survive cryopreservation relatively well (Morato et al., 2003). Reproductive traits of Latin American managed males (i.e., sperm concentration, motility and morphology) have been found to be inferior to counterparts living in North American zoos (Swanson et al., 1995) and freshly captured conspecifics (Morato et al., 2001).

Differences were unrelated to seasonal or weather factors, but appeared to be associated with poor health and nutrition in the ex situ population (Swanson et al., 1995; Morato et al., 1999; Morato et al., 2001).

Artificial insemination has not been successful in the jaguar as far as we know, so all breeding has been natural. Anecdotally, breeding success seems to increase when jaguars are separated for a period of time leading up to estrus. Cats that have been housed together for long periods may not be as apt to copulate. See Section 5.3 Introductions and Reintroductions for a discussion of animal introductions. Most large felids are solitary in nature except during periods of breeding activity. As a result, extreme caution and patience is recommended during introductions to facilitate pairings. Compatibility between animals can be achieved through extended, controlled introductions in a night house shift area, or adjacent enclosure, which allow auditory, olfactory, and visual contact, but prevent actual physical contact. Utilizing such “howdy” barriers, an introduction schedule can be set up over a period of days or weeks to gradually reduce them until the animals are introduced into the same space. Safe measures to separate the cats, such as water hoses or CO2 fire extinguishers, are recommended to be available in case of aggression. Prior to the introduction, male and female jaguars can be housed in adjacent enclosures without visual contact, but with olfactory and auditory contact. Further olfactory contact can be provided by allowing each animal out into the exhibit on alternate days. This allows each cat to be aware and investigate the presence of another jaguar nearby through olfactory recognition of marked spots and other deposits in the exhibit (AZA Jaguar SSP Management Group and Advisors, personal communication, 2014).

With anecdotal justification, male jaguars in zoos have the reputation for ferocity and unpredictable behavior (Rabinowitz, 2014). However, jaguars bred in North American zoos since the 1990s have demonstrated certain fairly predictable reproductive behaviors. When the male is introduced to a landscape already held by the female, his approach is often cautious. The female may, or may not, present herself for copulation, but, even if she does not, she will often turn on the male growling and snarling. If the pair is unfamiliar with one another, the female usually strikes at the male with her forepaws and may deliver wounds that draw blood. If this is already a compatible pair, this behavior may be gentler and even playful. Regardless, it is conjectured that the female assesses the male’s fitness in these encounters—expecting him to return and attempt copulation again. If he is ultimately accepted, the male mounts the female, grasping her neck in his jaws, and mating is completed in a few seconds. The male quickly dismounts and usually is driven off, yet again, by the female. This pattern is repeated, often
scores of times daily, during a two- or three-day period before she no longer accepts his advances at all (S. Johnson, personal communication, 2015).

The following describes a successful introduction at one AZA institution. Prior to initial introduction, the male and female jaguars were housed next to each other for a few days without visual contact. They could, however, hear and smell one another. The jaguars alternated days on exhibit before they were introduced. This permitted each cat to be aware and investigate the presence of another jaguar nearby through olfactory recognition of marked spots and other deposits in the exhibit. The introduction was not conducted until the female was in estrus. She vocalized, neck-rubbed on various parts of the exhibit, frequently rolled on her back and displayed lordosis posture at this time. Four people were stationed around the outside of the exhibit with CO₂ fire extinguishers and water hoses in case the animals needed to be separated. Each was instructed to allow aggressive or defensive physical contact lasting up to 30 seconds before attempting to separate the cats. It was also recommended that aggression initiated by the female be allowed as long as no serious injuries occurred. The female was released into the exhibit first. When she found a resting spot after her normal patrol of the exhibit, the male was introduced. No aggression was shown by either cat, although the female dominated the encounter by baring teeth and swatting with forepaws when the male attempted to approach from her rear. The jaguars were monitored continuously throughout their first day together on exhibit. Fire extinguishers were kept in easily accessible locations for the first week thereafter. The animals continued to be housed separately when off exhibit. During the first week, keepers noted in daily reports that the male was receiving numerous superficial bite and scratch marks, although the female had none. Copulation was first observed thirteen days after introduction. The female displayed estrus behavior lasting eight to nine days, beginning every four weeks. The first indication of possible pregnancy occurred when normally obvious estrus behavior failed to occur in the fourth month after they had been together. As this jaguar’s cycle had previously been very regular, a second skipped estrus behavior period led us to conclude that she was pregnant (Flores, Pavlik, & Volk, personal communication, 2003).

8.2 Assisted Reproductive Technology

Scientific interest in developing assisted reproductive technology for jaguars exists but, to date, no published information documents its successful implementation. The relative success of natural breeding by the SSP, combined with logistical obstacles to scientific development of an artificial insemination protocol for jaguars, has precluded its urgent prioritization (S. Johnson, personal communication, 2016).

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

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

Besides physical issues, AI procedures also bring issues of ownership of semen and/or the animal being inseminated. Very often, 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.

If natural mating is not an option because of behavioral incompatibility or location, assisted breeding techniques can be used to achieve recommended breeding. However, artificial insemination has not yet been achieved in jaguars, and additional research is required. For non-domestic carnivores, generally, the process requires semen collection (and possibly freezing) and administering the female with exogenous hormones to induce ovulation. Finally, females should be anesthetized for laparoscopic
insemination (Howard et al., 1992). If genetic material is required from individuals that cannot be imported, embryos can be produced in situ, cryopreserved, imported, and implanted into generic females in the target country/population. Artificial insemination is routinely used as a meta-population tool in many species.

Generally, artificial insemination would be employed to inseminate females with sperm from recommended males that are aggressive, or are at a different facility (either nationally or internationally). Assisted reproduction technology has been a topic of interest to several researchers in recent years, although a successful artificial insemination protocol has not yet been developed for jaguars. Embryo transfer has been successful in several cat species (Donoghue et al., 1990), but not jaguars as yet. The availability of AZA Jaguar SSP animals to participate in a study will be very important in undertaking the necessary research and trials.

8.3 Pregnancy and Parturition

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

Gestation period is generally 93-105 days, and litter size is one to four cubs. Confirmation of pregnancy can be obtained by ultrasound (requiring anesthesia) or fecal and urine levels of progesterone by radioimmunoassay or enzyme-immunoassay. Appendix L contains the protocol for labeling and sending fecal samples for fecal steroid analysis. The physical appearance of a pregnant jaguar may not visibly change until very near parturition, if it changes at all. As jaguars are a heavy-bodied cat normally, weight gain may simply not be apparent. Behaviorally, the most reliable indicator of pregnancy is the absence of a monthly estrus cycle. This, too, can be deceptive because the jaguar only skips two cycles prior to giving birth. For nutritional recommendations during pregnancy, refer to Chapter 6.

Like most carnivores, jaguars are secretive normally, and this tendency is often intensified in late-term pregnancy. Pacing, stereotypic behaviors, agitation, and attempts to hide or avoid interaction with keepers have been observed. Likewise, it is possible that a pregnant jaguar may become aggressive or, at the other end of the spectrum, appear to stare through people and animals unresponsively. These indicators of stress are not exclusively related to pregnancy, however.

Without endangering staff, the mother, or cubs, little can be done directly to intervene when difficulties in parturition or rearing occur. In such cases, the choice is usually binary: allow the mother to do her best unaided, or pull the cubs for hand-rearing. Thus, the best method of dealing with problems is to minimize stressors and to condition the animal(s) to accept their caretakers’ presence and interaction.

The dam should be conditioned to accept isolation and an altered feeding regimen at least two weeks prior to the earliest due date. In order to establish a consistent routine, only one keeper should be assigned to care for the jaguars beginning no less than one week prior to the earliest due date. Alternatively, two keepers can be assigned, providing alternate coverage to allow for days off or other absence. Only in emergencies should anyone else enter the jaguar night house after this time. During the week before parturition, and for at least the first week after, foot and vehicle traffic around the den building should be monitored and severely limited. Starting 10–14 days before the earliest due date, the birthing facilities should be prepared. It is recommended that animal care staff should have on hand a den box and video surveillance equipment and should be cognizant to minimize sights, sounds, and disturbances (Volk, Pavlik & Flores, 2003). For more information on birthing facilities, see Section 8.4.

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 “baby-proofed.” A recommended timeline for management and veterinary protocols for jaguar cubs can be found below in Table 15.

The dam should be conditioned to accept isolation and an altered feeding regimen at least two weeks prior to the earliest due date. Starting 10 to 14 days before the earliest due date, enclose dam’s bedroom caging with plywood, from floor to about one foot from the ceiling. The space is to allow ventilation and light. Complete this enclosure in stages over a period of at least one week. To establish a consistent routine, assign only one keeper to care for jaguars beginning no less than one week prior to earliest due date. Another recommended option would assign two keepers, providing alternate coverage to allow for days off or other absence. Only in emergencies should anyone else enter the jaguar night house after this time. Introduce bedding (e.g., hay or shavings) to allow the dam to hide cubs if she is nervous. However,
monitor closely for ingestion of bedding and prepare to remove it if necessary. Construct a den box with at least five completely enclosed sides, and a threshold on the sixth side that will prevent cubs from immediately wandering. Ensure that significant effort would be required by the jaguar to dismantle this den box. As on any animal enclosure, leave no sharp points or edges anywhere the animal might reach them. This should be done at least two days prior to the earliest due date to allow for acclimation and so as not to be caught off-guard by an early birth (Volk, Pavlik & Flores, 2003).

During the week before parturition and for at least the first week after, monitor and severely limit foot and vehicle traffic around the den building. After parturition, visually check the health of the cub(s) with as little invasion of the cats’ space as possible. Video monitoring is preferred, but if that is impossible it is recommended to wait 24 to 36 hours after birth to physically enter the den when the mother has been shifted outside to defecate, urinate and/or be fed. Disable and empty automatic water sources. Supply drinking water in areas inaccessible to cubs, or in containers small enough not to be a drowning hazard to them. This poses a risk of dehydration to the dam. Observe her for defecation and urination regularly. Ensure that her drinking water supply is adequate. Food need not be offered on the date of parturition, but when it is offered the diet should be placed to easily retrieve any uneaten portion. If cubs seem healthy and cared-for by the mother, do not enter the den area/bedroom for the first three days. Manage the dam’s food and water intake by shifting her outside for exercise and feeding.

On day three, request a veterinary examination and weigh the cubs. It is important to use gloves and to rub jaguar feces or soiled hay on them to mask any unfamiliar scent. Identify the sex of the animal(s) and check for normal physical development and condition. If possible, permanently identify the cubs with microchip transponders. Weigh the cubs weekly for as long as it is practical. Clean the bedroom/den area only as absolutely necessary during the first two weeks of the cubs’ life. At two weeks, begin reintroducing all normal keeper staff to the jaguar areas. At three weeks, begin routine daily cleaning of the bedroom but take care not to establish a wet environment. Also at three weeks, begin giving the dam access to the exercise yard throughout the day — depending on outdoor weather and temperature conditions. Between four and six weeks of age, under veterinary care, begin routine vaccination series. Minimize the number of veterinary staff and associated sensory cues (smells, sounds, etc.) Boosters will be given every four weeks through a series of three injections. At four weeks begin introducing novel items to the holding yard and den that will stimulate the cubs to varying conditions. Use extreme caution in choosing items that are not a potential hazard to cubs. At around two weeks after the second vaccination, or when she appears completely comfortable, allow the dam daily access to the exhibit and den area. If she chooses to move the cubs, simply monitor the activity without forcing any behavior.

After the first round of vaccinations, and for as long as is practical, separate the cubs from the dam for at least one hour each day and handle the cubs. Gradually introduce all the animal staff that will be involved in their long-term management and care. The purpose of this activity is to familiarize the animals with human activity and contact, NOT to tame them.

Until cubs are large and coordinated enough to easily navigate doors and transfer chutes, it is recommended to keep them in bedrooms and off-display holding areas. It is unpredictable, at best, to rely on the mother to carry cubs on and off exhibit on cue. It is probably reasonable to begin training efforts to condition cubs to move between den area and exhibit at between eight and 12 weeks of age. Expect to go hands-off with the cubs as early as 90 days of age. By the time they are weaned, jaguars are capable of inflicting substantial injuries. Their strength combined with predatory or even play behavior pose serious risk well before six months of age and all unprotected contact is discouraged by that age (Jaguar SSP Management Group and Advisors, personal communication, 2014).

Table 15. Recommended timeline for establishing management and veterinary protocols for jaguar cubs.

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<thead>
<tr>
<th>Day</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–14</td>
<td>Clean the bedroom/den area only as absolutely necessary</td>
</tr>
<tr>
<td>3</td>
<td>Request a veterinary examination and weigh the cubs. Identify the sex of the animal(s) and check for normal physical development and condition. Permanently identify the cubs with microchip transponders.</td>
</tr>
<tr>
<td>14</td>
<td>Begin reintroducing all normal keeper staff to the jaguar areas.</td>
</tr>
<tr>
<td>21</td>
<td>Begin routine daily cleaning of the bedroom, but take care not to establish a wet environment. Begin giving the dam access to the exercise yard during the day — depending on outdoor weather &amp; temperature conditions.</td>
</tr>
<tr>
<td>28</td>
<td>Begin introducing novel items to the holding yard and den that will stimulate the cubs to varying conditions. Use extreme caution in choosing items that are not a potential hazard to cubs.</td>
</tr>
</tbody>
</table>
28–42 Under veterinary care, begin routine vaccination series. Minimize the number of veterinary staff and associated sensory cues (e.g., smells, sounds, etc.). Boosters should be given every 4 weeks through a series of three injections.

~70 When she appears completely comfortable, allow the dam daily access to the exhibit and den area. If she chooses to move the cubs, simply monitor the activity without forcing any behavior.

~90 Begin hands-off management of jaguar cubs.

8.5 Assisted Rearing

Although mothers may successfully give birth, there are times when they are not able to properly care for their offspring, both in the wild and in ex situ populations. Fortunately, animal care staff in AZA-accredited institutions are able to assist with the rearing of these offspring when deemed necessary.

Jaguar mothers may not adequately care for their young due to various factors like aggression, refusal to nurse, poor lactation, lack of attention or rejection, or medical issues of the mother. If it is necessary, staff may provide total care and rearing or supplemental feedings with the cubs returned to the mother afterwards. Jaguars are strongly individualistic, so no formula exists for such reintroductions. However, similar to most animal introductions, it is probably best to gradually acclimate the animals to the sight, smell, and sounds of one another prior to permitting physical contact of any kind. Observation of their responses to others’ presence (e.g., attempts to groom, relaxed or inquisitive postures versus bared teeth, hissing or paw-slappling) will be strong indicators of potential success. Some risk will always be present in these situations; and eventually a subjective decision will be required on whether, or not, to proceed (AZA Jaguar SSP Management Group and Advisors, 2014).

No data currently exist on the composition of jaguar milk, and only limited information is available on the composition of milk for other cat species. The nutrient content of milk of the domestic cat, cheetah, lion, lynx, and puma is compared to some milk replacers in the following table (Table 16).

Table 16. The nutrient content of milk of several cat species compared to available milk replacers on a dry matter basis (Jenness & Sloan, 1970)

<table>
<thead>
<tr>
<th>Species</th>
<th>Protein %</th>
<th>Fat %</th>
<th>Carbohydrate %</th>
<th>Dry matter %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheetah (Acinonyx jubatus)</td>
<td>39.7</td>
<td>40.1</td>
<td>14.8</td>
<td>23.7</td>
</tr>
<tr>
<td>Lion (Panthera leo)</td>
<td>30.8</td>
<td>57.9</td>
<td>11.2</td>
<td>30.2</td>
</tr>
<tr>
<td>Leopard (Panthera pardus)</td>
<td>49.1</td>
<td>28.8</td>
<td>18.6</td>
<td>22.6</td>
</tr>
<tr>
<td>Puma (Puma concolor)</td>
<td>33.8</td>
<td>52.4</td>
<td>11.0</td>
<td>35.5</td>
</tr>
<tr>
<td>Lynx (Lynx lynx)</td>
<td>47.0</td>
<td>28.6</td>
<td>20.7</td>
<td>21.7</td>
</tr>
<tr>
<td>Domestic cat (Felis catus)</td>
<td>42.2</td>
<td>25.0</td>
<td>26.1</td>
<td>18.2</td>
</tr>
<tr>
<td>KMR®</td>
<td>42.2</td>
<td>25</td>
<td>26.1</td>
<td>18.2</td>
</tr>
<tr>
<td>Milk Matrix® 42/25</td>
<td>43.4</td>
<td>29.0</td>
<td>18.6</td>
<td>32.5</td>
</tr>
<tr>
<td>Esbilac®</td>
<td>33.2</td>
<td>43.0</td>
<td>15.8</td>
<td>15.2</td>
</tr>
<tr>
<td>Milk Matrix® 33/40</td>
<td>34.0</td>
<td>42.9</td>
<td>15.6</td>
<td>32.7</td>
</tr>
</tbody>
</table>

Mother’s milk will vary depending on stage of lactation (Oftedal, 1984), and it is not known at what stage during lactation the measures in Table 16 were taken. However, these values may provide a range which can be used as a reference. For more complete information on hand rearing diets see the AZA Infant Diet Notebook (Meehan, 1994). For an extensive review of milk composition see Oftedal (1984). Most institutions rearing jaguars use the KMR® formula, although Esbilac® and Milk Matrix® 33/40 can be effective and have a carbohydrate content more similar to the range for exotic species. A product such as Lactaid® can be added to formulas to assist with carbohydrate digestion.

The amount to feed should be based on body weight, as frequent adjustments to the amount fed based on body weight leads to a more consistent growth rate (Law, 2009). Cubs that are being hand reared should be weighed daily, or at least twice a week, and should be weighed at the same time of day to allow accurate comparison of weight over time. Weighing before or after feeding can significantly affect the weight. A general feeding amount for cats is 20% of body weight per 24-hour period. It appears that the maximum stomach capacity for carnivores may be 5–7% of body weight. Consequently, to feed 20% of body weight, a minimum of 5–7 feeds should be offered. Possible gastrointestinal tract stress can be avoided if the cub is not allowed to consume large volumes or inconsistent amounts. Animals should not be fed as much as they will take; this often leads to overfeeding and diarrhea. Refer to the Reproduction and Growth sections of Chapter 6 for additional information.
In general, felids of the genus *Panthera* nurse well from human nursing bottles. Preemie nipples or cross cut normal nipples can also be used. A wide selection of nipple types and openings should be available because some trial and error may be needed to find the best type to use with each individual cub. Bottles and bowls should be cleaned and sanitized between feedings. After cleaning, bottles can be boiled to avoid contamination from the environment. Formula left over at the end of a 24-hour period should be discarded. A detailed nursery log should be kept, recording date, times fed, amount fed, body weight, urination/defecation, stool condition, remarks/notes. See Appendix G for an example.

Solids can be introduced at 5 to 6 weeks in the form of a nutritionally complete canned cat food or a blended nutritionally complete raw meat diet. By this time, the cubs should be consuming formula from a bowl. The blended canned or raw meat diet can be added to the formula in the bowl. If canned cat food is used, it will need to be mixed with the raw meat diet and gradually decreased and removed over time. The benefit to using a canned diet initially is to delay microbial introduction to the cub’s gastrointestinal tract. However, several species have been weaned directly onto raw diets without apparent ill effects. At this time, the formula amount can begin to decrease as a percent of body weight. Complete removal of formula can be attempted as early as 7.2 weeks and as late as 11 weeks (AZA Jaguar SSP Management Group and Advisors, 2014).

### 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.

The AZA Jaguar SSP works closely with the AZA Reproductive Management Center (RMC) and recommends following the RMC’s recommendations for best practices in jaguar contraception. Gonadotropin releasing hormone (GnRH) agonist (e.g., Suprelorin® (deslorelin)) implants achieve contraception by suppressing the reproductive endocrine system, preventing production of pituitary (FSH and LH) and gonadal hormones (estradiol and progesterone in females and testosterone in males). The observed effects are similar to those following either ovariectomy in females or castration in males. GnRH agonists first stimulate the reproductive system, which can result in estrus and ovulation in females or temporary enhancement of testosterone and semen production in males. Then, down-regulation follows the initial stimulation. It is important to suppress the stimulatory phase to prevent the sustained elevation of progesterone following ovulation, which can cause mammary and uterine pathology. The stimulation phase can be suppressed by daily Ovaban® (megestrol acetate) administration for one week before and one week after implant placement (Wright et al., 2001). Suprelorin® should not be used during pregnancy, since it may cause spontaneous abortion or prevent mammary development necessary for lactation. It may prevent initiation of lactation by inhibiting progesterone secretion, but effects on established lactation are less likely. New data from domestic cats have shown no effect on subsequent reproduction when treatment began before puberty.

A drawback of Suprelorin® is that time of reversal can be quite variable. The most widely used formulations are designed to be effective for a minimum of either six or twelve months, but the actual time of suppression can be longer in some individuals. Preliminary results indicate that removing the implants can hasten reversal. Information for placing implants to facilitate removal can be found at [www.stlzoo.org/contraception](http://www.stlzoo.org/contraception). Although Suprelorin® can also be an effective contraceptive in males, it is more commonly used in females because monitoring efficacy in females by suppression of estrus behavior or gonadal steroids in feces is usually easier than ensuring continued absence of sperm in males because most institutions cannot perform regular semen collections. If it is used in males, the disappearance of sperm from the ejaculate following down-regulation of testosterone may take an additional six weeks, as with a vasectomy.

Melengestrol acetate (MGA) implants were previously the most commonly used method in jaguars and other felids. Other synthetic progestins include Depo-Provera® (medroxyprogesterone acetate) injections and Ovaban® (megestrol acetate) pills. Although MGA has proven effective in felids, possible side effects include uterine and mammary pathology. Studies by Dr. Linda Munson in the 1990’s found a correlation between MGA use for more than four years and the prevalence of mammary and uterine pathology including cancer in jaguars and other felids. Other progestins are also very likely to cause
these same side effects, although data are not available for all of them. An important disadvantage of Depo-Provera® is that, in addition to potential progestin-related side effects, time to reversal can be up to two years. Ovaban® is not a good option either, because effective contraceptive dosages have not been established, and it has to be administered reliably every day to be effective, so is not practical for most individuals.

If progestins are going to be used, they should be administered for no more than two years and then discontinued to allow for a pregnancy. Discontinuing progestin contraception and allowing non-pregnant cycles does not substitute for a pregnancy. Use of progestins for more than a total of four years is not recommended. MGA implants last at least two years, and clearance of the hormone from the system occurs rapidly after implant removal. Progestins are considered safe to use during lactation. Additionally, the porcine zona pellucida (PZP) vaccine may cause permanent sterility in felids after only one or two treatments. This approach is not recommended.

For individual jaguars unlikely to receive a breeding recommendation, permanent sterilization by ovariohysterectomy for females or castration for males may be the best option.

Although blocking access of sperm to eggs via tubal ligation will prevent fertilization, it will not prevent the potential adverse effects to females that can result from prolonged, cyclic exposure to the endogenous progesterone associated with the pseudo-pregnancy that follows ovulation induced by copulation. This method is not recommended for jaguars.

Separation, another option for contraception, has recently been called into question because repeated non-conceptive cycles have been associated with subsequent reproductive failure and uterine pathology in cheetahs (Crosier et al., 2011; Hermes et al., 2006) and canids (Asa et al., 2014). Comparable research hasn’t been conducted with jaguars, but the outcomes would likely be similar. Given the lack of good alternatives for jaguars, separation may be the preferable option among potentially reversible approaches.

Because it has become clear that regular reproduction may be necessary to maintain fertility in carnivores and perhaps in other taxa as well, Lifetime Reproductive Planning is being developed for females. This plan advocates allowing reproduction soon after puberty to establish fertility, and then allows breeding again at least every 2 to 3 years to maintain fertility. Because of the potential effects of this strategy on demographics and gene diversity, modeling is underway using representative carnivore species to explore the effects of various breeding strategies (K. Traylor-Holzer, personal communication, 2014).

Reproductive management does not end with the life of the animal. Many of the jaguars in zoos worldwide are valuable, but, even when individuals are not considered valuable; their reproductive tracts can provide essential information to help us determine reproductive requirements of the jaguar.

Contraceptive choices for jaguars and other carnivores are limited and all have disadvantages. Results to date indicate that the method that is safest (Suprelorin® implants) has an unpredictable time to reversal, whereas the methods that are more reliably reversible (e.g., MGA implants) carry a high risk of uterine and mammary pathology. Research efforts are focused primarily on improving reversal predictability for Suprelorin® (e.g., by removing implants and using hormone monitoring to better understand the reversal process). More details on each contraception method and ordering information can be found at www.stlzoo.org/contraception (AZA Jaguar SSP Management Group and Advisors, personal communication, 2014).
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 (US) that evokes an innate, often reflexive, response. 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).

Among the big cats, jaguars have proven to be not only highly intelligent, but intensely focused personalities. They possess a great aptitude for training with quick reactions, high energy, heightened food motivation, and an amazing tactile response, not hesitating to use their feet to reach, slap, or grab. Their intelligence and focus, combined with a keen curiosity, directly contribute to their trainability in a zoo setting. Nearly all zookeepers are communicating every day in a positive way with the animals in their care to achieve a desired behavior. Shifting in and out of exhibit or from one bedroom to the next are examples. In more recent years, using the positive reinforcement training techniques that are defined in *Don’t Shoot the Dog* (Pryor, 1999), jaguars have excelled in more formalized simple and complex trained behaviors.

Very often training begins by teaching verbal or visual cues for behaviors such as “sit,” “come,” “lie down,” “target,” “follow,” and “stand up.” Combining these cues, trained husbandry behaviors have included shifting, crating, or stepping onto a scale. More outgoing than some other big cats, jaguars are willing to work with their keepers in a protected contact setting during a feeding demonstration to educate the public. For example, they may follow a target pole to move from one point of an exhibit to the other, show off their powerful bodies by standing on their hind legs, or even open their mouths for a display of incredible jaw structure and impressive canine teeth. Drawing up tightly, they are quick to identify where they should be alert and will carefully watch a training tool being used and the keeper’s hand or body posture. With precision, they will often move their bodies just enough to further the behavior, but they are always ready to jump up in an explosion of movement if needed.

Training using aversive cues (e.g., hoses, fire extinguishers) may be effective in the short-term for behaviors such as shifting, but almost certainly degrades the quality of life and adds to animals’ stress levels. Cats often respond to aversive stimuli with fear or aggression. Such tools are discouraged and should be utilized only in emergency situations.

The following behaviors are very useful to have in a jaguar’s repertoire, and can be integrated into a basic training program:

- **Target**: To enable keepers to place and hold an animal at a directed location by approaching a target held by the keeper.
- **Stretch**: To direct an animal to stand on its hind feet, ventral surface against the mesh barrier with forelegs outstretched, for purposes such as physical examination.
- **Shift**: To direct an animal to move through a transfer chute toward a desired location.
- **Station**: To direct an animal to move to and remain at a pre-determined location, such as a scale platform, without using a target.

- **Recall**: To direct an animal into a holding area, bedroom, or other specific location. This is accomplished at a number of institutions through positive reinforcement (commonly including food) and using cues including the animals’ names, whistles, bells, or a variety of other purpose-specific noise makers.

- **Crate training**: To direct an animal to enter and remain within an enclosed space, such as a shipping crate. Regular practice with this behavior under varying circumstances of noise and distraction often makes it possible to crate and transport a jaguar without having to anesthetize it. As with other training, maximum attention should be given to security and safety for both animals and keepers. The crate should be within secure containment, and zookeepers should have an intact containment barrier between them and animals at all times.

- **Medical procedures**: Recently in *ex situ* environments, positive reinforcement techniques have led to amazing advances in which jaguars are voluntarily participating in their own medical care. Some of the trained medical behaviors achieved include nail trims, open mouth inspection, hand-injected vaccinations, blood draws from tail veins, and even ultrasounds. Jaguars have been responding very well to this work. Where a negative relationship might have been true previously, one tremendous byproduct of training is a greatly improved rapport between jaguars and veterinary staff.

The benefits of training work with jaguars, especially as training relates to medical behaviors, have proven to be quite valuable for both jaguars and zoo professionals. As a species, jaguars are outgoing, food motivated and focused, all of which promote the success of working toward a higher standard of care in *ex situ* settings (AZA Jaguar SSP Management Group and Advisors, personal communication, 2014).

### 9.2 Environmental Enrichment

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

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

Jaguar 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).
Because food, shelter, and water are provided under zoo management, the need to search for them is removed, and psychological stimulation becomes an important component of animal management. Research studies have shown that a good enrichment program can decrease stereotypic behaviors or increase an animal’s activity. One institution conducted a three month study on fourteen felids (including one jaguar) using bones, spices, and trout frozen in ice. Overall, the animals showed increased activity levels when presented with the enrichment items. On days the spices and frozen fish were presented, there was a decrease in stereotypic pacing. The jaguar showed a 56.52% decrease in stereotypic pacing on days he was presented with the frozen fish (Skibiel et al., 2007). A 24-day study of 14 managed jaguars was done at one institution in Argentina. The study used various scents to establish if stimulating the jaguars’ sense of smell would result in decreased resting and pacing. The scent enrichment resulted in an increase in playing and a decrease in resting, but no proportional change in pacing was observed (Glickman, 2005). Results of different enrichment studies can vary because of individual personalities and background. Ongoing research studies are needed to identify specific ways to understand and further enhance managed jaguars’ specific needs.

General examples and ideas are suggested here to encourage creativity, and more specific information is available in Appendix M. However, approval methods for environmental enrichment vary among institutions, the best safety and animal welfare being the ultimate goals. All enrichment should have area veterinarian and management approval before being provided to jaguars. Olfactory enrichment can encourage natural behaviors such as scent marking and exploratory behavior. Extracts such as spices and perfumes, as well as different hunting scents and animal fur or feathers, can be used. Items sourced from other animals should always be frozen to remove parasites. Hearing possible prey animals or another jaguar can stimulate exploratory behavior. A radio can be stimulating or comforting for a jaguar.

To promote species-appropriate hunting and feeding behaviors, jaguars can be offered edible items in a way that requires the cats to work for the food. Obesity, lethargy, and self-trauma could all indicate boredom and lack of species-specific hunting opportunities for jaguars. Providing enrichment opportunities on a randomized schedule will help to prevent the development of stereotypic behaviors, and ensure that the animals do not become desensitized to the presence of the enrichment initiatives.

Food items used for enrichment or training purposes should be counted against the overall caloric intake for an animal, not in addition to the base diet. This will prevent undesirable weight gain. Jaguars should be separated whenever possible at feeding time. See Chapter 6 for more detailed information on diet. Natural feeding practices using an environmental enrichment approach can stimulate foraging behavior and increase activity levels while lowering potential stereotypic behaviors. Random patterns of use should act as a variable reinforce in keeping with operant conditioning.

It is recommended that institutions develop a list of approved enrichment initiatives for jaguars and that this should be available and used by animal caretakers. Animal caretakers should take a programmatic approach to jaguar enrichment (e.g., see www.animalenrichment.org) to ensure that enrichment initiatives are developed, implemented, and then evaluated in a way that maximizes their ability to promote species-appropriate behaviors. Effective enrichment initiatives can have a significant impact on the welfare of managed jaguars. When selecting enrichment items, jaguar managers should keep in mind the strength of the species’ bite, and that its mode of predation often does include the “killing bite”. Anecdotal reports indicate that jaguars are more likely to destroy and consume enrichment items that individuals from the other big cat species may not damage (See Appendix M for more specifics on enrichment items used for jaguars) (AZA Jaguar SSP Management Group and Advisors, personal communication, 2014).

### 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. As has been stated or implied throughout this manual, this species is intelligent, strong, and possesses lightning reflexes. Sharing space with jaguars older than six months, while the animals are not under anesthesia, is strongly discouraged. As early as 90 days of
age, even protected contact should generally be avoided, and then conducted only when every possible measure to separate people from jaguar teeth and claws has been taken.

In most instances, it is recommended to involve more than one person when working directly with large carnivores. However, this is a safety assessment that must be made by each institution, often guided by the professional opinion(s) of state and federal regulatory officers. When shifting jaguars from one area to another, maintaining visibility of the animals and the functionality of doors, gates, and other mechanisms is important.

The single most important factor to successful husbandry would be the long-term, stable relationships established between keepers and jaguars. Keeper interaction through vocalization, tactile, feeding, and operant conditioning that develops a positive exchange with a cat is an integral part of this relationship. This type of relationship not only provides reassurance to an agitated specimen and diffuses aggressive behavior, but it also often allows access for examinations and veterinary procedures.

Jaguars patrol their home ranges frequently, are excellent climbers and swimmers, and make use of vegetation as cover. Designing an exhibit to showcase those behaviors provides built-in environmental enrichment. Jaguars are known to have periods of activity around the clock. Yet in most institutions they are in the exhibit itself less than one-third of the day. Providing exhibit furniture and the ability to increase the complexity and enrichment opportunities within off-exhibit enclosures (anchor points and reinforced attachment for large items, etc.) will play an important role in helping to improve the psychological welfare of jaguars. Likewise, maintaining awareness of the animals’ preferred daily routine can have important impacts – both positive and negative – on staff interaction with them.

Functionally, a jaguar exhibit should not contain any areas where animals cannot be observed by staff. Having a section of transfer chute that can be closed down to approximately one body length is useful, and some institutions have successfully employed actual squeeze chutes/cages. Care should be taken in facility design so that passing through such a restraint device is part of cats’ routine travel to and from the exhibit, but at the same time, that one animal refusing to shift or transfer does not prevent the shifting of others. The use of meat-sticks to provide rewards for correct behavior is successful, and safer than hand-feeding (AZA Jaguar SSP Management Group and Advisors, personal communication, 2014).

9.4 Staff Skills and Training

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

Supervised, on-the-job training, followed by a formal competence assessment and approval by someone experienced in managing jaguars or, at minimum, other Panthera species is strongly recommended.

One of the best ways to build confidence, experience, and a professional network is to send potential jaguar keepers to job-shadow and train at an institution already successfully managing the species. The AZA Jaguar SSP recommends that institutions seeking a first-time pairing and breeding recommendation demonstrate proficiency in caring for and breeding jaguars or have the endorsement of an approved AZA Jaguar SSP participant.

As with training for all animals, it is important for keepers training and caring for jaguars to understand and apply the basic terminology (e.g., the difference between positive and negative reinforcement). The observation skills of staff members should also be in tune and responsive to visual and vocal cues given by jaguars that indicate their psychological state (e.g., fear, aggression, playfulness, sexual receptiveness, etc.).

As with all animal care work, observation skills, critical thinking and a capability to successfully utilize the required physical tools and facilities are necessary fundamentals for safely and successfully managing jaguars. It should never be forgotten, working with this species, that simple errors can have potentially fatal consequences (AZA Jaguar SSP Management Group and Advisors, personal communication, 2014).
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 F) 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. 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’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. 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.

Due to the potential for serious caretaker injury or death, jaguars are not recommended to be used as ambassador animals.

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.
11.1 Known Methodologies

AZA believes that contemporary jaguar management, husbandry, veterinary care and conservation practices should be based in science, and that a commitment to scientific research, both basic and applied, is a trademark of the modern zoological park and aquarium. AZA-accredited institutions have the invaluable opportunity, and are expected, to conduct or facilitate research both in *in situ* and *ex situ* settings to advance scientific knowledge of the animals in our care and enhance the conservation of wild populations. This knowledge might be achieved by participating in AZA Taxon Advisory Group (TAG) or Species Survival Plan® (SSP) Program sponsored research, conducting 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 scale of its facilities, staff, and animals (AZA Accreditation Standard 5.0).

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.

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.

As with other *Panthera* species, the jaguar’s size, strength, and diet do not recommend it for traditional laboratory study. Most scientific research on jaguars, to date, has been conducted by field researchers with particular interest in the species and its ecology, independent conservation organizations, zoos, and combinations of the three groups.

A wide variety of research techniques have been used to study jaguar populations both in the wild and under zoo management. Some of these recently used techniques and their purposes are described below:

**Morphological Data:** Information on the structure, size, and proportions of the body of the jaguar has been used to explore evolutionary pressures on the jaguar. These data have contributed to controversy surrounding jaguar subspecies for more than 150 years. However, Larson (1997) found that more variation in skull morphology existed within proposed subspecies than existed within subspecies. Their form has also been used to better inform the function of the jaguar’s systems and the jaguar’s ecological niche and strategies as compared to other felids (Gonyea & Ashworth, 1975; Gonyea, 1976).

**Molecular genetics:** Analysis of microsatellite markers on somatic DNA and mtDNA has been used to show that jaguars from the northernmost and southernmost parts of their range are different, but that those living in Central and northern South America are not very different. This means that sub-species classifications would not be warranted. The analyses also show that jaguars might be in an expansion and rapid growth phase of habitat exploitation when compared with similar studies in other species (Eizirik *et al.*, 2001). More recent analyses have confirmed these results, and also shown that there is no sign of a genetic bottleneck in jaguars (Ruiz-Garcia *et al.*, 2006). Eizirik *et al.*, (2008) recommend improved standardization of DNA analysis in jaguars for improved comparability between studies.

**Radio telemetry:** Data collected from radio telemetry studies have provided information on the range and distribution of wild jaguars, which covers area from Northern Argentina, up through most of México...
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The status of the jaguar in the southwestern United States was investigated and addressed by David E. Brown of the Arizona Game and Fish Department (Brown, 1983). This method of research has also been used to map jaguars’ use of their home range and their activity levels (Mondolfi & Hoogesteijn, 1982). Other studies from the Pantanal in Brazil have been used to help estimate the efficacy of population and abundance methodologies (Soisalo & Cavalcanti, 2006).

**Camera traps:** Data collected from camera traps in have been used to estimate the abundance and density of wild jaguars. This technique was pioneered in 2004 by Silver et al. and has since seen a significant rise in popularity (Maffei et al., 2011). A recent study showed that this less invasive method yielded population estimates similar to those made using radio telemetry (Núñez-Pérez, 2011).

**Fecal analysis and blood sampling:** Analysis of scat in the wild has provided information about jaguar range, territorial behavior, diet, (Rabinowitz & Nottingham, 1986; Weckel et al., 2006; Harmsen et al., 2010a & 2010b) and hormone levels (Morato et al., 2004).

**Behavioral observations:** Jaguars are elusive nocturnal animals and can be very difficult to observe in the wild. Nonetheless, some behavioral observation has been conducted, mostly under zoo management. Research has included observations of reproductive behavior, parenting behavior (Stehlik, 1971; Ewer, 1973), and the suitability and efficacy of enrichment (Skibiel et al., 2007).

**Related research:** Other research related to jaguars and jaguar conservation has been conducted relating to threats to jaguar habitat, attitudes of people toward jaguars, and the possibility of jaguar reintroduction (Kelly & Silver, 2009).

These research projects, both in the wild and in managed environments, have greatly expanded our knowledge of jaguar behavior, physiology, and ecology. Understanding these things offers twofold benefits. First, knowing information about range, diet, reproduction, and behavior allows for more targeted conservation efforts that address concerns that are specific to the jaguar. Second, understanding jaguar behavior and ecology in the wild is very important to understanding how to best manage and enrich a managed animal. Furthermore, a good understanding of their physiology and ex situ behavior allows for a safer and healthier experience for both the jaguar and the humans that interact with it.

Positive reinforcement training is important for ex situ research on jaguars. It can be used for tasks as simple as reliably shifting animals so that fecal samples can be collected from their enclosure to training the animal to give voluntary blood samples. Stressed animals yield unreliable and inaccurate data, so any method of data collection that causes stress taints the results. Positive reinforcement training can make any behavior needed for data collection enjoyable and even enriching rather than stressful (AZA Jaguar SSP Management Group and Advisors, personal communication, 2014).

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).

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.

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. Since its inception in 1996, the AZA Jaguar SSP and its participants have contributed financial support, time, and biomaterials to numerous studies. These have been initiated, or endorsed, by AZA Scientific Advisory...
Groups and have also been research launched by institutions that participate in the AZA Jaguar SSP. Communicating the need for institutional participation in these projects continues to be a priority for this SSP, and this communication is done via the AZA Jaguar SSP email listserv and direct personal contact. The AZA Jaguar SSP has a process for endorsing research proposals and actively encourages institutions to support those projects. Appendix N outlines the SSP’s submission and review process (AZA Jaguar SSP Management Group and Advisors, personal communication, 2014).

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 these areas will maximize AZA-accredited institutions’ capacity for excellence in animal care and welfare as well as enhance conservation initiatives for the species.

Field investigation into all facets of jaguar ecology remains a high priority. Though it likely has the best likelihood for long-term survival of all Panthera species, large gaps exist in our understanding of jaguar ecology and natural history (Rabinowitz, 2014). One result is that jaguars in zoos may be managed as generic big cats because specific needs or variables are simply unknown.

Two core areas identified by the SSP for future research on zoo-managed jaguars include reproductive pathology, particularly cancer (Chapter 7.6), and assisted reproductive technology (Chapter 8.3).

Research into the motivators of chronic stress is a third high-priority area for jaguars. Factors in the ambient environment such as sensitivity to light and spectrum (Chapter 1.2), sound and vibration (Chapter 1.4) have not been quantified. Likewise, study of the variables affecting social interaction (Chapter 5) and behavior management (Chapter 9) would be of significant benefit, with particular emphasis placed on understanding and mitigating the underlying causes of chronic stress, as opposed to masking or eliminating the animals' responses to it.

Additional opportunities for scientific investigation include nutritional evaluation and the effect of body weight on long-term health (Chapter 6.3), and the efficacy and potential side effects of commercially-available vaccines (Chapter 7.4).
12.1 Surplus Animals

All SSP animals held by institutions should be reported to the SSP Program Leaders. The SSP Program Leader should be responsible for making the decision as to whether or not specific animals are to be included in the managed population (e.g., over-represented animals or animals beyond reproductive age). Those animals not included in the managed population should be considered surplus to the managed population, but records still must be maintained on them to the same degree as those in the managed population. The North American Regional Jaguar Studbook attempts to maintain a database of jaguars managed throughout the United States and Canada. However, it is known that a large number of jaguars are kept in private hands. While data are collected and included on a fair number of these animals, it is not possible to know the whereabouts or origins of every jaguar in the region. Participation in the studbook and the AZA Jaguar SSP is increasing in Mexico but it is nearly certain that more managed jaguars exist there than anywhere else in North America. The primary goal of the studbook is to stay current with data regarding jaguars which may have an impact on the AZA Jaguar SSP population and continue to collect the remainder as contacts are established and maintained (S. Johnson, personal communication, 2014).

The studbook is updated every three years and, presently, the AZA Jaguar SSP Breeding and Transfer Plan is published every other year.

Since the AZA Jaguar SSP’s inception in the mid-1990s, its goal has been to develop a sustainable population of known genetic diversity. However, at that time, either the pedigrees of jaguars in AZA institutions could not easily or reliably traced back more than a few generations or the animals were very closely related. The determination was made by the SSP Coordinator and management group to divide the population into two groups. The first group is termed "pedigreed" to form the basis of a sustainable breeding program. It consists only of animals whose ancestry could be documented back to wild origins or, at least, could be verified as unrelated to any others in the pedigreed group. The second group is made up of all other animals, never bred and managed to extinction as the individual animals lived out their otherwise normal lives.

This management strategy continues to be employed. As the pedigreed population grows through recommended breeding and importing unrelated animals, it is replacing the non-pedigreed group as those animals age out of the overall population (AZA Jaguar SSP Management Group and Advisors, personal communication, 2014).

12.2 Additional Information

As noted throughout this manual, detailed knowledge of the jaguar as a species is still somewhat sparse, especially when compared with lions, tigers and leopards. Although some generalizations regarding the genus Panthera are appropriate, they must be made carefully and weighed against empirical evidence. Observations of individual animals and taking local circumstances into account are often as valuable as anything else.

Scientific literature regarding jaguar management, ecology, and conservation is published with increasing regularity. Institutions managing jaguars are advised to stay abreast of developments and to participate actively in building the body of published work for this species in zoos and in the wild. Refer to Appendix O for a brief list of suggested additional reading. A more detailed, formal, bibliography of jaguar research and natural history, through 1999, is available from the AZA Jaguar SSP Coordinator upon request.
Acknowledgements

The AZA Jaguar Species Survival Plan® and North American Regional studbook owe their existence to the innovative planning and dedicated work of Mike Fouraker, Greta McMillan, and Bob Wiese.

Joseph Barber patiently and constructively helped shape the context and content of this Manual during the initial Standardized Guidelines development process.

Thank you to the institutional directors, researchers, collaborators, families, and friends who offered us time, resources, and encouragement to tackle what has become an epic project.

In 1997, the first new founder in more than two decades came into the AZA Jaguar SSP population, marking an improbable early step in the program’s growth toward sustainability. Today, 46 AZA institutions manage 97 jaguars, 80 percent of which have completely traceable pedigrees. Their dedication took a population once slated for phase-out and made it a Green SSP.

Muchacho, ~1994-2014
The one who proved it could be done

Stacey Johnson
AZA Jaguar SSP Coordinator
October 2014
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Appendix A: Accreditation Standards by Chapter

The following specific standards of care relevant to jaguars 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 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 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 and veterinary 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 record keeping 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 laws and/or regulations must be adhered to.

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 preparation and storage must meet all applicable laws and/or regulations.

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 animals 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 animals at the institution 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.

(1.5.5) 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.

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: Recordkeeping Guidelines for Group Accessions

Developed by the AZA Institutional Data Management Scientific Advisory Group
Published 23 May 2014
Edited to replace the document entitled “Updated Data Entry for Groups” published 16 December 2002

Animals can be accessioned into a collection as either individuals or as part of a group. The term "group" has many definitions when used in zoos and aquariums, and is usually defined by its application, such as a social group or animals grouped for husbandry purposes. To provide a consistent language that can be used throughout the Association of Zoos and Aquariums (AZA), the term “group accession”, as defined by the AZA Institutional Data Management Scientific Advisory Group (IDMAG),

- contains multiple animals of the same species or subspecies, which
- cannot be differentiated from one another, either physically (there are no scars or color pattern differences), artificially (they are not tagged or transpondered), or spatially (they are not held in separate enclosures), and
- are cared for as a whole.

Thus, no individually accessioned animals are included in a group accession and no individually identifiable animals are included in a group accession. As soon as an animal becomes individually identifiable, it is recommended that it be split from the group record and accessioned as an individual. For example, large clutches of amphibian tadpoles should first be accessioned as a group; then as individuals become identifiable, they should be removed from the group record and accessioned as individuals. Otherwise, information about an individual animal that could otherwise be tracked through the animal’s life will be lost in the group record. An exception to this occurs occasionally when a group member is removed and temporarily held separately for medical treatment, with the expectation that it will be returned to the group when treatment ends. In this case, the animal remains part of the group even though separated from it. As with individual records, group record accession numbers should not duplicate any other accession number, and once a group accession number has been assigned, it should not be changed.

Group accession provides less information on specific individuals than does individual accession. Group records make information less retrievable, and often need more clarifying comments than individual records. Whenever information applies to only part of the group, notes should be used to indicate which animal(s) the information applies to. It is of utmost importance that these notes be thorough and clear so future readers can easily understand them. Examples of information needing additional notations in group records include, but are not limited to, parentage when not every member of the group has the same parents. Thus, though it is preferable to accession animals as individuals, a group accession can capture considerable information when individual accession is not appropriate.

Although colonies are often confused with groups, the term “colony” should be used to designate truly colonial organisms: those that must live and function as an intact unit, such as corals and eusocial insects. Individuals within a colony are components of a single entity rather than separate members of a group. Also, colony members generally cannot be counted and true census data is not possible, so for the purposes of inventory, a colony is a singular unit while a group is composed of a number of individuals. However, for accessioning purposes, colonies are treated in the same manner as are groups.

Examples of Appropriate Group Accessions

- A group of animals that are not individually identifiable and are the same species or subspecies.
  Your institution receives 50 Puerto Rican crested toad tadpoles to rear. Unless each tadpole is raised in a separate numbered tank, there is no way to tell one tadpole from another. All tadpoles housed together are accessioned as one group.
- Colonial species, such as coral or eusocial insects (e.g., some species of bees or ants).
  Your institution receives a piece of coral. Since the coral is in one piece, you accession it as a group of one. You make a note of the dimensions or mass of the piece to give an estimate of colony size, since it is not possible to count individual animals in the colony. In the inventory,
the colony counts as one animal. When a section of the coral breaks off, you accession that new piece as a new colony.

- A self-sustaining, breeding group of small rodents or insects.

Your institution has a large number of Cairo spiny mice. No daily count is made, though births and deaths increase and decrease the count. A census is taken periodically, and the new count is recorded by sex and life stage. Exact counts are made whenever possible – for example, when the group is moved to a new enclosure.

- Young born to several females of the same species or subspecies and raised together without means of identifying which offspring were born to which mother.

A flock of 3.6 peafowl raise 25 chicks this year. Identity of the hens incubating each nest, hatch dates, and number of chicks hatched from each nest can be determined and recorded. However, unless the chicks are caught and banded at hatching, once the mothers and chicks join the main flock, it is no longer possible to tell which chicks belong to which females. All chicks in the flock have the same possible parents: all the peacocks and those peahens that incubated the nests. The chicks are accessioned as a group and are split out only when they are banded or tagged (and are thus individually identifiable).

- Historical records for a species or subspecies for which there is insufficient information to attribute events to specific individuals.

Some of your historical records are found as simple lists of events. Though there are dates for all transactions, and maybe even specified vendors or recipients for those events, you cannot create individual records for any of these animals without additional information: there is nothing connecting any specific individual to both acquisition and disposition information. If additional information is uncovered that makes this connection, then that individual can be removed from the group accession and given an individual record.

Managing Group Records

Maintaining Group Records - As with individual records, group records should also be maintained and updated. Addition of animals through births or transactions such as loans, purchases, donations, or trades are entered as acquisitions. Subtraction of animals through deaths or transactions such as loans, sales, donations, or trades are entered as dispositions.

Weights and lengths can be entered into a group record even if that data cannot be attributed to a specific individual. This information is still useful in describing the overall condition of group members, although care should be given to describe the animal that the measurement came from. For example, is the animal a juvenile or a breeding adult? Is it healthy, or sickly? Alternatively, average and/or median measurements can be entered into the record to give an indication of what size a “normal” individual might be. In this case, notes should include the maximum and minimum measurements, and how many animals were measured to calculate the average or median.

Censuses - Groups should be censused at regular intervals - ideally, no longer than one inter-birth interval. Institutions should establish and follow a census schedule for each group. An inventory must be done at least once yearly (AZA Accreditation Standard 1.4.1) but the frequency at which a group is censused depends on species biology, husbandry protocols, and animal welfare. For species in which births/hatches and deaths tend to go undetected, or for species that have high fecundity and mortality (which makes counting every animal very difficult or impossible), census data should be obtained more frequently than for species with longer inter-birth intervals. These more frequent censuses should not be undertaken when intrusion on the group has a negative effect on the welfare of the group, e.g., disruption of maternal care.

Censuses should provide as much detail as possible by recording numbers in distinctive life stages (such as newborn, immature, adult) and/or sex ratio (such as male, female, unknown/undetermined). If the census count is estimated, the estimation method and (when possible) the accuracy of the estimate should be included. When updating the sex ratio, who sexed the animals and how they were sexed should also be recorded.
**Splitting And Combining (Merging) Groups** - Splitting animals from groups and combining groups together are realities of group management. Animals may be removed to create additional groups, or perhaps new animals are received from another institution. When new groups are created, new group records also need to be created. However, if the entire group moves to a new location (such as a different tank), it retains the same accession number, and notation of the change in location is made.

When a single group is split into two or more groups, one of the new groups keeps the original accession number and the others are assigned new accession numbers. This is also true if a portion of a group is sent to another institution: the subgroup making the transfer must have an accession number distinct from that of the main group. The accession number(s) for the new group(s) should follow institutional procedures for the assignment of new accession numbers. Note of the new group accession number(s) should appear in the originating group record, and the new group accession record(s) should contain the originating group number. The reason for the split should be entered into both the originating and new group records.

When two or more groups combine to form a larger group, all but one of the groups are deaccessioned and their counts brought to zero. Notes in all the group records should indicate why the groups were merged, as well as the accession numbers of all groups involved – both the closed (empty) groups and the remaining group.

In all cases of splits and merges, the date of creation of the new record should be the same as the date of removal from the previous group or individual. Detailed notes should explain the reasons for all splits and merges.

**Merging Individuals Into Groups and Splitting Individuals From Groups** - Good husbandry dictates the use of identification methods that allow animals to be tracked as individuals whenever possible (AZA Accreditation Standard 1.4.3). Thus, most institutions initially accession newly-acquired animals as individual animals with individual identifiers.

Despite the best intentions, individual identification sometimes becomes impossible. For example, birds in large aviaries lose their bands; small frogs in a large terrarium die and decompose without being noticed. When individual identification of several of the animals in the group is lost and can't be resolved in a reasonable amount of time, it is best to move all potentially unidentifiable animals to a group record, by either creating a new group or merging them into an existing group. As with splitting and merging groups, the group record should contain the identities of the originating individuals and the individual records should show the new group identity. If the animals in the group ever become individually identifiable again, they can be split back to individual records to better capture demographic information. If this occurs, new accession numbers are generally needed for the new individual records since it is rarely possible to know which old individual record would apply to the newly identifiable group member.

Conversely, if one or more group members become identifiable, for example, the previously unbanded young of the year are caught up and banded, they should be split from the group record and given individual accessions. The group record should include the individual numbers assigned, and the records of all individuals should show the number of the originating group. In the case of new individual records, information particular to the animal being given the individual record (if known) should be transferred to the individual record. This includes birth date, origin, parent identification, etc. As in the cases of splitting and merging groups, the date of creation of the new record is the same as the date of removal from the previous group or individual, and detailed notes should explain the reasons for all changes in accession type.

**Transfers Between Institutions** - When accessioning a number of animals that were received from another institution, the new animals should be accessioned using the same type of record that the sending institution used, regardless of how the animals will ultimately be managed. If a group is received but the members will be managed as individuals, they should be accessioned as a group first, then split out as individuals. Similarly, if a number of individuals are received but the plan is to manage them as a group, they should be accessioned as individuals, then merged into a group. Although this is an extra step in the accession process, it allows the records from both institutions to more seamlessly link.
Removing Individuals From Historical Group Records - The decision of whether to use individual or group accession for historical records should be made thoughtfully and carefully. As detailed above, group accession should be used if there is insufficient information to create an accurate individual record. The use of group accession is preferable to the inclusion of “best guess” information, i.e. fiction, to fill the information necessary to complete an individual record.

If additional information is later found that allows the creation of an individual record for one of the members of a historical group record, the procedure for removal from the group is different from that for current records. This situation is treated differently because the historical individual was not truly part of a group accession – the information necessary for a complete individual record was merely not known and the group accession was used “temporarily” until the required information was found or learned. For this reason, the individual should NOT be split from the group, but all reference to the individual should instead be deleted entirely from the group, as if it were never part of the group. This will allow the individual record to begin with the initial acquisition (instead of the date of removal from a group) and will include the animal’s entire history in one record. It also prevents inflation of inventory numbers by eliminating the possible duplication of the same information in both the group and the individual records.
Appendix C: Guidelines for Creating and Sharing Animal and Collection Records

Developed by the AZA Institutional Data Management Scientific Advisory Group
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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)
Jaguar (Panthera onca) Care Manual

- 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 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 D: 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/code-of-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, RECORD-KEEPING, 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 record keeping 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/idmag-documents-and-guidelines).

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.

Association of Zoos and Aquariums
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 (https://www.aza.org/board-approved-policies-and-position-statements).

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 (e.g., 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 (https://www.aza.org/board-approved-policies-and-position-statements).

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 camels, 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):

<table>
<thead>
<tr>
<th>Reference Name</th>
<th>Phone</th>
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<tbody>
<tr>
<td>Facility</td>
<td>Fax</td>
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<tr>
<td>Address</td>
<td>E-mail</td>
</tr>
<tr>
<td>City</td>
<td>State</td>
</tr>
<tr>
<td>Country</td>
<td></td>
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<table>
<thead>
<tr>
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<th>Phone</th>
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</thead>
<tbody>
<tr>
<td>Facility</td>
<td>Fax</td>
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<tr>
<td>City</td>
<td>State</td>
</tr>
<tr>
<td>Country</td>
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</tbody>
</table>

Veterinary Information:

<table>
<thead>
<tr>
<th>Veterinarian</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinic/Practice</td>
<td>Fax</td>
</tr>
<tr>
<td>Address</td>
<td>E-mail</td>
</tr>
<tr>
<td>City</td>
<td>State</td>
</tr>
<tr>
<td>Country</td>
<td></td>
</tr>
</tbody>
</table>

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

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).
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 (INSITUTION) OF THE IDENTITY OF THE PROPOSED TRANSFEREE AND THE TERMS AND CONDITIONS OF SUCH DISPOSITION AND WILL PROVIDE (INSITUTION) THE OPPORTUNITY TO ACQUIRE THE ANIMAL(S) WITHOUT CHARGE. IF (INSITUTION) ELECTS NOT TO RECLAIM THE ANIMAL WITHIN TEN (10) BUSINESS DAYS FOLLOWING SUCH NOTIFICATION, THEN, IN SUCH EVENT, (INSITUTION) 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 E: 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 jaguars:
Jaguar:

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 F: 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.
References


Appendix G: Sample Forms Used With Jaguars

Example of a keeper’s daily reporting form (S. Johnson, personal communication, 2014)

<table>
<thead>
<tr>
<th>Date</th>
<th>Area/Dept.</th>
<th>Keeper(s)</th>
<th>Local ID</th>
<th>Species</th>
<th>Sex</th>
<th>Identifier(s)</th>
<th>Enclosure</th>
<th>Comments</th>
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Identification changes
Transactions
Enclosure Moves
Medical
Reproduction
Behavior
Enrichment
Nutrition
General comment(s)

Example of an animal transfer acquisition/disposition form (USDA-APHIS, 2014a)
Example of a nursery (hand-rearing) log. (S. Johnson, personal communication, 2016)

**NURSERY LOG**

Species: ______________________________

Local ID: ______________________________

Birth Date: ______________________________

Log date range: ______________________________

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Body weight</th>
<th>Amount offered</th>
<th>Amount consumed</th>
<th>Urinate/Defecate</th>
<th>Stool condition</th>
<th>Comments/Remarks</th>
</tr>
</thead>
<tbody>
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</table>
## Appendix H: Body Condition Scoring Chart

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1) Extreme Low</strong></td>
<td>(emaciated, no fat covering, skeleton sharply visible)</td>
</tr>
</tbody>
</table>

| **2-3) Low**      | (minimal fat covering, articulations angular, some bones visible)           |
| Forequarters:     | Neck thin & shrunken, sinews apparent but flowing into shoulder. Angles & bones of shoulder & arm prominent but with slight covering. Peak of scapula prominent. |
| Midsection:       | Multiple ribs visible; abdominal muscles may be apparent. Vertebral may be visible. Waist/belly shrunken & tucked. Abdominal skin flap may be apparent but not filled. Clear definition between shoulder, torso, & hip. |
| Hindquarters:     | Point of hip prominent but slightly covered. Ischium visible but blunt. Muscle & bones of upper leg angular but softened by slight covering. Sacrum flat or slightly depressed. Tail base becoming visible. |

| **4) Moderate-Low** | (slight fat covering, bones barely noticeable, articulations apparent but smooth) |
| Forequarters:       | Neck cylindrical but discernible from shoulder. Muscles of shoulder apparent but slightly smooth. Peak of scapula apparent. |
| Midsection:         | Some ribs visible; abdominal muscles apparent. Vertebral rarely visible. Waist evident. Abdominal skin flap may be apparent with nominal filling. Smooth but noticeable delineation between shoulder, torso, & hip. |
| Hindquarters:       | Point of hip visible but covered. Ischium noticeable but rounded. Muscles of upper leg apparent & smoothed by slight fat covering. Sacrum sloped but beginning to fill & round. |
(5) Moderate  
(slight fat covering, bones not apparent, articulations visible but smooth)

| Forequarters: | Neck filled in to flow smoothly into shoulder. Muscles of shoulder noticeable but with smooth covering. Peak of scapula noticeable but topline flows smoothly from neck into torso.  
Midsection: | Ribs not visible; abdominal muscles noticeable as a transverse line. Vertebrae not visible; back smooth or heart-shaped & muscled. Waist noticeable as a smooth concavity. Abdominal skin flap may be present with nominal filling. Slight delineation between shoulder, torso, & hip.  
Hindquarters: | Point of hip barely noticeable, well-rounded. Ischium noticeable when walking, barely noticeable (flat/straight) when standing. Upper leg smooth & filled with slight muscle definition. Slope of hip becoming rounder |
---|---|---|---|

(6) Moderate-High  
(noticeable fat covering, articulations becoming less noticeable)

| Forequarters: | Neck filled & becoming continuous with shoulder. Muscles of shoulder apparent but covered with fat. Peak of scapula noticeable but topline flows smoothly from neck into torso.  
Midsection: | Ribs not visible; abdominal muscles barely noticeable. Back smooth & rounded, becoming flat. Waist less discernable as a shallow depression. Abdominal skin flap filling with fat. Delineation between shoulder & torso but torso flows smoothly into hip.  
---|---|---|---|

(7-8) High  
(considerable fat covering, animal becoming rounded & bulging)

Midsection: | Abdomen smooth, rounded, & well-covered; ribs or muscles not visible. Back rounded & becoming flat. Waist almost filled, barely discernible. Abdominal skin flap apparent & thickened with fat. Shoulder barely differentiated from torso but torso continuous with hip.  
Hindquarters: | Point of hip & ischium |
Jaguar (*Panthera onca*) Care Manual


### (9) Extreme High
(animal bulging & completely covered in a heavy fat layer)

**Forequarters:** Cheeks filled out. Neck bulging & convex, continuous with head & shoulder. Shoulder rounded & muscles barely discernable. Pendulous fat accumulated beneath neck, chest, arms, & abdomen.

**Midsection:** Torso rounded & smooth, continuous with shoulder & hip. Back smooth & rounded or flat & table-like. Waist filled & not discernible. Thick, pendulous fat along undercarriage.

**Hindquarters:** Hip & upper leg smooth & rounded. Muscles of leg not apparent. Tail noticeably thickened.

---

Chart developed by Ann Ward and Amy Coslik, Fort Worth Zoo.
Appendix I: Fecal Scoring Chart

A fecal scoring chart for jaguars has not been developed. In the literature, 1–5 scales are described without a photo record. To minimize this subjective assessment, a scale with photos is highly recommended. The chart below, created by Purina (2000), is recommended to be used to provide consistency between evaluators.
## Appendix J: Physiological Reference Ranges

(ISIS, 2002)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Sample size</th>
<th>Animals</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBC ($10^9$/L)</td>
<td>11.77</td>
<td>3.883</td>
<td>236</td>
<td>109</td>
</tr>
<tr>
<td>RBC ($10^9$/L)</td>
<td>7.26</td>
<td>1.35</td>
<td>199</td>
<td>92</td>
</tr>
<tr>
<td>Hemoglobin (g/L)</td>
<td>118</td>
<td>22</td>
<td>205</td>
<td>98</td>
</tr>
<tr>
<td>Hematocrit (L/L)</td>
<td>0.351</td>
<td>0.061</td>
<td>249</td>
<td>114</td>
</tr>
<tr>
<td>MCV (fl)</td>
<td>48.9</td>
<td>9.3</td>
<td>197</td>
<td>90</td>
</tr>
<tr>
<td>MCH (pg/cell)</td>
<td>16.5</td>
<td>3.8</td>
<td>188</td>
<td>86</td>
</tr>
<tr>
<td>MCHC (g/L)</td>
<td>335</td>
<td>31</td>
<td>205</td>
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<tr>
<td>Platelet count ($10^{12}$/L)</td>
<td>0.2810</td>
<td>0.1150</td>
<td>59</td>
<td>40</td>
</tr>
<tr>
<td>NRBC/100 WBC</td>
<td>0</td>
<td>1</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>Reticulocytes (%)</td>
<td>0.0</td>
<td>0.0</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Segmented neutrophils ($10^9$/L)</td>
<td>8.896</td>
<td>3.426</td>
<td>213</td>
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<td>Lymphocytes ($10^9$/L)</td>
<td>2.096</td>
<td>1.936</td>
<td>222</td>
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<tr>
<td>Monocytes ($10^9$/L)</td>
<td>0.345</td>
<td>0.353</td>
<td>175</td>
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<td>Eosinophils ($10^9$/L)</td>
<td>0.316</td>
<td>0.288</td>
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<tr>
<td>Basophils ($10^9$/L)</td>
<td>0.074</td>
<td>0.112</td>
<td>30</td>
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<tr>
<td>Neutrophilic bands ($10^9$/L)</td>
<td>0.912</td>
<td>1.662</td>
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<tr>
<td>Calcium (mMol/L)</td>
<td>2.45</td>
<td>0.23</td>
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<td>96</td>
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<tr>
<td>Phosphorus (mMol/L)</td>
<td>1.58</td>
<td>0.39</td>
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<tr>
<td>Sodium (mMol/L)</td>
<td>151</td>
<td>4</td>
<td>172</td>
<td>87</td>
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<tr>
<td>Potassium (mMol/L)</td>
<td>4.1</td>
<td>0.4</td>
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<td>90</td>
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<tr>
<td>Chloride (mMol/L)</td>
<td>121</td>
<td>5</td>
<td>164</td>
<td>84</td>
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<tr>
<td>Bicarbonate (mMol/L)</td>
<td>91.9</td>
<td>223.5</td>
<td>8</td>
<td>6</td>
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<tr>
<td>CO$_2$ (mMol/L)</td>
<td>15.8</td>
<td>2.2</td>
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<tr>
<td>Osmolarity (Osmol/L)</td>
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<td>0.100</td>
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<tr>
<td>Iron (µmol/L)</td>
<td>15.04</td>
<td>3.580</td>
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<td>7</td>
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<tr>
<td>Magnesium (mMol/L)</td>
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<tr>
<td>BUN (mMol/L)</td>
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<td>3.570</td>
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<tr>
<td>Creatinine (µMol/L)</td>
<td>168</td>
<td>53</td>
<td>202</td>
<td>102</td>
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<td>Uric Acid (mMol/L)</td>
<td>0.012</td>
<td>0.018</td>
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<td>34</td>
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<tr>
<td>Total bilirubin (µMol/L)</td>
<td>3</td>
<td>2</td>
<td>176</td>
<td>92</td>
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<td>Direct bilirubin (µMol/L)</td>
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<td>51</td>
<td>27</td>
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<td>Indirect bilirubin (µMol/L)</td>
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<td>2</td>
<td>51</td>
<td>27</td>
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<tr>
<td>Glucose (mMol/L)</td>
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<td>102</td>
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<tr>
<td>Cholesterol (mMol/L)</td>
<td>6.294</td>
<td>1.606</td>
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<tr>
<td>Triglyceride (mMol/L)</td>
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<td>0.2260</td>
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<td>LDL Cholesterol (mMol/L)</td>
<td>7.200</td>
<td>0.2331</td>
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<td>2</td>
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<tr>
<td>HDL Cholesterol (mMol/L)</td>
<td>4.144</td>
<td>1.554</td>
<td>2</td>
<td>2</td>
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<tr>
<td>CK*** (U/L)</td>
<td>321</td>
<td>267</td>
<td>84</td>
<td>50</td>
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<tr>
<td>LD*** (U/L)</td>
<td>160</td>
<td>157</td>
<td>98</td>
<td>54</td>
</tr>
<tr>
<td>ALP*** (U/L)</td>
<td>32</td>
<td>33</td>
<td>194</td>
<td>97</td>
</tr>
<tr>
<td>AAT*** (U/L)</td>
<td>55</td>
<td>26</td>
<td>161</td>
<td>89</td>
</tr>
<tr>
<td>AST*** (IU/L)</td>
<td>35</td>
<td>16</td>
<td>196</td>
<td>98</td>
</tr>
<tr>
<td>GGT*** (U/L)</td>
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<td>2</td>
<td>82</td>
<td>41</td>
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<td>Amylase (U/L)</td>
<td>301.2</td>
<td>149.1</td>
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<td>34</td>
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<tr>
<td>Lipase (U/L)</td>
<td>4.448</td>
<td>3.336</td>
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<tr>
<td>Total protein (g/L)</td>
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<td>90</td>
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<tr>
<td>Globulin (g/L)</td>
<td>40</td>
<td>8</td>
<td>148</td>
<td>76</td>
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<tr>
<td>Albumin (g/L)</td>
<td>34</td>
<td>4</td>
<td>149</td>
<td>76</td>
</tr>
<tr>
<td>Progesterone (nMol/L)</td>
<td>0.4293</td>
<td>0.3552</td>
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<td>1</td>
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<tr>
<td>Total triiodothyronine (nMol/L)</td>
<td>1.297</td>
<td>0.0633</td>
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<td>5</td>
</tr>
<tr>
<td>Total thyroxine (nMol/L)</td>
<td>27</td>
<td>19</td>
<td>18</td>
<td>13</td>
</tr>
<tr>
<td>Body temperature (°C)</td>
<td>38.2</td>
<td>1.1</td>
<td>134</td>
<td>74</td>
</tr>
</tbody>
</table>

*Sample size - Number of tests run per parameter.
Animals** - Number of animals sampled per parameter.
*** CK – Creatinine phosphokinase; LD – Lactated dehydrogenase; ALP – Alkaline phosphatase; AAT – Alanine aminotransferase; AST – Aspartate aminotransferase; GGT – Gamma glutamyltransferase.
Appendix K: Necropsy Protocol and Tissue Collection Instructions

AZA JAGUAR SSP NECROPSY PROTOCOL
INSTITUTION/OWNER
ADDRESS

JAGUAR NAME OR ID # ______________ STUD BOOK # ________ SEX ______
BIRTH DATE/AGE _______________          WEIGHT ______________
DATE OF DEATH ________________         DATE OF NECROPSY ______________
BRIEF HISTORY (circumstances of death);

SHIPPING TISSUES: PLEASE OBTAIN PROPER CITES IMPORT AND EXPORT PERMITS BEFORE SHIPING TISSUES INTERNATIONALLY.
SHIP FROZEN TISSUES IN SEPARATE CONTAINERS FROM FIXED TISSUES.
After 72 hours in fixative, ship tissues in a leak-proof container in adequate formalin to keep tissues moist. Frozen tissues should be shipped with adequate dry ice to stay frozen for 72 hours. Tissues can be shipped by U.S. Mail or by courier to:

Dr. Dalen Agnew
Attn: Histo Research
Diagnostic Center for Population & Animal Health
4125 Beaumont Road
Lansing, MI USA 48910-8104
phone: 517-353-1683
dale.agnew@msu.edu

PROTOCOLS FOR FELID REPRODUCTIVE TISSUE PATHOLOGY AND GENE RESCUE

Please note that pathology protocols have not changed. For any felids in contraception studies or with any apparent lesions of the reproductive tissue, tracts should still be fixed in 10% formalin, accompanied by form for the contraceptive studies and shipped to:

Dr. Dalen Agnew
Attn: Histo Research
Diagnostic Center for Population & Animal Health
4125 Beaumont Road
Lansing, MI USA 48910-8104
phone: 517-353-1683
dale.agnew@msu.edu

Contact the laboratory, if necessary, to confirm labeling requirements and/or shipping restrictions.
Appendix L: Protocol for Labeling and Sending Fecal Samples for Fecal Steroid Analysis

Labeling and sending fecal samples
Contact Dr. Janine Brown at Smithsonian Conservation Biology Institute (brownjan@si.edu) to discuss schedules and cost of tests. Fecal samples should be collected every other day and placed in re-sealable plastic bags with a clear label including animal ID (name and studbook number), date of collection, and a.m. or p.m. collection. Bags and labels can be obtained from SCBI. Samples should be frozen immediately and kept frozen until they are sent. Samples will be processed and analyzed for steroid metabolites using procedures validated for other felid species (Brown et al., 1994). If at all possible, samples should be dried in a lyophilizer or oven at 70 °C (158 °F) for three days (Terio et al., 2002). Once dried, samples can remain in a dry place at room temperature. Before drying, all samples should remain frozen, and should be shipped on dry ice.
Appendix M: Enrichment Examples, Surveys, Problems, and Rating Charts

ENRICHMENT EXAMPLES (Law, 2009)

Night Holding: A resting platform for each cat. Logs and stumps for scent marking and sharpening claws.

Outside Exhibit: Usually natural substrate like grass or dirt is preferred (see Chapters 1 and 2). Logs can be hung, attached, or on the ground. There should be plenty of visual barriers for the animal to feel completely hidden from the public. The exhibit should have plenty of vertical perching for climbing including real or artificial logs, branches or rocks, and various high nesting sites. The top of the cage should have plenty of natural coverage for shade and security. There should be at least one water source. A heat or cold rock can encourage the jaguar to be in a favorable viewing area as well as keep the animal comfortable in hot or cold weather. Pools, ponds, and streams are recommended for drinking, playing, and cooling off.

Novel Objects: Objects such as boomer balls and cardboard boxes promote the natural stalk and pouncing behavior. Small logs can also be used on exhibits for a natural look.

Natural Feeding: “In order to provide opportunities to exhibit species-appropriate behaviors or otherwise enable animals to work for food, a number of enrichment items can be added to their outdoor or indoor enclosure and exhibits. It is recommended that large felids be offered edible (or other) items on an ongoing but random schedule in order to combat stereotypic behaviors such as pacing, hair pulling or self-mutilation as well as to add more interest to their daily lives. Offering items at random is important as felids easily become desensitized; offering no enrichment on some days may be equally as effective. Food items from non-domestic stock should be frozen prior to feeding to kill any pathogens that might be present” (Shoemaker, 2003).

Carcass Feeding: Because feeding live mammal or bird prey is not typically desirable or feasible, other techniques should be employed to provide appetitive or “hunting” opportunities for managed felids. Providing humanely-killed animals to jaguars can promote a wide range of species-appropriate hunting, food manipulation, and feeding behaviors. Whole animals (e.g., rats, mice), gutted carcasses (e.g., chickens, rabbits), or carcass fragments (e.g., shanks of sheep or calf) can be provided. On receiving whole or partial carcasses, many cats exhibit all or part of the stalk-rush-kill sequence (Richardson, 1982; J. Mellen, personal communication; D. Shepherdson, personal communication). In addition to the potential for improved psychological well-being (Lindburgh, 1988), feeding whole carcasses may enhance physical well-being (Shepherdson, Mellen & Hutchins, 1998).

Olfactory: Olfactory enrichment can encourage natural behaviors such as scent marking and exploratory behavior. Extracts such as spices and perfumes as well as different hunting scents and animal fur or feathers can be used. It is recommended to freeze items from other animals to remove parasites. One institution reports the use of urine from other species, centrifuged and examined for bacteria, as well. It is strongly recommended to obtain veterinary approval of any and all animal material before using it as enrichment.

Auditory: Auditory enrichment allows the jaguar to use their excellent hearing senses. Hearing possible prey animals or another jaguar can stimulate exploratory behavior. A radio can be stimulating or comforting for a jaguar.

Social: Social enrichment can decrease pacing and add a stimulating change to the day. Keeper interaction and visuals of other animals are two examples of social enrichment that can increase the complexity of a jaguar’s day.
ENRICHMENT SURVEY

A jaguar environmental enrichment survey was conducted during the creation of the AZA Jaguar SSP’s *Guidelines for the Captive Management of Jaguars* (Law, 2009). Twenty-two AZA institutions submitted data, which are detailed below. The results are broken down and intended to be a resource to show what other institutions are providing for enrichment and rate the success of each item. Each animal has its own individual demeanor, so the results here are by no means the definitive answer on how an animal will react. All the items submitted have not necessarily been tested, and what is fine for one jaguar can be problematic for another. Always have new items reviewed by your managers, nutritionists, and veterinarians and follow your facility’s safety guidelines.

**Exhibit Substrate:** Grass, dirt, sand, cement, wood chips, mulch

**Outside Exhibit Furniture:** Waterfall, pond, stream, rocks, bamboo, trees (evergreen, mulberry, elm) swinging logs, shrubs, deadfall trees, tree limbs at different levels, rock den, concrete cave, timber platform, straw bed, rock ledge, brush pile, fire hose hammock, hot rock, gunite rock/trees, tree stumps, vines, plants (honey suckle, palms, butterfly bush, junipers), wood bridge over 1 m (3.2 ft) dry moat

**Indoor Holding Area:** Wooden bench, shelves (wooden, gunite, plywood, metal, Corian®) pallets, kennel, den, vines, hide box, ropes, hanging cedar logs, hanging tire, wooden perching, pool (approximately 1 m [3.2 ft] deep)

**List of Food Enrichment Items:**
- Feline diet
- Rats
- crickets
- Fish - live tilapia, tuna, herring, frozen salmon, live goldfish, trout, minnows, live red shiners, smelts
- blood ice block
- fish ice block (successful)
- frozen bouillon blocks
- bagels soaked in blood
- gelatin made with blood
- blood ring with chicks
- meatballs
- boiled eggs
- fetal calf
- chunk horse meat
- rabbit, quail
- fresh blood
- frozen steaks
- frozen lamb
- mice
- fruit & vegetables
- grapes
- Chicken - Cooked chicken, necks, gizzard & hearts, liver, boneless chunks
- Bones: Venison, horse, cattle, frozen, beef tail, pork neck, horse shank, horse knuckle, mutton, cow leg
- Venison - ground or whole
- Horse - chunks of meat (training reward) liver, raw beef, pork hock
- Presentation - hidden, meat smeared on rocks, fish in pond, buckets meat training reward, hidden in PVC tubes, tree bags, perches in box with lid, tossed in on ropes
Social:
Non-tactile sensory contact (i.e. visual, auditory and olfactory) has been successfully implemented both conspecifically and inter-species in numerous institutions. Some remote inter-species sensory contact has been between predator and potential prey species (e.g. jaguars and horses, llamas, sheep, raccons, etc.) and between with other large predators (e.g. pumas and leopards). Tactile contact between jaguars, even through small-space steel mesh, has been reported to result in injury to paws, ears and other extremities. With vigilance during and after introductions, jaguars have successfully been housed in same-sex groups. However, social circumstances can change quickly and care must be taken to actively manage the animals’ daily.

Auditory:
Various animals throughout the Zoo. Tapes “rabbit in distress,” deer calls, radio.

Enrichment Problems:
 Destruction and ingestion of non-food enrichment items is the problem most commonly reported. Fabric cloth, rope, and plastic items have been offered and subsequently discontinued by numerous institutions, either in an abundance of caution or due to impaction or vomiting. Similarly, items that can be considered food (e.g. rawhide, small bones, whole prey) have been discontinued in some cases when vomiting or diarrhea resulted.

NOVEL OBJECTS RATING CHART
The average rating for the chart is from 1 = no reaction to 5 = strong reaction.

<table>
<thead>
<tr>
<th>Institutions</th>
<th>Novel objects</th>
<th>Average given</th>
<th>Average rating</th>
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</thead>
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<td>21</td>
<td>Cardboard box</td>
<td>Monthly, bi-weekly, 4x a week</td>
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<tr>
<td>18</td>
<td>Boomer ball</td>
<td>Weekly, daily</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Burlap bags</td>
<td>Weekly, bi-weekly, every 6 months</td>
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<tr>
<td>6</td>
<td>Bowling ball</td>
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<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Feather</td>
<td>Bi-weekly, weekly</td>
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</tr>
<tr>
<td>6</td>
<td>Large barrel</td>
<td>Daily, weekly, yearly</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>Large boomer ball</td>
<td>Weekly</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>PVC</td>
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<td>4</td>
<td>Ice block</td>
<td>Monthly</td>
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<td>Carpet tube</td>
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<td>4</td>
<td>Pumpkin</td>
<td>Yearly, in fall</td>
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</tr>
<tr>
<td>4</td>
<td>Paper mache prey animals</td>
<td>Yearly, every few months</td>
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</tr>
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<td>3</td>
<td>Phone book</td>
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<tr>
<td>3</td>
<td>Beer keg</td>
<td>Weekly, monthly</td>
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<td>3</td>
<td>Small boomer ball</td>
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<td>Horse tail</td>
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<td>Giant boomer ball</td>
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<tr>
<td>2</td>
<td>Bamboo stalks</td>
<td>Monthly</td>
<td>2, 4 with cinnamon</td>
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<td>2</td>
<td>Spool</td>
<td>Daily, weekly</td>
<td>4</td>
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<tr>
<td>2</td>
<td>Sheep’s wool</td>
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<tr>
<td>2</td>
<td>Plastic pails</td>
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<tr>
<td>1</td>
<td>Boomer ball with holes for food placement</td>
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<td>Tractor tire</td>
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<td>Large “pill”</td>
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<td>1</td>
<td>Log</td>
<td>Monthly</td>
<td>(likes to carry) 4</td>
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<tr>
<td>1</td>
<td>Lettuce head</td>
<td>Monthly</td>
<td>3</td>
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### Jaguar (Panthera onca) Care Manual

#### Association of Zoos and Aquariums

<table>
<thead>
<tr>
<th>Institutions</th>
<th>Novel objects</th>
<th>Average given</th>
<th>Average rating</th>
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<tr>
<td>1</td>
<td>Pigs ears</td>
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</tr>
<tr>
<td>1</td>
<td>Raw hides</td>
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<tr>
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<td>Frozen fish juice</td>
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</tr>
<tr>
<td>1</td>
<td>Beef noses/chins</td>
<td>Weekly</td>
<td>4</td>
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<tr>
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<td>Camel Hair</td>
<td>4x a year</td>
<td>3</td>
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<tr>
<td>1</td>
<td>Plastic hour glass toy</td>
<td>Bi-weekly</td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>Hay/wood wool</td>
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<td>3</td>
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<tr>
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<td>Paper bags</td>
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</tr>
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<td>1</td>
<td>Large heavy ball</td>
<td></td>
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</tr>
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<td>Small barrel</td>
<td></td>
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<td>Large plastic “spoolie”</td>
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<td>Large rubber trash can</td>
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<td>5</td>
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<td>Small rubber trash can</td>
<td>2–3x a week</td>
<td>4-5</td>
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<td>Large soft plastic hose reel</td>
<td>Weekly</td>
<td>2-3</td>
</tr>
<tr>
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<td>Large plastic trash can lids</td>
<td>1–2x a week</td>
<td>2-3</td>
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<td>4-5</td>
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<td>Bobbins</td>
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<td>Oranges</td>
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<td>Large Tub</td>
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<tr>
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<td>5 gallon water jugs</td>
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<tr>
<td>1</td>
<td>Guanaco hair</td>
<td>Once a month</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>5 gallon bucket</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>Tire</td>
<td>3x a week</td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>Polyethylene bucket</td>
<td>4x a week</td>
<td>1</td>
</tr>
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</table>

### Olfactory Rating Chart

<table>
<thead>
<tr>
<th>Institutions</th>
<th>Olfactory items</th>
<th>Average given</th>
<th>Average Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>Perfume / Cologne</td>
<td>Bi-weekly, weekly</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
<td>Dry catnip</td>
<td>Bi-weekly</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>Cinnamon</td>
<td>Monthly, weekly</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Garlic</td>
<td>Monthly, weekly, quarterly</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Nutmeg</td>
<td>Bi-monthly</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Vanilla extract</td>
<td>Bi-monthly, every 6 months</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Boxes / hay with scent</td>
<td>Weekly</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Basil</td>
<td>Monthly, weekly</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Doe scent</td>
<td>Bi-monthly</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Fresh catnip</td>
<td>Weekly in summer</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Oregano</td>
<td>Bi-weekly, weekly</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Cloves</td>
<td>Bi-weekly, weekly</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Paprika</td>
<td>Bi-weekly</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Fox urine</td>
<td>2x a week</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Mint extract</td>
<td>Bi-weekly</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Toys from other exhibits</td>
<td>Weekly, monthly</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>Berry bliss (body mist)</td>
<td>Bi-weekly</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>Catnip oil</td>
<td>Every 2–3 weeks</td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>Vinegar spray bottle with added scents</td>
<td>Once a week</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>Allspice</td>
<td>Bi-weekly</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>Sage</td>
<td>Bi-weekly</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>5 Chinese spice</td>
<td>Bi-monthly</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>Curry</td>
<td>Bi-monthly</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>Pumpkin pie spice</td>
<td>Bi-monthly</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>Onion</td>
<td>Bi-weekly</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>Fresh spices</td>
<td>Weekly</td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>Fox scent</td>
<td>Occasionally</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>Fox, Mink, Deer, oil</td>
<td>Bi-weekly</td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>Orange extracts</td>
<td>Bi-weekly</td>
<td>3</td>
</tr>
<tr>
<td>Item</td>
<td>Frequency</td>
<td>Amount</td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------</td>
<td>--------</td>
<td></td>
</tr>
<tr>
<td>Anise extracts</td>
<td>Bi-weekly</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Lemon extracts</td>
<td>Bi-monthly</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Rum extracts</td>
<td>Bi-monthly</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Chicken spray</td>
<td>2x a week</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Skunk scent</td>
<td>Monthly</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Fish herbs</td>
<td>When available</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Bongo feces</td>
<td>Bi-monthly</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Hoofstock feces</td>
<td>Monthly</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Boomer ball from other cats</td>
<td>Weekly</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>New logs/stumps</td>
<td>Yearly</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Logs from other animals</td>
<td>Bi-monthly</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Explore Tiger cage</td>
<td>Weekly in winter</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Lanolin</td>
<td>Bi-monthly</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Deodorant</td>
<td>Bi-monthly</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Leaves from hoofstock</td>
<td>Bi-monthly</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Ginger</td>
<td>Weekly</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Maned wolf scent</td>
<td>Once a week</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
Appendix N: Jaguar SSP® Conservation/Research Proposal Format

The following information must be provided for consideration of research proposals or conservation projects for endorsement by the Jaguar SSP. To ensure that the SSP has ample time to review the request it should be submitted at least one month prior to any project or grant application deadlines.

I. BIOGRAPHICAL INFORMATION FOR PRINCIPAL INVESTIGATOR
   a) A resume or curriculum vitae for the principal investigator(s). Include any publication citations for the past five years.
   b) Grants funded or grant applications pending on this project or potential funding pending SSP approval

II. IDENTIFICATION OF COOPERATING RESEARCHERS/INSTITUTIONS
   Provide a list of other researchers, consultants, or cooperating institutions involved in the proposed conservation and/or research project.

III. ABSTRACT OF THE PROPOSED CONSERVATION/RESEARCH PROGRAM
   Describe the proposed conservation/research program, including:
   a) Statement of the problem and the program objectives
   b) Contribution of the proposed project to the field of study
   c) Long term goals of the proposed project
   d) Objectives planned for addressing the long-term goals described above

IV. EXPERIMENTAL DESIGN FOR PROPOSED PROJECT
   Provide specific details on the experimental design, including:
   a) Hypothesis to be tested (if applicable)
   b) Methods and materials
   c) Protocols for handling biological samples and assays (if applicable)
   d) Justification for species choice
   e) Measures to guarantee well being of animals
   f) Preliminary results (if available)

V. PROJECT BUDGET (if applicable)
   Provide a description of sources and levels of funding to be applied to the proposed project, including remuneration for Jaguar SSP resources.

VI. PROPOSED USE OF CONSERVATION/RESEARCH RESULTS/MATERIALS
   Provide a description of the anticipated use and distribution of the results, including:
   a) Professional journals
   b) Conferences (posters and papers)
   c) Other publications

VII. TIMELINE
   Provide a timeline that includes the following information:
   a) Anticipated starting and completion dates
   b) The Jaguar SSP would appreciate periodic updates and a notification of any publications arising from the project.

IX. LITERATURE REVIEW RELATED TO OVERALL RESEARCH PROGRAM
   These publications will support your "thesis" and your evaluation of the current state of understanding. Please follow the standard reference format as used by the Journal of the American Veterinary Medical Association. The list and discussion need not be extensive but should be representative of the most pertinent and worthy publications.
Proposals must be submitted to Stacey Johnson, AZA Jaguar SSP Coordinator, San Diego Zoo Global, PO Box 120551, San Diego, CA 92112-0551; sjohnson@sandiegozoo.org. Include a proposal cover letter including an abstract and request for endorsement.
Appendix O: Suggested Additional Reading


