<u>BEHAVIORAL ASSESSMENT OF THE CLOUDED LEOPARD (*NEOFELIS NEBULOSA*); A COMPARATIVE ANALYSIS OF REPRODUCTIVE SUCCESS</u>

by

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Behavioral Assessment of the Clouded Leopard (*Neofelis nebulosa*);
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A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science at George Mason University

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## DEDICATION

To my husband, Patrick Kennedy who put up with many years of torture and rarely complained, you’re my favorite.

To Dr. JoGayle Howard who serves as my inspiration for all things clouded and without whom, I would still be in New Jersey.

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**ABSTRACT**

BEHAVIORAL ASSESSMENT OF THE CLOUDED LEOPARD (*NEOFELIS NEBULOSA*); A COMPARATIVE STUDY OF REPRODUCTIVE SUCCESS

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George Mason University, 2010

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This thesis details a behavioral assessment of the clouded leopard (*Neofelis nebulosa*). The clouded leopard is classified as "Vulnerable" by the International Union for Conservation of Nature's (IUCN 2010) Endangered Species commission, and faces many challenges surrounding its conservation both in the wild and in captivity. In captivity, the issue of highest concern is mate compatibility. This study utilizes two separate methods to determine temperament and behavioral differences within the species, including behavioral observations and a keeper rated temperament assessment. Behavioral observations were used to analyze three specific tests; urine scent test, mirror image stimulation (Gallup, 1968), and a novel object test. These tests were chosen to elicit behaviors similar to those seen during breeding introductions. Animal care staff was asked to complete a temperament assessment which was compared with the

behavioral observations to identify and link anecdotal "personalities" with quantifiable behaviors. The project included 24 clouded leopards housed at the Khao Kheow Open Zoo in Thailand as well as the Smithsonian's Conservation Research Center, Front Royal, Virginia.

This study revealed that the clouded leopards in the test population had four separate quantifiable temperaments including; "high-strung;" "active;" "calm;" and "aggressive." These temperaments were found to be significantly correlated to reproductive success and gender, with reproductively successful individuals and males rating higher on "calm." The temperaments were also significantly correlated with the method by which the individual was reared from birth, with mother-reared individuals rating higher on "aggressive."

Behavioral observations recorded during test trials were found to be significantly correlated with reproductive success. Overall, reproductively successful individuals were quicker to respond, more vocal and spent less time out of sight and more time lying. Several behaviors were also found to be sex specific. Reproductively successful males exhibited more "territorial" behaviors, including "patrol," "defecate" and "urinewalk." The "urinewalk" was an unusual behavior not previously recorded in this species. The urine scent tests served best to elicit these behaviors and further testing is recommended to determine the possible use of urine scent tests in predicting reproductive success in the male clouded leopard. The reproductively successful females responded with defensive behaviors including, "retreat" and "flinch." The mirror image stimulation was the best test to elicit these behaviors and further testing is recommended to determine the possible use of the MIS in predicting reproductive success in clouded leopard females.

The data obtained in all eight treatments combined served as the best overall indicator of reproductive success in the clouded leopard. Due to the small sample size in this study, further testing is recommended, specifically of reproductively successful individuals. These tests may serve as a helpful tool in the management of this species in captivity.

# CHAPTER 1: INTRODUCTION

Successful captive management has become an important, and in some cases vital, component of wildlife conservation (Mallinson 1995). As habitat destruction, poaching and climate change threaten species and their ecosystems, captive animals serve as current and future genetic banks to be drawn on when numbers in the wild dwindle (Iyengar *et al.* 2007). They can also act as ambassadors for their wild counterparts, educating the public not only about their natural history, but the geographical, economic and social issues surrounding their conservation in the wild (Snyder *et al.* 1996). Internationally, researchers have applied knowledge from many captive animal studies to help conserve species in the wild (Howard 2002, Wisely 2003, Russello and Amato 2007). However, many species, such as the clouded leopard are still shrouded in mystery and further research is required to help conserve them in the future. Specifically, the study of reproduction in the clouded leopard and other exotic species is little understood and needs further exploration (Wildt *et al.* 2009).

The clouded leopard species survival program has identified mate compatibility as the number one threat to the captive population (Fletchall 2007). Yet, few studies have focused on the reproductive behavior of the clouded leopard (MacKinnon 2008. Wielebnowski *et al.* 2002, Wielebnowski 2002). It is well known that the behavior of captive animals' can change drastically under different environmental conditions (Powell *et al.* 2002; Wielebnowski *et al.* 2002; Wells *et al.* 2004). The clouded leopard in particular is extremely sensitive to environmental change (Wielebnowski *et al.* 2002).

Regardless of environmental factors, this study was designed to indicate differing temperaments between individual clouded leopards, with the goal of determining certain temperaments that may indicate reproductive success. These temperaments were defined by a keeper rated assessment and then supported by the occurrence and frequency of particular behaviors observed during a testing period. By pinpointing these behaviors and identifying temperaments, we can make more informed decisions about the pairing and transfer of the captive population of clouded leopards. This will serve to increase reproduction and ensure genetic diversity of the population for use in the future when wild populations need to be replenished. What still needs to be considered in all captive breeding programs are the possible genetic linkages, if any, that exist between behavior and temperament. Temperaments well adjusted to life and reproduction in captivity may not be the same temperaments necessary to survive in the wild. Specifically, the practice of hand-rearing individuals for use in breeding populations can be highly controversial and should be examined. Our ability to breed only certain temperaments may be breeding out the "wild" in this species. On the other hand, certain behaviors may be so "hardwired" that regardless of captivity, certain individuals maintain these behaviors and are reproductively successful. If this is the case, it is imperative to identify the specific behaviors that these individuals possess. By determining temperaments and pinpointing behavioral responses associated with these temperaments, we can better manage clouded leopards now, bringing us closer toward their conservation in the future.

## BIOLOGY AND ECOLOGY OF THE CLOUDED LEOPARD

The clouded leopard (*Neofelis nebulosa*) is one of the least known species in the Family Felidae. They are in the subfamily Pantherinae and are considered to be the first species to diverge from this lineage (IUCN 2010). Weighing only 10-25kg, the clouded leopard is the smallest of the "big" cat species, and is placed in with this family because of one characteristic found only in the Panthera lineage. The Panthera can not purr – the epihyoidium or part of the hyoid apparatus is connected by elastic ligament rather than bone (Weissengruber *et al.* 2002). Small cats have the ability to purr due to the fact that the hyoid apparatus is connected by bone – hence the cheetah and puma are classified as "small cats" and the clouded leopard is classified as a "big cat."

The clouded leopard is extremely elusive; found throughout Southeast Asia they, inhabit lowland tropical forest regions with dense vegetation. They have also been seen in both primary and secondary logged forests as well as cloud forests, grasslands and forest edges (Sunquist and Sunquist 2002). The clouded leopard is named for the large, black, cloud-like patterns found along its torso, with black stripes and spots found along the head and neck. All of these markings are found on a backdrop ranging from golden brown to orange that helps camouflage this animal in the dense forest vegetation. They have a long tail similar in length to their body, which in addition to large paws and short, stout legs aid in their movement through the trees. They can rotate their back ankles 180 degrees which allows them to hang from branches by their back legs and climb down trees head first (Sunquist and Sunquist 2002). These features make the clouded leopard the most arboreal of the large cat species; their climbing abilities rival that of the much smaller margay (*Leopardus wiedii*) from South America (Leyhausen 1963; Nowell and Jackson 1996).

Clouded leopards are considered nocturnal, stalking and hunting prey from trees as well as on the ground in open and closed forest areas (Wilting *et al.* 2006, Grassman *et al.* 2005). They are powerful hunters with canine teeth approximately 4.0 cm in length - the longest canine teeth in relation to their skull size of any other felid species. These teeth allow them to take down fairly large prey items which vary based on region include bearded pig (*Sus barbatas*), sambar deer (*Cervus unicolor*), mouse (*Tragulus* spp) (Rabinowitz 1987), and barking deer (*Muntiacus muntjak*), porcupine (Hystrix *hodgsoni*), monkey (*Macaca* spp) (Rabinowitz and Walker 1991), hog deer (*Axis porcinus*), muntjak (*Muntiacus muntjak*) and even Malayan pangolin (*Manis javanica*) (Grassman, *et al.* 2005, Sunquist and Sunquist 2002).

Clouded leopards are difficult to locate and monitor for any length of time. To date, only seven cats have been radio-collared in the wild (Austin 2002; Grassman *et al.* 2005, Hearn *et al.* 2008), and the exact population is still unknown. Recently, camera traps set on the ground in Borneo have been mildly successful (Wilting *et al.* 2006) at locating this species and helped reveal two separate species of clouded leopard. This separation has been determined both by molecular genetics showing 40 nucleotide differences (Buckley-Beason *et al.* 2006; Wilting *et al.* 2007), and morphmetrically (Kitchener *et al.* 2006). In the wild, this new species, named the Sunda clouded leopard, ranges throughout the Sundaland on the islands of Borneo and Sumatra.

Within the mainland species, there are three recognized subspecies: *Neofelis nebulosa nebulosa* ranges throughout southern china and Indochina, and is the sub-species in collections found throughout North America; *Neofelis nebulosa macrosceloides* typically has a darker grey color with larger blotches and are found primarily throughout Nepal; and finally *Neofelis nebulosa brachyurus*, a sub-species that was found found only in Taiwan, is believed to be extinct (Chiang 2007).

## CLOUDED LEOPARD CONSERVATION

The clouded leopard was classified as “vulnerable” in 1986, by the International Union for Conservation of Nature’s (IUCN) Endangered Species commission, with an estimated population of less than 10,000 mature individuals in the wild, with a predicted or observed decline, and no subpopulation with more than 1000 individuals (Sanderson *et al.* 2008). It is also listed as vulnerable due to exploitation and a decline in area and quality of habitat (Nowell and Jackson 1996). Since 1975, it has been listed on Appendix I by the Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES) (UNEP-WCMC, 2009). This means that clouded leopards are threatened with extinction and international trade of this species is strictly prohibited except in the case of scientific research and conservation. Since 1970, the clouded leopard has also been listed as Endangered under the US Fish and Wildlife Service’s United States Endangered Species Act.

The newly distinguished Sunda clouded leopard species, *Neofelis diardi*, is found only on the Indonesian islands of Borneo and Sumatra (Wilting *et al.* 2007). This species is also considered “vulnerable” by the IUCN (Hearn *et al.* 2008). The main threat to this forest-dependant species is habitat destruction due to palm oil plantations. This species occurs in relatively low densities with an estimate of 9 individuals per 100km$^2$ coming from the Tabin Wildlife Reserve in Borneo (Wilting *et al.* 2006). Other research in this area indicates this number may be even lower; camera traps revealing 4-6 adults per 100km$^2$ (Hearn *et al.* 2008). Although this species is newly discovered, the data collected on their movements and behavior is the most revealing about the clouded leopard to date. The separation of this additional species further limits what was thought to be the current population estimates, increasing the importance of conservation of both species. In 2009, a "Clouded Leopard and Small Felid Conservation Summit" was held in Thailand at the Kasetsart University. This three day meeting brought together 65 participants from 13 countries and served as a way to facilitate information sharing between government organizations, NGOs, field researchers and zoo professionals regarding clouded leopards and other small Southeast Asian cats, such as the marbled cat (Pardofelis marmonata) and fishing cat (*Prionailurus viverrinus*). This was a first step at sharing the scarce data existing on the clouded leopard, The general lack of knowledge on the ecology of this species in the wild however makes the clouded leopard one of the most difficult to conserve and manage in captivity.

The main threats to the clouded leopard include habitat destruction and degradation, as well as poaching and prey reduction (Nowell and Jackson 1996). The bones and teeth of this species are extremely valuable; and the pelt is worth varying amounts depending on the region, ranging from US$ 2,000 in Sumatra to US$ 100 in Bangledesh (Sunquist and Sunquist 2002). These animals are also accidentally trapped in snares set for other animals (Hearn *et al.* 2008). The clouded leopard has legal protection within protected areas throughout Southeast Asia. Hunting is prohibited in most regions enforcement however is constantly an issue and pelts are still being traded. Low (1991) did a survey of black market wildlife traders in southeastern China and found clouded leopard pelts were the most common. They are also found as menu items for the wealthy throughout Asia and Europe (Nowell and Jackson 1996).

There are currently 225 clouded leopards living in captivity throughout the world. There are 75 included in the North American Species Survival Plan (SSP). There are few established breeding pairs including: three in North America; one in Japan; one in the United Arab Emirates; two in Germany; and three in England. There are also several pairs at the Khao Kheow Open Zoo in Thailand that are currently reproducing (Fletchall 2008).

The studbook for this species began in the 1970's. The Smithsonian's Conservation Research Center (CRC) in Front Royal, Virginia was renowned for its ability to breed clouded leopards. In the late 1970s through the early 1990s; there were 71 cubs born at this facility alone. Fewer than half of those cubs however survived the first few weeks of life, and only 11 went on to reproduce (Dr. Jogayle Howard, pers. comm.). The clouded leopard SSP was formed in 1989, with several goals including: addressing captive management issues; stabilizing population demographics; improving the population's genetics and developing conservation efforts in clouded leopard range countries. In 1993, several established breeding pairs were separated due to concerns over the genetic diversity of the population; these pairs were unable to be reestablished

(Fletchall, 2007). In 1996, there was one successful artificial insemination at the Nashville Zoo (Howard *et al.* 1996); there have been numerous attempts since with no success. Reproductive assistance with this species is extremely challenging due to their propensity for spontaneous ovulation and without a predictable ovulation cycle artificial insemination is practically impossible. In 1998, the SSP declared the clouded leopard captive population as a research population due to the lack of pair formation and breeding.

The experience and research obtained by the SSP over the past 40 years, eventually led CRC animal care staff and scientists, as well as their colleagues throughout the country, to form the "Thailand Clouded Leopard and Fishing Cat Consortium." The Consortium was started in 2003 as a joint venture between the Smithsonian's National Zoological Park and Conservation Research Center, the Nashville Zoo and the Thailand Zoological Parks Organization (ZPO) in conjunction with the Species Survival Program of both the clouded leopard and fishing cat species. The program began to increase genetic diversity among the captive population as well as educate the range countries of these species on husbandry, breeding and conservation practices. This consortium has developed an *ex situ* breeding program as well as an *in situ* field project in Khao Yai National Park to monitor carnivore activity and locate any potential clouded leopards and fishing cats in the area. A large population of 28 clouded leopards, some of which were wild caught and had been confiscated by the government from private hands or poachers, were housed in the five ZPO zoos throughout Thailand. These cats were moved to a centralized location, the Khao Kheow Open Zoo (KKOZ) where a new breeding area was set aside and renovated to house these animals. As of 2009, 35 valuable clouded leopards are housed at this facility and there have been 48 births. There have also been six clouded leopards imported to North America to be introduced into that SSP population in order to increase the genetic diversity of this population. Since their importation, these pairs have produced three litters that are in the process of being paired themselves.

## REPRODUCTIVE CHALLENGES

The clouded leopard has many challenges facing its breeding success in captivity including: genetic make-up of the population; high-stress; and behavioral incompatibility among pairs. The clouded leopard Species Survival Plan (SSP) focuses on managing the small North American population to maintain demographics and genetic diversity, which is currently 78.2% of the original founder genes. One of the primary goals is to sustain a healthy captive population that can serve to replenish dwindling wild populations in the future. The SSP must exercise extreme caution when selecting pairs. Once paired, individuals form a pair-bond and can not be split up, which further hinders the ability to rotate individuals and thereby limits genetic diversity. The current clouded leopard population in North America is aging and there are very few potential breeders (N=26). A majority of the individuals in the population have been taken out of the potential breeding population due to their aggression or age, with only eight females and 18 males remaining as “breedable” (Fletchall 2007). The population that does remain has very low genetic diversity. Currently, the mean inbreeding coefficient or average relatedness of individuals in the population ranges from 0.21-0.44, which is close to full cousins (0.25) or even siblings (0.50). This indicates the North American population is highly ‘inbred’

(Fletchall 2007), resulting in extremely limited options for pairing genetically compatible animals.

Clouded leopards tend to have an extremely shy, secretive nature. In captivity, situations such as construction, maintenance and special events can easily stress these animals. Prolonged stress is known to cause acyclicity in females (Brown, *et al.* 1994), as well as increased infant mortality due to neglect or infanticide. In males, stress can lower testosterone. It has been found that clouded leopards with lower stress levels tend to be more reproductively successful (Wielebnowski 2002, MacKinnon 2008).

The main factor limiting the potential establishment of new pairs, however, remains behavioral incompatibility. The SSP has stated that, “One issue of highest concern is male aggression during introduction to females for breeding” (Fletchall 2007). Clouded leopard males express a propensity for attacking and killing females during introductions (Yamada and Durrant 1989). Through fecal hormone analysis it has been shown that female cortisol levels are often increased prior to an attack (MacKinnon, 2008). There are many hypotheses as to why this may be. Carlstead *et al.* (1992) found that psychological stressors in domestic cats raised urine cortisol concentrations. Males housed with these females may be picking up on urine cortisol concentrations and attacking the females because they can sense the female is stressed. On the contrary, the female may be stressed by the presence of an aggressive male. Mackinnon (2008) has also found that just the introduction of a male to a female significantly raised the female’s cortisol levels. In addition, higher cortisol levels have been found in individuals killed by conspecific trauma versus any other cause of death such as accidental mortality, renal failure, and infection (Terio *et al.* 2005). Some aggression between conspecifics during courtship and breeding is normal; in fact most felid species engage in some form of fighting before and even after mating (Sunquist and Sunquist 2002), but overall fitness is greatly decreased when physical confrontation results in death. With clouded leopards, however, the females rarely survive an attack. Most attacks occur in a manner similar to that used in attacking prey (Rabinowitz 1987), resulting in the death of the female from one fatal bite to the spinal cord (Collins 1987, Seager and Demorest 1978).

Unfortunately, so little is known about clouded leopards in the wild that there is no way to be sure to what extent these cats socialize. Kitchener *et al.* (2006) and Austin (2002) both found home ranges overlapping by more than 50% between males and females. Kitchener *et al.* (2006) also found that adult males had significantly overlapping home ranges. Other felid species which had been thought to be strictly solitary have been known to coexist in close proximities, sharing home ranges well after the breeding season, tolerating young, and even sharing in hunting (Sunquist and Sunquist 2002). Perhaps the clouded leopard's natural history falls more in line with this.

Over the past thirty years of animal management, it has been determined that the most successful strategy for pairing clouded leopards and keeping the captive population healthy is by hand raising all cubs and introducing them as pairs before they reach sexual maturity, ideally by six months of age (Baudy 1971, Geidel and Gensch 1976, Fletchall 2007). Compared to mother-reared cubs, hand-reared individuals tend to pair bond more easily with potential mates because they can be introduced to one another at an early age. Hand-reared individuals tend to have lower stress levels because they can be acclimated to new environments and sounds from a very young age which helps them adjust to captivity; these individuals are also often better exhibit animals (Wielebnowski *et al.* 2002). Mother-reared cats can be very flighty, nervous and elusive. In general, hand-rearing also greatly reduces the risk of infant mortality due to neglect or infanticide by the mother (Dr. Jogayle Howard, pers comm.). There are, however, several pitfalls to this management strategy. Hand-rearing requires large financial and staff resources. It also increases human habituation; and animals raised in this manner would not be viable if reintroduced to the wild. Hand-rearing is a last resort, used only when a species is at the brink of extinction. The clouded leopard is one such species, and the reality exists that hand-rearing can not remain the primary method for managing this species in the future. It is imperative to determine what this species needs in captivity to allow them to breed and reproduce naturally. Therefore, alternatives must be found.

## BEHAVIOR

In the wild, felids rely heavily on scent as a form of communication. Primarily solitary in nature, individuals leave signs such as urine and feces to provide information to conspecifics such as, age, health and reproductive status (Sunquist and Sunquist 2002). These signs may function to serve several purposes including territory marking or communication of reproductive status. Scent-marking can also occur as an aggressive act, elicited by intruders or the scent of conspecifics (Ralls 1971). These types of signs or "range marks," are left for later investigation by a conspecific. They are most often discovered by accident depending mainly on spatial and temporal movement of an individual (Alberts 1992). It would be expected that males who are more successful at breeding would be well adapted to picking up these signs left by the females. If urine marking is an effective form of communication among felid species in the wild, then in captivity olfactory behaviors associated with urine marking should also exist. In a captive setting, one can see most felids react in various ways to different scents given as enrichment or behavioral stimulation (personal obs.). Common behaviors noted during these scent introductions include those similar to their wild counterparts, primarily rubbing and clawing the scented area as well as marking over the scent. Another common behavior observed is the Flehman response or an open-mouthed grimace, often with curled upper lip; the tongue may or may not protrude from the mouth. This behavior is usually seen after a cat sniffs urine, feces or the body of another cat; it allows the cat to process the scent, gaining as much information as possible through their vomeronasal or Jacobson's organ. Mellen (1993) found several of these behaviors were more prevelant among reproductively active small felids (*felis*), and specifically the behaviors "flehman" and "urine spray" were higher among males of most species studied.

As a first step to clouded leopard introductions in captivity, males are often given access to a female's area without the female in it, in order to explore her scents and become familiar with her, as he would in the wild. During these familiarization events several behaviors can be noted. Common behaviors include: urine and claw marking of the areas marked by the females; increased Flehman response; and even vocalizations. All of these behaviors are expected to be seen with a successful introduction. Olfactory behaviors are easily identifiable and tend to increase during reproductive periods (Sunquist and Sunquist 2002). Scent tests with felids have focused primarily on the creation of scent-stations for tracking and census of wild felids (Sargeant *et al.* 2003, Harrison 1997). An olfactory assessment, or scent test, using domestic cat urine has not been investigated in the past for the clouded leopard.

A mirror image stimulation (MIS) (Gallup, 1968) has been used with dolphins (Reiss and Marino 2001), chimpanzees (Povinelli *et al.* 1993) and most recently the elephants (Plotnick *et al.* 2006) to help determine self-recognition. Few non-human species however exhibit mirror self-recognition. In different species that are believed to lack self-recognition, such as the clouded leopard, the MIS is a way to assess social behavior and aggression (Svendsen and Armitage 1973). It is also thought to be indicative of an individual's territorial nature (Gallup 1968). Clouded leopards cannot self-recognize, therefore a mirror placed in their view represents a conspecific and their reaction can be correlated to how they would respond to an unknown individual in their territory.

The MIS proposed for this study is a replication of the test performed by Wielebnowski (1999) on cheetahs at the Smithsonian's National Zoo (Wielebnowski, 1999). The study revealed behavioral differences between cheetahs that could be correlated with breeding success. This study intends to produce similar results with the clouded leopard in order to assist with captive management and increase successful pairings. One of the steps during breeding introductions is giving the animals' visual access to each other. Animals that remain calm and exhibit affiliative behaviors, such as rubbing or prustening (which is a friendly vocalization produced by an expulsion of air) would be considered for physical pairing. Only when these behaviors are observed consistently are the individuals allowed full access to each other. During the mirror image stimulation it would be expected that reproductively successful individuals would exhibit these affiliative behaviors toward the mirror as they would toward a conspecific.

The novel object test was used by Powell (2005) during the temperament assessment done with giant pandas (*Ailuropoda melanoleuca*), and also with polar bears (*Ursus maritimus*) in a study focusing on stereotypic behaviors (Shepardson 2004). Specifically, the novel object test serves as a measure of the animal's response to acute stress as well as their ability to adapt to changes and handle new stimuli in their environment. In giant pandas (*Ailuropoda melanoleuca*), the results of the novel object tests were found to correlate with keeper assessments when determining personality of this species (Powell 2005). Hansen and Moller (2001) have used a stick test with weasels (*Mustela vison*) as a quick and accurate determination of personality. Keeper assessments are most accurate when the keeper has had many experiences with the animal, which can take months or years. If novel object tests can be used to determine personality, they can replace keeper assessments as a less subjective and more time-efficient personality assessment. This study utilizes the novel object test as one of eight different treatments given to the clouded leopards.

## JUSTIFICATION

There are many challenges to the current captive management of the clouded leopard (*Neofelis nebulosa*). Few studies have focused on the behavior of this species in captivity (MacKinnon 2008, Wielebnowski 2002; Wielebnowski *et al.* 2002). The issue of highest concern is male aggression toward females during breeding introductions

(Fletchall 2007). Successful pairing within the limited captive population is integral to clouded leopard survival; behavioral research is a powerful tool for achieving this goal. A complete behavioral assessment of clouded leopards was performed to help quantify temperaments among reproductively successful (RS) and unsuccessful individuals (RUS). The purpose of this study is to establish which clouded leopard temperaments tend to be more reproductively successful than others, and to pinpoint certain behavioral responses that may act as indicators of reproductive success in the clouded leopard.

There have been previous attempts to characterize temperament in other captive species (Stevenson-Hinde *et al.* 1980; Gold and Maple 1994; Gosling and John 1999; Carlstead *et al.* 1999a,b; Wielebnowski 1999; Powell 2005). The Behavior and Husbandry Advisory Group (BHAG) of the Association of Zoos and Aquariums published the "methods of behavioral assessment" (MBA) in 1997 which describes tests similar to those performed during this study that can be developed to assist in creating behavioral profiles for animals in captivity. The MBA was modeled by combining several behavioral studies on animals with reproductive challenges, including the black rhinoceros (*Diceros bicornis michaeli* and *minor*) (Carlstead *et al.* 1999a,b) and cheetah (*Acinonyx jubatus jubatus)* (Wielebnowski 1999), among others. Powell (2005) also performed similar tests on the giant panda (*Ailuropoda melanoleuca*) to determine characteristics that would help predict breeding success in four individuals housed at the National Zoo in Washington D.C., and the Atlanta Zoo.

Behavioral research on the clouded leopard has been limited. A majority of *ex situ* research on clouded leopards has focused primarily on reproductive physiology

(Pukazhenthi *et al.* 2000), specifically on cryopreservation (Pukazhenthi *et al.* 2006), female reproductive cycles (Pelican *et al.* 2006), and artificial insemination (Howard *et al.* 1996). Some behavioral work performed by Wielebnowski, *et al.* in 2002 was primarily related to stress and specifically linked certain husbandry practices to elevated fecal cortisol levels. The findings from this study served as a breakthrough in captive husbandry of this species, and the results continue to be a resource to captive managers. A great deal of the work on clouded leopards has been conducted by the Smithsonian's National Zoo and Conservation and Research Center. Much of their research has focused on the individual cats housed at CRC as well as the individuals at the Khao Kheow Open Zoo in Thailand that were used in this study. The data collected during this study will be combined with the results from previous research on these individuals to enhance our knowledge of the reproductive challenges facing this species.

Mellen (1989) believes that "reproductive activity" and "reproductive potential" can be quantified through behavioral analysis. Since behavioral data on the clouded leopard are lacking (MacKinnon 2008, Wielebnowski *et al.* 2002), this study attempts to increase the knowledge that exists about this species by quantifying temperaments related to breeding success. It also serves to identify behaviors that may pinpoint individuals who are more likely to be reproductively successful. This will benefit the captive management of this species by allowing the SSP to make more informative recommendations, possibly pinpointing aggressive males before female injury or death. It may also avoid the potential transfer of individuals between institutions that would cause unneeded stress on the animal (Wells *et al.* 2004) and help identify individuals more suitable for transfer. Also, the individual's rearing is examined and the results can help determine if behaviors necessary for reproductive success in the wild are being maintained in the captive collection. This can serve to reveal possible effects the current management of hand-rearing all individuals in the captive population may be having on individual behavior and more clearly identify possible behavioral or genetic ramifications.

# CHAPTER 2: METHODOLOGY

Since the worldwide captive population of clouded leopards is limited (N=225), there are few facilities that maintain large collections. Therefore, the two facilities with the largest populations were chosen to perform this study; the Smithsonian's Conservation and Research Center (CRC) located in Front Royal, Virginia (N=10); and the Khao Kheow Open Zoo (KKOZ) in Chonburi, Thailand (N=14). Due to the non-invasive nature of this study and the fact that the focus is on behavior, it was advantageous to have a large sample size in order to obtain as many temperament variations as possible. Both of these facilities allow for comparative analysis between individuals without having to account for major variations due to differences in husbandry, housing, keeper staff, diet etc (which should be constant throughout the entire collection). They both are also closed to the public, and have limited activity and consistent staffing which further minimizes the environmental variables that may otherwise affect behavioral responses normally found when cats are housed under different conditions or on public exhibit. The study ran from January to June, 2008.

## ANIMAL SUBJECTS

The clouded leopards included in this study ranged in age from three to sixteen years; calculated at the time of data collection (Table 1). This sample was not skewed toward any particular age. The study sites offered the unique opportunity to study multiple cats within single facilities with 4 females and 6 males at CRC (N=10) and 5 males and 9 females at KKOZ (N=14). These cats were then divided into two subgroups; reproductively successful individuals: (referred to throughout the paper as RS, were defined as those that had produced offspring (N=5)); and reproductively unsuccessful individuals, (referred to throughout the paper as RUS, were all that had not produced offspring (N=19)). All the cats were housed separately although they all had visual access to conspecifics. All individuals were tested between the hours of 13:00 and 19:30 and whenever possible before they were fed.

To carry out each test, the individual cat was invited into the holding cage where it was normally fed, and was therefore comfortable and familiar with the area. This area was pre-determined by the animal care staff. All exposure to, and exploration of, the items was completely voluntary. The cat was rewarded for its participation in the study per the recommendations and procedures of the animal keeper who normally worked with it. This most often included a reward for shifting in and out of the testing area. The whole series of tests took about 4 ¼ hours for each cat. A total of approximately 108 hours of video was recorded.

The experiments were conducted over several weeks' time to accommodate normal husbandry schedules and included eight different treatments. Only the urine scent required multiple treatments (five in total); the choice test, MIS, and novel object tests were single trials since the behavioral observations for these two relied more heavily on an initial response than T1. Animals under veterinary care or with health complications were not used for this study.

**Table 1: Animal Subjects - Clouded Leopard information obtained from keeper survey.**

| Clouded Leopard | Studbook Number | Success | Sex | Facility | Rearing | Age |
|---|---|---|---|---|---|---|
| Noname | 1192 | Y | M | KKOZ | HAND | 5 |
| Songkla | 1232 | Y | M | KKOZ | MOTHER | 7 |
| Wanchai | 1217 | Y | M | KKOZ | HAND | 3 |
| Sakda | 1222 | N | M | KKOZ | HAND | 3 |
| Mei | 1265 | N | M | KKOZ | MOTHER | 2 |
| Thap-thim | 1251 | N | F | KKOZ | HAND | 3 |
| Manow | 1159 | N | F | KKOZ | MOTHER | 7 |
| Pukluk | 1155 | N | F | KKOZ | MOTHER | 10 |
| Gaint | 1189 | N | F | KKOZ | MOTHER | 8 |
| Mesa | 1223 | N | F | KKOZ | HAND | 3 |
| Somsri | 1187 | N | F | KKOZ | MOTHER | 6 |
| Nok | 1219 | N | F | KKOZ | HAND | 3 |
| Mini | 1221 | Y | F | KKOZ | MOTHER | 4 |
| Numfun | 1165 | Y | F | KKOZ | MOTHER | 11 |
| Junior | 995 | N | M | CRC | HAND | 13 |
| Xing | 1015 | N | M | CRC | HAND | 13 |
| Brandon | 1087 | N | M | CRC | HAND | 11 |
| Dao | 1218 | N | M | CRC | HAND | 3 |
| Zoe | 1008 | N | F | CRC | HAND | 14 |
| Jasmine | 1731 | N | F | CRC | MOTHER | 15 |
| Nattie | 1124 | N | F | CRC | HAND | 7 |
| Thistle | 967 | N | F | CRC | MOTHER | 15 |
| Nellie | 1123 | N | F | CRC | HAND | 7 |
| Jogayle | 1214 | N | F | CRC | HAND | 4 |

## TEMPERAMENT ASSESSMENT

In order to determine temperaments that existed within the test population each keeper was asked to complete a “temperament assessment” (TA) (Appendix V). This was a general assessment of the individual clouded leopard’s “personality” from the animal keepers that work closely with them everyday and would presumably know the animals best. The TA survey was set up on a sliding scale (Feaver *et al.* 1986; Wielebnowski 1999) in order to make the analysis as accurate as possible. Each respondent was asked to place a dash on the line where she or he felt the animal fell for frequency of exhibiting each trait. Three keepers responded for each subject animal.

Many variables play a role in why an animal behaves a certain way. In order to help tease out any environmental factors that may be affecting the cat's behavior, another survey was used (keeper survey, See Appendix V) and completed by the author. The main purpose of this survey was to pinpoint any differences within each individual cat's history and environment. Since all the subjects were at either KKOZ or CRC, variables such as diet, weather, animal care staff etc., were constant within each institution. Other variables such as age, sex, rearing (mother or hand), or facility, which may have influenced the animal's response to stimuli, varied among cats (Table 1). Therefore, this survey served as a general history base for each individual cat to see if any other confounding factors influenced behavioral response to the trials.

## BEHAVIORAL OBSERVATIONS

The order of the test trials was randomized without replacement to avoid the possibility of any order effect (Appendix I). During the period of behavioral observation, interval or scan sampling was used to record the behavioral states, such as sitting or lying. These behaviors are commonly performed for long durations (several minutes or hours). By interval sampling every minute, a general time budget for the individual was determined. Many breeding behaviors however associated with introductions are of relatively short duration behaviors, such as Flehmen or urine marking/scraping. These behavioral events were recorded using continuous sampling, meaning each time the behavior was performed during the 15 minute observation period, it was recorded. In order to maintain consistency during behavioral observations, a single observer (the author) used the same check sheet of behaviors for each trial (See Appendix II).

Definitions for each behavioral event and state were clearly defined before observations were made and are listed in Table 2.

Each clouded leopard was video recorded during all trials. Video recording began from the moment the animal was given access to the test area; and behavioral information was then recorded for fifteen minutes. After the initial observations, all video was again reviewed by the initial observer to ensure accuracy of data collection. A total of 108 hours of quantitative behavioral data was recorded during the study period.

During video coding, several changes were made to the behaviors being recorded. These changes were due to observations made by the researcher during the initial testing period and defined at that point. It was determined that behaviors existed among the test population that were not initially acknowledged and were added to the check sheet once it became clear that they were fairly common among the clouded leopards being tested. Due to the uniqueness of the behavior itself, it was determined they were important to include. These behaviors included: one response; "time to shift;" one state, "patrol;" and four events, "rubtrial", "sniffobject", "flinch" and "urinewalk." Both "stare" and "stare time" were removed at the start of video coding due to the inability for the researcher to clearly define the start and stop points.

Once these data were obtained each response was averaged, the events were converted to proportion of time, and the states were converted to rate per hour for analysis. Several behaviors (see Table 2 for definitions) were also combined for analysis to see if separation was necessary during coding. Since these behaviors are often performed in combination with each other, they may be combined in future observations. Therefore they were analyzed both separately, and as combined totals including:

Rub object/trial = Rubtotal;

Urine Squat/Walk = Urinetotal;

Meow/Cry/Prusten = Voctotal.

During analysis, “rubtotal”, sniffobject” and “snifftotal” were removed because it was determined these could not be accurately measured across all cats.

**Table 2.Clouded leopard behavioral definitions and codes (adapted from Wielebnowski et al. 2002)**

| | | |
|---|---|---|
| **Behavioral Responses (behaviors recorded once for each trial):** | | |
| Latency of response | LAT | Amount of time in seconds for the animal to first respond to the trial indicated by any part of the animal’s body crossing into the test area. |
| Time to approach | TIA | Amount of time in seconds for the cat to first approach the object and interact. By interact any behavior including, retreat, rub, hiss, sniff, swat etc. |
| Total spent interacting | TSI | Total time in seconds the cat spent interacting with the object. Time ended when the animal stepped away. Time was ended after 5 seconds of last interaction if animal did not step away. |
| *Time to shift | TTS | Amount of time in seconds it took for the animal to shift their entire body into the testing area. Four paws on surface. |
| **Behavioral States (behaviors that usually occur for longer time periods)** | | |
| Lying | LY | Cat lies in horizontal reclining position, cat may or may not be asleep |
| Sitting | SIT | Cat sitting on hindquarters in upright position with forelegs braced |
| Standing | ST | Cat remains motionless while in upright position on all four feet |
| Walking | WA | Cat walks at a moderate pace in a directed manner towards something |
| Running | RU | Cat moves swiftly |
| Pacing (P) | PA | Cat walks or runs back and forth in a repetitive, non-directed pattern (stereotypic movement) must repeat movement 3X and the cat should not be performing other behaviors (i.e. sniffing, urinating etc.) |

| | | |
|---|---|---|
| *Patrolling | PAT | Cat walks around enclosure in a calm and deliberate manner, usually in a somewhat repetitive pattern around the perimeter, and often includes some investigative behavior or urine marking. Varies from Pacing in that the same pattern is not followed 3x. |
| Out of Sight | OOS | Cat is out of view from the observer |
| **Behavioral Events (behaviors that are usually of a relatively short duration)** | | |
| Approach | AP | Animal moves toward object, and interacts with it in some way (i.e. sniff, paw etc.). Animal must move away from object for 3 or more seconds for it to count as a new approach. |
| Bite . | BI | Cat uses teeth to move, tear, rip or attack an object |
| Claw | CL | Cat scratches object, often wood, with front claws |
| Defecate | DEF | Animal defecates |
| Flehmen | FLE | Open-mouthed grimace, often with curled upper lip, tongue may or may not protrude out of mouth. This behavior is usually seen after cat sniffs urine, feces or body of another cat |
| *Flinch | FLIN | Cat begins to approach or sniff an object and then abruptly stops and moves backward. This may be accompanied with the raising of a paw. |
| Groom | GR | Cat cleans itself by licking |
| Growl/hiss | GH | Growl is a low-pitched throaty rumbling sound; hissing is a rapid expulsion of air, teeth exposed and nose wrinkled. Both vocalizations are usually performed in an aggressive context |
| *Lick Trial | LT | Cat touches tongue to trial sometimes followed by Flehman |
| Meow/cry | MC | Either short high-pitched meow call, or loud extended crying call. Both calls appear to be emitted when one cat is trying to locate another over a short or long distance |
| Prusten | PR | Soft expulsion of air through lips, similar to snorting in horses. Cat may raise muzzle while vocalizing. Often used in ‘friendly’ greeting or a ‘reassurance’ context |
| Retreat | RT | Animal quickly moves away from the object in a submissive manner (hind end down, tail down) and may glance back, pause or stare at object while retreating |
| Roll | ROL | Cat rolls on back and rubs back against the ground, rolling back and forth |
| Rub object | RBO | Cat rubs on an object (e.g., fence, log, etc.) with cheek or head and may continue rubbing along entire length of its body |

| | | |
|---|---|---|
| *Rub Trial | RBT | Cat rubs on an trial with cheek or head and may continue rubbing along entire length of its body |
| Sniff Trial | SNT | Cat sniffs the trial object with its nose |
| *Sniff Object | SNO | Can sniffs anything other than the trial object |
| Paw/Swat | PS | Cat uses forepaws to tap or strike an object– occasionally this occurs without making any physical contact with the object. |
| Urine scrape | US | Cat shifts hind legs back and forth in the squatting position while urinating |
| *Urine walk | UW | Cat urinates in the standing position usually combined with walking. |
| *Indicates behavioral states and events that were added after initial behavioral observations and recorded during video coding. | | |

## SCENT TEST

All scents were presented on 1/6 piece of a 12 inch, non-coated, paper plate. For this study, domestic cat urine was chosen to elicit behaviors that may be observed during breeding introductions in captivity. Both estrus and non-estrus female urine was used to see if differences in hormone levels might affect response. Male domestic cat urine was used as well to help determine if responses were at all sex related. The positive control used was blood because it can be expected that all the cats would respond to this, and the negative control was just the test plate alone. If successfully reproductive males tend to exhibit olfactory behaviors, (sniff, urination, rub, claw, flehman), in higher frequencies than unsuccessful males, this test could be used as a management tool to predict a male's reproductive success before being paired.

The scent test involved five different treatments given to each individual animal on three separate occasions summarized in Table 3. The urine was collected from reproductively active domestic cats housed in the cat colony at the Smithsonian's Conservation and Research Center. This urine was collected non-invasively during routine daily husbandry to ensure safety in collection. The urine was non-sterile and the individuals used were housed alone to avoid misrepresentation of the sample. Upon collection it was immediately separated out into 2 ml units and frozen in cryo vials to maintain hormone integrity.

Blood collection was arranged with the animal care staff. Blood was taken from the defrosted meat fed to the clouded leopards. It was stored in 2 ml vials and frozen immediately to limit bacterial growth.

Each scent was presented independently on a clean piece of 1/6 non coated paper plate. The plate was placed as centrally as possible within the testing area. Often times, however, it was necessary to vary the position from the exact center in order to provide the best view for video recording. Test plates were never reused and were thrown out after each use. In order to determine preference, a Choice test with all the test samples 1-5 being offered at the same time each on their own separate piece of paper plate. These samples were lined up approximately three inches apart. To avoid any behavioral response due to the novelty of the scent, this test was given only after each scent had been presented to the cat at least one time independantly.

## MIRROR IMAGE STIMULATION

During clouded leopard pairing, face-to-face introductions of the male to the female begin with access through a mesh divider to determine the animals' responses to one another. Typically, there are some aggressive displays of hissing and swatting, but all of these introductions are done though a mesh door to prevent any injuries. To help test the possible aggressiveness of each individual to conspecifics, a mirror image stimulation (MIS) (Gallup 1968) was performed, with the hypothesis being that the response of reproductively successful individuals would vary from that of unsuccessful ones.

For the MIS experiment a (18" x 24") piece of acrylic plexi-glass mirror was secured to the inside mesh of the individual clouded leopard's cage. Due to the fact that all of the clouded leopards being tested had visual access to conspecifics, it was determined that the mirror would be most effective if placed in with the animal. In this way, it appeared that the conspecific was actually inside the animal's enclosure, instead of next door, which was common place. Each cat was tested only once, video taped and behavioral observations were recorded on the same behavior check sheet used for the other treatments. The mirror was bleached and fully dried before each use.

NOVEL OBJECT TEST

The novel object used was a 16" x 12" x 35" unprinted biodegradable "lawn and leaf" Kraft paper bag. This item was placed standing upright in the center of the individual's holding area while the animal was out of the area. Once the item was ready, the animal was invited into the area to investigate the object. Each cat was tested once, video taped and behavioral observations recorded on the same behavior check sheet used for the other treatements.

All information collected from the temperament assessment, the keeper survey, and the behavioral observations was entered into excel worksheets. The temperament assessments and keeper surveys were coded and the appropriate information was combined with the behavioral observations. All of this data were transferred to SPSS 12.0 for Windows for analysis.

**Table 3: Test Samples presented to each cat during Scent Test**

| | |
|---|---|
| Test Sample 1 | Paper plate with nothing on it |
| Test Sample 2 | 2 mls of blood collected from daily diet |
| Test Sample 3 | 2 mls of male domestic cat urine |
| Test Sample 4 | 2 mls of female domestic cat non-estrus urine |
| Test Sample 5 | 2 mls of female domestic cat estrus urine |

# CHAPTER 3: RESULTS

For the purpose of analysis, "reproductively successful" (RS) individuals (N =5), were considered so only if they had successfully paired with another individual and produced offspring. Therefore, "reproductively unsuccessful" (RUS) individuals (N=19) were those which had not paired or had paired but produced no offspring. Mother-reared (MR) individuals (N=10), were those who were raised for any period of time past birth by a clouded leopard. This includes individuals that were handled by humans, but remained with the female clouded leopard for rearing. Hand-reared (HR) individuals (N=14), were those taken from the female clouded leopard and bottle-fed by humans since birth. The data were tested using the Kolmogorov-Smirnov test for normality (Field 2002) and was found to be significantly different ($p<0.001$) than the expected normal distribution. Therefore, non-parametric tests were applied.

An inter-observer reliability test using Spearman rank-order correlation (one-tailed) was run on the temperament assessments (Appendix III) to determine the degree of association between raters (Feaver *et al.* 1986). Only scores that were significant at the $p\leq0.05$ were used. All items with an inter-observer correlation coefficient of less than 0.5 were rejected from analysis. All correlation coefficients ranged from 0.996 to 0.505 (Appendix IV). Of the original twenty temperament characteristics rated, three were dropped: completely; "fearful of strangers;" "investigative;" and "tense." Two new characteristics were formed into "total" temperament characteristics created from the separate ratings for "aggressive" and "friendly." So the characteristics "aggressive to conspecific," "aggressive to familiar people," and "aggressive to strangers" were averaged into a single score for "aggression." The same was done with the three separate friendly scores, "friendly to conspecifics," "friendly to familiar people," and "friendly to strangers" were combined to create a single score for "friendly."

A total of thirteen temperament characteristics remained. The mean score from the raters on the remaining characteristics of the temperament assessments were then averaged (Appendix VI) and analyzed using an R-type Principle Component Analysis (PCA). This analysis has been used to characterize temperament in similar studies (Stevenson-Hinde *et al.*1980; Gold and Maple 1994; Wielebnowski 1999). This analysis is used when there are no assumptions about the data and predictions are made based on covariance of the variables. This allowed for a comparison of temperament characteristics between individuals, indicating specific traits that tend to group together, such that when X temperament characteristic has a high frequency, Y temperament characteristic also tends to be high. Hypotheses 1-7 are summarized in Table 4 and represent the results of the analysis on clouded leopard temperaments.

Hypothesis 1 predicted clouded leopards would have identifiable temperaments. The analysis of the temperament assessments was performed using the R-type principle component analysis. This analysis resulted in four components, with eigenvalues >1 and accounted for 82% of the observed variance. This followed Kaiser's criterion (Kaiser, 1960) where there were less than 30 variables and communalities are greater than 0.7

(Field 2002). Each component is representative of a clouded leopard temperament. The first component produced significantly high positive loadings for the characteristics "high-strung," "insecure" and "playful," and significantly high negative loadings for "calm" and "smart". The second component produced significantly high positive loadings for the characteristics "active," "confident," "smart," and "vocal." The third component produced significantly high positive loadings for "aggressive" and "fearful of conspecifics" and significantly high negative loadings for "friendly" and "active." Finally, the fourth component produced significantly high positive loadings for "calm" and "food aggressive" and significantly high negative loadings for "high-strung" and "fearful of familiar people." The thirteen characteristics and appropriate loadings can be found in Appendix VI. Table 5 represents the four components with significant loadings. Each component was named for the first significant characteristic as follows: component 1 = *High-strung* (N = 7); component 2 = *Active* (N = 4); component 3 = *Aggressive* (N = 10); and component 4 = *Calm* (N = 3). Hypothesis 1 can be accepted with four components representing the temperaments for this population of clouded leopards.

**Table 4: Hypotheses 1-7 predicting differences in Clouded leopard temperaments**

| | **Hypothesis** | **Result** |
|---|---|---|
| H1 | Clouded leopards have distinct temperaments | Accept |
| H2 | Reproductively successful clouded leopards have significantly different temperaments | Accept |
| H3 | Male and female clouded leopards have significantly different temperaments | Accept |
| H4 | Mother-reared and hand-reared clouded leopards have significantly different temperaments. | Accept |
| H5 | Clouded leopards housed at different facilities have significantly different temperaments | Reject |
| H6 | The age of a clouded leopard significantly influences reproductive success | Reject |
| H7 | The age of a clouded leopard significantly influences their temperament | Reject |

**Table 5:** **Four major components of temperament in the clouded leopard derived from keeper rated temperament assessments on 24 clouded leopards.**

| Component | Temperament | Characteristics with significantly high eigenvalues | Associated eigenvalue | Characteristics with significantly low eigenvalues | Associated eigenvalue |
|---|---|---|---|---|---|
| 1 | High-strung | High-strung | 0.674 | Calm | -0.690 |
| | | Insecure | 0.930 | Smart | -0.419 |
| | | Playful | 0.930 | | |
| 2 | Active | Active | 0.588 | NONE | |
| | | Confident | 0.754 | | |
| | | Smart | 0.794 | | |
| | | Vocal | 0.859 | | |
| 3 | Aggressive | Aggressive | 0.931 | Friendly | -0.887 |
| | | Fearful of Conspecifics | 0.703 | Active | -0.579 |
| 4 | Calm | Calm | 0.580 | High-strung | -0.568 |
| | | Food aggressive | 0.822 | Fearful of familiar people | -0.880 |

The factor scores for each cat obtained through the Principle Component Analysis and resulting "temperament" for each individual clouded leopard can be found in Table 6. The data obtained from the Keeper Survey (Appendix IV), specifically, reproductive success, rearing, sex, age and facility were then compared to the individual factor scores obtained in the PCA using the Mann-Whitney U-test (Wielebnowski 1999). This analysis was chosen because of the small sample size; since this is a non-parametric test it makes no assumptions about the data. The drawbacks of this analysis are a loss in magnitude of difference between the data and an increased chance of Type II error (Field 2002). This analysis is ideal for comparing two groups such as reproductively successful (RS) and reproductively unscuccessful (RUS) individuals.

Hypothesis 2 predicted reproductively successful (RS) individuals would tend to have specific temperaments. Several other factors however could influence temperament and need to be tested as well. The Mann-Whitney U-test was used to test Hypotheses 2-6 which compare the resulting component scores of the PCA to reproductive success, as well as sex, rearing and facility to determine if there may have been any influence on temperament from these variables (Table 8). The analysis was also used to determine that there was no significant correlation between age and reproductive success ($U=40$, $P=0.590$). The Spearman rank-order correlation was used tosupport Hypothesis 7 and determine that there was no significant correlation between age and temperament (component 1 $p=0.261$; component 2 $p=0.320$; component 3 $p=0.074$; component 4 $p=0.937$). The temperaments were coded 1-4 depending on the factor score (see table 6).

When comparing component scores between the individual cats, RS individuals scored significantly higher for Component 4, CALM ($p = 0.004$); males scored significantly higher for Component 4, CALM ($p = 0.008$); and mother-reared (MR) individuals scored significantly higher for Component 3, AGGRESSIVE ($p = 0.04$). There was no significant difference in temperament between individuals housed at different facilities. The factor scores were then compared to reproductive success using logistical regression. Both Factor 3 (aggression) and Factor 4 (calm) were both highly correlated ($p=0.000$) with reproductive success. Each temperament was then coded and again compared to reproductive success using logistical regression. Overall, it was found that reproductive success is significantly correlated with clouded leopard temperament ($p=0.013$).

**Table 6: Individual Clouded leopard Temperaments based on factor scores (reproductively successful individuals are highlighted in gray)**

| Clouded leopard | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Highest Factor | Corresponding Temperament |
|---|---|---|---|---|---|---|
| Noname | 1.09403 | 0.37385 | -1.47374 | 1.48076 | 4 | Calm |
| Songkla | -1.45921 | -0.79607 | 1.68400 | 0.78965 | 3 | Aggressive |
| Wanchai | -1.08220 | -0.01007 | -1.08067 | 1.30416 | 4 | Calm |
| Sakda | -0.20284 | -1.69566 | -0.75896 | -0.71977 | 1 | High-strung |
| Mei | 2.01811 | 0.17499 | 1.40411 | -0.07637 | 1 | High-strung |
| Thap-thim | 0.61462 | 0.91182 | -0.20359 | 0.64782 | 2 | Active |
| Manow | 0.48181 | 1.66692 | -0.73392 | -1.41833 | 2 | Active |
| Pukluk | -0.70574 | -0.62980 | 1.44568 | -0.73234 | 3 | Aggressive |
| Gaint | -0.90224 | 0.70857 | 0.35340 | -1.78489 | 2 | Active |
| Mesa | -0.92060 | -1.12974 | -0.55551 | -0.22453 | 4 | Calm |
| Somsri | 1.19912 | -2.24220 | 2.27372 | -1.30497 | 3 | Aggressive |
| Nok | 0.76867 | -0.39740 | -0.05776 | -1.06737 | 1 | High-strung |
| Mini | -0.36740 | -0.03734 | 0.72444 | 0.69858 | 3 | Aggressive |
| Numfun | 0.02547 | -1.16580 | 0.94588 | 0.60061 | 3 | Aggressive |
| Junior | -0.96651 | 1.02710 | 1.81752 | 0.98371 | 3 | Aggressive |
| Xing-xing | 1.12479 | -0.40490 | 1.44217 | 0.84411 | 3 | Aggressive |
| Brandon | 1.12065 | -1.23172 | -0.10245 | 0.17563 | 1 | High-strung |
| Dao | 0.67590 | -1.56477 | 1.01051 | 0.27531 | 3 | Aggressive |
| Zoe | 1.74158 | -1.47532 | 0.47507 | -0.00911 | 1 | High-strung |
| Jasmine | 1.15161 | -1.66218 | 1.34194 | 0.00524 | 3 | Aggressive |
| Nattie | 1.17335 | -0.81535 | 1.34449 | -0.03780 | 3 | Aggressive |
| Thistle | 1.44156 | -1.48490 | 0.47627 | -1.03625 | 1 | High-strung |
| Nellie | 1.08935 | -1.14704 | -0.32704 | -0.78371 | 1 | High-strung |
| Jogayle | -1.29763 | 0.50038 | -0.70262 | 0.47196 | 2 | Active |

The Mann-Whitney U-test was then used for Hypotheses 8-11 (Table 7) which compared reproductive success, sex, rearing, and facility, respectively with the actual scores that the individual clouded leopards received by the keepers on the temperament assessments. It produced the significant mean ranks between characteristics for each group by ranking the data in order of each cat's average score. In this way it showed which group scored significantly higher or lower for different temperament characteristics. The full table of results can be found in Appendix VII.

**Table 7: Hypotheses 8-11 predicted differences between reproductively successful clouded leopard temperament characteristics from keeper rated assessment.**

| | Hypothesis | Result |
|---|---|---|
| H8 | Clouded leopard temperament characteristics vary between reproductively successful and reproductively unsuccessful individuals | Accept |
| H9 | Clouded leopard temperament characteristics vary between males and females. | Accept |
| H10 | Clouded leopard temperament characteristics vary depending on rearing. | Accept |
| H11 | Clouded leopard temperament characteristics vary based on facility. | Accept |

Analysis of the characteristics rated by keepers on the temperament assessment (Table 8) showed that RS individuals (N = 5) ranked significantly higher on characteristics including; "calm" (p=0.017); "confident" (p=0.023); and "food aggressive" (p=0.027); and significantly lower on "fear of conspecifics" (p=0.010) and "high-strung" (p=0.013) than RUS individuals (N=19) which corresponds to the results from the PCA. The only characteristics found to be significant between gender were the males (N=9) ranking higher for "food aggressive" (p=0.011), and females (N=15) ranking higher for "fear of familiar people" (p=0.027). When comparing individuals between facilities, the individuals housed at Khao Kheow Open Zoo (N=14) ranked higher on the characteristics of "confident" (p=0.040), "friendly" (p=0.008), and "vocal" (p=0.014) than individuals housed at the CRC (N=10). Individuals that were mother-reared (N=10) scored significantly higher for "aggressive" (p=0.043) and "fearful of familiar people" (p=0.006), and significantly lower for "active" (p=0.016) than hand-reared individuals (N=14).

Hypotheses 12-17, summarized in Table 9, predicted differences between male and female clouded leopards, and these again were examined separately using the Mann-Whitney U-test to see if temperament characteristics were significantly associated with one gender or another. Reproductively successful males scored higher on "friendly" (p=0.039) than unsuccessful males; there was no significant difference between characteristics based on whether males were mother or hand reared. Males at KKOZ in Thailand, scored higher on "friendly" (p=0.014) then males at CRC. RUS females scored significantly higher on "fearful of conspecifics" (p=0.027) than RS females; MR females scored higher on "fearful of familiar people" (p=0.015) than HR females. There was no difference within the female population between facilities.

**Table 8: Mean and standard deviations of component scores of individual clouded leopards grouped by reproductive success, gender, rearing, and facility.**

| | | Component 1 | Component 2 | Component 3 | Component 4 |
|---|---|---|---|---|---|
| Reproductively successful (N=5) | MEAN | -0.36 | -0.33 | 0.16 | 0.97 |
| | STDEV | 1.00 | 0.63 | 1.37 | 0.39 |
| Reproductively unsuccessful (N=19) | MEAN | 0.51 | -0.57 | 0.52 | -0.30 |
| | STDEV | 1.02 | 1.11 | 0.96 | 0.80 |
| Mann Whitney | | U=23, P=0.082 | U=38, P=0.499 | U=39, P=0.546 | U=7, **P=0.004*** |
| Females(N=15) | MEAN | 0.37 | -0.56 | 0.45 | -0.40 |
| | STDEV | 0.99 | 1.10 | 0.90 | 0.82 |
| Males (N=9) | MEAN | 0.26 | -0.46 | 0.44 | 0.56 |
| | STDEV | 1.22 | 0.93 | 1.29 | 0.71 |
| Mann Whitney | | U=60, P=0.655 | U=64, P=0.835 | U=65, P=0.881 | U=23, **P=0.008*** |
| Hand-reared (N=14) | MEAN | 0.35 | -0.50 | 0.06 | 0.24 |
| | STDEV | 1.03 | 0.93 | 1.01 | 0.78 |
| Mother-reared (N=10) | MEAN | 0.29 | -0.55 | 0.99 | -0.43 |
| | STDEV | 1.15 | 1.19 | 0.84 | 0.95 |
| Mann Whitney | | U = 66, P = 0.815 | U=66,P=0.815 | U=35, **P=0.04*** | U=42, P=.101 |
| KKOZ (N=14) | MEAN | 0.04 | -0.30 | 0.28 | -0.13 |
| | STDEV | 1.02 | 1.06 | 1.15 | 1.06 |
| CRC (N=10) | MEAN | 0.73 | -0.83 | 0.68 | 0.09 |
| | STDEV | 1.02 | 0.93 | 0.85 | 0.63 |
| Mann Whitney | | U=42, P=0.101 | U=47, P=0.178 | U=55, P=0.380 | U=60, P=0.558 |

*** indicates $p \leq 0.05$ (two-tailed)**

**Table 9: Hypotheses12-17 predicting differences in male and female clouded leopards based on temperament characteristics from keeper rated assessment**

| | Hypothesis | Result |
|---|---|---|
| H12 | Male clouded leopard temperament characteristics vary depending on reproductive success. | Reject |
| H13 | Male clouded leopard temperament characteristics vary depending on rearing | Reject |
| H14 | Male clouded leopard temperament characteristics vary depending on facility. | Accept |
| H15 | Female clouded leopard temperament characteristics vary depending on reproductive success. | Accept |
| H16 | Female clouded leopard temperament characteristics vary depending on rearing. | Accept |
| H17 | Female clouded leopard temperament characteristics vary depending on facility. | Reject |

In order to accurately analyze the behavioral observations, the data were transformed. The behavioral responses remained as averages of time in seconds. The behavioral states were converted into a time budget for each animal by dividing each state by the total number of observations for each individual to determine the proportion of time (POT) or frequency that the animal spent in that state. The behavioral events were multiplied by four and were reported as rate per hour (RPH). For each individual cat, a single average value was obtained for each behavioral observation of all eighteen trials and this value was used in analysis.

All behavioral observations recorded during video analysis were analyzed using logistical regression to determine if any of the behaviors exhibited by clouded leopards during these periods of testing were significantly correlated to the dependant variables reproductive success, sex, rearing or facility. This analysis was selected due to the non-parametric nature of the data and the fact that the dependant variables are dichotomous and categorical (Field 2002). The analysis determines the probability of success based on an individual's behavioral responses by pinpointing which behavioral responses occurred in significantly higher or lower frequencies depending on success. Normally, a multiple linear regression model would be used, but these data are non-linear and therefore violate the assumption of linearity. A logistical regression log transforms the data so that they can be analyzed in a linear fashion while maintaining their non-linear relationship. This analysis will show significant variation in the independant variables (behavioral observation) based on the dependant variable (success, sex, rearing, or facility). The significance values for all behavioral observations can be found in Appendix VIII.

Hypotheses 18-21 are summarized in Table 10 and predicted that the behavior observations obtained during the trials would vary based on reproductive success, sex, rearing and facility, respectively.

**Table 10: Hypotheses 18-21 predicted differences in behavioral observations of 24 clouded leopards**

| | Hypothesis | Result |
|---|---|---|
| H18 | Clouded leopard behaviors vary during testing depending on reproductive success. | Accept |
| H19 | Clouded leopard behaviors vary during testing depending on sex. | Accept |
| H20 | Clouded leopard behaviors vary during testing depending on whether they were mother versus hand-rearing. | Accept |
| H21 | Clouded leopard behaviors vary during testing depending on facility. | Accept |

Hypothesis 18 predicted that there would be significant differences in the behaviors observed between RS and RUS individuals. It was found that RS individuals had a significantly shorter latency to respond (p=0.035) and time to shift (p=0.047). They also had significantly higher frequencies of “lying” (p=0.018), “patrol” (p=0.036), “voctotal” (p=0.014), “defecate” (p=0.04), “retreat” (p=0.021) and urine walking (p=0.022). The RUS individuals had significantly higher frequencies of out of sight (p=0.045).

Hypothesis 19 predicted there would be significant differences between male and female clouded leopards. When the average rate per hour of all trials was compared

(Table 8) the behaviors “sit” (p=0.025), “patrol” (p=0.022) and “flinch” (0.035) were significantly different. On average, females spent more time sitting (0.16 seconds) than males (0.09 seconds), and males spent more time patrolling (0.03 seconds) than females (0.00 seconds). On average, females were observed flinching (1.93 times) more often than males (0.44 times)

**Table 11: Hypothesis 18 – Significant correlations between reproductively successful and unsuccessful clouded leopards obtained by logistical regression from behavioral observations.**

| Dependant Variable | | LAT | TTS | LY | OOS | PAT | VOCTOTAL | RETREET | DEFEC | URINEWALK |
|---|---|---|---|---|---|---|---|---|---|---|
| Reproductively successful (N=5) | MEAN | 1.40 | 22.57 | 0.58 | 0.01 | 0.03 | 21.87 | 0.30 | 0.07 | 1.67 |
| | STDEV | 1.32 | 28.69 | 0.14 | 0.01 | 0.03 | 27.87 | 0.45 | 0.09 | 2.52 |
| Reproductively unsuccessful (N=19) | MEAN | 101.10 | 136.66 | 0.36 | 0.22 | 0.01 | 3.66 | 0.03 | 0.01 | 0.18 |
| | STDEV | 98.16 | 120.15 | 0.18 | 0.22 | 0.02 | 6.73 | 0.11 | 0.04 | 0.58 |
| Significance | | 0.035 | 0.047 | 0.018 | 0.045 | 0.036 | 0.014 | 0.021 | 0.04 | 0.022 |

**Table 12: Hypothesis 19 – Significant correlations between male and female clouded leopards obtained by logistical regression from behavioral observations.**

| | | SIT | PATROL | FLINCH |
|---|---|---|---|---|
| Males (N=9) | MEAN | 0.09 | 0.03 | 0.44 |
| | STDEV | 0.06 | 0.03 | 0.58 |
| Females (N=15) | MEAN | 0.16 | 0.00 | 1.93 |
| | STDEV | 0.08 | 0.02 | 1.94 |
| Significance | | 0.025 | 0.022 | 0.035 |

Hypothesis 20 predicted there would be significant differences between hand-reared and mother-reared clouded leopards (Table 9). When the average rate per hour of all trials were compared between MR and HR individuals, there were significant differences found between latency to respond (p=0.027), time spent investigating, lying (p=0.004), out of sight (p=0.05), lick (p=0.02), and roll (p=0.024). HR individuals had a longer average latency to respond (p=0.027) and had a lower average for time spent investigating (p=0.011). HR individuals also had significantly lower rates per hour of lying, out of sight and licking, and significantly higher rates for roll.

**Table 13: Hypothesis 20 – Significant correlations between hand-reared and mother-reared clouded leopards obtained by logistical regression from behavioral observations**

| | | LAT | TSI | LY | OOS | LICK | ROLL |
|---|---|---|---|---|---|---|---|
| Hand-reared (N=14) | MEAN | **92.75** | **67.69** | **0.38** | **0.16** | **11.55** | **0.90** |
| | STDEV | **109.88** | **39.36** | **0.16** | **0.21** | **8.99** | **1.61** |
| Mother-reared (N=10) | MEAN | **62.94** | **72.01** | **0.45** | **0.19** | **13.97** | **0.08** |
| | STDEV | **75.02** | **47.04** | **0.23** | **0.22** | **15.55** | **0.21** |
| Significance | | **0.027** | **0.011** | **0.004** | **0.05** | **0.02** | **0.024** |

Hypothsis 21 predicted there would be significant differences in the behaviors observed between the clouded leopards housed at KKOZ and CRC. When looking at all individuals, only one significant difference ws found. The behavior that occurred at higher frequencies from individuals housed at KKOZ was retreat (p=0.04).

**Table 14: Hypothesis 21 – Significant correlations between KKOZ and CRC clouded leopards obtained by logistical regression from behavioral observations**

| | | RETREAT |
|---|---|---|
| KKOZ (N=14) | MEAN | **0.14** |
| | STDEV | **0.31** |
| CRC (N=10) | MEAN | **0.00** |
| | STDEV | **0.00** |
| Significance | | **0.04** |

Hypotheses 22-27 are summarized in Table 15 and predicted that there would be differences within a sex between reproductive success, rearing and facility. Therefore, males and females were examined separately to determine if behaviors could be considered sex-dependant.

**Table 15: Hypotheses 22-27 predicting differences in behavioral observations based on sex**

| | **Hypothesis** | **Result** |
|---|---|---|
| H22 | Reproductively successful male clouded leopards exhibit specific behaviors during testing. | Accept |
| H23 | Reproductively successful female clouded leopards exhibit specific behaviors during testing. | Accept |
| H24 | Male clouded leopards exhibit specific behaviors during testing depending on rearing. | Accept |
| H25 | Female clouded leopards exhibit specific behaviors during testing depending on rearing. | Accept |
| H26 | Male clouded leopards exhibit specific behaviors during testing depending on facility. | Accept |
| H27 | Female clouded leopards exhibit specific behaviors during testing depending on facility. | Accept |

Hypotheses 22 and 23 predicted significant behaviors between RS and RUS males and females respectively (Table 16). There were several behaviors that were significantly different between RS and RUS individuals. RS females had significantly higher rates for flinch (p=0.013), lying (p=0.016), meow p=(0.025), prusten (p=0.002), retreat (p=0.000), and voctotal (p=0.005), and lower rates for sit (p=0.041). RS males had significantly higher rates for patrolling (p=0.034), defecate (p=0.023), urinesquat (p=0.039), urinewalk (p=0.037), and urinetotal (p=0.018).

Hypotheses 24 and 25 predicted significant behavioral differences between MR and HR male and female clouded leopards, respectively (Table 17). MR males exhibited significantly higher rates of “claw” (p=0.04) and “retreat” (p=0.047).

Hypothesis 26 and 27 predicted significant differences in behavioral observations between KKOZ and CRC male and female clouded leopards, respectively (Table 18). When examining the genders separately between institutions, “latency to respond” (p=0.040) was lower, and “stand” (p=0.035) and “lying” (p=0.042) were higher among KKOZ males. The KKOZ females spent significantly more time “lying” (p=0.031) and less “time spent investigating” (0.022) than the CRC females.

**Table 16: Hypotheses 22 and 23 – Significant behavioral differences between RS and RUS males and RS and RUS females obtained from logistical regression of behavioral observations from 24 clouded leopards**

| Behavioral Observation | Sex | Reproductive success | Mean | Stdev | P Value |
|---|---|---|---|---|---|
| **FLIN** | Female | RUS | 1.4623 | 1.5478 | 0.013 |
| | | RS | 5 | 1.41421 | |
| **LY** | Female | RUS | 0.34 | 0.16941 | 0.016 |
| | | RS | 0.695 | 0.02121 | |
| **MEOW** | Female | RUS | 2.4615 | 3.82619 | 0.025 |
| | | RS | 16.42 | 22.27386 | |
| **PRUSTEN** | Female | RUS | 1.1031 | 2.40962 | 0.002 |
| | | RS | 26.5 | 23.80121 | |
| **RT** | Female | RUS | 0 | 0 | 0.000 |
| | | RS | 0.75 | 0.35355 | |
| **SIT** | Female | RUS | 0.18 | 0.0728 | 0.041 |
| | | RS | 0.06 | 0.02828 | |
| **VOCtotal** | Female | RUS | 3.41 | 5.14975 | 0.005 |
| | | RS | 40.835 | 43.36686 | |
| **Variable** | **Sex** | **Reproductive success** | **Mean** | **Stdev** | **P Value** |
| **DEFAC** | Male | RUS | 0 | 0 | 0.023 |
| | | RS | 0.1133 | 0.09815 | |
| **PAT** | Male | RUS | 0.0133 | 0.0216 | 0.034 |
| | | RS | 0.0533 | 0.02082 | |
| **URINES** | Male | RUS | 0.585 | 0.66533 | 0.039 |
| | | RS | 3.6667 | 3.08338 | |
| **URINEW** | Male | RUS | 0.0283 | 0.0694 | 0.037 |
| | | RS | 2.78 | 2.8366 | |
| **URINtotal** | Male | RUS | 0.6117 | 0.64836 | 0.018 |
| | | RS | 2.4433 | 1.00481 | |

**Table 17: Hypotheses 24 and 25 – Significant behavioral differences between MR and HR males and MR and HR females obtained from logistical regression of behavioral observations from 24 clouded leopards**

| Variable | Sex | Rearing | Mean | StDev | P Value |
|---|---|---|---|---|---|
| **CL** | Male | mother | 2.085 | 2.24153 | 0.040 |
| | | hand | 0.2157 | 0.42836 | |
| **RT** | Male | mother | 0.25 | 0.35355 | 0.047 |
| | | hand | 0 | 0 | |

**Table 18: Hypotheses 26 and 27 – Significant behavioral differences between KKOZ and CRC males and KKOZ and CRC females obtained from logistical regression of behavioral observations from 24 clouded leopards**

| Variable | Sex | Facility | Mean | StDev | P Value |
|---|---|---|---|---|---|
| **LAT** | Male | KKOZ | 13.192 | 24.49165 | 0.040 |
| | | CRC | 166.1775 | 137.35449 | |
| **ST** | Male | KKOZ | 0.258 | 0.05675 | 0.035 |
| | | CRC | 0.1525 | 0.06397 | |
| **LY** | Male | KKOZ | 0.542 | 0.11077 | 0.42 |
| | | CRC | 0.31 | 0.17455 | |
| | Female | KKOZ | 0.4756 | 0.2132 | 0.031 |
| | | CRC | 0.255 | 0.07007 | |
| **TSI** | Female | KKOZ | 83.6733 | 34.97489 | 0.022 |
| | | CRC | 34.905 | 34.9743 | |

Hypotheses 28-30 are summarized in Table 19. They predicted that regardless of facility, reproductively successful individual's exhibit significantly different behaviors. This was examined by comparing individuals housed only within KKOZ to see what behaviors were still significant within the reproductively successful population of clouded leopards housed at that facility.

**Table 19: Hypotheses 28-30 predict differences in behavioral observations within the individuals housed at KKOZ.**

| | **Hypothesis** | **Result** |
|---|---|---|
| H28 | Reproductively successful clouded leopards exhibit specific behaviors during testing regardless of facility. | Accept |
| H29 | Reproductively successful males exhibit specific behaviors during testing regardless of facility. | Accept |
| H30 | Reproductively successful female clouded leopards exhibit specific behaviors during testing regardless of facility. | Accept |

The results (Table 20), revealed that even when looking at only clouded leopards housed within KKOZ there were still behaviors that were significantly different between RUS and RS individuals. The results show that RUS clouded leopards still had a significantly longer "latency to approach" (p=0.032, 68.40 second) than the RS clouded leopards' average time of 1.40 seconds. RS clouded leopards were also found to have significantly higher rates of "patrol" (p=0.014), "defecate" (p=0.04), and "prusten" (p=0.027) than RUS individuals. When examining males only, "patrol" (p=0.046) emerged again as being significantly higher among RS individuals; other behaviors may not have been significant due to the low sample size (N=5) (three RS males and two RUS males). The RS females (N=2) when analyzed separately exhibited "prusten" (p=0.020), "flinch" (p=0.041), "voctotal" (p=0.037), and "retreat" (p=0.005) in significantly higher rates than the RUS females (N=7).

**Table 20: Hypotheses 28-30 significant behavioral differences between RUS and RS clouded leopards housed at KKOZ.**

| | | All Cats (N=14) | | | Males (N=5) | | | Females (N=9) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Behavioral Observation** | **Success** | **Mean** | **StDev** | **Pvalue** | **Mean** | **StDev** | **Pvalue** | **Mean** | **StDev** | **Pvalue** |
| **LAT** | RUS | 68.40 | 60.86 | 0.032 | | | | | | |
| | RS | 1.40 | 1.33 | | | | | | | |
| **PAT** | RUS | 0.00 | 0.00 | 0.014 | 0.00 | 0.00 | 0.046 | | | |
| | RS | 0.03 | 0.03 | | 0.05 | 0.02 | | | | |
| **DEFAC** | RUS | 3.94 | 11.83 | 0.04 | | | | | | |
| | RS | 5.03 | 7.97 | | | | | | | |
| **PRUSTEN** | RUS | 1.58 | 2.80 | 0.027 | | | | 1.93 | 3.13 | 0.020 |
| | RS | 13.50 | 17.41 | | | | | 26.50 | 23.80 | |
| **FLINCH** | RUS | | | | | | | 1.81 | 1.64 | 0.041 |
| | RS | | | | | | | 5.00 | 1.41 | |
| **VocTotal** | RUS | | | | | | | 5.36 | 6.22 | 0.037 |
| | RS | | | | | | | 40.84 | 43.37 | |
| **RETREAT** | RUS | | | | | | | 0.00 | 0.00 | 0.005 |
| | RS | | | | | | | 0.75 | 0.35 | |

Hypotheses 31-38 are summarized in Table 21 and predicted that individual trials could be used to determine different behavioral responses between RS and RUS clouded leopards. For this analysis, the 15 trials ran for the independent urine scent tests were divided by scent. The mean of all three tests for each scent was used for analysis, so there were only five representative averages (one for each treatment), and one value for each behavior recorded per cat per treatment. The"novel object," "MIS," and "choice" tests were left as separate treatments. This left a total of eight different treatments per cat and all behaviors recorded during each of these eight treatments were compared to each other using a logistical regression. Mean values for behavioral observations found to be significantly different ($p \leq 0.05$) between RUS and RS individuals can be found Table 22.

**Table 21: Hypotheses 31-38 predicted differences in behavioral observations of reproductively successful individuals based on treatment.**

| | Hypothesis | Result |
|---|---|---|
| H31 | Reproductively successful clouded leopards exhibit different behaviors during control treatment. | Accept |
| H32 | Reproductively successful clouded leopards exhibit different behaviors during blood treatment. | Accept |
| H33 | Reproductively successful clouded leopards exhibit different behaviors during trials with domestic cat estrus urine. | Accept |
| H34 | Reproductively successful clouded leopards exhibit different behaviors during trials with domestic cat non-estrus urine | Accept |
| H35 | Reproductively successful clouded leopards exhibit different behaviors during trials with domestic cat male urine. | Accept |
| H36 | Reproductively successful clouded leopards exhibit different behaviors during Choice test. | Accept |
| H37 | Reproductively successful clouded leopards exhibit different behaviors during the mirror image stimulation test | Accept |
| H38 | Reproductively successful clouded leopards exhibit different behaviors during the novel object test. | Accept |

When all cats were combined and the average responses to each scent trial was examined separately it turned out that each treatment did result in significantly different behaviors between RS and RUS clouded leopards. The most significant behavior in all 5 trials was “prusten.”

During the control trials when the cats were given only an empty piece of paper plate, “lying” (p=0.008), “prusten” (p=0.028) and “voctotal” (p=0.033) were significantly higher among RS individuals. RS clouded leopards exhibited “lying” (p=0.013), “defecate” (p=0.046), “meow” (p=0.28), “prusten” (p=0.033) and “voctotal” (p=0.19) more often during the blood trials. During the female domestic cat estrus urine trials “patrol” (p=0.003), “prusten” (p=0.001), “urinewalk” (p=0.011), and “urinetotal” (p=0.029) were significantly higher among RS individuals. The female domestic cat nonestrus urine trials showed the RS clouded leopards exhibiting “lying” (p=0.007) and “prusten” (0.032) significantly more often. Finally, the male domestic cat urine trials resulted in several behaviors that were significantly higher in RS clouded leopards, including “claw” (p=0.037), “defecate” (p=0.046), “lying” (0.008), “prusten” (0.012), and “voctotal” (p=0.027). During this trial the RS clouded leopards also had a significantly faster “time to approach” (p=0.014), with an average of 46.47 seconds versus the RUS clouded leopards average time to approach, 325.25 seconds.

When analyzing the non-scent treatments, there were also differences between the RS and RUS clouded leopards. Again “prusten” was significantly higher in RS individuals for all three trials. The novel object test resulted in RS individuals exhibiting significantly higher rates of “lying” (p=0.11) and “prusten” (p=0.042).

The choice test resulted in RS individuals exhibiting significantly higher rates of “patrol” (p=0.042), “prusten” (p=0.021), “urinewalk” (p=0.025), and “voctotal” (p=0.010). The data was broken down into three more variables to look closer at the choice test and see if there were any preferences for scent. The three new variables include: the scent with the lowest “time to approach,” in other words the cat’s first choice; the position of the first choice; and the scent with the highest “time spent investigating.” Of the 24 cats tested, four individuals did not respond to the test at all, so the analysis was only carried out on the 20 cats that participated. When examining these three new variables a Kendall’s tau (two-tailed) test was run and there was no significant correlation found between the position of the scent and the cats’ first choice; “shortest TIA.” There was also no significant correlation found between the cats’ first choice, “shortest TIA,” and the scent they spent the most time with, “longest TSI.” No single treatment was selected first more frequently than the others. The male (N=1) and estrus urine (N=2) were both selected first the least. In twelve of the twenty trials, the blood treatment was the treatment with the “longest TSI” (see figure 1). The second most popular scent was the nonestrus urine, which was selected first 5 times, and four times had the “longest TSI.” It also had the highest average TSI with 55.5 seconds versus the average blood TSI of 22.2 seconds. This average was mainly due to one cat “Nellie” who spent 121 seconds with the scent. As the statistics showed however there did not seem to be any correlation between the treatment the cat selected first and the one they spent the most time with.

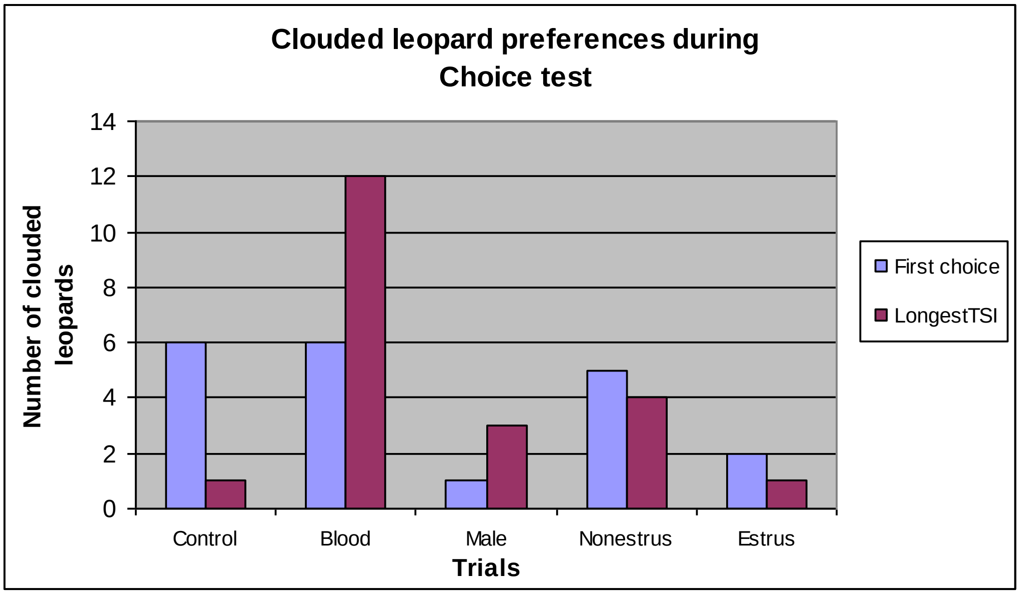



**Figure 1: Results of preferences during choice test given to 24 clouded leopards**

The mirror image stimulation resulted in RS individuals exhibiting significantly higher rates of "lick" (p=0.046), "prusten" (p=0.035), "retreat" (p=0.004), and they also had a significantly higher duration of "time spent investigating" (p=0.007), with 657.60 seconds versus the RUS individuals with a mean time of 266.84 seconds. Overall, when examining all the cats between treatements, the MIS had also had significantly longer "time spent investigating" (p<0.001-0.000) compared to all the other treatments (See Figure 2).

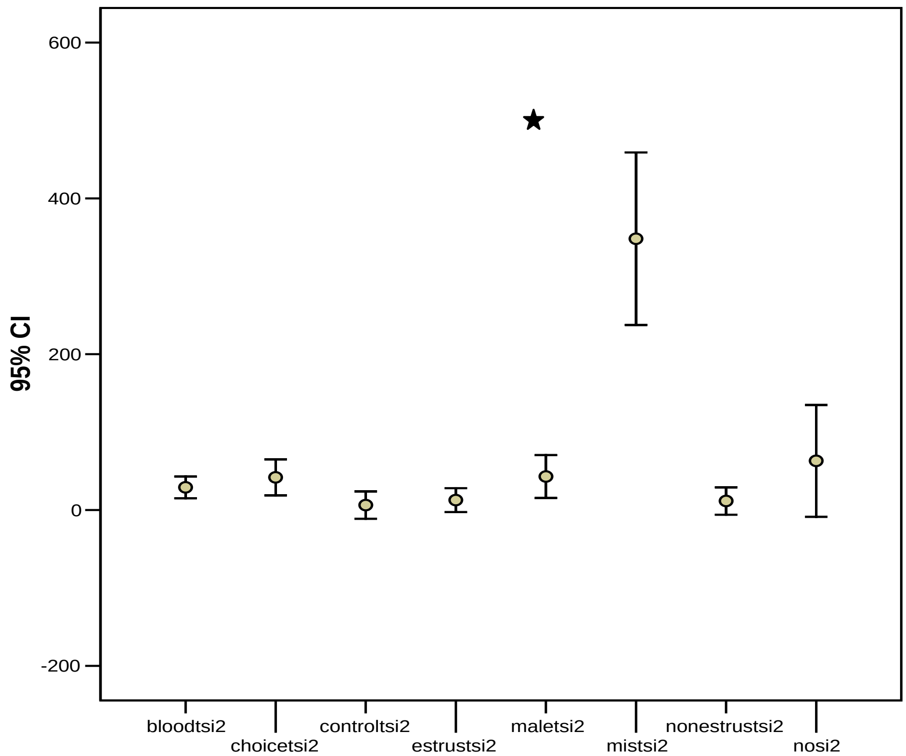



**Figure 2: Mean values of "time spent investigating" comparing 24 clouded leopards during the MIS to all other trials (* indicates p ≤ 0.05)**

Hypotheses 39-48 are summarized in Table 23. They predicted that reproductively successful male and female clouded leopards would exhibit significantly different behaviors during the individual treatements. The treatments were examined separately to see if there were any treatements that had specific influences on the RS individuals' behavior. This analysis was done to help tease out the behavioral traits of RS male and female clouded leopards. The results for all the urine scent treatments are in Table 24.

**Table 22: Mean values of behavioral observations by trial for RUS and RS clouded leopards.**

| Behavioral Observation | Cats | Control | Blood | Estrus | Non-estrus | Male | Choice | MIS | NO |
|---|---|---|---|---|---|---|---|---|---|
| **CL** | ALL | 0.33 | 0.44 | 0.39 | 0.39 | 0.17 | 3.33 | 0.33 | 0.83 |
| | RUS | 0.35 | 0.56 | 0.42 | 0.49 | 0.07 | 4.21 | 0.42 | 1.05 |
| | RS | 0.27 | 0.00 | 0.27 | 0.00 | ***0.53** | 0.00 | 0.00 | 0.00 |
| **DEFAC** | ALL | 0.06 | 0.06 | 0.00 | 0.00 | 0.06 | 0.00 | 0.00 | 0.00 |
| | RUS | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | ***0.27** | 0.00 | 0.00 | ***0.27** | 0.00 | 0.00 | 0.00 |
| **LICK** | ALL | 0.00 | 56.61 | 1.67 | 2.61 | 3.89 | 35.17 | 0.50 | 0.00 |
| | RUS | 0.00 | 56.70 | 1.54 | 2.46 | 4.91 | 31.16 | 0.00 | 0.00 |
| | RS | 0.00 | 56.27 | 2.13 | 3.20 | 0.00 | 50.40 | ***2.40** | 0.00 |
| **LY** | ALL | 0.44 | 0.43 | 0.47 | 0.47 | 0.43 | 0.38 | 0.13 | 0.49 |
| | RUS | 0.36 | 0.37 | 0.44 | 0.39 | 0.36 | 0.36 | 0.16 | 0.42 |
| | RS | ***0.73** | ***0.67** | 0.58 | ***0.77** | ***0.71** | 0.45 | 0.03 | ***0.73** |
| **MEOW** | ALL | 3.44 | 3.94 | 1.44 | 3.56 | 4.22 | 9.17 | 4.83 | 2.33 |
| | RUS | 2.11 | 2.95 | 2.81 | 5.47 | 2.32 | 6.32 | 3.79 | 2.95 |
| | RS | 12.00 | ***17.87** | 6.93 | 14.93 | 10.67 | 24.00 | 4.80 | 1.60 |
| **PA** | ALL | 0.02 | 0.00 | 0.01 | 0.02 | 0.01 | 0.02 | 0.00 | 0.00 |
| | RUS | 0.02 | 0.01 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.01 | 0.00 | 0.03 | 0.00 | 0.01 | 0.11 | 0.00 | 0.00 |
| **PAT** | ALL | 0.01 | 0.01 | 0.02 | 0.01 | 0.00 | 0.04 | 0.00 | 0.00 |
| | RUS | 0.01 | 0.02 | 0.00 | 0.01 | 0.00 | 0.02 | 0.00 | 0.00 |
| | RS | 0.01 | 0.01 | ***0.10** | 0.00 | 0.00 | ***0.13** | 0.00 | 0.00 |
| **PRUSTEN** | ALL | 10.11 | 7.83 | 7.17 | 9.33 | 8.00 | 34.17 | 1.50 | 5.00 |
| | RUS | 0.21 | 1.61 | 0.21 | 0.70 | 0.56 | 1.05 | 1.47 | 0.63 |
| | RS | ***15.73** | ***12.80** | ***6.13** | ***14.40** | ***18.13** | ***40.00** | ***17.60** | ***8.80** |
| **RETREAT** | ALL | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.33 | 0.33 |
| | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.21 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | ***1.60** | 0.80 |
| **TIA** | ALL | 414.87 | 253.17 | 277.24 | 314.13 | 267.17 | 187.29 | 246.50 | 221.25 |
| | RUS | 393.08 | 269.68 | 282.10 | 346.35 | 325.25 | 234.16 | 306.95 | 275.42 |
| | RS | 497.60 | 190.40 | 257.20 | 191.67 | ***46.47** | 9.20 | 16.80 | 15.40 |
| **TSI** | ALL | 6.31 | 29.06 | 12.69 | 11.57 | 42.97 | 41.92 | 348.25 | 63.13 |
| | RUS | 7.17 | 27.82 | 12.53 | 10.00 | 49.72 | 42.84 | 266.84 | 72.47 |
| | RS | 3.07 | 33.77 | 13.33 | 17.53 | 17.33 | 38.40 | ***657.60** | 27.60 |
| **URINEW** | ALL | 1.11 | 2.33 | 1.11 | 1.56 | 1.67 | 14.17 | 1.83 | 1.33 |
| | RUS | 0.00 | 0.07 | 0.00 | 0.07 | 0.00 | 1.05 | 0.00 | 0.21 |
| | RS | 0.00 | 0.00 | **1.07** | 0.27 | 0.00 | ***12.00** | 0.00 | 0.00 |
| **URINtotal** | ALL | 1.11 | 2.39 | 1.33 | 1.67 | 1.67 | 3.50 | 1.83 | 1.50 |
| | RUS | 1.26 | 2.67 | 0.91 | 1.89 | 1.96 | 2.95 | 2.11 | 1.47 |
| | RS | 0.53 | 1.33 | ***2.93** | 0.80 | 0.53 | 5.60 | 0.80 | 1.60 |
| **Voctotal** | ALL | 7.61 | 10.00 | 5.11 | 11.00 | 8.22 | 3.83 | 8.83 | 5.00 |
| | RUS | 2.32 | 4.56 | 3.02 | 6.18 | 2.88 | 1.47 | 5.26 | 3.58 |
| | RS | ***27.73** | ***30.67** | 13.07 | 29.33 | ***28.53** | ***12.80** | 22.40 | 10.40 |

**Table 23: Hypotheses 39-48 predicted differences in behavioral observations of reproductively successful male and female clouded leopards during the different scent trials.**

| | Hypothesis | Result |
|---|---|---|
| H39 | Reproductively successful male clouded leopards exhibit different behaviors during control trials. | Accept |
| H40 | Reproductively successful female clouded leopards exhibit different behaviors during control trials. | Accept |
| H41 | Reproductively successful male clouded leopards exhibit different behaviors during blood trials. | Accept |
| H42 | Reproductively successful female clouded leopards exhibit different behaviors during blood trials. | Accept |
| H43 | Reproductively successful male clouded leopards exhibit different behaviors during estrus trials. | Accept |
| H44 | Reproductively successful female clouded leopards exhibit different behaviors during estrus trials. | Accept |
| H45 | Reproductively successful male clouded leopards exhibit different behaviors during nonestrus trials. | Reject |
| H46 | Reproductively successful female clouded leopards exhibit different behaviors during nonestrus trials. | Accept |
| H47 | Reproductively successful male clouded leopards exhibit different behaviors during male trials. | Reject |
| H48 | Reproductively successful female clouded leopards exhibit different behaviors during male trials. | Accept |

During the control treatment RS males exhibited only “prusten” (p=0.005) significantly more often than RUS males. RS females, on the other hand, had several significant behaviors: “lying” (p=0.019); “meow” (p=0.028); “prusten” (p=0.007); and “voctotal” (p=0.011). RS females also had a significantly longer “time to initial approach” (p=0.047) than RUS females during the control treatment. In fact, the RS females had a mean “time to approach” of approximately 12.5 minutes and the RUS females had a mean of approximately 6 minutes. During the blood trial, RS females exhibited “lying” (p=0.010), “meow” (p=0.010), “prusten” (p=0.030), and “voctotal” (0.010) at significantly higher rates than the RUS females.

The three types of urine samples used during testing were all obtained from domestic cats. During the estrus urine trials, the RS males exhibited eight behaviors significantly more often than RUS males. These were the most significant behaviors of all the treatments. The choice test had the second highest number and showed only two significant behaviors. The significantly higher behaviors for the RS males were "flehman" (p=0.030), "meow" (p=0.009), "prusten" (p=0.020), "voctotal" (p=0.009), "patrol" (p=0.018), "urinesquat" (p=0.044), "urinewalk" (p=0.049) and "urinetotal" (p=0.008). In comparison, the RS females exhibited only one significant behavior, "prusten" (p=0.014), which was the least number of significant behaviors of any of the trials for the RS females.

During the nonestrus urine trial, the RS males did not exhibit any behaviors with any significance over the RUS males. The RS females, however, exhibited "lying" (p=0.018), "meow" (p=0.011), "prusten" (p=0.010), and "voctotal" (p=0.010) more often than RUS females.

During the male urine trial, the RS males again did not exhibit any behaviors with any significance over the RUS males. This however was one of the most responsive trials for the RS females, with "claw" (p=0.008) and "pace" (p=0.025) being significant for the only time. In addition, "lying" (p=0.031), "meow" (p=0.009), "prusten" (p=0.008) and "voctotal" (p=0.009) were also significant. RS females also had a much faster average TIA (p=0.075), 30.84 seconds versus 348.77 seconds. The RS males also had a faster TIA (p=0.112), 56.89 seconds versus the RUS males of 274.28 seconds, but neither were found to be significant by each sex alone.

Hypotheses 49-54 are summarized in Table 25 and predict that reproductively successful male and female clouded leopards will exhibit significantly different behaviors during the choice; mirror image stimulation; and novel object treatments. The results can be found in Table 26.

**Table 24: Mean values of significantly different behavioral observations from scent trials of 24 clouded leopards**

| | | CONTROL | | BLOOD | | ESTRUS | | NONESTRUS | | MALE | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Behav Obser** | **Succ** | ♂ | ♀ | ♂ | ♀ | ♂ | ♀ | ♂ | ♀ | ♂ | ♀ |
| **CL** | RUS | 0.22 | 0.41 | 0.33 | 0.62 | 0.22 | 0.51 | 0.44 | 0.51 | 0.22 | 0.00 |
| | RS | 0.44 | 0.00 | 0.00 | 0.00 | 0.44 | 0.00 | 0.00 | 0.00 | 0.44 | **0.67** |
| | Pval | 0.571 | 0.6 | 0.35 | 0.662 | 0.571 | 0.560 | 0.257 | 0.617 | 0.571 | ***.008** |
| **FLEH** | RUS | 0.67 | 0.10 | 0.22 | 0.62 | 0.67 | 1.54 | 2.44 | 1.23 | 1.56 | 1.54 |
| | RS | 0.00 | 0.00 | 0.44 | 0.00 | **3.11** | 2.67 | 2.67 | 2.00 | 1.33 | 2.00 |
| | Pval | 0.45 | 0.69 | 0.57 | 0.49 | ***0.030** | 0.42 | 0.92 | 0.58 | 0.81 | 0.68 |
| **LY** | RUS | 0.36 | 0.36 | 0.44 | 0.35 | 0.48 | 0.42 | 0.39 | 0.39 | 0.42 | 0.34 |
| | RS | 0.66 | **0.84** | 0.59 | **0.78** | 0.46 | 0.77 | 0.71 | **0.86** | 0.71 | **0.70** |
| | Pval | 0.147 | ***.019** | 0.416 | ***.012** | 0.893 | 0.108 | 0.131 | ***.018** | 0.16 | ***.031** |
| **MEOW** | RUS | 1.78 | 2.26 | 4.33 | **2.58** | 0.00 | 4.10 | 14.45 | 1.33 | 6.44 | 0.41 |
| | RS | 4.44 | **23.34** | 6.67 | **34.67** | **4.00** | 11.34 | 0.00 | **37.34** | 2.67 | **22.67** |
| | Pval | 0.454 | ***.028** | 0.676 | ***.006** | ***0.009** | 0.348 | 0.453 | ***.011** | 0.605 | ***.009** |
| **PA** | RUS | 0.03 | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.03 | 0.01 | 0.00 |
| | RS | 0.01 | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | **0.02** |
| | Pval | 0.647 | 0.594 | | 0.598 | 0.134 | 0.685 | 0.453 | 0.618 | 0.453 | ***.025** |
| **PAT** | RUS | 0.03 | 0.00 | 0.05 | 0.01 | 0.01 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 |
| | RS | 0.02 | 0.00 | 0.02 | 0.00 | **0.17** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Pval | 0.817 | | 0.656 | 0.598 | ***0.018** | | 0.26 | 0.685 | | |
| **PRUSTEN** | RUS | 0.00 | 0.31 | 0.00 | 2.04 | 0.00 | 0.31 | 0.67 | 0.72 | 0.00 | 0.82 |
| | RS | **2.22** | **36.00** | 5.78 | **23.34** | **5.78** | **6.67** | 2.67 | **32.00** | 7.56 | **34.00** |
| | Pval | ***.005** | ***.007** | 0.172 | ***.017** | ***0.020** | ***0.014** | 0.134 | ***.010** | 0.134 | ***.008** |
| **SIT** | RUS | 0.05 | 0.16 | 0.03 | 0.20 | 0.13 | 0.18 | 0.07 | 0.17 | 0.07 | 0.20 |
| | RS | 0.14 | 0.06 | **0.17** | 0.12 | 0.05 | 0.10 | 0.08 | 0.03 | 0.05 | 0.09 |
| | Pval | 0.132 | 0.183 | ***.050** | 0.169 | 0.319 | 0.371 | 0.757 | 0.135 | 0.72 | 0.173 |
| **TIA** | RUS | 404.39 | 387.86 | 331.34 | 253.24 | 276.67 | 285.21 | 362.72 | 338.79 | 274.28 | 348.77 |
| | RS | 328.45 | **751.50** | 107.11 | 315.34 | 83.11 | 518.33 | 107.11 | 318.50 | 56.89 | 30.84 |
| | Pval | 0.653 | ***.047** | 0.326 | 0.735 | 0.228 | 0.179 | 0.157 | 0.925 | 0.112 | 0.075 |
| **URINES** | RUS | 0.45 | 1.64 | 0.22 | 3.69 | 0.67 | 1.02 | 0.45 | 2.46 | 1.56 | 2.15 |
| | RS | 0.89 | 0.00 | 1.78 | 0.67 | **2.67** | 0.67 | 0.44 | 0.67 | 0.89 | 0.00 |
| | Pval | 0.49 | 0.32 | 0.08 | 0.64 | ***0.044** | 0.77 | 1.00 | 0.65 | 0.64 | 0.59 |
| **URINEW** | RUS | 0.00 | 0.00 | 0.22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | **1.78** | 0.00 | 0.44 | 0.00 | 0.00 | 0.00 |
| | Pval | | | 0.45 | | ***0.049** | | 0.13 | 0.69 | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **URINE total** | RUS | 0.45 | 1.64 | 0.67 | 3.20 | 0.67 | 1.02 | 0.45 | 2.56 | 1.56 | 2.15 |
| | RS | 0.89 | 0.00 | 1.78 | 0.67 | **4.44** | 0.67 | 0.89 | 0.67 | 0.89 | 0.00 |
| | Pval | 0.494 | 0.315 | 0.333 | 0.681 | ***0.008** | 0.774 | 0.494 | 0.627 | 0.635 | 0.59 |
| **VOCAL** | RUS | 1.78 | 2.56 | 4.33 | 4.62 | 0.00 | 4.41 | 15.11 | 2.05 | 6.44 | 1.23 |
| | RS | 6.67 | **59.33** | 12.44 | **58.00** | **9.78** | 18.00 | 2.67 | **69.34** | 10.22 | **56.00** |
| | Pval | 0.21 | ***.011** | 0.167 | ***.006** | ***0.009** | 0.147 | 0.533 | **0.01** | 0.641 | ***.009** |

**Table 25: Hypotheses 49-54 predicted differences in behavioral observations of reproductively successful male and female clouded leopards during the choice, mirror image stimulation and novel object trials.**

| | Hypothesis | Result |
|---|---|---|
| H49 | Reproductively successful male clouded leopards exhibit different behaviors during choice trial. | Accept |
| H50 | Reproductively successful female clouded leopards exhibit different behaviors during choice trial. | Accept |
| H51 | Reproductively successful male clouded leopards exhibit different behaviors during mirror image stimulation trial. | Accept |
| H52 | Reproductively successful male clouded leopards exhibit different behaviors during mirror image stimulation trial. | Accept |
| H53 | Reproductively successful male clouded leopards exhibit different behaviors during novel object trial. | Accept |
| H54 | Reproductively successful male clouded leopards exhibit different behaviors during novel object trial. | Accept |

During the choice test RS males had significantly higher rates of “patrol” (p=0.005), “urinesquat” (0.034), “urinewalk” (0.034), and “urinetotal” (p=0.007), the RUS males had significantly higher rates of “groom” (p=0.046).. RS females had significantly higher rates of “lying” (p=0.038) and “prusten” (p=0.031)

During the mirror image stimulation the RS males had a significantly faster “time to initial approach” (p=0.041) than the RUS males; this however was the only significant difference during this test. On the other hand, the MIS was one of the most responsive tests for the RS females. The RS females had significantly higher rates of “bite” (p=0.008), “flinch” (p=0.007), “paw” (p=0.025), “prusten” (p=0.008), “retreat” (p=0.000), and they had a much longer “time spent investigating” (p=0.029), with a mean of 650.00 seconds versus 233.31 seconds for RUS females. The behavior“voctotal” (p=0.053) was close to significant with RS females vocalizing an average rate of 40 vocalizations per hour and RUS females at a rate of 7.08 vocalizations per hour.

During the novel object test there were no behaviors found to be significantly different between the RS and RUS males. The RS females had several behaviors that were exhibited at significantly higher rates, including “paw” (p=0.014), “prusten” (p=0.010) and “retreat” (p=0.008).

**Table 26: Mean values for RUS and RS male and female clouded leopards obtained from behavioral observations during Choice test; Mirror Image Stimulation and Novel Object tests**

| | | TRIALS | | | | | |
|---|---|---|---|---|---|---|---|
| | | CHOICE | | MIS | | NOVEL OBJECT | |
| Behavioral Observation | Success | ♂ | ♀ | ♂ | ♀ | ♂ | ♀ |
| **AP** | RUS | 48.67 | 32.92 | 11.33 | 23.38 | 12.000 | 6.769 |
| | RS | 41.33 | 18.00 | **38.67** | 38.00 | 9.333 | 8.000 |
| | Pvalue | 0.73 | 0.51 | ***0.041** | 0.42 | 0.540 | 0.790 |
| **BI** | RUS | 2.00 | 0.31 | 11.33 | 0.00 | 1.333 | 0.000 |
| | RS | 0.00 | 0.00 | 0.00 | **8.00** | 0.000 | 0.000 |
| | Pvalue | 0.45 | 0.67 | 0.45 | ***0.008** | 0.450 | |
| **FLIN** | RUS | 0.00 | 0.00 | 4.00 | 8.31 | 0.000 | 2.769 |
| | RS | 0.00 | 0.00 | 1.33 | **36.00** | 0.000 | 4.000 |
| | Pvalue | | | 0.36 | ***0.007** | | 0.732 |
| **LY** | RUS | 0.38 | 0.35 | 0.32 | 0.09 | 0.410 | 0.431 |
| | RS | 0.16 | **0.90** | 0.04 | 0.00 | 0.733 | 0.735 |
| | Pvalue | 0.28 | ***0.038** | 0.13 | 0.35 | 0.113 | 0.052 |
| **PAT** | RUS | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | **0.22** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Pvalue | ***0.005** | 0.67 | | | | |
| **PAW** | RUS | 1.33 | 0.12 | 97.33 | 10.15 | 0.000 | 3.077 |
| | RS | 0.00 | 0.00 | 1.33 | **96.00** | 1.333 | **64.000** |
| | Pvalue | 0.45 | 0.67 | 0.44 | ***0.025** | 0.134 | ***0.014** |
| **PRUSTEN** | RUS | 0.00 | 1.54 | 0.00 | 2.15 | 0.667 | 0.615 |
| | RS | 53.33 | **20.00** | 2.67 | **40.00** | 1.333 | **20.000** |
| | Pvalue | 0.13 | ***0.031** | 0.13 | **0.01** | 0.571 | ***0.010** |
| **RETREAT** | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.667 | 0.000 |
| | RS | 0.00 | 0.00 | 0.00 | **4.00** | 0.000 | **2.000** |
| | Pvalue | | | | ***.000** | 0.453 | ***0.008** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **TSI** | RUS | 38.50 | 44.85 | 339.50 | 233.31 | 33.000 | 90.692 |
| | RS | 54.00 | 15.00 | 662.67 | **650.00** | 35.333 | 16.000 |
| | Pvalue | 0.35 | 0.43 | 0.15 | ***0.029** | 0.893 | 0.655 |
| **URINES** | RUS | 0.00 | 20.00 | 0.00 | 3.08 | 1.333 | 1.231 |
| | RS | **20.00** | 10.00 | 1.33 | 0.00 | 1.333 | 2.000 |
| | Pvalue | ***0.034** | 0.83 | 0.13 | 0.57 | 1.000 | 0.591 |
| **URINEW** | RUS | 0.00 | 1.54 | 0.00 | 0.00 | 0.000 | 0.308 |
| | RS | **20.00** | 0.00 | 0.00 | 0.00 | 0.000 | 0.000 |
| | Pvalue | ***0.034** | 0.67 | | | 0.680 | |
| **URINtotal** | RUS | 0.00 | 4.31 | 0.00 | 3.08 | 1.333 | 1.538 |
| | RS | **8.00** | 2.00 | 1.33 | 0.00 | 1.333 | 2.000 |
| | Pvalue | ***0.007** | 0.80 | 0.13 | 0.57 | 1.000 | 0.756 |
| **VOCtotal** | RUS | 4.00 | 0.31 | 1.33 | 7.08 | 2.000 | 4.308 |
| | RS | **18.67** | **4.00** | 10.67 | **40.00** | 2.667 | 22.000 |
| | Pvalue | ***0.085** | ***0.031** | 0.08 | ***0.053** | 0.805 | 0.083 |

***indicates p value ≤ 0.05 (highlighted value indicates significantly higher response)**

The individual treatments were examined for differences in behavioral observations to see if there were any trends depending on the specific stimuli given. For this analysis a paired two-tailed t-test was used for a comparison of the means (Results can be found in Appendix X). Further investigation of aggression during the MIS was done using the Wilcoxon signed ranks test (Appendix X). It was found that “growl/hiss” was significantly higher during this treatment than during the control (p=0.028); blood (p=0.031); male (p=0.036); and choice (p=0.036) treatments. Also, “paw/swat” was found only to be significantly higher than the control (p=0.035); estrus (p=0.033); choice (p=0.014); and novel object (p=0.038) treatments.

A Kruskal-Wallis mean rank analysis was used to determine if the four temperaments were significantly correlated with any of the behavioral observations. Only two behaviors were found to be positively correlated, including “defacate” (p=0.020) in the cats rated as “calm,” and “rubtrial” (p=0.004) in the cats rated as “active.” A one-way ANOVA (Table 27) was run on all the trials as independent variables (instead of the average of all the trials) to determine differences in behavioral observations between temperaments (see Appendix X for complete results).

**Table 27: Behavioral observations found to be significantly different between temperaments in 24 clouded leopards.**

| BETWEEN GROUP RESULTS | | | | | | MEANS BY TEMPERAMENT | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Sum of Squares** | **df** | **Mean Square** | **F** | **Sig.** | **Highstrung** | **Active** | **Aggressive** | **Calm** |
| CLAW | 147.26 | 3 | 49.09 | 6.928 | 0.000 | 1.12 | 0.04 | 0.10 | **3.22** |
| LAT | 513484.10 | 3 | 171161.37 | 3.757 | 0.011 | 93.07 | 21.14 | **113.58** | 18.67 |
| LICK | 5560.17 | 3 | 1853.39 | 6.849 | 0.000 | 6.79 | **26.00** | 10.62 | 14.56 |
| Paw/S wat | 34070.99 | 3 | 11357.00 | 3.057 | 0.028 | 2.14 | 3.55 | **24.10** | 1.56 |
| PRUST EN | 2151.61 | 3 | 717.20 | 3.264 | 0.021 | 0.29 | 3.29 | 5.35 | **10.06** |
| RUB trial | 867.83 | 3 | 289.28 | 7.645 | 0.000 | 0.40 | **3.17** | 0.30 | 0.00 |
| Sniff Trial | 58485.50 | 3 | 19495.17 | 2.894 | 0.035 | 70.21 | **100.67** | 58.38 | 75.67 |
| TIA | 4246588.73 | 3 | 1415529.58 | 10.670 | 0.000 | **353.04** | 105.28 | 329.61 | 118.78 |
| TTS | 875305.11 | 3 | 291768.37 | 4.759 | 0.003 | 129.46 | 26.70 | **154.71** | 49.79 |
| Urine total | 385.54 | 3 | 128.51 | 5.729 | 0.001 | **3.62** | 0.42 | 0.93 | 2.89 |
| URIN Walk | 99.15 | 3 | 33.05 | 5.849 | 0.001 | 0.07 | 0.67 | 0.02 | **2.78** |

A Spearman rank-order correlation (two-tailed) was run to determine if there were any trends across trials (Table 28). The only behavior that increased in duration over the trials was “lying.” The behaviors, “flehman” and “meow” significantly decreased over the trials.

**Table 28: Significant trends of behavioral observations across trials**

| Spearman's rho | Behavioral observation | | |
|---|---|---|---|
| | **FLEH** | **LY** | **MEO** |
| Correlation Coefficient | -.131(**) | .119(*) | -.103(*) |
| Sig. (2-tailed) | 0.006 | 0.013 | 0.033 |
| N | 432 | 432 | 432 |

**** Correlation is significant at the 0.01 level (two-tailed)**

*** Correlation is significant at the 0.05 level (two-tailed)**

# CHAPTER 4: DISCUSSION

*Temperament Assessment*

Temperament assessments (TA's) have been used in several animal species to determine personality (Powell 2005; Carlstead and Brown 2005; Wielebnowski 1999; Gosling 1998; Feaver *et al.* 1986, Stevenson-Hinde *et al.* 1980). Animal care staffs spend countless hours observing their animals under various conditions and life stages and should therefore be the best predictors of their personality (Gosling 1998). The results from the keeper-rated temperament assessment given during this study served as the basis for the temperaments that were determined in the clouded leopard test population. Characteristics that were not accurately rated by the keepers were "fearful of strangers," "investigative," and "tense." Several characteristics (aggressive to conspecifics, aggressive to familiar people, aggressive to strangers, friendly to conspecifics, friendly to familiar people, and friendly to strangers) that had initially been separated for the keepers to rate ended up being averaged into "total" behaviors due to low inter-rater reliability (<0.50). They were averaged to create a total "aggressive" and "friendly" characteristic which did have high inter-rater reliability. These characteristics, when separated, may be too vague or too subjective for keepers to score accurately.

Each keeper has different experiences with each animal and may or may not have seen the cat with a stranger or a conspecific; therefore the keeper may not be able to accurately determine the animal's temperament during these times (Manteca and Deag

1993). This could have led to the discrepancy between scores. The other characteristics that were separated in this way on the assessment were: “fearful of conspecifics;” “fearful of familiar people;” and “fearful of strangers.” Two of these temperament characteristics, (fearful of conspecifics and fearful of familiar people), had high inter-rater reliability and were therefore kept separate. “Fearful of strangers” however had to be dropped due to its low reliability score. The reason characteristics involving fear may have had higher reliability even when separated, may be due to the fact that clouded leopards tend to be a more skittish and fearful animal (personal observation). The “fearful” characteristics tend to be exhibited more frequently and be observed by more care takers. Therefore, it can be more accurately scored by several different people. It was beneficial during this study to keep the “fearful” temperament characteristics separate because the individual characteristics were found to be significant among different groups of cats, including reproductively successful (RS) cats scoring lower on “fearful of conspecifics,” and all females and all mother-reared individuals scoring higher on “fearful of familiar people.”

For future keeper-rated temperament assessments it is suggested that these types of characteristics be combined into one as was done later in the analysis. It also might be beneficial to put an option next to each characteristic of “not enough experience” which could be checked off by a keeper if he or she do not feel they can accurately rate the characteristic. In this way, there would be no score instead of an inaccurate one to compare to the other raters and it could lead to a more accurate assessment of the temperaments. Overall, however, the methods described for the temperament assessment survey yielded reliable data.

*Temperament*

The temperament of an animal is difficult to measure. Temperament should remain stable over time and circumstance (Gosling and John 1999). Stevenson-Hinde *et al.* (1980) found that (*Macaca mulatta*) certain personality traits in rhesus monkeys remained stable over time and can depend on early infancy experiences. Other studies have also shown that certain temperaments can be determined at very early stages and remain unchanged into adulthood (Suomi 1997; Suomi *et al.* 1996). In this study there was no correlation between the age of the animal and their resulting temperament. There is no way however to determine from these data if the temperaments are stable over time. This study utilized a temperament assessment rated by three keepers who worked closely with the clouded leopard tested to reveal their personalities.

There were four temperaments that existed within the test population of clouded leopards: “high-strung;” “active;” “calm;” and “aggressive.” There were no reproductively successful individuals that were found to be “high-strung” or “active.” These temperaments were also found to be not significant between gender, rearing or facility. Although, there were no male clouded leopards rated “active.” All reproductively successful individuals were rated as either “calm” or “aggressive.” The reproductively successful (RS) clouded leopards that were hand-reared (HR) were rated as “calm” and the reproductively successful (RS) clouded leopards that were mother-reared (MR) were rated as “aggressive.” The “calm” temperament was also significantly correlated with reproductive success (0.004) and sex ($p=0.008$), with RS individuals and males scoring higher than females. It should be noted however that only the RS males were rated as "calm;" none of the other males fit into this category. The "aggressive" temperament was significantly correlated with rearing (p=0.04), with mother-reared (MR) individuals scoring higher than hand-reared (HR). The only HR males that obtained a temperament of "calm" were the two RS males. The only MR male that received a temperament of "aggressive" was the remaining RS male clouded leopard. There were no other MR males with which to compare his temperament. The two RS females were both MR, and received a temperament of "aggressive." There were other reproductively unsuccessful (RUS), MR clouded leopards both male and female, that were rated "aggressive" as well. This may be an indication that experiences during infancy, such as rearing, may significantly influence personality with this species. Wielebnowski (1999) however did not find any significance with rearing when examining temperament in cheetahs. The findings in this study could be due in part to small sample size (N=5 RS individuals). This study predicts that reproductively successful individuals will most likely be rated with a temperament of "calm" or "aggressive" and that individuals rated with a temperament of "active" or "high-strung" will most likely be reproductively unsuccessful. It also predicts that HR males with a "calm" temperament and MR individuals with an "aggressive" temperament are more likely to be reproductively successful, but since N=5, additional testing is needed.

When examining the actual characteristic ratings from the temperament assessment, RS individuals scored higher on "calm," "confident," and "food aggressive," and lower on "fearful of conspecifics," and "high-strung." This follows the pattern of the temperaments, with RS individuals more often having a "calm" temperament and the “calm” temperament being comprised of higher scores on the characteristics “calm” and “food aggressive,” and low on “high-strung” and “fearful of familiar people.” All three of the individuals who were “calm” were also HR. The one female clouded leopard to receive this rating thus far has been reproductively unsuccessful, but the two HR males rated “calm” were successful.

Mellen (1992) found that hand-reared female domestic cats were less likely to copulate and were more aggressive than mother-reared cats. In this study however it was the mother-reared clouded leopards that scored significantly higher on “aggressive” and “fearful of familiar people,” and lower on “active” than hand-reared individuals. This is consistent with a study on cheetahs where mother-reared cats scored higher for characteristics like “tense-fearful” and “aggressive” (Wielebnowski 1999). If mother-reared individuals tend to exhibit these characteristics then it may be indicative of higher stress levels. This would be detrimental to their reproductive success in captivity (MacKinnon 2008; Wielebnowski *et al.* 2002). On the basis of this finding, the current management of this species (where all individuals are hand-reared) would be supported. The hand-rearing method would reduce the stress level of potential mothers by making them more comfortable and secure in captivity. On the other hand, the two RS females in this study were MR so there may be no connection between stress and rearing. Further testing is needed to determine if MR females are more often reproductively successful than HR individuals as was found in previous studies (Mellen 1992), or if behavioral characteristics typically found in MR clouded leopards are more often associated with high stress and reproductively unsuccessful individuals.

Another interesting finding was that RUS females were rated higher for "fearful of conspecifics." This could be true for several reasons. It could be a result of past experiences, such as introductions during which these females may have been attacked. RUS individuals were also found to be more "high-strung," and this lack of confidence or anxiety may cause them to be more fearful in general. Finally, this characteristic may just be part of their temperament and could be one of the many variables that lead to their lack of reproductive success.

*Behavioral Observations*

Initially, all the cats were compared using four dependant variables including: reproductive success; gender; rearing and facility to determine overall differences within the test population. RS individuals were found to have significantly faster "latency to respond" (p=0.035), mean of 1.4 seconds, versus a mean of 101.1 seconds for RUS. This was apparent when working these individuals, RS cats shifted into and out of the testing area almost immediately allowing the researcher to set up each trial. RS individuals also had significantly faster "time to shift" (p=0.047) (Table 2) once the testing began, with a mean of 22.57 seconds versus 136.66 seconds for RUS. Both of these responses indicated that they were comfortable with change in their environment and that they were food motivated since rewards were given to the animals when they shifted out of the testing area. These individuals also had significantly higher rates of behaviors including: "lying" (p=0.018); "patrol" (p=0.036); "voctotal" (p=0.014); "defecate" (p=0.04); "retreat" (p=0.021) and "urine walk" (p=0.022). These behaviors were reoccurring as significant among RS individuals throughout the analysis in various combinations, depending on trial and gender.  The other interesting result was that the RUS individuals spent significantly more time “out of sight” ($p=0.045$); this behavior is typically indicative of stress.  Animals will often “over-sleep” or hide when they are stressed (Wielebnowski 2002).  Many of the cats tested spent their time “out of sight” in their nestbox, which would be considered hiding.

There were very few differences between the sexes, and those differences seemed to be directly related to the RS individuals’ behavior.  The males had higher rates of “patrol” ($p=0.030$) and the females had higher rates of “sit” ($p=0.025$) and “flinch” ($p=0.035$).  The fact that “patrol” and “flinch” emerged as sex-based behaviors makes sense.  Most males patrol their territories and females are typically more defensive, which could cause higher rates of flinch.

When comparing MR and HR individuals some interesting differences emerged. HR individuals had a longer “latency to response” (LAT) ($p=0.027$), with a mean of 92.75 seconds compared to a mean of 62.94 seconds for the MR individuals.  HR individuals had a shorter “time spent investigating” (TSI) ($p=0.011$), however, they spent less time “out of sight” ($p=0.05$), and less time “lying” ($p=0.004$).  This may indicate that they were up and moving around a bit more than the MR individuals, just not as interested in the test items.  These results further support the hypothesis that the behaviors exhibited by clouded leopards are more likely indicative of reproductive success than rearing.  The behaviors found to be significant among reproductively successful individuals do not match up with the behaviors found to be significant based on rearing.  The reproductively successful individuals, (N= 2 hand-reared, N= 3 mother-reared), had an overall faster LAT, unlike the HR individuals overall even though 2 were hand-reared. The RS individuals also spent less time "out of sight" (OOS) (1%) even though it was found that MR individuals spent more time OOS (19%) and three of the RS individuals were MR. So the behaviors that emerged as significant among the RS individuals do not correspond to the behaviors predicted to be significant based on rearing.

When comparing male and female RS and RUS individuals, it became clear that there were behaviors specific to each gender. There were no behaviors that emerged as significant among RS male clouded leopards that were in common with RS female clouded leopards. The RS males had significantly higher rates of "defecate" (p=0.023), "patrol" (0.034), "urinewalk" (p=0.037), "urinesquat" (p=0.039) and "urinetotal" (p=0.018). The RS females had significantly higher rates of "flinch" (p=0.013), "lying" (0.016), "meow" (p=0.025), "prusten" (p=0.002), "retreat" (0.000), "sit" (p=0.041), "voctotal' (p=0.005). It should be noted that although there were many very vocal cats, the one RS female, Numfun, was the most vocal cat I have ever encountered, with an average of 43.33 prustens per hour and 32.17 meows per hour. The other RS female, Mini, was also very vocal and had the third highest average of prustens (9.67 per hour) out of the 24 cats. The second highest rate of "prusten" came from the RS male, Wanchai with 26.83 per hour. Mini and Wanchai are a successful breeding pair.

Both the CRC and KKOZ facilities were compared to determine if housing may have affected individual responses. Only one behavior was found to be significantly different in cats between facilities. The individuals at KKOZ exhibited higher rates per hour of “retreat” (p=0.04). One major reason examining facility as a dependant variable may have had this result, was that all the RS individuals (N=5) were housed at KKOZ. This may have led to finding significance in behaviors that were not related to facility, but instead to RS. This may be why “retreat” was found to be significant among individuals housed at KKOZ. This behavior was observed only in three individuals out of the 24 tested, (two females and one male). The two females were both the RS individuals, and of the 14 female clouded leopards tested, they were the only two that exhibited this behavior. When comparing just females at KKOZ (N=9), RS females were still found to be significantly more likely to “retreat” (p=0.005), so this behavior may be more indicative of reproductive success than facility. RS females at KKOZ were also found to “flinch” (p=0.041), “prusten” (p=0.020), and “voctotal” (p=0.037) at significantly higher rates than RUS females housed at the same facility, so these behaviors seem to be linked more to reproductive success than to facility.

When comparing RS and RUS males at KKOZ the only behavior that was found to be significantly different, with higher rates among RS males, was “patrol” (p=0.046). However, “urinetotal” (p=0.061) approached significance and was observed in higher frequencies among the RS males. The small sample size (N=5) of males at KKOZ that may be affecting the significance of the data. When comparing all males (N=9) at both CRC and KKOZ, not only was “urinetotal” highly significant (p=0.019); but also “urinesquat” (p=0.039) and “urinewalk” (p=0.037) were seen in higher frequencies among RS males, along with “defecate” (0.023) and “patrol” (0.034).

Another significant difference was with “latency to respond” (LAT). There was no difference between facilities in LAT. When examining all the cats however at both facilities RS individuals had a significantly shorter LAT (p=0.035). This means they tended to respond much faster. Even when examining KKOZ cats only, it was found that overall the RS cats had significantly shorter LAT times (p=0.032), with RS cats responding in 1.4 seconds on average and RUS cats responding in 68.4 seconds on average. In KKOZ, I observed obvious differences with the cats’ responses. These individuals were easier to shift around and manage during testing. Even within this population however there was a clear distinction between the RS and RUS cats. Just as the data show, the RS cats shifted almost immediately. This was attributed at the time to their high food motivation which they all also seemed to have. Although, some RUS individuals did respond quickly; the calm, food motivated cats that responded quickly during testing were almost always the RS individuals. When examining the temperament findings, the “high-strung” cats had the longest “time until initial approach” (343.04 seconds) and shortest “time spent investigating” (57.13 seconds) and the “calm” cats had the longest “time spent investigating” (100.96 seconds) and the shortest LAT (18.67 seconds). The finding that LAT was much longer in the RUS cats fits the theory that these cats may have higher stress levels which could cause them to be less likely or slower to respond during testing. In the black rhino (*Diceros bicornis michaeli*), stress has been shown to reduce olfactory behaviors associated with reproduction (Carlstead and Brown 2005). Clouded leopards with higher stress levels are also less likely to be reproductively successful (Wielebnowski 2002, MacKinnon 2008). Therefore, LAT may be one easy to measure indicator, of an animal that is stressed therefore reproductively unsuccessful.

When the Kruskal-wallis mean rank test was used on individual averages to compare the cats' temperaments with their corresponding behavioral observations, only two behaviors emerged as being significantly correlated with temperament. The cats with "calm" temperaments were found to be more likely to "defecate" (p=0.020), and the cats with "active" temperaments were found to be more likely to "rubtrial" (p=0.004). Although both of these seemed accurate, it was believed that there was more correlation between temperament and behavioral observations than this analysis revealed.. Therefore, the data was split so that all trials were individual and the sample size increased to 432 (instead of 24). This made it possible to run a one-way ANOVA, which revealed several behaviors to be significantly different between temperaments. Cats with "high-strung" temperaments had the highest average "time to approach" (353.04 seconds), and "urinetotal" (3.62 rate per hour). This was mainly due however to one RUS female, "Nellie" who was rated "high-strung." Nellie had the highest average urine total of any cat in this study, with a rate of 21.33 per hour. The next closest was a "calm" rated RS male with a "urinetotal" of 3.5 per hour. This one cat, Nellie, was exceptional in her ability to urinate and therefore skewed the data. "High-strung" cats also had the lowest averages of "lick" and "prusten". Cats with "active" temperaments were more often the fastest to respond; with a mean "time to shift" of 26.7 seconds, and a mean "time to approach" of 105.28 seconds. "Active" cats also had the highest average of "lick," "rubtrial," and "snifftrial," and the lowest average of "claw," and "urinetotal."

Conversely, cats with “aggressive” temperaments had the slowest “time to shift;” with a mean of 154.71 seconds, and the longest “latency to respond;” with a mean of 113.58 seconds. Not surprisingly, these cats also had the highest average “paw/swat,” with a mean of 24.10 per hour, and the lowest mean for “snifftrial” (58.38 per hour) and “urinewalk” (0.02 per hour). Finally, cats with a “calm” temperament had the lowest average of “paw/swat” (1.56 per hour), and fastest “latency to respond;” with a mean of 18.67 seconds. “Calm” cats also had the highest mean for “claw” (3.22 per hour), “prusten” (10.06 per hour), and “urinewalk” (2.78 per hour), and lowest mean for “rubtrials” (0.00), (a behavior none of the calm cats performed during the entire study). The “claw” mean was also skewed by one RUS female, Mesa, who had the highest average for “claw” with 9.67 per hour. The second highest was RUS male, Mei, with 3.67 “claw” per hour. Further analysis and investigation into the behavioral differences associated with certain temperaments is warranted, perhaps using a Wilcoxon signed rank test.

*Individual Trials*

When examining all the treatments separately the one behavior that was significant among RS individuals was “prusten.” The next most commonly exhibited behavior from the RS individuals was “lying.” The only trials in which this behavior was not significantly higher among RS individuals was during the estrus, choice and mirror image stimulation trials. This indicates that the RS individuals were more active during these three trials. This was supported by the data which showed active behaviors emerge as significant in RS cats during these trials, such as: “patrol” during the estrus (p= 0.003), and choice trials (p=0.042); and time spent investigating (p=0.007) during the mirror image stimulation.  These behaviors preclude “lying” so the RS individuals that normally exhibited the “lying” behavior during other trials were not able to exhibit both “lying” and these active behaviors at the same time.  Therefore, those three treatments (choice, MIS and NO) can be assumed to have significantly changed the behavior of the reproductively successful individuals.

*Scent Test*

The scent test was designed to mimic the first phase of breeding introductions which is when the male clouded leopard is allowed access to the female’s area to investigate when she is not in there.  The control treatment (plain piece of paper plate) was given to determine a baseline of normal behavior and determine responses when no stimuli were present.  As expected, the control test yielded the significantly lowest average “time spent investigating” (6.31 seconds) and the significantly longest average “time to initial approach” (414.87 seconds) when compared to all the other treatments.  It also had a significantly lower rate of “flehman” than the three urine treatments and the significantly lowest mean of “snifftrial” (22.56 per hour) compared to all the other treatments.  The significant behaviors found during this treatment for all RS individuals were “lying” and “prusten”, RS males had higher rates of “prusten” and RS females had higher rates of “lying,” “meow,” “prusten,” and “voctotal,” and had a significantly longer “time to initial approach.”  These are the general behaviors that can be considered significantly different among reproductively successful individuals when no testing occurs, and these behaviors are significantly higher throughout the testing as well.

Therefore, it can be assumed that reproductively successful individuals spend more time lying and vocalizing than reproductively unsuccessful individuals.

The blood treatment was given as the positive control, or the test to which the cats were expected to respond. It is not surprising that the mean responses for the blood treatments were very close to the grand mean of all the treatments combined. RS individuals again exhibited, “lying’ (p=0.013), “meow” (p=0.28), “prusten” (p=0.033), and “voctotal” (p=0.19) more often during the blood treatments. “Defecate” (p=0.046) however was also significantly higher among RS individuals. This may indicate a territorial response due to the presense of “food,” however the treatment resulted in no behaviors that were significantly different between the RS and RUS males. The RS females exhibited “lying,” “meow,” “prusten,” and “voctotal” at significantly higher rates than RUS females during this treatment. These behaviors are the same as the control treatment, so although the response times were closer to the grand mean, this treatment did not change the RS individual’s behavior significantly.

It was predicted that RS males would spend more time investigating during the urine treatments with more sniffs, licks, flehman response, and urine marking. This prediction was supported, with the estrus treatment being the only treatment showing RS males with significantly higher rates of “flehman,” “patrol,” “urinesquat,” urinewalk,” and “urinetotal.” Other significant behaviors during this treatment were “meow,” “prusten,” and “voctotal.” These behaviors tend to increase in captive male clouded leopards housed with a female clouded leopard when she is beginning to cycle (personal observation).

The non-estrus urine was used to measure change in behavior due to possible differences in hormone level in the urine. This treatment was second only to the control in the mean "time to initial approach" (314.13 seconds), and "time spent investigating" (11.57 seconds). The RS males had no behaviors that were significantly different than RUS males during this treatment which would indicate that the behaviors the RS males exhibited during the estrus treatments may be due to their ability to detect hormone level in the urine.

The RS females responded significantly stronger to the male urine treatments, with six different behaviors showing significance. As with other treatments, "lying," "meow," "prusten," and "voctotal" were significantly higher. For this treatment however "claw" and "pace" were also found to be significantly higher. Each of these behaviors was recorded only once, for one RS female, during one of the three male urine treatments. This female, or the other RS female, did not exhibit these behaviors at any other point during any other test. It is hard to say however that it was directly related to the test or indicative of reproductive success when it only occurred one time in one individual. One RUS female was also recorded pacing one time during one of the male urine treatments, so this was not a behavior exclusive to RS females. Unlike the RS female, who was not recorded pacing at any other time besides during the one male urine trial, the RUS female (Jogayle) was recorded pacing during five out of the 18 tests that were given. Each one of these five times was during a different scent test. The "claw" behavior was not recorded during any other male urine trials except for the trial involving the RS female. There was another RUS female (Thistle) however that was recorded clawing one time during the choice test (which included male urine). Further testing therefore is needed to see if these behaviors (claw and pace) are truly significant for this type of treatment, or if the small sample size accounts for the significance.

*Choice Test*

On average, the most sniffing occurred during the choice test and was found to be significantly different than the other seven treatments, with an overall average of 576.33 sniffs per hour recorded. The higher average was from the RUS individuals with 595.16 sniffs per hour. It is to be expected that more sniffs would be observed during the choice test because, with all five scents being presented at the same time; there were more options for the cats to investigate. Despite the fact that the RUS individuals seemed more interested in the choice test, it did not significantly affect their behavior. The RS males were the only ones to show significantly higher rates of “patrol” (p=0.005), “urinesquat” (p=0.034), “urinewalk” (p=0.034), and “urinetotal” (p=0.007). This may indicate the RS males were again responding to the estrus urine offered during this treatment, since the estrus treatments were the only other treatments where these behaviors were significantly higher. The RS females however did not respond to this treatment in a similiar manner to the way they responded during the male urine treatment, even though that male urine was available during both tests. Overall, this treatment did not add much to the analysis, but did serve as an additional scent test.

*Mirror Image Stimulation*

Overall, RS individuals exhibited “lick” (p=0.046), “prusten” (p=0.035), “retreat” (p=0.004) at significantly higher rates then RUS individuals. They also had a longer “time spent investigating” (p=0.007). This was likely due to the fact that the RS individuals were rated more “confident” and “calm” by keepers, indicating they may have felt more comfortable with the mirror overall. A few RUS individuals (N=2) did not even shift into the testing area or even approach the mirror if they did shift in (N=2). So they did not respond to the mirror at all, whereas all the RS individuals (N=5) responded, making the average “time spent investigating” for RUS individuals 266.84 seconds. If those RUS individuals are removed from analysis, the average time spent investigating of the RUS clouded leopards jumps to 425.11 seconds; however this is still lower than the RS individuals’ average of 657.60 seconds. In general, most of the cats that responded at all to the mirror spent from four to 15 minutes interacting with it; they were up and active for a majority of the 15 minute treatment. The MIS had a significantly longer “time spent investigating” than any of the other seven treatments with the longest mean of (348.25 seconds). This treatment also had the lowest mean rate of “lying” (0.13 pot) and highest mean rate of “stand” (0.45 pot) and “flinch” (8.67 per hour); three three results significantly lower than the other seven treatments. The RS individuals were the only cats rated “aggressive” to exhibit any friendly vocalizations during this treatment.

The mirror image stimulation was the most revealing for the RS females. They were found to exhibit the most significant behaviors including “bite” (p=0.008), “flinch” (p=0.007), “paw” (p=0.025), “prusten” (p=0.010), “retreat” (p=0.000), and “voctotal” approached significance (p=0.053). The RS females also had a longer “time spent investigating” (p=0.029) with a mean of 650.00 seconds versus 233.31 seconds for RUS females. Both of the RS females were the only cats to exhibit the “retreat” behavior during this treatment. This test may be useful for pinpointing individual females that may be reproductively successful. However, the sample size (N=2) is extremely small, so further testing is necessary.

The MIS had the highest average of “growl/hiss” (55 per hour) and “paw/swat” (38 per hour). Although when these measures were used to determine increased aggression, the MIS only increased aggression significantly higher than the blood, male, choice and control treatments for “growl/hiss,” and control, estrus, choice and novel object treatements for “paw/swat.” The “paw/swat” average however may be inaccurate. Most of the “paw/swats” seen during the MIS were aggressive, while during other tests “paw/swat” may have been high, but the behavior was more investigative (i.e. male urine treatment). Overall, most of the cats were more aggressive during this trial however it was inconsistent among RS and RUS individuals and among temperaments as well.

With respect to the determining temperament, the mirror image stimulation yielded varying results. All the temperaments exhibited “paw/swat” which can be both an inquisitive or aggressive behavior so it is hard to determine what the intent was. In the future, this type of rating should be split for this treatment into two variables, “paw” (investigative) and “swat” (aggressive). Only two females rated “active” (N=4) and two rated “aggressive” (N=6) exhibited friendly vocalizations (the two RS females), but several others rated with the same temperaments did not.

With regards to the predictive power of the MIS for determining temperament or reproductive success in males that were given this test, the results were inconclusive. The only behavior significantly different among RS and RUS individuals was the “number of approaches” (p=0.041); with RUS males approaching at an average rate of 11 times per hour and RS males approaching at an average rate of 38 times per hour. The behavior of the males during this treatment varied greatly. It was expected that overall RS males would behave in a manner similar to how they would behave during “howdy” introductions to a female. “Howdy” introductions are done by giving males access to a female through wire caging. This allows the animals to have visual, olfactory and auditory access to eachother, with minimal physical contact, which in turn, protects the female from any possible aggression. If affiliative behaviors are observed this would indicate that a physical introduction could be done. When the RS males saw the mirror it was thought they would assume this was a conspecific and would in turn present affiliative behaviors to the mirror. However, of the three RS males tested, they all exhibited quite different behaviors. Wanchai, who was rated with a “calm” temperament and in general exhibited non-aggressive behavior throughout the behavioral treatments, was extremely aggressive to the mirror. In fact, his behaviors were more indicative of being territorial than affiliative. He spent a total of 834 out of a possible 900 seconds with the mirror and the majority of that time he was tail flicking and growling with a rate of 76 “growl/hiss” per hour. At one point he even exhibited a “urinesquat” directly in front of the mirror. He did not exhibit any friendly vocalizations. This was obviously not the reaction that was expected. The RS male, Noname, who was also rated “calm,” spent 67 percent of his time sitting calmly next to the mirror and exhibited affliative behaviors, including “meow” and two “prustens” directed at the mirror image. Finally, the third RS male, Songkla who was rated “aggressive”, which one would think might indicated what his response would be, also responded with the affiliative vocalization “meow” and exhibited no “growl/hiss” and even licked the mirror at one point.  Both of these males also spent time grooming which would indicate they were comfortable during the treatment.  These responses are in stark contrast to Wanchai, who behaved in a very “territorial” manner, not predicted by the researcher.

On the other hand, the RUS males, in general, responded with varying degrees of aggression, regardless of their temperament.  Sakda (rated “high-strung”), was the only RUS that did not “growl/hiss,” and he exhibited friendly vocalizations (meow).  The rest of the RUS males (N= 5) did exhibit the “growl/hiss” in some frequency, and none of them exhibited any friendly vocalizations or any of the urine marking behaviors seen from the RS males.  Junior, rated “aggressive”, immediately charged the image and exhibited “growl/hiss” at a rate of 516 per hour and “paw/swat” at a rate of 564 per hour; needless to say he was extremely aggressive.  Another RUS male rated “aggressive,” Xing, exhibited “growl/hiss” and “paw/swat,” but only spent 44 seconds with the mirror before going into his nestbox and spending 93 percent of his time “out of sight.”  Dao, another RUS male rated “aggressive,” did not approach the mirror at all during the entire treatment and Brandon, an RUS male rated “high-strung,” spent 73 percent of his time during this treatment “lying.”  On the other hand, Mei, RUS male rated “high-strung,” spent 625 out of 900 seconds interacting with the mirror, he exhibited “growl/hiss,” “paw/swat,” and “flinch” (but at very low rates).  So, although the RUS males overall seemed to respond in an aggressive manner to the mirror, so did one of the RS males. Although two of the RS males exhibited friendly vocalizations, so did one RUS male.

Individuals rated both “aggressive” and “calm” reacted aggressively and the “high-strung” individuals either reacted at a low level, or ignored the mirror. Therefore, it is hard to say that the response of male clouded leopards to a MIS would be indicative of temperament or reproductive success.

*Novel Object Test*

The novel object test again revealed the most about the RS females. The RS females had significantly higher rates of “paw” (p=0.014), “prusten” (p=0.010), and again exhibited “retreat” (p=0.008). Overall, the RS individuals exhibited “lying” (p=0.011), and “prusten” (p=0.42) at higher frequencies. This test was not as revealing as hypothesized. Overall, the cats seemed uninterested in the bag, spending an average 49 percent of their time “lying,” the highest percentage of any treatment. Perhaps they were reluctant to move around with the large object in their enclosure. Several of the RUS individuals (N=4) exhibited the “growl/hiss” during this treatment which may also indicate that they were uneasy with the bag in their enclosure. One of the RS females did “retreat” from the bag, a behavior that was not commonly seen, however, the other RS female did not. Both RS and RUS females exhibited “flinch,” and no males exhibited this behavior during this treatment. The test did result in the second highest “time spent interacting,” with an average of 63 seconds, but this was still under the grand mean “time spent interacting” of 69 seconds.

There were only three behavioral observations that varied across trials. Both “flehman” and “meow” decreased in frequency as the trials went on. The “flehman” response is associated with the investigation of a scent, and the processing of these scents. It makes sense that this behavior decreased as the individuals became more familiar with the scents presented. The "meow" behavior can often be associated with feeding. Clouded leopards tend to meow frequently when waiting for food (personal observation). Since trials were run before the animals were fed, it is possible that in the beginning of the study the cats were still expecting food; whereas towards the end of the study they understood that the food was not coming for awhile. This could also explain the one behavior that increased as the trials progressed, "lying." When the study first started the animals may have been more active expecting to be fed or interested with the novel stimuli. However, as the trials went on the cats may have realized they were not going to be fed right away and may have become less interested in the stimuli presented.

The behavior termed "urinewalk," defined as, "cat urinates in the standing position and may be combined with walking," had not previously been observed by the researcher and no reports of this behavior were found to be documented in this species. The behavior was recorded a total of eleven times during 9 separate trials. It was exhibited most frequently by the RS male, Noname, with a record 6 times throughout the study period: during two estrus; one nonestrus treatment; and the choice test. During one of his estrus treatments and the choice test he exhibited this behavior twice within the 15 minute treatment period. The other RS male that exhibited this behavior was Wanchai, with a total of two times, once during the choice test and once during an estrus test. It should be noted that the other RS male, Songkla did not exhibit this behavior at all. In addition, three of the female clouded leopards tested exhibited this behavior on one occasion each: Thap-thim during an estrus treatment; Gaint during her choice test; and

Zoe during the novel object test. It is believed that this behavior is highly instinctual and seems to be an innate response that the animal has a hard time preventing themselves from performing. It almost seems as if they begin urinating without realizing it.

# CHAPTER 5 CONCLUSION

It is impossible to say what came first - the behavior or the reproductive success. In general, these tests were designed to elicit behaviors that are seen during the preliminary introductions of a breeding pair of clouded leopards. Several behaviors were significantly different between the RS and RUS individuals, including quicker 'latency to respond" and "time to shift" as well as a lower frequency of "out of site" and higher frequencies of "lying," "retreat," "patrol," "defecate," "urinewalk," and "voctotal." It is important to acknowledge that all of the individuals tested were already sexually mature and had past experiences being paired with another clouded leopard at some point in their life, so they were either RS or RUS already. These past experiences may be influencing their behavior and even may have had an impact on their temperament. Therefore, it is hard to say that clouded leopards are reproductively successful because they exhibit these behaviors, perhaps it's just the opposite. They may exhibit these behaviors because they have been successfully paired. However, it should be noted that none of the pairs were housed together during the study and one of the males tested, Noname, had not been paired with a female in over four years. This study attempts to reveal a small glimpse into clouded leopard behavior, which is a mystery to those of us that work closely with them. Hopefully, it will be the beginning of many behavioral studies to come on this species that are in dire need of understanding. The most significant temperament characteristics and behavioral observations expressed by reproductively successful individuals throughout the entire study can be found in Table 29.

**Table 29: Temperament characteristics and behaviors exhibited by RS and RUS clouded leopards.**

| Variable | Temperament Characteristic | Behavioral Observations |
|---|---|---|
| | **Signficantly High** | **Signficantly High** |
| RS (all cats) | Calm | Lying |
| | Confident | Patrol |
| | Food Aggressive | VocTotal |
| | | Retreat |
| | | Defacate |
| | | Urine - Walk |
| RS Male | Friendly | Defecate |
| | | Patrol |
| | | Urine - squat |
| | | Urine - walk |
| | | Urine - total |
| RS Female | | Lying |
| | | Sitting |
| | | Flinch |
| | | Retreat |
| | | Meow |
| | | Prusten |
| | | Voctotal |

Some of the behavioral observations that were used during this study can be altered for ease of recording in future studies. The behaviors originally recorded “run” and “stereotypy” were exhibited with such infrequency that it was not worth recording them and unlike “defecate” and “retreat” which were also scarce, “run” and “stereotypy” were never found to be significant. “Sniffobject” was difficult to accurately score, it was hard to determine if the cats were sniffing residual food or something that had been tracked into their cage by someone else, so this was removed and only “snifftrial” was analyzed. However, “snifftrial” was never found to be significant among the dependant variables, just significantly different between different tests. Also, as previously mentioned "paw/swat" should be separated in the future, especially for the mirror image stimulation. These are two separate behaviors with distinctly different intents. An animal usually paws an object when they are curious or investigating something. However, the swat behavior is most commonly seen when they animal is being defensive or aggressive. For example, when "growl/hiss" and "paw/swat" were used as a measure of aggression, the MIS only resulted in aggression rates that were significantly higher than some of the treatments, not all. This was surprising, since animals that can not self-recognize are believed to exhibit "territorial" (Gallup, 1968) and or "aggressive" behaviors (Svendsen and Armitage, 1993) during mirror image stimulation tests. However, for some individuals, the MIS did elicit some of the most aggressive responses during the whole study. Specifically with Junior, who immediately charged and attacked the mirror, and with Wanchai a "calm" rated cat who exhibited the "growl/hiss" only during this treatment. These results may be due to the fact that "paw/swat" were combined and many of the cats pawed at the other trial stimuli in a playful, investigative manner. Therefore, for this study "paw/swat" was combined, but this would not be suggested for future studies.

Several behaviors added after the initial tests were run and were recorded during video analysis turned out to be extremely important, including the response "time to shift" which was found to be significantly faster for RS individuals and also "patrol" which was found to be significantly higher among RS individuals and RS males. The behavior "patrol" was noted from the beginning during the initial observation period;

however, it was impossible to accurately code this behavior when observing the cat in real time. It is much easier to record from video due to the duration and similiarities it has to other behaviors. However, it is believed that “patrol” should be a more commonly recorded behavior among researchers studying the clouded leopard.

Some behaviors were analyzed as a “total” behavior in addition to being kept as separate variables. It is probably best to just record “voctotal” (p=0.005), which was highly significant in RS females, instead of separating the behaviors for females into “meow” and “prusten” which are also significant on their own. Both of these vocalizations are friendly and are generally performed in concert with one another. The behavior “voctotal” was also found to be significant on its own without both “prusten” or “meow. Also, “rubtrial” versus “rubother,” which were also combined into “rubtotal,” did not seem to be significant in any way and could probably be removed from future analysis.

This would not be recommended for behaviors such as “urinetotal.” It was found that all three urine behaviors: “urinesquat” (p=0.039); “urinewalk” (p=0.037); and “urinetotal” (0.018) were exhibited in significantly higher rates by RS males than RUS males. During any treatment when RS males were found to have significantly higher rates of urinating; all three urine behaviors were significant. Therefore, “urinetotal” could be used as an accurate measure when determining differences between males. When examining both male and female clouded leopards together however, only “urinewalk” (p=0.022) was found to be significantly higher. The behavior “urinewalk” defined as “cat urinates in the standing position and may be combined with walking,” was one of the most significant findings of this study. This behavior has not been observed by the author previously and was added to the ethogram after it had been recorded several times throughout the study, primarily by RS male clouded leopards. This behavior seems to be indicative of an explicit territorial behavior that is not part of the daily or regular behavioral repertoire of this species. A similar behavior has been described in male elephants in musth. These males exhibit a "urine-dribble" which is almost a constant dribble of highly pungent urine that leaks down the sides of their legs and leaves a trail as they walk (Buss and Smith 1966). This also has not previously been recorded during behavioral research in the clouded leopard (MacKinnon 2008; Wielebnowski 2002). In addition, no reports of this behavior could be found in the literature. Several experienced animal professionals were questioned about this behavior; only one, Rick Passaro, the manager of the KKOZ clouded leopards, could remember ever having even seen this behavior. His impression was the same, that it was done to mark territory (per comm.). This is consistent with other findings from this study; RS males tend to exhibit behaviors that are "territorial" (i.e. patrol; urinetotal; defecate).

It is believed that the effectiveness of scent marks is highly dependant on the spatial and temporal movements of an animal (Alberts 1992). The findings of this study support that theory. The RS males were found to have significantly higher rates of "patrol". In the wild, increased patrolling would greatly increase the probability that males would find scent marks left by a female and therefore would be more likely to locate a female when she is receptive to breeding. Interestingly, the RS males had significantly higher rates of "voctotal" only during the estrus treatment. Again, this type of communication is best utilized if a female in estrus is nearby. In the wild, a female in estrus will scent mark and if the male picks up on this communication it makes sense that he would vocalize to alert the female of his presence. The RS males also had a faster average “time to initial approach” during the male urine treatment than the RUS males. It would definitely be advantageous to discover and respond to an intruder faster in the wild (Both *et al.* 2005). So although it was not significant, this response time could be indicative of the ability these individuals have to detect an intruder was in their territory. Finally, RS males had much higher rates of urine mark and defecate throughout the study and these behaviors were found to be highly significant when compared to the RUS males. This indicates that these males may be better at representing their presence and communicating their fitness to females, which may in turn make these females more receptive. Specifically, the “urine-walk” behavior increases the surface area of the scent mark making it much more likely a female or even intruder would happen upon it. The urine marking behaviors were only found to be significant among the RS males during the estrus urine and choice tests, which may indicate that these males are also more resourceful when it comes to expending the energy it takes to produce these forms of communication. It makes sense to invest the most during periods when the probability of success is greatest. In other words, although they seemed to scent mark more overall, they also seemed to have a more advantageous approach at distributing their signals. In this way, the behaviors exhibited by the RS males in captivity seem to align with the natural behavior that would lead to reproductive success when a male is searching for a female in the wild during periods of estrus.

The RS females exhibited what the author has termed “defensive” or “preventative” behaviors in higher frequencies than RUS females. It has often been found that females exhibit more fearful (Wielebnoski 2002) or cautious behaviors (Both *et al.* 2005) than males. Females, in general need to be more cautious because often times they are not only protecting themselves, but also their young. For a species, such as the clouded leopard that has several predators in their natural habitat (i.e. tiger; leopard; wild dog), the defensive behaviors recorded during this study would be advantageous (Cavigelli *et al.* 2005). The first defensive behavior observed was, “retreat” (p=0.000), which was found to be highly significant among reproductively successful female clouded leopards. Although there was a small sample size (N=2), these individuals both reacted exactly the same way during the mirror image stimulation; both retreated, and one female Numfun, also retreated from the novel object. There were very few other individuals that exhibited this behavior; only one, a MR male, Mei, exhibited this behavior during the mirror image stimulation. This male was also found to have a “high-strung” temperament, which may partially explain his reaction to this treatment. This male may also have been the reason that MR males were found to have significantly higher rates of “retreat” (p=0.47) than HR males. Even though he was the only one to exhibit this behavior, the sample size of MR males was very small (N=2).

Another defensive behavior, “flinch” (p=0.013), was also highly significant among RS females. This behavior was seen in the RS females during the mirror image stimulation. Numfun flinched 12 times during that treatment and Mini flinched six times. These were two of the highest rates among all the cats that exhibited this behavior. By far, “flinch” was most frequently observed during the mirror image stimulation (N=49) versus all the other treatments (p=0.002-0.045). The next highest observation of the behavior flinch was during the novel object test (N=14) (p=0.028-0.045). Some of the cats flinched during some of the scent treatments as well (N=9); none of them however wer in significant frequencies. The MIS and NO treatments were the most revealing when determining differences between the female RS and RUS individuals and the MIS would be highly recommended for further studies to determine if it could be used for pinpointing females that may be reproductively successful. The mirror image stimulation did not seem to help determine either temperament or reproductive success in the male clouded leopards tested for this treatment.

The other behaviors that were found to be highly significant among RS females were termed “preventative behaviors,” and were classified as such because by exhibiting these behaviors it is thought that a female may be able to prevent an attack either by a predator or conspecific in the wild, or a male conspecific in captivity. These behaviors included “lying,”and “voctotal.” The “voctotal” behavior which included the friendly vocalizations, “meow” and “prusten,” was considered highly preventative for this species. “Prusten” is used between clouded leopards as a friendly greeting as well as a sign of reassurance when they seem unsure of something. The use, or apparent overuse, of this behavior may be how the female communicates to the male that she is friendly and calm. “Voctotal” may also serve to keep the male at bay and reminding him that all is friendly. This behavior was found to be significantly higher in RS females during the control, blood, male and choice tests.

In the wild, lying can be an advantageous way of stalking prey. Clouded leopards have been observed during the day resting high up in the trees along the edge of open grassland keeping an eye on the hoofstock grazing below (Grassman *et al.* 2005). Lying may also prevent an attack, due to the fact that the more an animal moves the more likely they can be considered a target or prey. Therefore, it is not unexpected that this behavior was highly significant among RS individuals as well as the RS female clouded leopards. Perhaps in the wild and in captivity, the advantageous position of lying in the trees or on a perch, where the female can see the male and move away before being detected, or before he can reach her, may contribute to her success. In other species, females have been found to be more reproductively successful if they are slow to explore their territory; this makes them more adaptable to change and enhances their ability to react to novel stimuli (Both *et al.* 2005). Therefore, clouded leopard females that spend more time lying may be equivalent to these "slow exploring" females.

In captivity, it has been observed during periods of estrus, that the male clouded leopard becomes the most interested in the female when she is up and moving around. If the male is persistent when the female is not in full estrus and she continually avoids his advances, this can cause aggression (personal observation). By spending a lot of time lying, the female can almost avoid these encounters until she is actually receptive to breeding. The lying behavior may also be indicative of the cat's temperament, although it was not found to be highly correlated with temperament; it makes sense that cats that are calm and relaxed would spend more time lying, especially out in the open. These individuals differ from the high-strung individuals in that although they were inactive; they were not hiding or oversleeping "out of sight."

This study revealed that the clouded leopards in the test population had four separate quantifiable temperaments: "high-strung;" "active;" "aggressive;" and "calm." These temperaments were found to be significantly correlated to reproductive success, (RS= "calm" p=0.004) and sex (M= "calm" p=0.008). They were also correlated with the method by which the individual was reared from birth (MR="aggressive" p=0.040). The findings in this study coincide with other animal personality research on several non-human primates as well as other non-primate mammals (Gosling and John 1999; Wielebnowski 1999). These studies found that most often animal personalities corresponded with the three most common factors derived from the human five factor model (John and Srivastava 1999):

1. Neoroticism corresponds to the "high-strung" clouded leopard temperament.
2. Antagonism corresponds to the "aggressive" clouded leopard.temperament
3. Extraversion corresponds to the "active" clouded leopard temperament

The only temperament found in clouded leopards that did not correspond with one of the three most common human factors was "calm." No other studies of clouded leopards or exotic cats were reviewed (Gosling and John 1999).

Overall, the temperaments seemed to correspond with the general demeanor of the cats. The behavioral observations that corresponded to each temperament also seemed accurate. The high-strung and aggressive cats were the least likely to respond and interact during testing. This makes sense, often times animals that are high-strung have higher stress levels and it has been found that these individuals tend to be more secretive, with increased hiding and sleeping (Wielebnowski *et al.* 2002) and less exploration (Byrne and Suomi 2002). Many of these cats were also MR (N= 8) and the MR cats were also significantly less likely to respond and were rated “fearful of familiar people” so it makes sense that they were also found to be hesitant to shift and then once they did they interacted minimally with the test stimuli. The cats with active temperaments were the opposite. These cats were the most interactive the most often. They fast to respond and spent a significantly longer time licking, sniffing and rubbing the test stimuli. The cats with the calm temperament were the fastest to respond, but tended to have little interest in the test stimuli. These individuals also exhibited “prusten” and “urinewalk” the most and these behaviors were also significantly correlated with RS individuals.

It is believed that behavioral variation between individuals is more than just chance (Gosling and John 1999); that temperament may be a trait that has evolutionary ties that can be selected for (Dall *et al.* 2004). This information becomes pertinent to the captive management of these endangered species. We must be very deliberate in our pairings and diligent in our observance of these captive breeding populations. If certain individuals or temperament types tend to breed better or more frequently, there exists the possibility that we could be losing the genes necessary for survival in the wild. When a species such as the clouded leopard has a mean kinship of 0.21-0.44 (Fletchall 2007), there is no room for continued loss of genetic diversity.

The results of this study reveal that the temperaments in captivity that tend to be reproductively successful, (“calm” if hand-reared and “aggressive” if mother-reared), as well as the corresponding behavioral observations, seem to fit into what ecologist would predict to be good fitness in the wild. Behaviors such as “retreat” and “flinch” exhibited during the mirror image stimulation and novel object test by the reproductively successful females may be indicative of defensive behaviors that would be beneficial to these individuals in the wild. Likewise, the reproductively successful males had increased urine marking, vocalizing and patrolling which would be essential for success in the wild. These males also scored higher on the temperament assessment for being food aggressive, which is another advantageous quality for survival. It seems that even when hand-reared, which can be highly controversial amongst managers, these individuals still exhibit the necessary behaviors to survive and breed in captivity as they would in the wild. The temperament of the individual may vary based on behavioral history (Dall *et al.* 2004), but the behavioral traits exhibited during this study among reproductively successful males were consistent regardless of the method which they were reared. These findings indicate that certain behaviors may be hard-wired, and animals that exhibit these behaviors may tend to be reproductively successful both in the wild and in captivity regardless of rearing or other circumstances. The two temperament types that were successful were at opposite extremes; “calm” and “aggressive.” Increased aggression has been found to have a positive effect on reproductive success in both males and females. This result may be an indication that for clouded leopards, temperament is linked to individual fitness (Smith and Blumstein 2008).

For a species on the brink of extinction, both in the wild and in captivity, each individual is valuable. It is essential that the captive management of the clouded leopard is successful.  These tests offer a way to quantify individual behavior in the clouded leopard and could serve as a helpful management tool.  The SSP needs to make calculated decisions when recommending breeding pairs.  These decisions are currently based on genetics, age and keeper intuition.  Often times because of a valuable animal's age, there is only one chance for a successful pairing.  Although keepers know their animals extremely well and their experience is unmatched, these tests seek to quantify their intuition and may offer a way to make a better informed decision about which animals to pair.  This could help avoid spending time and money trying to pair animals that may be unsuccessful.  It could also avoid unnecessary animal shipments or serious attacks by males on females that often result in death.

*Future studies*

Due to the small sample size in this study, further testing is recommended, specifically of reproductively successful individuals.  The individuals used in this study came from only two facilities.  Although testing individuals in various other facilities would increase variability in the data, it would also help tease out other factors that may be influencing temperament or the behavioral responses to the tests offered.  Although there was significance found between reproductively successful and unsuccessful clouded leopards, increasing the sample size and finding similar results would make a stronger case for using these tests to predict reproductive success in the clouded leopard.

Future studies should include a repeat of these tests on the same individuals that were tested.  It is believed that "personality" or the temperament of an individual should be unchanged overtime and regardless of situation (Stevenson-Hinde *et al.* 1980; Scolan *et al.* 1987; Gosling and John 1999; Cavigelli 2005). Therefore, the best way to support this would be to retest the same individuals again to see if their responses are consistent over time. If they are, it would be a very powerful argument for using these tests to determine the potential reproductive success of clouded leopards in the future.

In order to test the validity of using domestic cat urine as a substitute for clouded leopard urine, it would also be useful to run a test comparing behavioral response of the clouded leopard to domestic cat urine versus clouded leopard urine. Testing similar to that performed in this study could also focus on the hormone levels in the urine to see if hormone levels or stages in an estrous cycle could account for differences in behavioral response.

Finally, these tests should be run on juvenile clouded leopards, ideally one year old or younger before there is any attempted pairing to see if there is truly any predictive power. The true value of these tests would be in using them to determine success before pairing, which is done most successfully before one year of age.

This study revealed that the clouded leopards in the test population had four separate quantifiable temperaments including: “high-strung;” “active;” “calm;” and “aggressive.” These temperaments were found to be significantly correlated to reproductive success, with successful individuals rating higher on “calm.” The temperaments were also significantly correlated with the method by which the individual was reared from birth, with mother-reared individuals rating higher on “aggressive.” Behavioral observations recorded during test treatments were also found to be significantly correlated with reproductive success. Reproductively successful individuals were quicker to respond, more vocal, spent less time out of sight, and more time lying.

Several behaviors were also found to be gender specific. Reproductively successful males exhibited more "territorial" behaviors, including "patrol," "defecate," as well as an unusual behavior, not previously recorded in this species, termed "urinewalk." The urine scent tests served best to elicit these behaviors and further testing is recommended to determine the possible use of urine scent tests in predicting reproductive success in male clouded leopards. The reproductively successful females responded with defensive behaviors, including "retreat" and "flinch." The mirror image stimulation was the best test to elicit these behaviors and further testing is recommended to determine the possible use of the MIS in predicting reproductive success in female clouded leopards. The data obtained in all eight treatments combined served as the best overall indicator of reproductive success in the clouded leopard. The temperament characteristics and corresponding behavioral traits of the clouded leopard may be linked to fitness both in captivity and in the wild. Behavioral research can be vastly revealing; this study adds to the foundation of behavioral knowledge that is lacking for the clouded leopard.

# APPENDIX I

## Random Order of Treatments

**A1-1: Randomized order of treatments by cat**

| CLOUDED LEOPARD KKOZ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mei | C | E | B | E | C | N | M | N O | C H | N | B | MI S | N | E | C | M | M | B |
| Name | N | B | M | B | E | C | M | M IS | M | C | N | C | N | CH | E | E | B | NO |
| Wanchai | N | N O | M | MI S | E | C | C | B | N | CH | E | M | M | B | B | E | C | N |
| Songkla | E | B | B | MI S | C | B | N O | N | C | N | M | C | E | M | CH | M | E | N |
| Sakda | N | C | B | B | C | N | E | M | N | B | E | E | C | MI S | NO | M | C H | M |
| Nok | E | E | M IS | C | M | C | N | M | N | B | E | CH | B | N | NO | M | C | B |
| Gaint | C | N | N | N | M | C | E | B | M | C | MI S | M | E | NO | CH | E | B | B |
| Manow | C | E | B | E | N | B | B | M | C | C | M | N | NO | N | MI S | M | C H | E |
| Pukluk | C | E | E | B | E | M IS | M | M | N | B | NO | N | CH | C | B | C | N | M |
| Somsri | M | M | C | N | M | E | N | E | C | N | E | B | NO | B | CH | B | MI S | C |
| Thap-Thim | M IS | B | M | M | N | N | E | B | C | N | C | B | M | E | C | NO | C H | E |
| Mesa | N | E | C | B | C | M | N | M IS | C H | B | NO | B | E | N | M | C | M | E |
| Numfun | E | N | M | C | M | M | N | M IS | N O | C | B | B | CH | E | C | E | B | N |
| Mini | N | N | M | B | C | M IS | N | B | C | M | M | B | E | E | CH | C | N O | E |
| **CLOUDED LEOPARD CRC** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** |
| Junior | M IS | C 1 | N O | N 1 | B 1 | E 1 | C 2 | C 3 | M 1 | N 2 | E 2 | B 2 | E 3 | N 3 | M 2 | CH | M 3 | B 3 |
| Brandon | C 1 | M 1 | M 2 | B 1 | M 3 | N 1 | M IS | C 2 | B 2 | C 3 | N 2 | E 1 | E 2 | B 3 | N 3 | CH | N O | E 3 |
| Xing-Xing | M 1 | C 1 | N 1 | E 1 | E 2 | M 2 | N 2 | B 1 | C 2 | MI S | E 3 | N 3 | CH | NO | C 3 | B 2 | B 3 | M 3 |

| CLOUDED LEOPARD CRC | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dao | N 1 | E 1 | M 1 | C 1 | M 2 | M 3 | N O | E 2 | E 3 | C 2 | B 1 | MI S | CH | N 2 | B 2 | C 2 | B 3 | N 3 |
| Zoe | C 1 | M 1 | B 1 | E 1 | C 2 | M 2 | M 3 | C 3 | N 1 | B 2 | CH | NO | B 3 | N 2 | N 3 | E 2 | E 3 | MIS |
| Jasmine | C 1 | M 1 | M 2 | E 1 | M IS | B 1 | N 1 | C 2 | C H | NO | B 2 | C 3 | E 2 | N 2 | B 3 | N 3 | M 3 | E 3 |
| Thistle | B 1 | M IS | C 1 | E 1 | E 2 | N 1 | M 1 | M 2 | C H | B 2 | B 3 | C 2 | N 2 | NO | M 3 | C 3 | N 3 | E 3 |
| Nattie | B 1 | N 1 | M 1 | C 1 | N 2 | N 3 | N O | C 2 | E 1 | MI S | E 2 | CH | C 3 | M 2 | B 3 | M 3 | B 3 | E 3 |
| Nellie | C 1 | M 1 | N 1 | E 1 | M 2 | N 2 | E 2 | N O | B 1 | M 3 | MI S | C 2 | B 2 | N 3 | C 3 | E 3 | C H | B 3 |
| JoGayle | N 1 | C 1 | M 1 | MI S | C 2 | N O | B 1 | E 1 | B 2 | CH | E 2 | N 2 | C 3 | N 3 | M 2 | B 3 | E 3 | M 3 |

**Table Coding**

E = Estrus Urine
N = Nonestrus Urine
M = Male Urine
B = Blood
C = Control
CH = Choice Test
MIS = Mirror Image Stimulation
NO = Novel Object

APPENDIX II

Behavioral Checksheet

Observer: __________ Date: __________ Time: start: __________ end: __________

Animal(s): __________ Enclosure(s): __________ Treatment: __________

Weather: __________

Latency to response __________

Time to initial approach __________

Total # of approaches __________

Total time spent interacting with object __________ Total stare time _______________

**Behavioral States - recorded at the end of every minute from the time of initial response**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lying | | | | | | | | | | | | | | | | |
| Out of Sight | | | | | | | | | | | | | | | | |
| Pacing | | | | | | | | | | | | | | | | |
| Running | | | | | | | | | | | | | | | | |
| Sitting | | | | | | | | | | | | | | | | |
| Standing | | | | | | | | | | | | | | | | |
| Walking | | | | | | | | | | | | | | | | |

**Behavioral Events - recorded continuously from the time of initial response**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach | | | | | | | | | | | | | | | | |
| Bite | | | | | | | | | | | | | | | | |
| Claw | | | | | | | | | | | | | | | | |
| Defecate | | | | | | | | | | | | | | | | |
| Flehmen | | | | | | | | | | | | | | | | |
| Groom self | | | | | | | | | | | | | | | | |
| Growl/hiss | | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lick | | | | | | | | | | | | | | | | |
| Meow/cry | | | | | | | | | | | | | | | | |
| Prusten | | | | | | | | | | | | | | | | |
| Retreat | | | | | | | | | | | | | | | | |
| Roll | | | | | | | | | | | | | | | | |
| Rub on object | | | | | | | | | | | | | | | | |
| Stare | | | | | | | | | | | | | | | | |
| Stare time | | | | | | | | | | | | | | | | |
| Swat | | | | | | | | | | | | | | | | |
| Sniff object | | | | | | | | | | | | | | | | |
| Urinate/scrape | | | | | | | | | | | | | | | | |

Comments:

APPENDIX III

Temperament assessment

| TEMPERAMENT ASSESSMENT | | |
|---|---|---|
| **Your Name___________________________** | **Animal Name _______________________ Date__________________** | |
| **Questions should be answered for the individuals when they are most active during the DAY<br>Place a hash mark i.e. ( - ) -------------I--------------------- ( + ) indicating the frequency of each behavior<br>( - ) being NEVER and ( + ) being ALWAYS** | | |
| ACTIVE | Moves frequently (i.e. patrols, runs stalks a lot) | ( - ) ____________________ ( + ) |
| Aggressive to CONSPECIFICS | Frequently reacts hostile (i.e. attacks, growls) at other clouded leopards | ( - ) ____________________ ( + ) |
| Aggressive to FAMILIAR people | Frequently reacts, strikes out or displays aggressive behavior or vocalizations to primary staff | ( - ) ____________________ ( + ) |
| Aggressive to STRANGERS | Frequently reacts, strikes out or displays aggressive behavior or vocalizations to primary staff | ( - ) ____________________ ( + ) |
| CALM | Not easily disturbed by changes in the environment | ( - ) ____________________ ( + ) |
| HIGH-STRUNG | Exhibits stereotypic or unusual behavior (i.e. excessive pacing, tailbiting, hiding etc.) | ( - ) ____________________ ( + ) |

| | | |
|---|---|---|
| INVESTIGATIVE | Readily approaches and explores changes in the environment | ( - ) ______________________________ ( + ) |
| Friendly to CONSPECIFICS | Social; initiates and seeks out close proximity to other clouded leopards | ( - ) ______________________________ ( + ) |
| Friendly to FAMILIAR people | Initiate proximity; approaches fence readily and in a friendly manner (i.e. prusten or chuffs, rubs on fence) to primary staff | ( - ) ______________________________ ( + ) |
| Friendly to STRANGERS | Initiate proximity; approaches fence readily and in a friendly manner (i.e. prusten or chuffs, rubs on fence) to strangers | ( - ) ______________________________ ( + ) |
| Fearful of CONSPECIFICS | Retreats and hides from other clouded leopards | ( - ) ______________________________ ( + ) |
| Fearful of FAMILIAR people | Retreats and hides from primary staff | ( - ) ______________________________ ( + ) |
| Fearful of STRANGERS | Retreats and hides from strangers (may hide or freeze if they are in the area) | ( - ) ______________________________ ( + ) |
| FOOD AGGRESSIVE | Animal becomes aggressive when food is present (i.e. may jump up, bite or claw at mesh, growl of hiss) | ( - ) ______________________________ ( + ) |
| INSECURE | Seems scared easily; "jumpy" and fearful in general (i.e. may hide or not eat when a change occurs) | ( - ) ______________________________ ( + ) |

| | | |
|---|---|---|
| PLAYFUL | Initiates and engages in play behavior (seemingly meaningless, but nonaggressive behavior with objects and/or other clouded leopards | ( - ) ______________________________ ( + ) |
| CONFIDENT | Moves in a seemingly well-coordinated and relaxed manner (enters areas that have been changed with little hesitation) | ( - ) ______________________________ ( + ) |
| SMART | Readily observes surroundings and appears to associate and even anticipate certain events regardless of the time that has passed since the last occurance | ( - ) ______________________________ ( + ) |
| TENSE | Shows restraint in movement and posture | ( - ) ______________________________ ( + ) |
| VOCAL | Frequently and readily vocalizes to humans or conspecifics | ( - ) ______________________________ ( + ) |

**COMMENTS:**

| |
|---|
| |
| |
| |

APPENDIX IV

Keeper Survey

**STUDY: Behavioral assessment of the clouded leopard (*Neofelis nebulosa*); a comparative analysis of reproductive success.**

**Please take your time to answer the following questions to the best of your ability. If you need clarification on any of the questions please do not hesitate to contact researcher at fazioj@si.edu.**

Your Name:________________________ Date:____________________

Your Position:______________________

Facility:_________________________

***The following questions relate only to the study animal. A separate sheet should be filled out for each individual animal.***

**Each answer will depend on your experience with the individual animal there are no right or wrong answers.**

Study animal name:___________________Studbook #_________Facility ID#:_________

**HISTORY:**

How many years have you worked with this individual animal? ______

| | | |
|---|---|---|
| Intact | Y | N |
| Hand-reared | Y | N |
| Mother-reared | Y | N |
| Partially mother/hand-reared | Y | N |
| Ever successfully paired | Y | N |
| Currently paired | Y | N |
| Hand-reared with its mate | Y | N |
| Sired young | Y | N |
| Killed or injured a mate | Y | N |
| Been injured by mate | Y | N |

Total number of individuals attempted to pair_____________

**Please list all pairing attempts, for each instance please list the age of both leopards (from the categories provided) as well as the following information**

Age: *0-3 months* *4-7 months* *8-12 months* *13-16 months* *Mature adult*

Rearing: mother hand co-reared

Successful: Y N

If they injured or killed the mate

| Individual's age | Other Leopard | Other's Age | Other's Rearing | Successful | Injured/Killed |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**MANAGEMENT:**

Enclosure size (specifically indicating height animals have access too)

Indoor ____________________ Outdoor__________________

How busy is your holding area while cats are locked inside or have access to their exhibit?

1-quiet (1-2 people once or twice a day)
2-moderately active (1-2 people several times a day)
3- active (several people in and out but all primary keepers)
4-moderately busy (several people in and out including strangers)
5- busy (multitudes of people in and out)

How many primary keepers are there?

1- One
2- Two
3- Three
4- Four
5-More than four

Please list the components of the primary diet and how often they are fed.

___________________________________________________________________________

How many fast days?
0 1 2 3

How is the individual housed?
1 - Single cat
2 - Paired opposite sex
3 - Paired with same sex
4 - Multiple mixed sex
5 - Multiple same sex

How often do they have access outside?
1- 24 hr access
2- During the day only
3- During the night only
4- Depends on the day
5- No outside access available

Do they have visual access to other animals? (if conspecific please note sex)

On exhibit Y N

List species___________________________________________

In holding Y N

List species___________________________________________

Are there any other animals housed in their holding building or exhibit area that they do not have visual access too?
Y N List species___________________________________________

ENRICHMENT AND TRAINING

Are these animals part of a formal training program? Y N

In a one month period, how many days do you formally train this individual? (Circle one)

0 1 2 3 4 5 6 7 8 9 10 1 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

If less than one day a month, have you ever trained? Y N

Are these animals part of a formal enrichment program? Y N

In one month period, how many days do you enrich your cats (other than training)? (Circle one)

0 1 2 3 4 5 6 7 8 9 10 1 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

If less than one day a month, have you ever? Y N

In a one month period, how often are cologne/perfume scents used as enrichment? (Circle one)

0 1 2 3 4 5 6 7 8 9 10 1 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

If less than one day a month, have you ever? Y N

In a one month period, how often do you utilize other species scent as enrichment? For example hay from a prey species.

0 1 2 3 4 5 6 7 8 9 10 1 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

If less than one day a month, have you ever? Y N

List common species used______________________________________

In a one month period, how often do you utilize conspecific scent as enrichment? (Circle one)

0 1 2 3 4 5 6 7 8 9 10 1 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

If less than one day a month, have you ever? Y N

Have you ever used a mirror with this animal? Y N
Any response?__________________________

Have you ever used large paper bags/boxes with this animal? Y N
Any response?__________________________

APPENDIX V

Spearman Rank-Order Correlation to determine
Inter-Observer Reliability on Temperament Assessment

**A5-1 Temperament characteristics that are stricken through were not used in final analysis.**

| Temperament Characteristic | Correlations | **CRC Raters** | | | **KKOZ Raters** | | |
|---|---|---|---|---|---|---|---|
| | | active1 | active2 | active3 | active1 | active2 | ~~active3~~ |
| active1 | Correlation Coefficient | 1 | **.851(**)** | **.608(**)** | 1 | **.582(**)** | .298(**) |
| | Sig. (1-tailed) | . | 0 | 0 | . | 0 | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| active2 | Correlation Coefficient | **.851(**)** | 1 | **.864(**)** | **.582(**)** | 1 | .422(**) |
| | Sig. (1-tailed) | 0 | . | 0 | 0 | . | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| active3 | Correlation Coefficient | **.608(**)** | **.864(**)** | 1 | .298(**) | .422(**) | 1 |
| | Sig. (1-tailed) | 0 | 0 | . | 0 | 0 | . |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| | | aggcon1 | aggcon2 | ~~aggcon3~~ | ~~aggcon1~~ | ~~aggcon2~~ | ~~aggcon3~~ |
| aggcon1 | Correlation Coefficient | 1 | **.699(**)** | .309(**) | 1 | -.198(**) | 0.014 |
| | Sig. (1-tailed) | . | 0 | 0 | . | 0 | 0.327 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| aggcon2 | Correlation Coefficient | **.699(**)** | 1 | -.182(**) | -.198(**) | 1 | .101(**) |
| | Sig. (1-tailed) | 0 | . | 0.001 | 0 | . | 0.001 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| aggcon3 | Correlation Coefficient | .309(**) | -.182(**) | 1 | 0.014 | .101(**) | 1 |
| | Sig. (1-tailed) | 0 | 0.001 | . | 0.327 | 0.001 | . |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| | | aggfam1 | aggfam2 | aggfam3 | aggfam1 | aggfam2 | ~~aggfam3~~ |
| aggfam1 | Correlation Coefficient | 1 | **.783(**)** | **.624(**)** | 1 | **.505(**)** | .062(*) |
| | Sig. (1-tailed) | . | 0 | 0 | . | 0 | 0.023 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| aggfam2 | Correlation Coefficient | **.783(**)** | 1 | **.909(**)** | **.505(**)** | 1 | .096(**) |
| | Sig. (1-tailed) | 0 | . | 0 | 0 | . | 0.001 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |

| Temperament Characteristic | Correlations | **CRC Raters** | | | **KKOZ Raters** | | |
|---|---|---|---|---|---|---|---|
| aggfam3 | Correlation Coefficient | **.624(**)** | **.909(**)** | 1 | .062(*) | .096(**) | 1 |
| | Sig. (1-tailed) | 0 | 0 | . | 0.023 | 0.001 | . |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| | | aggstran1 | ~~aggstran2~~ | aggstran3 | ~~aggstran1~~ | ~~aggstran2~~ | ~~aggstran3~~ |
| aggstran1 | Correlation Coefficient | 1 | .394(**) | **.905(**)** | 1 | .221(**) | .223(**) |
| | Sig. (1-tailed) | . | 0 | 0 | . | 0 | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| aggstran2 | Correlation Coefficient | .394(**) | 1 | **.586(**)** | .221(**) | 1 | 0.045 |
| | Sig. (1-tailed) | 0 | . | 0 | 0 | . | 0.075 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| aggstran3 | Correlation Coefficient | **.905(**)** | **.586(**)** | 1 | .223(**) | 0.045 | 1 |
| | Sig. (1-tailed) | 0 | 0 | . | 0 | 0.075 | . |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| | | AGTOTAL1 | ~~AGTOTAL2~~ | AGTOTAL3 | AGTOTAL1 | AGTOTAL2 | AGTOTAL3 |
| AGTOTAL1 | Correlation Coefficient | 1 | -.261(**) | **.624(**)** | 1 | **.517(**)** | **.544(**)** |
| | Sig. (1-tailed) | . | 0 | 0 | . | 0 | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| AGTOTAL2 | Correlation Coefficient | -.261(**) | 1 | -0.032 | **.517(**)** | 1 | -0.048 |
| | Sig. (1-tailed) | 0 | . | 0.564 | 0 | . | 0.124 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| AGTOTAL3 | Correlation Coefficient | **.624(**)** | -0.032 | 1 | **.544(**)** | -0.048 | 1 |
| | Sig. (1-tailed) | 0 | 0.564 | . | 0 | 0.124 | . |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| | | calm1 | calm2 | calm3 | ~~calm1~~ | calm2 | calm3 |
| calm1 | Correlation Coefficient | 1 | **.945(**)** | **.851(**)** | 1 | 0.055 | -.194(**) |
| | Sig. (1-tailed) | . | 0 | 0 | . | 0.074 | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| calm2 | Correlation Coefficient | **.945(**)** | 1 | **.957(**)** | 0.055 | 1 | **.594(**)** |
| | Sig. (1-tailed) | 0 | . | 0 | 0.074 | . | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| calm3 | Correlation Coefficient | **.851(**)** | **.957(**)** | 1 | -.194(**) | **.594(**)** | 1 |
| | Sig. (1-tailed) | 0 | 0 | . | 0 | 0 | . |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |

| Temperament Characteristic | Correlations | **CRC Raters** | | | **KKOZ Raters** | | |
|---|---|---|---|---|---|---|---|
| | | confident1 | confident2 | confident3 | confident1 | confident2 | confident3 |
| confident1 | Correlation Coefficient | 1 | **.976(**)** | **.595(**)** | 1 | **.596(**)** | **.620(**)** |
| | Sig. (1-tailed) | . | 0 | 0 | . | 0 | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| confident2 | Correlation Coefficient | **.976(**)** | 1 | **.600(**)** | **.596(**)** | 1 | .383(**) |
| | Sig. (1-tailed) | 0 | . | 0 | 0 | . | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| confident3 | Correlation Coefficient | **.595(**)** | **.600(**)** | 1 | **.620(**)** | .383(**) | 1 |
| | Sig. (1-tailed) | 0 | 0 | . | 0 | 0 | . |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| | | fearcon1 | ~~fearcon2~~ | fearcon3 | fearcon1 | ~~fearcon2~~ | fearcon3 |
| fearcon1 | Correlation Coefficient | 1 | -.542(**) | **.578(**)** | 1 | 0.033 | **.633(**)** |
| | Sig. (1-tailed) | . | 0 | 0 | . | 0.288 | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| fearcon2 | Correlation Coefficient | -.542(**) | 1 | -.855(**) | 0.033 | 1 | **.525(**)** |
| | Sig. (1-tailed) | 0 | . | 0 | 0.288 | . | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| fearcon3 | Correlation Coefficient | **.578(**)** | -.855(**) | 1 | **.633(**)** | **.525(**)** | 1 |
| | Sig. (1-tailed) | 0 | 0 | . | 0 | 0 | . |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| | | ~~fearfam1~~ | fearfam2 | fearfam3 | fearfam1 | ~~fearfam2~~ | fearfam3 |
| fearfam1 | Correlation Coefficient | 1 | .178(**) | 0.025 | 1 | -0.03 | **.649(**)** |
| | Sig. (1-tailed) | . | 0.001 | 0.655 | . | 0.164 | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| fearfam2 | Correlation Coefficient | .178(**) | 1 | **.587(**)** | -0.03 | 1 | .226(**) |
| | Sig. (1-tailed) | 0.001 | . | 0 | 0.164 | . | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| fearfam3 | Correlation Coefficient | 0.025 | **.587(**)** | 1 | **.649(**)** | .226(**) | 1 |
| | Sig. (1-tailed) | 0.655 | 0 | . | 0 | 0 | . |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| | | ~~fearstran1~~ | ~~fearstran2~~ | ~~fearstran3~~ | ~~fearstran1~~ | ~~fearstran2~~ | ~~fearstran3~~ |
| fearstran1 | Correlation Coefficient | 1 | -.284(**) | .485(**) | 1 | -.246(**) | -.168(**) |
| | Sig. (1-tailed) | . | 0 | 0 | . | 0 | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| fearstran2 | Correlation Coefficient | -.284(**) | 1 | 0.016 | -.246(**) | 1 | .121(**) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Sig. (1-tailed) | 0 | . | 0.778 | 0 | . | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| | | ~~fearstran1~~ | ~~fearstran2~~ | ~~fearstran3~~ | ~~fearstran1~~ | ~~fearstran2~~ | ~~fearstran3~~ |
| fearstran3 | Correlation Coefficient | .485(**) | 0.016 | 1 | -.168(**) | .121(**) | 1 |
| | Sig. (1-tailed) | 0 | 0.778 | . | 0 | 0 | . |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| | | FEAR TOTAL1 | ~~FEAR TOTAL2~~ | FEAR TOTAL3 | ~~FEAR TOTAL1~~ | ~~FEAR TOTAL2~~ | ~~FEAR TOTAL3~~ |
| FEAR TOTAL1 | Correlation Coefficient | 1 | -.239(**) | **.652(**)** | 1 | -.481(**) | .313(**) |
| | Sig. (1-tailed) | . | 0 | 0 | . | 0 | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| FEAR TOTAL2 | Correlation Coefficient | -.239(**) | 1 | .378(**) | -.481(**) | 1 | .433(**) |
| | Sig. (1-tailed) | 0 | . | 0 | 0 | . | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| FEAR TOTAL3 | Correlation Coefficient | **.652(**)** | .378(**) | 1 | .313(**) | .433(**) | 1 |
| | Sig. (1-tailed) | 0 | 0 | . | 0 | 0 | . |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| | | foodagg1 | foodagg2 | foodagg3 | foodagg1 | foodagg2 | ~~foodagg3~~ |
| foodagg1 | Correlation Coefficient | 1 | **.622(**)** | **.687(**)** | 1 | **.761(**)** | .467(**) |
| | Sig. (1-tailed) | . | 0 | 0 | . | 0 | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| foodagg2 | Correlation Coefficient | **.622(**)** | 1 | **.973(**)** | **.761(**)** | 1 | .098(**) |
| | Sig. (1-tailed) | 0 | . | 0 | 0 | . | 0.001 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| foodagg3 | Correlation Coefficient | **.687(**)** | **.973(**)** | 1 | .467(**) | .098(**) | 1 |
| | Sig. (1-tailed) | 0 | 0 | . | 0 | 0.001 | . |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| | | highstrung1 | highstrung2 | ~~highstrung3~~ | highstrung1 | ~~highstrung2~~ | highstrung3 |
| highstrung1 | Correlation Coefficient | 1 | **.928(**)** | **.694(**)** | 1 | .425(**) | **.746(**)** |
| | Sig. (1-tailed) | . | 0 | 0 | . | 0 | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| highstrung2 | Correlation Coefficient | **.928(**)** | 1 | .461(**) | .425(**) | 1 | **.563(**)** |
| | Sig. (1-tailed) | 0 | . | 0 | 0 | . | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| highstrung3 | Correlation Coefficient | **.694(**)** | .461(**) | 1 | **.746(**)** | **.563(**)** | 1 |
| | Sig. (1-tailed) | 0 | 0 | . | 0 | 0 | . |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |

| Temperament Characteristic | Correlations | **CRC Raters** | | | **KKOZ Raters** | | |
|---|---|---|---|---|---|---|---|
| | | Friendly con1 | ~~Friendly con2~~ | Friendly con3 | ~~Friendly con1~~ | ~~Friendly con2~~ | ~~Friendly con3~~ |
| friendlycon1 | Correlation Coefficient | 1 | .417(**) | **.996(**)** | 1 | .120(**) | .482(**) |
| | Sig. (1-tailed) | . | 0 | 0 | . | 0 | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| friendlycon2 | Correlation Coefficient | .417(**) | 1 | .414(**) | .120(**) | 1 | .406(**) |
| | Sig. (1-tailed) | 0 | . | 0 | 0 | . | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| friendlycon3 | Correlation Coefficient | **.996(**)** | .414(**) | 1 | .482(**) | .406(**) | 1 |
| | Sig. (1-tailed) | 0 | 0 | . | 0 | 0 | . |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| | | friendlyfam1 | friendlyfam2 | friendlyfam3 | friendlyfam1 | friendlyfam2 | ~~friendlyfam3~~ |
| friendlyfam1 | Correlation Coefficient | 1 | **.644(**)** | **.784(**)** | 1 | **.534(**)** | **.530(**)** |
| | Sig. (1-tailed) | . | 0 | 0 | . | 0 | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| friendlyfam2 | Correlation Coefficient | **.644(**)** | 1 | **.855(**)** | **.534(**)** | 1 | .329(**) |
| | Sig. (1-tailed) | 0 | . | 0 | 0 | . | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| friendlyfam3 | Correlation Coefficient | **.784(**)** | **.855(**)** | 1 | **.530(**)** | .329(**) | 1 |
| | Sig. (1-tailed) | 0 | 0 | . | 0 | 0 | . |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| | | Friendly stranger1 | ~~Friendly stranger2~~ | Friendly stranger3 | Friendly stranger1 | ~~Friendly stranger2~~ | Friendly stranger3 |
| Friendly Stranger1 | Correlation Coefficient | 1 | .456(**) | **.910(**)** | 1 | **.623(**)** | **.754(**)** |
| | Sig. (1-tailed) | . | 0 | 0 | . | 0 | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| Friendly Stranger2 | Correlation Coefficient | .456(**) | 1 | .450(**) | **.623(**)** | 1 | .355(**) |
| | Sig. (1-tailed) | 0 | . | 0 | 0 | . | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| Friendly Stranger3 | Correlation Coefficient | **.910(**)** | .450(**) | 1 | **.754(**)** | .355(**) | 1 |
| | Sig. (1-tailed) | 0 | 0 | . | 0 | 0 | . |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| | | FRIEND TOTAL1 | FRIEND TOTAL2 | FRIEND TOTAL3 | FRIEND TOTAL1 | ~~FRIEND TOTAL2~~ | FRIEND TOTAL3 |
| FRIENDLY TOTAL1 | Correlation Coefficient | 1 | .664(**) | .838(**) | 1 | .406(**) | **.688(**)** |
| | Sig. (1-tailed) | . | 0 | 0 | . | 0 | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |

| Temperament Characteristic | Correlations | **CRC Raters** | | | **KKOZ Raters** | | |
|---|---|---|---|---|---|---|---|
| FRIENDLY TOTAL2 | Correlation Coefficient | .664(**) | 1 | .821(**) | .406(**) | 1 | .344(**) |
| | Sig. (1-tailed) | 0 | . | 0 | 0 | . | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| FRIENDLY TOTAL3 | Correlation Coefficient | .838(**) | .821(**) | 1 | **.688(**)** | .344(**) | 1 |
| | Sig. (1-tailed) | 0 | 0 | . | 0 | 0 | . |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| | | insecure1 | insecure2 | insecure3 | insecure1 | insecure2 | ~~insecure3~~ |
| insecure1 | Correlation Coefficient | 1 | **.601(**)** | **.959(**)** | 1 | **.691(**)** | .402(**) |
| | Sig. (1-tailed) | . | 0 | 0 | . | 0 | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| insecure2 | Correlation Coefficient | **.601(**)** | 1 | **.575(**)** | **.691(**)** | 1 | .264(**) |
| | Sig. (1-tailed) | 0 | . | 0 | 0 | . | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| insecure3 | Correlation Coefficient | **.959(**)** | **.575(**)** | 1 | .402(**) | .264(**) | 1 |
| | Sig. (1-tailed) | 0 | 0 | . | 0 | 0 | . |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| | | invest1 | invest2 | invest3 | ~~invest1~~ | ~~invest2~~ | ~~invest3~~ |
| invest1 | Correlation Coefficient | 1 | **.970(**)** | **.952(**)** | 1 | -.133(**) | .070(*) |
| | Sig. (1-tailed) | . | 0 | 0 | . | 0 | 0.023 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| invest2 | Correlation Coefficient | **.970(**)** | 1 | **.991(**)** | -.133(**) | 1 | .452(**) |
| | Sig. (1-tailed) | 0 | . | 0 | 0 | . | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| invest3 | Correlation Coefficient | **.952(**)** | **.991(**)** | 1 | .070(*) | .452(**) | 1 |
| | Sig. (1-tailed) | 0 | 0 | . | 0.023 | 0 | . |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| | | playful1 | playful2 | playful3 | playful1 | ~~playful2~~ | playful3 |
| playful1 | Correlation Coefficient | 1 | **.801(**)** | **.935(**)** | 1 | **.680(**)** | **.699(**)** |
| | Sig. (1-tailed) | . | 0 | 0 | . | 0 | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| playful2 | Correlation Coefficient | **.801(**)** | 1 | **.781(**)** | **.680(**)** | 1 | .432(**) |
| | Sig. (1-tailed) | 0 | . | 0 | 0 | . | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |

| Temperament Characteristic | Correlations | **CRC Raters** | | | **KKOZ Raters** | | |
|---|---|---|---|---|---|---|---|
| | | playful1 | playful2 | playful3 | playful1 | ~~playful2~~ | playful3 |
| playful3 | Correlation Coefficient | **.935(**)** | **.781(**)** | 1 | **.699(**)** | .432(**) | 1 |
| | Sig. (1-tailed) | 0 | 0 | . | 0 | 0 | . |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| | | smart1 | smart2 | ~~smart3~~ | smart1 | smart2 | ~~smart3~~ |
| smart1 | Correlation Coefficient | 1 | **.702(**)** | **.564(**)** | 1 | **.530(**)** | .273(**) |
| | Sig. (1-tailed) | . | 0 | 0 | . | 0 | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| smart2 | Correlation Coefficient | **.702(**)** | 1 | .211(**) | **.530(**)** | 1 | .205(**) |
| | Sig. (1-tailed) | 0 | . | 0 | 0 | . | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| smart3 | Correlation Coefficient | **.564(**)** | .211(**) | 1 | .273(**) | .205(**) | 1 |
| | Sig. (1-tailed) | 0 | 0 | . | 0 | 0 | . |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| | | tense1 | tense2 | tense3 | ~~tense1~~ | ~~tense2~~ | ~~tense3~~ |
| tense1 | Correlation Coefficient | 1 | **.872(**)** | **.957(**)** | 1 | .431(**) | .437(**) |
| | Sig. (1-tailed) | . | 0 | 0 | . | 0 | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| tense2 | Correlation Coefficient | **.872(**)** | 1 | **.883(**)** | .431(**) | 1 | .387(**) |
| | Sig. (1-tailed) | 0 | . | 0 | 0 | . | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| tense3 | Correlation Coefficient | **.957(**)** | **.883(**)** | 1 | .437(**) | .387(**) | 1 |
| | Sig. (1-tailed) | 0 | 0 | . | 0 | 0 | . |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| | | vocal1 | vocal2 | vocal3 | vocal1 | vocal2 | ~~vocal3~~ |
| vocal1 | Correlation Coefficient | 1 | **.986(**)** | **.762(**)** | 1 | **.816(**)** | .366(**) |
| | Sig. (1-tailed) | . | 0 | 0 | . | 0 | 0 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| vocal2 | Correlation Coefficient | **.986(**)** | 1 | **.812(**)** | **.816(**)** | 1 | .088(**) |
| | Sig. (1-tailed) | 0 | . | 0 | 0 | . | 0.002 |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |
| vocal3 | Correlation Coefficient | **.762(**)** | **.812(**)** | 1 | .366(**) | .088(**) | 1 |
| | Sig. (1-tailed) | 0 | 0 | . | 0 | 0.002 | . |
| | N | 332 | 332 | 332 | 1043 | 1043 | 1043 |

APPENDIX VI
Hypotheses

Hypothesis 1: Clouded leopards have quantifiable temperaments.

**A6-1: Individual clouded leopard score averages on Temperament Assessment after Spearman-rank order correlation, used for analysis in PCA.**

| CLOUDED LEOPARD | ACTIVE | AGGRESSIVE Total | CALM | HIGH-STRUNG | FRIENDLY Total | FEARFUL of CONSPECIFICS | FEARFUL of FAMILIAR people | FOOD AGGRESSIVE | INSECURE | PLAYFUL | CONFIDENT | SMART | VOCAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Noname | 109 | 11 | 73 | 43 | 109 | 4 | 4 | 107 | 72 | 49 | 108 | 107 | 115 |
| Songkla | 26 | 78 | 79 | 18 | 32 | 60 | 37 | 118 | 6 | 17 | 106 | 83 | 39 |
| Wanchai | 90 | 6 | 104 | 5 | 105 | 6 | 7 | 113 | 5 | 50 | 110 | 108 | 118 |
| Sakda | 91 | 25 | 23 | 40 | 73 | 40 | 49 | 25 | 46 | 24 | 44 | 68 | 98 |
| Mei | 69 | 88 | 8 | 96 | 28 | 63 | 73 | 69 | 99 | 9 | 48 | 107 | 32 |
| Thap-thim | 111 | 33 | 61 | 38 | 87 | 62 | 14 | 88 | 64 | 95 | 96 | 105 | 117 |
| Manow | 117 | 18 | 39 | 118 | 94 | 14 | 98 | 53 | 34 | 102 | 112 | 112 | 119 |
| Pukluk | 28 | 78 | 60 | 42 | 48 | 73 | 86 | 41 | 42 | 49 | 79 | 84 | 70 |
| Gaint | 86 | 55 | 50 | 45 | 79 | 46 | 106 | 3 | 25 | 106 | 103 | 101 | 116 |
| Mesa | 88 | 44 | 80 | 21 | 82 | 26 | 32 | 5 | 31 | 34 | 57 | 93 | 118 |
| Somsri | 1 | 106 | 2 | 62 | 2 | 108 | 119 | 2 | 120 | 1 | 1 | 59 | 1 |
| Nok | 89 | 33 | 34 | 97 | 68 | 67 | 76 | 18 | 68 | 30 | 48 | 90 | 107 |
| Mini | 34 | 67 | 79 | 2 | 48 | 7 | 58 | 70 | 46 | 49 | 104 | 115 | 40 |
| Numfun | 19 | 90 | 59 | 23 | 41 | 3 | 73 | 87 | 57 | 6 | 71 | 93 | 26 |
| Junior | 100 | 72 | 91 | 12 | 20 | 90 | 11 | 107 | 15 | 65 | 109 | 113 | 33 |
| Xing | 42 | 87 | 27 | 65 | 18 | 45 | 33 | 114 | 74 | 29 | 51 | 96 | 4 |
| Brandon | 51 | 42 | 48 | 43 | 25 | 15 | 49 | 30 | 102 | 55 | 44 | 84 | 61 |
| Dao | 30 | 70 | 14 | 32 | 23 | 35 | 77 | 106 | 70 | 11 | 23 | 80 | 16 |
| Zoe | 27 | 59 | 15 | 101 | 58 | 60 | 59 | 81 | 101 | 13 | 15 | 73 | 86 |
| Jasmine | 22 | 73 | 33 | 118 | 5 | 66 | 52 | 95 | 83 | 20 | 14 | 60 | 12 |
| Nattie | 51 | 88 | 10 | 89 | 9 | 39 | 68 | 102 | 73 | 24 | 32 | 81 | 9 |
| Thistle | 8 | 19 | 29 | 112 | 5 | 40 | 109 | 6 | 97 | 5 | 9 | 92 | 4 |
| Nellie | 35 | 6 | 21 | 74 | 24 | 19 | 76 | 5 | 87 | 49 | 32 | 93 | 18 |
| Jogayle | 107 | 13 | 102 | 8 | 89 | 31 | 10 | 73 | 8 | 108 | 108 | 104 | 111 |

**A6-2: R-Type Principle Component Analysis – Total variance from resulting components**

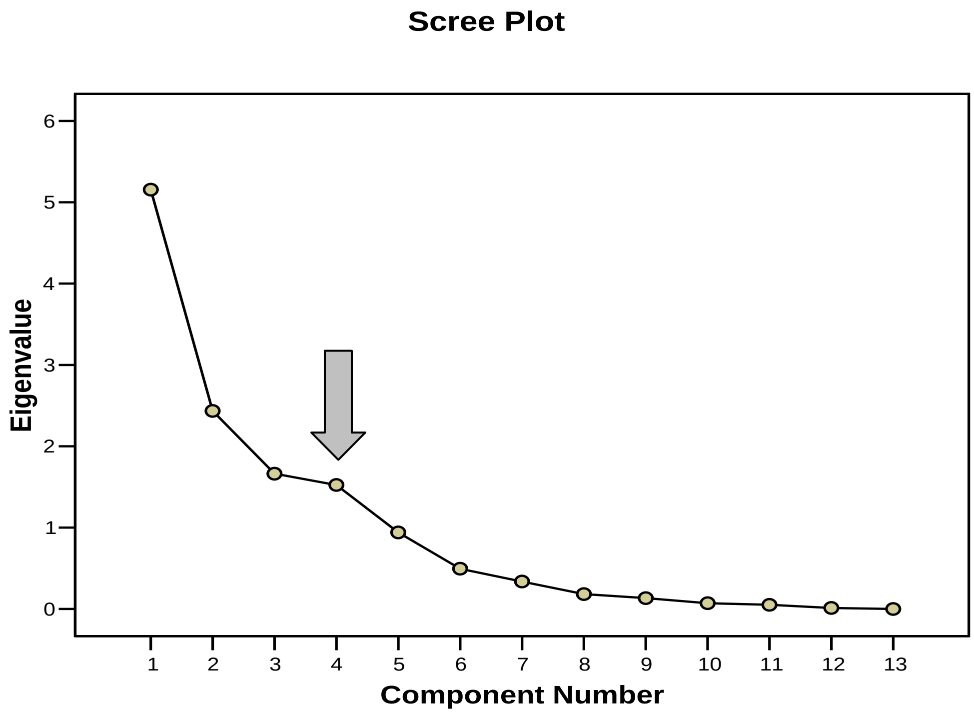
| Total Variance Explained | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | | Rotation Sums of Squared Loadings | | |
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 5 | 39.654 | 39.654 | 5.155 | 39.654 | 39.654 | 3.053 | 23.488 | 23.488 |
| 2 | 2 | 18.727 | 58.381 | 2.435 | 18.727 | 58.381 | 2.722 | 20.937 | 44.425 |
| 3 | 2 | 12.793 | 71.174 | 1.663 | 12.793 | 71.174 | 2.692 | 20.707 | 65.132 |
| 4 | 2 | 11.725 | 82.899 | 1.524 | 11.725 | 82.899 | 2.31 | 17.768 | 82.899 |
| 5 | 1 | 7.237 | 90.136 | | | | | | |
| 6 | 0 | 3.805 | 93.941 | | | | | | |
| 7 | 0 | 2.594 | 96.536 | | | | | | |
| 8 | 0 | 1.404 | 97.94 | | | | | | |
| 9 | 0 | 1.026 | 98.966 | | | | | | |
| 10 | 0 | 0.544 | 99.51 | | | | | | |
| 11 | 0 | 0.393 | 99.903 | | | | | | |
| 12 | 0 | 0.097 | 100 | | | | | | |
| 13 | 0 | 0 | 100 | | | | | | |
| Extraction Method: Principal Component Analysis. | | | | | | | | | |

**A6-3: Communalities**

| | Initial | Extraction |
|---|---|---|
| ACTIVE | 1.000 | .689 |
| AGGTOTAL | 1.000 | .902 |
| CALM | 1.000 | .898 |
| CONFIDENT | 1.000 | .768 |
| FEARCON | 1.000 | .513 |
| FEARFAM | 1.000 | .863 |
| FOODAG | 1.000 | .816 |
| HIGHS | 1.000 | .836 |
| INSECURE | 1.000 | .938 |
| PLAYFUL | 1.000 | .938 |
| SMART | 1.000 | .901 |
| VOCAL | 1.000 | .814 |
| FRIENDTOTAL | 1.000 | .898 |

Extraction Method: Principal Component Analysis.

**A6-4: Scree Plot - 4 factors were extracted which should be expected since there were less than 30 variables and communalities are greater than 0.7**




**A6-5: Rotated Component Matrix – Four major components of individual temperament derived from combined keeper rated temperament assessments from 24 clouded leopards.**

| | Component | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| ACTIVE | -.079 | ***.588** | ***-.579** | -.041 |
| AGGRESSIVETOTAL | .095 | -.160 | ***.931** | -.034 |
| CALM | ***-.690** | .238 | -.172 | ***.580** |
| CONFIDENT | -.315 | ***.754** | -.246 | -.201 |
| FEARCON | -.017 | .075 | ***.703** | -.113 |
| FEARFAM | .195 | .039 | .223 | ***-.880** |
| FOODAG | .104 | .319 | .166 | *.822 |
| HIGHS | ***.694** | .176 | .021 | ***-.568** |
| INSECURE | ***.930** | -.261 | .076 | .017 |
| PLAYFUL | ***.930** | -.261 | .076 | .017 |
| SMART | ***-.419** | ***.794** | -.170 | .257 |
| VOCAL | -.036 | ***.859** | .006 | .275 |
| FRIENDLYTOTAL | -.163 | .286 | ***-.887** | -.046 |

***eigenvalues ≥ 0.4**

Hypothesis 2: Reproductively successful clouded leopards have significantly different temperaments.

**A6-6: Logistical Regression using factor scores for each cat and comparing RS and RUS clouded leopards**

| | | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|---|
| Step 0 | Constant | | -1.306 | .066 | 393.496 | 1 | .000 | .271 |

| | | | Score | df | Sig. |
|---|---|---|---|---|---|
| Step 0 | Variables | FAC1_4 | 2.675 | 1 | .102 |
| | | FAC2_4 | 1.999 | 1 | .157 |
| | | FAC3_4 | 66.441 | 1 | ***.000** |
| | | FAC4_4 | 490.467 | 1 | ***.000** |
| | Overall Statistics | | 561.581 | 4 | .000 |

**Logistical Regression using coded temperament scores for each cat and comparing RS and RUS clouded leopards**

| | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|
| Step 0 | Constant | -1.335 | .503 | 7.055 | 1 | ***.008** | .263 |

| | | | Score | df | Sig. |
|---|---|---|---|---|---|
| Step 0 | Variables | TEMP | 6.215 | 1 | ***.013** |
| | Overall Statistics | | 6.215 | 1 | .013 |

**A6-7: Mann Whitney U – Resulting Factor scores from PCA with dependant variable "reproductive success" to determine temperaments that are significantly reproductively successful**

| | Success | N | Mean Rank | Sum of Ranks | U Score | P Value |
|---|---|---|---|---|---|---|
| REGR factor score 1 for analysis 4 | RUS | 19 | 13.79 | 262.00 | 23 | 0.082 |
| | RS | 5 | 7.60 | 38.00 | | |
| | Total | 24 | | | | |
| REGR factor score 2 for analysis 4 | RUS | 19 | 12.00 | 228.00 | 38 | 0.499 |
| | RS | 5 | 14.40 | 72.00 | | |
| | Total | 24 | | | | |
| REGR factor score 3 for analysis 4 | RUS | 19 | 12.95 | 246.00 | 39 | 0.546 |
| | RS | 5 | 10.80 | 54.00 | | |
| | Total | 24 | | | | |
| REGR factor score 4 for analysis 4 | RUS | 19 | 10.37 | 197.00 | 7 | ***0.004** |
| | **RS** | **5** | **20.60** | 103.00 | | |
| | Total | 24 | | | | |

Hypothesis 3: Male and Female clouded leopards have significantly different temperaments.

**A6-8: Mann Whitney U – Resulting factor scores from PCA with dependant variable "sex"**

| | sex | N | Mean Rank | Sum of Ranks | U score | P value |
|---|---|---|---|---|---|---|
| REGR factor score 1 for analysis 4 | male | 9 | 11.67 | 105.00 | 60 | 0.655 |
| | female | 15 | 13.00 | 195.00 | | |
| | Total | 24 | | | | |
| REGR factor score 2 for analysis 4 | male | 9 | 12.89 | 116.00 | 64 | 0.835 |
| | female | 15 | 12.27 | 184.00 | | |
| | Total | 24 | | | | |
| REGR factor score 3 for analysis 4 | male | 9 | 12.78 | 115.00 | 65 | 0.881 |
| | female | 15 | 12.33 | 185.00 | | |
| | Total | 24 | | | | |
| REGR factor score 4 for analysis 4 | **male** | **9** | **17.44** | 157.00 | 23 | ***0.008** |
| | female | 15 | 9.53 | 143.00 | | |
| | Total | 24 | | | | |

* indicates p<0.05

Hypothesis 4: Mother-reared and hand-reared clouded leopards have significantly different temperaments.

**A6-9: Mann – Whitney U – Resulting Factor Scores from PCA with dependant variable "rearing"**

| | rearing | N | Mean Rank | Sum of Ranks | U Score | P Value |
|---|---|---|---|---|---|---|
| REGR factor score 1 for analysis 4 | mother-reared | 10 | 12.90 | 129.00 | 66 | 0.815 |
| | hand-reared | 14 | 12.21 | 171.00 | | |
| | Total | 24 | | | | |
| REGR factor score 2 for analysis 4 | mother-reared | 10 | 12.10 | 121.00 | 66 | 0.815 |
| | hand-reared | 14 | 12.79 | 179.00 | | |
| | Total | 24 | | | | |
| REGR factor score 3 for analysis 4 | **mother-reared** | **10** | **16.00** | 160.00 | 35 | ***0.040** |
| | hand-reared | 14 | 10.00 | 140.00 | | |
| | Total | 24 | | | | |
| REGR factor score 4 for analysis 4 | mother-reared | 10 | 9.70 | 97.00 | 42 | 0.101 |
| | hand-reared | 14 | 14.50 | 203.00 | | |
| | Total | 24 | | | | |

Hypothesis 5: Clouded leopards housed at different facilities have significantly different temperaments.

**A6- 10: Mann Whitney U – Resulting factor scores from PCA with dependant variable "facility"**

| | facility | N | Mean Rank | Sum of Ranks | U Score | P Value |
|---|---|---|---|---|---|---|
| REGR factor score 1 for analysis 4 | kkoz | 14 | 10.50 | 147.00 | 42 | 0.101 |
| | crc | 10 | 15.30 | 153.00 | | |
| | Total | 24 | | | | |
| REGR factor score 2 for analysis 4 | kkoz | 14 | 14.14 | 198.00 | 47 | 0.178 |
| | crc | 10 | 10.20 | 102.00 | | |
| | Total | 24 | | | | |
| REGR factor score 3 for analysis 4 | kkoz | 14 | 11.43 | 160.00 | 55 | 0.403 |
| | crc | 10 | 14.00 | 140.00 | | |
| | Total | 24 | | | | |
| REGR factor score 4 for analysis 4 | kkoz | 14 | 11.79 | 165.00 | 60 | 0.558 |
| | crc | 10 | 13.50 | 135.00 | | |
| | Total | 24 | | | | |

Hypothesis 6: The age of a clouded leopard significantly influences reproductive success.

**A6-11: Mann Whitney U – Reproductive success with "age" as dependant variable**

| Dependant Variable | Reproductive Success | N | Mean Rank | Sum of Ranks | U Score | P Value |
|---|---|---|---|---|---|---|
| age | RUS | 19 | 12.89 | 245.00 | 40 | 0.590 |
| | successful | 5 | 11.00 | 55.00 | | |
| | Total | 24 | | | | |

Hypothesis 7: The age of a clouded leopard significantly influences temperament.

**A6-12: Spearman's Rank – Order Correlation – Age versus Temperament.**

| | | Age | Factor Score 1 | Factor Score 2 | Factor Score 3 | Factor Score 4 |
|---|---|---|---|---|---|---|
| Age | Correlation Coefficient | 1 | 0.239 | -0.212 | 0.372 | -0.017 |
| | Sig. (2-tailed) | . | 0.261 | 0.32 | 0.074 | 0.937 |
| | N | 24 | 24 | 24 | 24 | 24 |
| * Correlation is significant at the 0.05 level (2-tailed). | | | | | | |

APPENDIX VII

Results of Keeper rated Temperament Assessments of 24 clouded leopards

**A7-1: Mean and Standard Deviations of Temperament Characteristics from keeper rated temperament assessments of 24 clouded leopards grouped by reproductive success.**

| | | ALL CATS | | MALE | | FEMALE | |
|---|---|---|---|---|---|---|---|
| **Temperament Characteristic** | **Success** | **Mean** | **StDev** | **Mean** | **StDev** | **Mean** | **StDev** |
| **ACTIVE** | RUS | 60.68 | 37.08 | 63.83 | 27.78 | 59.23 | 41.63 |
| | RS | 55.60 | 40.98 | 75.00 | 43.49 | 26.50 | 10.61 |
| **AGGRESSIVE** | RUS | 53.11 | 29.91 | 64.00 | 25.34 | 48.08 | 31.43 |
| | RS | 50.40 | 39.14 | 31.67 | 40.20 | 78.50 | 16.26 |
| **CALM** | RUS | 39.32 | 28.61 | 35.17 | 30.60 | 41.23 | 28.73 |
| | RS | 78.80 | 16.28 | 85.33 | 16.44 | 69.00 | 14.14 |
| **CONFIDENT** | RUS | 53.95 | 36.72 | 53.17 | 29.08 | 54.31 | 40.86 |
| | RS | 99.80 | 16.25 | 108.00 | 2.00 | 87.50 | 23.33 |
| **FEARCON** | RUS | 49.42 | 25.22 | 48.00 | 25.77 | 50.08 | 26.00 |
| | RS | 16.00 | 24.65 | 23.33 | 31.77 | 5.00 | 2.83 |
| **FEARFAM** | RUS | 63.00 | 33.18 | 48.67 | 24.74 | 69.62 | 35.30 |
| | RS | 35.80 | 30.49 | 16.00 | 18.25 | 65.50 | 10.61 |
| **FOODAG** | RUS | 53.84 | 41.41 | 75.17 | 40.17 | 44.00 | 39.59 |
| | RS | 99.00 | 20.04 | 112.67 | 5.51 | 78.50 | 12.02 |
| **FRIENDLY** | RUS | 44.05 | 32.84 | 31.17 | 20.80 | 50.00 | 36.28 |
| | RS | 67.00 | 36.98 | 82.00 | 43.35 | 44.50 | 4.95 |
| **HIGHSTRUNG** | RUS | 63.84 | 36.21 | 48.00 | 29.10 | 71.15 | 37.82 |
| | RS | 18.20 | 16.39 | 22.00 | 19.31 | 12.50 | 14.85 |
| **INSECURE** | RUS | 65.21 | 32.67 | 67.67 | 33.01 | 64.08 | 33.80 |
| | RS | 37.20 | 30.38 | 27.67 | 38.40 | 51.50 | 7.78 |
| **PLAYFUL** | RUS | 43.63 | 35.79 | 32.17 | 23.07 | 48.92 | 40.04 |
| | RS | 34.20 | 21.09 | 38.67 | 18.77 | 27.50 | 30.41 |
| **SMART** | RUS | 89.21 | 16.29 | 91.33 | 17.11 | 88.23 | 16.52 |
| | RS | 101.20 | 12.93 | 99.33 | 14.15 | 104.00 | 15.56 |
| **VOCAL** | RUS | 59.58 | 47.22 | 40.67 | 34.02 | 68.31 | 50.99 |
| | RS | 67.60 | 44.99 | 90.67 | 44.77 | 33.00 | 9.90 |

**A7-2: Mean and Standard Deviations of Temperament Characteristics from keeper rated temperament assessments of 24 clouded leopards grouped by rearing.**

| | | ALL CATS | | MALE | | FEMALE | |
|---|---|---|---|---|---|---|---|
| **Temperament Characteristic** | **Rearing** | **Mean** | **StDev** | **Mean** | **StDev** | **Mean** | **StDev** |
| **ACTIVE** | MR | 41.00 | 37.36 | 47.50 | 30.41 | 39.38 | 40.59 |
| | HR | 72.93 | 31.69 | 73.29 | 31.44 | 72.57 | 34.46 |
| **AGGRESSIVE** | MR | 67.20 | 29.09 | 83.00 | 7.07 | 63.25 | 31.49 |
| | HR | 42.07 | 29.04 | 44.71 | 32.15 | 39.43 | 27.87 |
| **CALM** | MR | 43.80 | 26.66 | 43.50 | 50.20 | 43.88 | 23.53 |
| | HR | 50.21 | 34.34 | 54.29 | 35.49 | 46.14 | 35.46 |
| **CONFIDENT** | MR | 64.70 | 43.73 | 77.00 | 41.01 | 61.63 | 46.52 |
| | HR | 62.64 | 35.53 | 69.86 | 37.61 | 55.43 | 34.64 |
| **FEARCON** | MR | 48.00 | 33.08 | 61.50 | 2.12 | 44.63 | 36.62 |
| | HR | 38.50 | 24.69 | 33.57 | 29.83 | 43.43 | 19.36 |
| **FEARFAM** | MR | 81.10 | 27.08 | 55.00 | 25.46 | 87.63 | 24.64 |
| | HR | 40.36 | 27.99 | 32.86 | 27.23 | 47.86 | 28.71 |
| **FOODAG** | MR | 54.40 | 40.99 | 93.50 | 34.65 | 44.63 | 37.99 |
| | HR | 69.57 | 43.03 | 86.00 | 40.11 | 53.14 | 42.12 |
| **FRIENDLY** | MR | 38.20 | 30.98 | 30.00 | 2.83 | 40.25 | 34.76 |
| | HR | 56.43 | 35.51 | 53.29 | 41.31 | 59.57 | 31.67 |
| **HIGHSTRUNG** | MR | 63.60 | 44.28 | 57.00 | 55.15 | 65.25 | 45.51 |
| | HR | 47.71 | 32.58 | 34.29 | 20.36 | 61.14 | 38.27 |
| **INSECURE** | MR | 60.90 | 37.05 | 52.50 | 65.76 | 63.00 | 33.50 |
| | HR | 58.29 | 32.36 | 54.86 | 34.80 | 61.71 | 32.10 |
| **PLAYFUL** | MR | 36.40 | 39.47 | 13.00 | 5.66 | 42.25 | 42.47 |
| | HR | 45.43 | 28.67 | 40.43 | 19.36 | 50.43 | 36.72 |
| **SMART** | MR | 90.60 | 19.65 | 95.00 | 16.97 | 89.50 | 21.17 |
| | HR | 92.50 | 13.92 | 93.71 | 16.84 | 91.29 | 11.53 |
| **VOCAL** | MR | 45.90 | 42.73 | 35.50 | 4.95 | 48.50 | 48.01 |
| | HR | 72.21 | 46.42 | 63.57 | 47.51 | 80.86 | 47.29 |

**A7-3: Mean and Standard Deviations of Temperament Characteristics from keeper rated temperament assessments of 24 clouded leopards grouped by rearing.**

| | | ALL CATS | | MALE | | FEMALE | |
|---|---|---|---|---|---|---|---|
| **Temperament Characteristic** | **Facility** | **Mean** | **StDev** | **Mean** | **StDev** | **Mean** | **StDev** |
| **ACTIVE** | CRC | 47.30 | 32.39 | 55.75 | 30.73 | 41.67 | 35.03 |
| | KKOZ | 68.43 | 38.75 | 77.00 | 31.84 | 63.67 | 43.15 |
| **AGGRESSIVE** | CRC | 52.90 | 30.83 | 67.75 | 18.77 | 43.00 | 34.72 |
| | KKOZ | 52.29 | 32.47 | 41.60 | 38.59 | 58.22 | 29.29 |
| **CALM** | CRC | 39.00 | 32.32 | 45.00 | 33.71 | 35.00 | 33.91 |
| | KKOZ | 53.64 | 29.51 | 57.40 | 40.33 | 51.56 | 24.24 |
| **CONFIDENT** | CRC | 43.70 | 36.61 | 56.75 | 36.81 | 35.00 | 37.05 |
| | KKOZ | 77.64 | 33.81 | 83.20 | 34.02 | 74.56 | 35.35 |

| | | ALL CATS | | MALE | | FEMALE | |
|---|---|---|---|---|---|---|---|
| **Temperament Characteristic** | **Facility** | **Mean** | **StDev** | **Mean** | **StDev** | **Mean** | **StDev** |
| | KKOZ | 41.36 | 32.40 | 34.60 | 28.44 | 45.11 | 35.46 |
| **FEARFAM** | CRC | 54.40 | 30.75 | 42.50 | 27.78 | 62.33 | 32.41 |
| | KKOZ | 59.43 | 37.01 | 34.00 | 29.09 | 73.56 | 34.26 |
| **FOODAG** | CRC | 71.90 | 42.51 | 89.25 | 39.66 | 60.33 | 43.68 |
| | KKOZ | 57.07 | 42.06 | 86.40 | 39.38 | 40.78 | 35.53 |
| **FRIENDLY** | CRC | 27.60 | 26.36 | 21.50 | 3.11 | 31.67 | 34.57 |
| | KKOZ | 64.00 | 31.61 | 69.40 | 38.60 | 61.00 | 29.15 |
| **HIGHSTRUNG** | CRC | 65.40 | 40.28 | 38.00 | 22.11 | 83.67 | 40.32 |
| | KKOZ | 46.43 | 35.32 | 40.40 | 34.83 | 49.78 | 37.22 |
| **INSECURE** | CRC | 71.00 | 33.43 | 65.25 | 36.40 | 74.83 | 34.24 |
| | KKOZ | 51.07 | 32.39 | 45.60 | 41.13 | 54.11 | 28.81 |
| **PLAYFUL** | CRC | 37.90 | 31.77 | 40.00 | 24.58 | 36.50 | 38.06 |
| | KKOZ | 44.36 | 34.93 | 29.80 | 18.75 | 52.44 | 40.01 |
| **SMART** | CRC | 87.60 | 15.36 | 93.25 | 14.82 | 83.83 | 15.82 |
| | KKOZ | 94.64 | 16.65 | 94.60 | 18.23 | 94.67 | 16.86 |
| **VOCAL** | CRC | 35.40 | 37.76 | 28.50 | 24.72 | 40.00 | 46.22 |
| | KKOZ | 79.71 | 43.14 | 80.40 | 41.76 | 79.33 | 46.38 |

## Mann Whitney U Mean Rank Analysis of Temperament Assessments

Hypothesis 8: Clouded leopard temperament characteristics vary between reproductively successful and RUS individuals

**A7-4: Mean ranks for each characteristic in the Temperament Assessments with dependant variable "success"**

| Temperament Characteristic | REPRODUCTIVE SUCCESS | N | Mean Rank | Sum of Ranks | U Score | P Values |
|---|---|---|---|---|---|---|
| ACTIVE | RUS | 19 | 12.79 | 243.00 | 42 | 0.696 |
| | RS | 5 | 11.40 | 57.00 | | |
| | Total | 24 | | | | |
| AGGRESSIVE | RUS | 19 | 12.63 | 240.00 | 45 | 0.859 |
| | RS | 5 | 12.00 | 60.00 | | |
| | Total | 24 | | | | |
| **CALM** | RUS | 19 | 10.74 | 204.00 | **14** | ***0.017** |
| | **RS** | **5** | **19.20** | **96.00** | | |
| | Total | 24 | | | | |
| CONFIDENT | RUS | 19 | 10.82 | 205.50 | 15.5 | *0.023 |
| | RS | 5 | 18.90 | 94.50 | | |
| | Total | 24 | | | | |
| **FEARCON** | **RUS** | **19** | **14.39** | **273.50** | **11.5** | ***0.010** |
| | RS | 5 | 5.30 | 26.50 | | |
| | Total | 24 | | | | |

| Temperament Characteristic | REPRODUCTIVE SUCCESS | N | Mean Rank | Sum of Ranks | U Score | P Values |
|---|---|---|---|---|---|---|
| FEARFAM | RUS | 19 | 13.76 | 261.50 | 23.5 | 0.088 |
| | RS | 5 | 7.70 | 38.50 | | |
| | Total | 24 | | | | |
| **FOODAG** | RUS | 19 | 10.87 | 206.50 | **16.5** | ***0.027** |
| | **RS** | **5** | **18.70** | **93.50** | | |
| | Total | 24 | | | | |
| FRIENDLY | RUS | 19 | 11.39 | 216.50 | 26.5 | 0.135 |
| | RS | 5 | 16.70 | 83.50 | | |
| | Total | 24 | | | | |
| **HIGHSTRUNG** | **RUS** | **19** | **14.34** | **272.50** | **12.5** | ***0.013** |
| | RS | 5 | 5.50 | 27.50 | | |
| | Total | 24 | | | | |
| INSECURE | RUS | 19 | 13.76 | 261.50 | 23.5 | 0.088 |
| | RS | 5 | 7.70 | 38.50 | | |
| | Total | 24 | | | | |
| PLAYFUL | RUS | 19 | 12.68 | 241.00 | 44 | 0.836 |
| | RS | 5 | 11.80 | 59.00 | | |
| | Total | 24 | | | | |
| SMART | RUS | 19 | 11.34 | 215.50 | 25.5 | 0.117 |
| | RS | 5 | 16.90 | 84.50 | | |
| | Total | 24 | | | | |
| VOCAL | RUS | 19 | 11.97 | 227.50 | 37.5 | 0.477 |
| | RS | 5 | 14.50 | 72.50 | | |
| | Total | 24 | | | | |

*** indicates $p < 0.05$**

Hypothesis 9: Clouded leopard temperament characteristics vary between males and females.

**A7-5: Mean ranks of clouded leopard characteristic from keeper rated Temperament Assessments with dependant variable "sex".**

| Temperament Characteristic | SEX | N | Mean Rank | Sum of Ranks | U Score | P Values |
|---|---|---|---|---|---|---|
| ACTIVE | MALE | 9 | 14.39 | 129.50 | 50.5 | 0.311 |
| | FEMALE | 15 | 11.37 | 170.50 | | |
| | Total | 24 | | | | |
| AGGRESSIVE | MALE | 9 | 12.50 | 112.50 | 67.5 | 1.000 |
| | FEMALE | 15 | 12.50 | 187.50 | | |
| | Total | 24 | | | | |
| CALM | MALE | 9 | 13.06 | 117.50 | 62.5 | 0.766 |
| | FEMALE | 15 | 12.17 | 182.50 | | |
| | Total | 24 | | | | |

| Temperament Characteristic | SEX | N | Mean Rank | Sum of Ranks | U Score | P Values |
|---|---|---|---|---|---|---|
| CONFIDENT | MALE | 9 | 14.33 | 129.00 | 51 | 0.325 |
| | FEMALE | 15 | 11.40 | 171.00 | | |
| | Total | 24 | | | | |
| FEARCON | MALE | 9 | 11.78 | 106.00 | 61 | 0.698 |
| | FEMALE | 15 | 12.93 | 194.00 | | |
| | Total | 24 | | | | |
| **FEARFAM** | MALE | 9 | 8.39 | 75.50 | **30.5** | ***0.027** |
| | **FEMALE** | **15** | **14.97** | **224.50** | | |
| | Total | 24 | | | | |
| **FOODAG** | **MALE** | **9** | **17.22** | **155.00** | **25** | ***0.011** |
| | FEMALE | 15 | 9.67 | 145.00 | | |
| | Total | 24 | | | | |
| FRIENDLY | MALE | 9 | 12.44 | 112.00 | 67 | 0.976 |
| | FEMALE | 15 | 12.53 | 188.00 | | |
| | Total | 24 | | | | |
| HIGHSTRUNG | MALE | 9 | 9.89 | 89.00 | 44 | 0.161 |
| | FEMALE | 15 | 14.07 | 211.00 | | |
| | Total | 24 | | | | |
| INSECURE | MALE | 9 | 11.83 | 106.50 | 61.5 | 0.720 |
| | FEMALE | 15 | 12.90 | 193.50 | | |
| | Total | 24 | | | | |
| PLAYFUL | MALE | 9 | 12.11 | 109.00 | 64 | 0.834 |
| | FEMALE | 15 | 12.73 | 191.00 | | |
| | Total | 24 | | | | |
| SMART | MALE | 9 | 13.50 | 121.50 | 58.5 | 0.591 |
| | FEMALE | 15 | 11.90 | 178.50 | | |
| | Total | 24 | | | | |
| VOCAL | MALE | 9 | 12.11 | 109.00 | 64 | 0.835 |
| | FEMALE | 15 | 12.73 | 191.00 | | |
| | Total | 24 | | | | |

***indicates p<0.05**

Hypothesis 10: Clouded leopard temperament characteristics vary depending on rearing.

**A7-6: Mean ranks of clouded leopard characteristic from keeper rated Temperament Assessments with dependant variable "rearing"**

| Temperament Characteristic | REARING | N | Mean Rank | Sum of Ranks | U Score | P Values |
|---|---|---|---|---|---|---|
| **ACTIVE** | MOTHER-REARED | 10 | 8.40 | 84.00 | **29** | ***0.016** |
| | **HAND-REARED** | **14** | **15.43** | **216.00** | | |
| | Total | 24 | | | | |
| **AGGRESSIVE** | **MOTHER-REARED** | **10** | **15.95** | **159.50** | **35.5** | ***0.043** |
| | HAND-REARED | 14 | 10.04 | 140.50 | | |
| | Total | 24 | | | | |
| CALM | MOTHER-REARED | 10 | 11.80 | 118.00 | 63 | 0.682 |
| | HAND-REARED | 14 | 13.00 | 182.00 | | |
| | Total | 24 | | | | |
| CONFIDENT | MOTHER-REARED | 10 | 12.35 | 123.50 | 68.5 | 0.930 |
| | HAND-REARED | 14 | 12.61 | 176.50 | | |
| | Total | 24 | | | | |
| FEARCON | MOTHER-REARED | 10 | 13.90 | 139.00 | 56 | 0.412 |
| | HAND-REARED | 14 | 11.50 | 161.00 | | |
| | Total | 24 | | | | |
| **FEARFAM** | **MOTHER-REARED** | **10** | **17.20** | **172.00** | **23** | ***0.006** |
| | HAND-REARED | 14 | 9.14 | 128.00 | | |
| | Total | 24 | | | | |
| FOODAG | MOTHER-REARED | 10 | 10.60 | 106.00 | 51 | 0.266 |
| | HAND-REARED | 14 | 13.86 | 194.00 | | |
| | Total | 24 | | | | |
| FRIENDLY | MOTHER-REARED | 10 | 10.60 | 106.00 | 51 | 0.266 |
| | HAND-REARED | 14 | 13.86 | 194.00 | | |
| | Total | 24 | | | | |
| HIGHSTRUNG | MOTHER-REARED | 10 | 14.10 | 141.00 | 54 | 0.349 |
| | HAND-REARED | 14 | 11.36 | 159.00 | | |
| | Total | 24 | | | | |
| INSECURE | MOTHER-REARED | 10 | 12.55 | 125.50 | 69.5 | 0.977 |
| | HAND-REARED | 14 | 12.46 | 174.50 | | |
| | Total | 24 | | | | |
| PLAYFUL | MOTHER-REARED | 10 | 10.10 | 101.00 | 46 | 0.159 |
| | HAND-REARED | 14 | 14.21 | 199.00 | | |
| | Total | 24 | | | | |
| SMART | MOTHER-REARED | 10 | 12.40 | 124.00 | 69 | 0.953 |
| | HAND-REARED | 14 | 12.57 | 176.00 | | |
| | Total | 24 | | | | |
| VOCAL | MOTHER-REARED | 10 | 10.65 | 106.50 | 51.5 | 0.278 |
| | HAND-REARED | 14 | 13.82 | 193.50 | | |
| | Total | 24 | | | | |

*** indicates p<0.05**

Hypothesis 11: Clouded leopard temperament characteristics vary based on facility.

**A7-7: Mean ranks of clouded leopard characteristic from keeper rated Temperament Assessments with dependant variable "facility".**

| Temperament Characteristic | FACILITY | N | Mean Rank | Sum of Ranks | U Score | P Values |
|---|---|---|---|---|---|---|
| ACTIVE | CRC | 10 | 10.70 | 107.00 | 52 | 0.292 |
| | KKOZ | 14 | 13.79 | 193.00 | | |
| | Total | 24 | | | | |
| AGGRESSIVE | CRC | 10 | 12.40 | 124.00 | 69 | 0.953 |
| | KKOZ | 14 | 12.57 | 176.00 | | |
| | Total | 24 | | | | |
| CALM | CRC | 10 | 10.30 | 103.00 | 48 | 0.198 |
| | KKOZ | 14 | 14.07 | 197.00 | | |
| | Total | 24 | | | | |
| **CONFIDENT** | CRC | 10 | 9.00 | 90.00 | **35** | ***0.040** |
| | **KKOZ** | **14** | **15.00** | **210.00** | | |
| | Total | 24 | | | | |
| FEARCON | CRC | 10 | 12.90 | 129.00 | 66 | 0.815 |
| | KKOZ | 14 | 12.21 | 171.00 | | |
| | Total | 24 | | | | |
| FEARFAM | CRC | 10 | 12.10 | 121.00 | 66 | 0.815 |
| | KKOZ | 14 | 12.79 | 179.00 | | |
| | Total | 24 | | | | |
| FOODAG | CRC | 10 | 14.10 | 141.00 | 54 | 0.349 |
| | KKOZ | 14 | 11.36 | 159.00 | | |
| | Total | 24 | | | | |
| **FRIENDLY** | CRC | 10 | 8.00 | 80.00 | **25** | ***0.008** |
| | **KKOZ** | **14** | **15.71** | **220.00** | | |
| | Total | 24 | | | | |
| HIGHSTRUNG | CRC | 10 | 14.50 | 145.00 | 50 | 0.241 |
| | KKOZ | 14 | 11.07 | 155.00 | | |
| | Total | 24 | | | | |
| INSECURE | CRC | 10 | 15.60 | 156.00 | 39 | 0.069 |
| | KKOZ | 14 | 10.29 | 144.00 | | |
| | Total | 24 | | | | |
| PLAYFUL | CRC | 10 | 12.00 | 120.00 | 65 | 0.769 |
| | KKOZ | 14 | 12.86 | 180.00 | | |
| | Total | 24 | | | | |
| SMART | CRC | 10 | 10.45 | 104.50 | 49.5 | 0.229 |
| | KKOZ | 14 | 13.96 | 195.50 | | |
| | Total | 24 | | | | |
| **VOCAL** | CRC | 10 | 8.30 | 83.00 | **28** | ***0.014** |
| | **KKOZ** | **14** | **15.50** | **217.00** | | |
| | Total | 24 | | | | |

Hypothesis 12: Male clouded leopard temperament characteristics vary depending on reproductive success.

**A7-8: Mean ranks of male clouded leopard characteristics from keeper rated Temperament Assessments with dependant variable "success."**

| Temperament Characteristic | Reproductive Success | N | Mean Rank | Sum of Ranks | U Score | P Values |
|---|---|---|---|---|---|---|
| ACTIVE | RUS | 6 | 4.83 | 29.00 | 8 | 0.796 |
| | RS | 3 | 5.33 | 16.00 | | |
| | Total | 9 | | | | |
| AGGRESSIVE | RUS | 6 | 5.83 | 35.00 | 4 | 0.197 |
| | RS | 3 | 3.33 | 10.00 | | |
| | Total | 9 | | | | |
| CALM | RUS | 6 | 3.83 | 23.00 | 2 | 0.071 |
| | RS | 3 | 7.33 | 22.00 | | |
| | Total | 9 | | | | |
| CONFIDENT | RUS | 6 | 3.83 | 23.00 | 2 | 0.70 |
| | RS | 3 | 7.33 | 22.00 | | |
| | Total | 9 | | | | |
| FEARCON | RUS | 6 | 5.83 | 35.00 | 4 | 0.197 |
| | RS | 3 | 3.33 | 10.00 | | |
| | Total | 9 | | | | |
| FEARFAM | RUS | 6 | 6.17 | 37.00 | 2 | 0.70 |
| | RS | 3 | 2.67 | 8.00 | | |
| | Total | 9 | | | | |
| FOODAG | RUS | 6 | 3.92 | 23.50 | 2.5 | 0.092 |
| | RS | 3 | 7.17 | 21.50 | | |
| | Total | 9 | | | | |
| FRIENDLY | RUS | 6 | 3.67 | 22.00 | 1 | 0.390 |
| | RS | 3 | 7.67 | 23.00 | | |
| | Total | 9 | | | | |
| HIGHSTRUNG | RUS | 6 | 5.75 | 34.50 | 4.5 | 0.243 |
| | RS | 3 | 3.50 | 10.50 | | |
| | Total | 9 | | | | |
| INSECURE | RUS | 6 | 6.00 | 36.00 | 3 | 0.121 |
| | RS | 3 | 3.00 | 9.00 | | |
| | Total | 9 | | | | |
| PLAYFUL | RUS | 6 | 4.83 | 29.00 | 8 | 0.796 |
| | RS | 3 | 5.33 | 16.00 | | |
| | Total | 9 | | | | |
| SMART | RUS | 6 | 4.58 | 27.50 | 6.5 | 0.517 |
| | RS | 3 | 5.83 | 17.50 | | |
| | Total | 9 | | | | |
| VOCAL | RUS | 6 | 3.83 | 23.00 | 2 | 0.071 |
| | RS | 3 | 7.33 | 22.00 | | |
| | Total | 9 | | | | |

Hypothesis 13: Male clouded leopard temperaments characteristics vary depending on rearing

**A7-9: Mean ranks male clouded leopard characteristics from keeper rated Temperament Assessments with dependant variable "rearing".**

| Temperament Characteristic | REARING | N | Mean Rank | Sum of Ranks | U Score | P Values |
|---|---|---|---|---|---|---|
| ACTIVE | MOTHER-REARED | 1 | 1.00 | 1.00 | 0 | 0.121 |
| | HAND-REARED | 8 | 5.50 | 44.00 | | |
| | Total | 9 | | | | |
| AGGRESSIVE | MOTHER-REARED | 1 | 7.00 | 7.00 | 2 | 0.439 |
| | HAND-REARED | 8 | 4.75 | 38.00 | | |
| | Total | 9 | | | | |
| CALM | MOTHER-REARED | 1 | 7.00 | 7.00 | 2 | 0.439 |
| | HAND-REARED | 8 | 4.75 | 38.00 | | |
| | Total | 9 | | | | |
| CONFIDENT | MOTHER-REARED | 1 | 6.00 | 6.00 | 3 | 0.697 |
| | HAND-REARED | 8 | 4.88 | 39.00 | | |
| | Total | 9 | | | | |
| FEARCON | MOTHER-REARED | 1 | 7.00 | 7.00 | 2 | 0.439 |
| | HAND-REARED | 8 | 4.75 | 38.00 | | |
| | Total | 9 | | | | |
| FEARFAM | MOTHER-REARED | 1 | 5.00 | 5.00 | 4 | 1.000 |
| | HAND-REARED | 8 | 5.00 | 40.00 | | |
| | Total | 9 | | | | |
| FOODAG | MOTHER-REARED | 1 | 9.00 | 9.00 | 0 | 0.120 |
| | HAND-REARED | 8 | 4.50 | 36.00 | | |
| | Total | 9 | | | | |
| FRIENDLY | MOTHER-REARED | 1 | 6.00 | 6.00 | 3 | 0.699 |
| | HAND-REARED | 8 | 4.88 | 39.00 | | |
| | Total | 9 | | | | |
| HIGHSTRUNG | MOTHER-REARED | 1 | 3.00 | 3.00 | 2 | 0.437 |
| | HAND-REARED | 8 | 5.25 | 42.00 | | |
| | Total | 9 | | | 1 | |
| INSECURE | MOTHER-REARED | 1 | 2.00 | 2.00 | | 0.245 |
| | HAND-REARED | 8 | 5.38 | 43.00 | | |
| | Total | 9 | | | | |
| PLAYFUL | MOTHER-REARED | 1 | 3.00 | 3.00 | 2 | 0.439 |
| | HAND-REARED | 8 | 5.25 | 42.00 | | |
| | Total | 9 | | | | |
| SMART | MOTHER-REARED | 1 | 3.00 | 3.00 | 2 | 0.436 |
| | HAND-REARED | 8 | 5.25 | 42.00 | | |
| | Total | 9 | | | | |
| VOCAL | MOTHER-REARED | 1 | 5.00 | 5.00 | 4 | 1.000 |
| | HAND-REARED | 8 | 5.00 | 40.00 | | |
| | Total | 9 | | | | |

Hypothesis 14: Male clouded leopard temperament characteristics vary depending on facility.

**A7-10: Mean ranks of male clouded leopard characteristics from keeper rated Temperament Assessments with dependant variable "facility".**

| Temperament Characteristic | FACILITY | N | Mean Rank | Sum of Ranks | U Score | P Values |
|---|---|---|---|---|---|---|
| ACTIVE | CRC | 4 | 4.25 | 17.00 | 7 | 0.462 |
| | KKOZ | 5 | 5.60 | 28.00 | | |
| | Total | 9 | | | | |
| AGGRESSIVE | CRC | 4 | 5.75 | 23.00 | 7 | 0.462 |
| | KKOZ | 5 | 4.40 | 22.00 | | |
| | Total | 9 | | | | |
| CALM | CRC | 4 | 4.75 | 19.00 | 9 | 0.806 |
| | KKOZ | 5 | 5.20 | 26.00 | | |
| | Total | 9 | | | | |
| CONFIDENT | CRC | 4 | 4.13 | 16.50 | 6.5 | 0.389 |
| | KKOZ | 5 | 5.70 | 28.50 | | |
| | Total | 9 | | | | |
| FEARCON | CRC | 4 | 5.50 | 22.00 | 8 | 0.624 |
| | KKOZ | 5 | 4.60 | 23.00 | | |
| | Total | 9 | | | | |
| FEARFAM | CRC | 4 | 5.63 | 22.50 | 7.5 | 0.539 |
| | KKOZ | 5 | 4.50 | 22.50 | | |
| | Total | 9 | | | | |
| FOODAG | CRC | 4 | 4.88 | 19.50 | 9.5 | 0.902 |
| | KKOZ | 5 | 5.10 | 25.50 | | |
| | Total | 9 | | | | |
| **FRIENDLY** | CRC | 4 | 2.50 | 10.00 | **0** | ***0.014** |
| | **KKOZ** | **5** | **7.00** | **35.00** | | |
| | Total | 9 | | | | |
| HIGHSTRUNG | CRC | 4 | 5.13 | 20.50 | 9.5 | 0.902 |
| | KKOZ | 5 | 4.90 | 24.50 | | |
| | Total | 9 | | | | |
| INSECURE | CRC | 4 | 6.00 | 24.00 | 6 | 0.327 |
| | KKOZ | 5 | 4.20 | 21.00 | | |
| | Total | 9 | | | | |
| PLAYFUL | CRC | 4 | 6.00 | 24.00 | 6 | 0.327 |
| | KKOZ | 5 | 4.20 | 21.00 | | |
| | Total | 9 | | | | |
| SMART | CRC | 4 | 5.00 | 20.00 | 10 | 1.000 |
| | KKOZ | 5 | 5.00 | 25.00 | | |
| | Total | 9 | | | | |
| VOCAL | CRC | 4 | 3.25 | 13.00 | 3 | 0.086 |
| | KKOZ | 5 | 6.40 | 32.00 | | |
| | Total | 9 | | | | |

Hypothesis 15: Female clouded leopard temperament characteristics vary depending on reproductive success.

**A7-11: Mean ranks of female clouded leopards characteristics from keeper rated Temperament Assessments with dependant variable "success".**

| Temperament Characteristic | REPRODUCTIVESUCCESS | N | Mean Rank | Sum of Ranks | U Score | P Values |
|---|---|---|---|---|---|---|
| ACTIVE | RUS | 13 | 8.46 | 110.00 | 7 | 0.308 |
| | RS | 2 | 5.00 | 10.00 | | |
| | Total | 15 | | | | |
| AGGRESSIVE | RUS | 13 | 7.38 | 96.00 | 5 | 0.174 |
| | RS | 2 | 12.00 | 24.00 | | |
| | Total | 15 | | | | |
| CALM | RUS | 13 | 7.46 | 97.00 | 6 | 0.234 |
| | RS | 2 | 11.50 | 23.00 | | |
| | Total | 15 | | | | |
| CONFIDENT | RUS | 13 | 7.54 | 98.00 | 7 | 0.308 |
| | RS | 2 | 11.00 | 22.00 | | |
| | Total | 15 | | | | |
| **FEARCON** | **RUS** | **13** | **9.00** | **117.00** | **0** | ***0.027** |
| | RS | 2 | 1.50 | 3.00 | | |
| | Total | 15 | | | | |
| FEARFAM | RUS | 13 | 8.23 | 107.00 | 10 | 0.610 |
| | RS | 2 | 6.50 | 13.00 | | |
| | Total | 15 | | | | |
| FOODAG | RUS | 13 | 7.62 | 99.00 | 8 | 0.395 |
| | RS | 2 | 10.50 | 21.00 | | |
| | Total | 15 | | | | |
| FRIENDLY | RUS | 13 | 8.19 | 106.50 | 10.5 | 0.671 |
| | RS | 2 | 6.75 | 13.50 | | |
| | Total | 15 | | | | |
| HIGHSTRUNG | RUS | 13 | 8.85 | 115.00 | 2 | 0.061 |
| | RS | 2 | 2.50 | 5.00 | | |
| | Total | 15 | | | | |
| INSECURE | RUS | 13 | 8.23 | 107.00 | 10 | 0.610 |
| | RS | 2 | 6.50 | 13.00 | | |
| | Total | 15 | | | | |
| PLAYFUL | RUS | 13 | 8.23 | 107.00 | 10 | 0.609 |
| | RS | 2 | 6.50 | 13.00 | | |
| | Total | 15 | | | | |
| SMART | RUS | 13 | 7.38 | 96.00 | 5 | 0.173 |
| | RS | 2 | 12.00 | 24.00 | | |
| | Total | 15 | | | | |
| VOCAL | RUS | 13 | 8.23 | 107.00 | 10 | 0.610 |
| | RS | 2 | 6.50 | 13.00 | | |
| | Total | 15 | | | | |

Hypothesis 16: Female clouded leopard temperament characteristics vary depending on rearing.

**A7-12: Mean ranks of female clouded leopard characteristics from keeper rated Temperament Assessments with dependant variable "rearing".**

| Temperament Characteristic | REARING | N | Mean Rank | Sum of Ranks | U Score | P Values |
|---|---|---|---|---|---|---|
| ACTIVE | MOTHER-REARED | 7 | 5.86 | 41.00 | 13 | 0.830 |
| | HAND-REARED | 8 | 9.88 | 79.00 | | |
| | Total | 15 | | | | |
| AGGRESSIVE | MOTHER-REARED | 7 | 9.57 | 67.00 | 17 | 0.203 |
| | HAND-REARED | 8 | 6.63 | 53.00 | | |
| | Total | 15 | | | | |
| CALM | MOTHER-REARED | 7 | 7.14 | 50.00 | 22 | 0.487 |
| | HAND-REARED | 8 | 8.75 | 70.00 | | |
| | Total | 15 | | | | |
| CONFIDENT | MOTHER-REARED | 7 | 7.43 | 52.00 | 24 | 0.643 |
| | HAND-REARED | 8 | 8.50 | 68.00 | | |
| | Total | 15 | | | | |
| FEARCON | MOTHER-REARED | 7 | 8.86 | 62.00 | 22 | 0.487 |
| | HAND-REARED | 8 | 7.25 | 58.00 | | |
| | Total | 15 | | | | |
| **FEARFAM** | **MOTHER-REARED** | **7** | **11.00** | **77.00** | **7** | ***0.015** |
| | HAND-REARED | 8 | 5.38 | 43.00 | | |
| | Total | 15 | | | | |
| FOODAG | MOTHER-REARED | 7 | 7.00 | 49.00 | 21 | 0.417 |
| | HAND-REARED | 8 | 8.88 | 71.00 | | |
| | Total | 15 | | | | |
| FRIENDLY | MOTHER-REARED | 7 | 6.50 | 45.50 | 17.5 | 0.223 |
| | HAND-REARED | 8 | 9.31 | 74.50 | | |
| | Total | 15 | | | | |
| HIGHSTRUNG | MOTHER-REARED | 7 | 9.57 | 67.00 | 17 | 0.203 |
| | HAND-REARED | 8 | 6.63 | 53.00 | | |
| | Total | 15 | | | | |
| INSECURE | MOTHER-REARED | 7 | 8.14 | 57.00 | 27 | 0.908 |
| | HAND-REARED | 8 | 7.88 | 63.00 | | |
| | Total | 15 | | | | |
| PLAYFUL | MOTHER-REARED | 7 | 6.86 | 48.00 | 20 | 0.353 |
| | HAND-REARED | 8 | 9.00 | 72.00 | | |
| | Total | 15 | | | | |
| SMART | MOTHER-REARED | 7 | 7.00 | 49.00 | 21 | 0.416 |
| | HAND-REARED | 8 | 8.88 | 71.00 | | |
| | Total | 15 | | | | |
| VOCAL | MOTHER-REARED | 7 | 6.86 | 48.00 | 20 | 0.355 |
| | HAND-REARED | 8 | 9.00 | 72.00 | | |
| | Total | 15 | | | | |

Hypothesis 17: Female clouded leopard temperament characteristics vary depending on facility.

**A7-13: Mean ranks of female clouded leopard characteristics from keeper rated Temperament Assessments with dependant variable "facility".**

| Temperament Characteristic | FACILITY | N | Mean Rank | Sum of Ranks | U Score | P Values |
|---|---|---|---|---|---|---|
| ACTIVE | CRC | 6 | 6.83 | 41.00 | 20 | 0.409 |
| | KKOZ | 9 | 8.78 | 79.00 | | |
| | Total | 15 | | | | |
| AGGRESSIVE | CRC | 6 | 6.67 | 40.00 | 19 | 0.345 |
| | KKOZ | 9 | 8.89 | 80.00 | | |
| | Total | 15 | | | | |
| CALM | CRC | 6 | 5.83 | 35.00 | 14 | 0.126 |
| | KKOZ | 9 | 9.44 | 85.00 | | |
| | Total | 15 | | | | |
| CONFIDENT | CRC | 6 | 5.67 | 34.00 | 13 | 0.099 |
| | KKOZ | 9 | 9.56 | 86.00 | | |
| | Total | 15 | | | | |
| FEARCON | CRC | 6 | 7.83 | 47.00 | 26 | 0.906 |
| | KKOZ | 9 | 8.11 | 73.00 | | |
| | Total | 15 | | | | |
| FEARFAM | CRC | 6 | 6.92 | 41.50 | 20.5 | 0.443 |
| | KKOZ | 9 | 8.72 | 78.50 | | |
| | Total | 15 | | | | |
| FOODAG | CRC | 6 | 9.75 | 58.50 | 16.5 | 0.216 |
| | KKOZ | 9 | 6.83 | 61.50 | | |
| | Total | 15 | | | | |
| FRIENDLY | CRC | 6 | 6.17 | 37.00 | 16 | 0.194 |
| | KKOZ | 9 | 9.22 | 83.00 | | |
| | Total | 15 | | | | |
| HIGHSTRUNG | CRC | 6 | 10.08 | 60.50 | 14.5 | 0.140 |
| | KKOZ | 9 | 6.61 | 59.50 | | |
| | Total | 15 | | | | |
| INSECURE | CRC | 6 | 10.17 | 61.00 | 14 | 0.126 |
| | KKOZ | 9 | 6.56 | 59.00 | | |
| | Total | 15 | | | | |
| PLAYFUL | CRC | 6 | 7.00 | 42.00 | 21 | 0.478 |
| | KKOZ | 9 | 8.67 | 78.00 | | |
| | Total | 15 | | | | |
| SMART | CRC | 6 | 6.17 | 37.00 | 16 | 0.193 |
| | KKOZ | 9 | 9.22 | 83.00 | | |
| | Total | 15 | | | | |
| VOCAL | CRC | 6 | 5.67 | 34.00 | 13 | 0.099 |
| | KKOZ | 9 | 9.56 | 86.00 | | |
| | Total | 15 | | | | |

APPENDIX VIII

Results of Behavioral observations obtained from 18 different treatments of 24 individual clouded leopards

**A8-1: Mean and Standard Deviations of Behavioral Responses from all treatments on 24 clouded leopards grouped by sex and reproductive success.**

| | | ALL CATS | | MALE | | FEMALE | |
|---|---|---|---|---|---|---|---|
| **Variable** | **Success** | **Mean** | **StDev** | **Mean** | **StDev** | **Mean** | **StDev** |
| **Age** | RUS | 7.74 | 4.59 | 7.50 | 5.36 | 7.85 | 4.43 |
| | RS | 6.00 | 3.16 | 5.00 | 2.00 | 7.50 | 4.95 |
| **AP** | RUS | 11.83 | 6.73 | 12.78 | 6.21 | 11.40 | 7.16 |
| | RS | 12.84 | 5.40 | 14.50 | 5.11 | 10.34 | 6.60 |
| **BI** | RUS | 1.54 | 2.63 | 2.72 | 3.57 | 1.00 | 2.01 |
| | RS | 0.40 | 0.89 | 0.00 | 0.00 | 1.00 | 1.41 |
| **CL** | RUS | 0.95 | 2.33 | 0.86 | 1.44 | 0.99 | 2.70 |
| | RS | 0.13 | 0.22 | 0.17 | 0.29 | 0.09 | 0.12 |
| **DEFAC** | RUS | 0.01 | 0.04 | 0.00 | 0.00 | 0.01 | 0.05 |
| | RS | 0.07 | 0.09 | 0.11 | 0.10 | 0.00 | 0.00 |
| **FLE** | RUS | 1.02 | 1.27 | 1.28 | 1.66 | 0.90 | 1.10 |
| | RS | 1.30 | 0.81 | 1.11 | 0.79 | 1.58 | 1.06 |
| **FLIN** | RUS | 1.18 | 1.38 | 0.58 | 0.66 | 1.46 | 1.55 |
| | RS | 2.10 | 2.75 | 0.17 | 0.29 | 5.00 | 1.41 |
| **GH** | RUS | 12.84 | 20.69 | 18.58 | 25.76 | 10.19 | 18.48 |
| | RS | 9.63 | 15.06 | 4.17 | 4.86 | 17.84 | 25.22 |
| **GR** | RUS | 12.49 | 8.94 | 12.25 | 8.77 | 12.60 | 9.36 |
| | RS | 9.67 | 5.03 | 8.33 | 3.94 | 11.67 | 7.54 |
| **LAT** | RUS | 101.10 | 98.16 | 121.24 | 128.17 | 91.81 | 85.51 |
| | RS | 1.40 | 1.33 | 1.08 | 0.94 | 1.88 | 2.12 |
| **LICK** | RUS | 12.10 | 11.95 | 8.75 | 7.17 | 13.64 | 13.58 |
| | RS | 14.30 | 12.95 | 21.61 | 11.18 | 3.34 | 4.48 |
| **LY** | RUS | 0.36 | 0.18 | 0.41 | 0.20 | 0.34 | 0.17 |
| | RS | 0.58 | 0.14 | 0.51 | 0.14 | 0.70 | 0.02 |
| **MEOW** | RUS | 3.59 | 8.40 | 6.03 | 14.44 | 2.46 | 3.83 |
| | RS | 11.60 | 13.63 | 8.39 | 9.20 | 16.42 | 22.27 |
| **OOS** | RUS | 0.21 | 0.22 | 0.23 | 0.30 | 0.21 | 0.18 |
| | RS | 0.00 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 |
| **PA** | RUS | 0.01 | 0.02 | 0.01 | 0.01 | 0.01 | 0.02 |
| | RS | 0.02 | 0.04 | 0.03 | 0.05 | 0.01 | 0.01 |

| | | ALL CATS | | MALE | | FEMALE | |
|---|---|---|---|---|---|---|---|
| Variable | Success | Mean | StDev | Mean | StDev | Mean | StDev |
| **PAT** | RUS | 0.01 | 0.02 | 0.01 | 0.02 | 0.01 | 0.02 |
| | RS | 0.03 | 0.03 | 0.05 | 0.02 | 0.00 | 0.00 |
| **PRUSTEN** | RUS | 0.81 | 2.03 | 0.17 | 0.41 | 1.10 | 2.41 |
| | RS | 16.70 | 18.08 | 10.16 | 14.51 | 26.50 | 23.80 |
| **PS** | RUS | 12.30 | 32.03 | 13.61 | 28.01 | 11.69 | 34.80 |
| | RS | 8.23 | 17.76 | 0.39 | 0.35 | 20.00 | 28.28 |
| **ROL** | RUS | 0.71 | 1.42 | 1.50 | 2.25 | 0.35 | 0.67 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **RT** | RUS | 0.03 | 0.11 | 0.08 | 0.20 | 0.00 | 0.00 |
| | RS | 0.30 | 0.45 | 0.00 | 0.00 | 0.75 | 0.35 |
| **RU** | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **RUBother** | RUS | 12.17 | 17.83 | 13.56 | 22.23 | 11.53 | 16.41 |
| | RS | 3.63 | 4.87 | 4.83 | 6.41 | 1.83 | 1.41 |
| **RUBtotal** | RUS | 9.20 | 13.26 | 12.34 | 21.14 | 7.76 | 8.38 |
| | RS | 2.03 | 1.55 | 2.17 | 1.93 | 1.83 | 1.41 |
| **RUBtrial** | RUS | 0.97 | 1.72 | 0.78 | 1.10 | 1.06 | 1.97 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **SIT** | RUS | 0.15 | 0.08 | 0.07 | 0.06 | 0.18 | 0.07 |
| | RS | 0.10 | 0.06 | 0.12 | 0.07 | 0.06 | 0.03 |
| **SNIFFobject** | RUS | 111.55 | 119.06 | 123.72 | 68.21 | 105.94 | 138.62 |
| | RS | 75.37 | 26.82 | 61.78 | 18.50 | 95.75 | 28.40 |
| **SNIFFtrial** | RUS | 72.82 | 44.06 | 75.33 | 27.71 | 71.65 | 50.87 |
| | RS | 64.30 | 17.66 | 71.72 | 18.17 | 53.17 | 13.20 |
| **ST** | RUS | 0.18 | 0.09 | 0.20 | 0.09 | 0.18 | 0.10 |
| | RS | 0.22 | 0.05 | 0.24 | 0.05 | 0.18 | 0.02 |
| **STEREO** | RUS | 0.16 | 0.43 | 0.00 | 0.00 | 0.23 | 0.50 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **TIA** | RUS | 304.17 | 220.30 | 288.65 | 218.77 | 311.34 | 229.52 |
| | RS | 153.10 | 95.44 | 87.54 | 45.81 | 251.44 | 0.03 |
| **TSI** | RUS | 61.17 | 42.00 | 64.94 | 45.53 | 59.44 | 42.09 |
| | RS | 101.08 | 23.00 | 105.20 | 21.97 | 94.91 | 32.01 |
| **TTS** | RUS | 136.66 | 120.15 | 168.83 | 138.16 | 121.82 | 113.78 |
| | RS | 22.57 | 28.69 | 28.34 | 38.40 | 13.92 | 9.72 |
| **URINES** | RUS | 3.20 | 10.27 | 0.59 | 0.67 | 4.41 | 12.37 |
| | RS | 2.90 | 2.67 | 3.67 | 3.08 | 1.75 | 2.23 |
| **URINEW** | RUS | 0.18 | 0.58 | 0.03 | 0.07 | 0.24 | 0.69 |
| | RS | 1.67 | 2.52 | 2.78 | 2.84 | 0.00 | 0.00 |
| **URINtotal** | RUS | 1.90 | 4.78 | 0.61 | 0.65 | 2.50 | 5.73 |
| | RS | 1.77 | 1.24 | 2.44 | 1.00 | 0.75 | 0.82 |
| **VOCtotal** | RUS | 3.66 | 6.73 | 4.20 | 9.95 | 3.41 | 5.15 |
| | RS | 21.87 | 27.87 | 9.22 | 3.67 | 40.84 | 43.37 |
| **WA** | RUS | 0.08 | 0.05 | 0.08 | 0.04 | 0.08 | 0.05 |
| | RS | 0.05 | 0.03 | 0.04 | 0.02 | 0.07 | 0.03 |

**A8-2: Mean and Standard Deviations of Behavioral Responses from all treatments on 24 clouded leopards grouped by rearing.**

| | | ALL CATS | | MALE | | FEMALE | |
|---|---|---|---|---|---|---|---|
| **Behavioral Observation** | **Rearing** | **Mean** | **StDev** | **Mean** | **StDev** | **Mean** | **StDev** |
| **Age** | MR | 8.50 | 4.30 | 4.50 | 3.54 | 9.50 | 4.04 |
| | HR | 6.57 | 4.33 | 7.29 | 4.82 | 5.86 | 4.02 |
| **AP** | MR | 9.83 | 6.26 | 11.92 | 6.72 | 9.31 | 6.51 |
| | HR | 13.62 | 6.21 | 13.76 | 5.78 | 13.48 | 7.07 |
| **BI** | MR | 0.97 | 2.11 | 0.50 | 0.71 | 1.08 | 2.36 |
| | HR | 1.55 | 2.64 | 2.19 | 3.50 | 0.90 | 1.37 |
| **CL** | MR | 0.70 | 1.30 | 2.09 | 2.24 | 0.36 | 0.87 |
| | HR | 0.83 | 2.56 | 0.22 | 0.43 | 1.45 | 3.63 |
| **DEFAC** | MR | 0.02 | 0.05 | 0.00 | 0.00 | 0.02 | 0.06 |
| | HR | 0.02 | 0.06 | 0.05 | 0.08 | 0.00 | 0.00 |
| **FLE** | MR | 0.67 | 0.74 | 0.34 | 0.23 | 0.75 | 0.81 |
| | HR | 1.37 | 1.36 | 1.48 | 1.47 | 1.26 | 1.35 |
| **FLIN** | MR | 1.90 | 2.29 | 0.75 | 1.06 | 2.19 | 2.48 |
| | HR | 1.00 | 1.09 | 0.36 | 0.48 | 1.64 | 1.18 |
| **GH** | MR | 13.33 | 21.63 | 1.84 | 1.65 | 16.21 | 23.54 |
| | HR | 11.35 | 18.44 | 17.19 | 23.85 | 5.50 | 9.40 |
| **GR** | MR | 10.15 | 8.93 | 10.17 | 2.60 | 10.15 | 10.07 |
| | HR | 13.16 | 7.84 | 11.17 | 8.55 | 15.14 | 7.15 |
| **LAT** | MR | 62.94 | 75.02 | 28.42 | 40.18 | 71.57 | 81.12 |
| | HR | 92.75 | 109.88 | 96.26 | 130.53 | 89.24 | 95.34 |
| **LICK** | MR | 13.97 | 15.55 | 16.92 | 21.09 | 13.23 | 15.63 |
| | HR | 11.55 | 8.98 | 11.93 | 7.69 | 11.17 | 10.75 |
| **LY** | MR | 0.45 | 0.23 | 0.58 | 0.04 | 0.41 | 0.25 |
| | HR | 0.38 | 0.16 | 0.40 | 0.19 | 0.36 | 0.13 |
| **MEOW** | MR | 6.38 | 9.94 | 3.34 | 4.72 | 7.15 | 10.98 |
| | HR | 4.45 | 10.22 | 7.81 | 13.96 | 1.10 | 2.21 |
| **OOS** | MR | 0.19 | 0.22 | 0.03 | 0.04 | 0.23 | 0.24 |
| | HR | 0.16 | 0.21 | 0.19 | 0.29 | 0.13 | 0.09 |
| **PA** | MR | 0.01 | 0.03 | 0.05 | 0.06 | 0.00 | 0.00 |
| | HR | 0.01 | 0.02 | 0.01 | 0.01 | 0.01 | 0.02 |
| **PAT** | MR | 0.00 | 0.01 | 0.02 | 0.02 | 0.00 | 0.00 |
| | HR | 0.02 | 0.03 | 0.03 | 0.03 | 0.01 | 0.02 |
| **PRUSTEN** | MR | 5.98 | 13.54 | 0.17 | 0.23 | 7.44 | 14.96 |
| | HR | 2.79 | 7.18 | 4.45 | 9.94 | 1.12 | 2.54 |
| **PS** | MR | 17.14 | 40.55 | 0.75 | 0.35 | 21.23 | 44.92 |
| | HR | 7.39 | 18.49 | 11.62 | 26.10 | 3.17 | 4.23 |
| **ROL** | MR | 0.08 | 0.21 | 0.09 | 0.12 | 0.08 | 0.24 |
| | HR | 0.91 | 1.61 | 1.26 | 2.15 | 0.55 | 0.86 |
| **RT** | MR | 0.20 | 0.35 | 0.25 | 0.35 | 0.19 | 0.37 |
| | HR | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | ALL CATS | | MALE | | FEMALE | |
|---|---|---|---|---|---|---|---|
| **Behavioral Observation** | **Rearing** | **Mean** | **StDev** | **Mean** | **StDev** | **Mean** | **StDev** |
| **RU** | MR | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | HR | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **RUBother** | MR | 4.27 | 6.63 | 1.00 | 1.41 | 5.08 | 7.24 |
| | HR | 14.76 | 19.74 | 13.41 | 20.27 | 16.12 | 20.71 |
| **RUBtotal** | MR | 4.13 | 6.40 | 1.25 | 1.06 | 4.85 | 7.04 |
| | HR | 10.26 | 14.65 | 11.14 | 19.56 | 9.38 | 8.97 |
| **RUBtrial** | MR | 0.27 | 0.43 | 0.25 | 0.35 | 0.27 | 0.47 |
| | HR | 1.13 | 1.98 | 0.60 | 1.07 | 1.67 | 2.58 |
| **SIT** | MR | 0.13 | 0.07 | 0.09 | 0.04 | 0.14 | 0.08 |
| | HR | 0.14 | 0.09 | 0.09 | 0.07 | 0.19 | 0.08 |
| **SNIFFobject** | MR | 46.28 | 38.92 | 50.67 | 15.08 | 45.19 | 43.68 |
| | HR | 145.25 | 121.67 | 118.05 | 63.68 | 172.45 | 162.15 |
| **SNIFFtrial** | MR | 63.25 | 49.20 | 91.67 | 2.35 | 56.15 | 53.13 |
| | HR | 76.61 | 32.41 | 69.12 | 24.93 | 84.09 | 39.03 |
| **ST** | MR | 0.17 | 0.07 | 0.21 | 0.01 | 0.16 | 0.07 |
| | HR | 0.21 | 0.09 | 0.21 | 0.09 | 0.21 | 0.10 |
| **STEREO** | MR | 0.03 | 0.10 | 0.00 | 0.00 | 0.04 | 0.12 |
| | HR | 0.19 | 0.49 | 0.00 | 0.00 | 0.38 | 0.66 |
| **TIA** | MR | 342.03 | 237.62 | 200.26 | 224.68 | 377.47 | 241.25 |
| | HR | 223.18 | 177.55 | 227.72 | 213.21 | 218.64 | 151.00 |
| **TSI** | MR | 72.01 | 47.04 | 90.92 | 12.02 | 67.28 | 51.93 |
| | HR | 67.69 | 39.36 | 74.77 | 48.34 | 60.61 | 30.05 |
| **TTS** | MR | 95.45 | 120.69 | 30.92 | 40.60 | 111.58 | 130.41 |
| | HR | 125.36 | 117.14 | 148.02 | 138.38 | 102.69 | 96.85 |
| **URINES** | MR | 1.30 | 1.37 | 1.75 | 2.47 | 1.19 | 1.21 |
| | HR | 4.45 | 11.94 | 1.57 | 2.38 | 7.33 | 16.84 |
| **URINEW** | MR | 0.25 | 0.79 | 0.00 | 0.00 | 0.31 | 0.88 |
| | HR | 0.66 | 1.61 | 1.22 | 2.20 | 0.10 | 0.19 |
| **URINtotal** | MR | 0.95 | 0.86 | 0.75 | 1.06 | 1.00 | 0.88 |
| | HR | 2.54 | 5.52 | 1.36 | 1.23 | 3.71 | 7.83 |
| **VOCtotal** | MR | 11.75 | 21.76 | 2.50 | 3.54 | 14.06 | 24.01 |
| | HR | 4.38 | 7.10 | 6.83 | 9.41 | 1.93 | 2.60 |
| **WA** | MR | 0.06 | 0.04 | 0.04 | 0.03 | 0.06 | 0.04 |
| | HR | 0.09 | 0.05 | 0.07 | 0.04 | 0.10 | 0.06 |

**A8-3: Mean and Standard Deviations of Behavioral Responses from all treatments on 24 clouded leopards grouped by facility.**

| | | ALL CATS | | MALE | | FEMALE | |
|---|---|---|---|---|---|---|---|
| **Variable** | **Facility** | **Mean** | **StDev** | **Mean** | **StDev** | **Mean** | **StDev** |
| **Age** | KKOZ | 5.36 | 2.87 | 4.00 | 2.00 | 6.11 | 3.10 |
| | CRC | 10.20 | 4.57 | 10.00 | 4.76 | 10.33 | 4.89 |
| **AP** | KKOZ | 11.44 | 5.27 | 12.67 | 4.81 | 10.76 | 5.66 |
| | CRC | 12.88 | 7.92 | 14.21 | 7.14 | 12.00 | 8.94 |
| **BI** | KKOZ | 1.11 | 1.95 | 0.20 | 0.45 | 1.61 | 2.29 |
| | CRC | 1.58 | 3.02 | 3.83 | 4.02 | 0.08 | 0.14 |
| **CL** | KKOZ | 1.10 | 2.66 | 1.07 | 1.53 | 1.11 | 3.21 |
| | CRC | 0.33 | 0.78 | 0.09 | 0.10 | 0.50 | 1.00 |
| **DEFAC** | KKOZ | 0.02 | 0.06 | 0.07 | 0.09 | 0.00 | 0.00 |
| | CRC | 0.02 | 0.05 | 0.00 | 0.00 | 0.03 | 0.07 |
| **FLE** | KKOZ | 1.15 | 0.78 | 1.17 | 0.95 | 1.15 | 0.74 |
| | CRC | 0.97 | 1.62 | 1.29 | 1.95 | 0.75 | 1.51 |
| **FLIN** | KKOZ | 1.76 | 1.96 | 0.40 | 0.65 | 2.52 | 2.06 |
| | CRC | 0.83 | 1.18 | 0.50 | 0.58 | 1.06 | 1.46 |
| **GH** | KKOZ | 3.92 | 9.48 | 2.63 | 4.03 | 4.63 | 11.68 |
| | CRC | 23.73 | 24.03 | 27.71 | 27.80 | 21.09 | 23.54 |
| **GR** | KKOZ | 11.19 | 8.59 | 8.10 | 2.83 | 12.91 | 10.33 |
| | CRC | 12.90 | 8.12 | 14.50 | 10.38 | 11.83 | 7.11 |
| **LAT** | KKOZ | 44.47 | 58.23 | 13.19 | 24.49 | 61.85 | 65.25 |
| | CRC | 130.53 | 118.10 | 166.18 | 137.35 | 106.76 | 109.95 |
| **LICK** | KKOZ | 17.13 | 13.27 | 16.83 | 11.60 | 17.30 | 14.79 |
| | CRC | 6.15 | 5.45 | 8.29 | 6.77 | 4.72 | 4.45 |
| **LY** | KKOZ | 0.50 | 0.18 | 0.54 | 0.11 | 0.48 | 0.21 |
| | CRC | 0.28 | 0.12 | 0.31 | 0.17 | 0.26 | 0.07 |
| **MEOW** | KKOZ | 8.54 | 12.01 | 12.13 | 15.04 | 6.54 | 10.42 |
| | CRC | 0.67 | 1.89 | 0.17 | 0.34 | 1.00 | 2.45 |
| **OOS** | KKOZ | 0.10 | 0.16 | 0.02 | 0.02 | 0.14 | 0.19 |
| | CRC | 0.27 | 0.24 | 0.33 | 0.34 | 0.23 | 0.18 |
| **PA** | KKOZ | 0.01 | 0.03 | 0.02 | 0.04 | 0.01 | 0.02 |
| | CRC | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| **PAT** | KKOZ | 0.01 | 0.02 | 0.03 | 0.03 | 0.00 | 0.00 |
| | CRC | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 | 0.02 |
| **PRUSTEN** | KKOZ | 7.00 | 12.72 | 6.30 | 11.55 | 7.39 | 13.98 |
| | CRC | 0.08 | 0.26 | 0.00 | 0.00 | 0.14 | 0.34 |
| **PS** | KKOZ | 4.16 | 10.46 | 1.47 | 2.10 | 5.65 | 12.98 |
| | CRC | 21.67 | 42.93 | 18.88 | 34.55 | 23.53 | 50.90 |
| **ROL** | KKOZ | 0.07 | 0.18 | 0.03 | 0.08 | 0.09 | 0.22 |
| | CRC | 1.25 | 1.82 | 2.21 | 2.54 | 0.61 | 0.92 |
| **RT** | KKOZ | 0.14 | 0.31 | 0.10 | 0.22 | 0.17 | 0.35 |
| | CRC | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **RU** | KKOZ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | CRC | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **RUBother** | KKOZ | 7.94 | 14.44 | 3.03 | 5.16 | 10.67 | 17.39 |
| | CRC | 13.82 | 18.83 | 20.17 | 25.48 | 9.58 | 13.96 |
| **RUBtotal** | KKOZ | 5.38 | 7.25 | 1.53 | 1.61 | 7.52 | 8.35 |
| | CRC | 10.97 | 16.71 | 18.21 | 24.64 | 6.14 | 8.27 |
| **RUBtrial** | KKOZ | 0.58 | 1.56 | 0.10 | 0.22 | 0.85 | 1.92 |
| | CRC | 1.03 | 1.64 | 1.04 | 1.30 | 1.03 | 1.96 |
| **SIT** | KKOZ | 0.13 | 0.08 | 0.09 | 0.07 | 0.15 | 0.08 |
| | CRC | 0.15 | 0.09 | 0.09 | 0.07 | 0.19 | 0.07 |
| **SNIFFobject** | KKOZ | 66.14 | 39.89 | 68.10 | 30.86 | 65.06 | 45.89 |
| | CRC | 157.03 | 146.94 | 146.79 | 68.43 | 163.86 | 189.52 |
| **SNIFFtrial** | KKOZ | 78.11 | 40.91 | 75.50 | 16.30 | 79.56 | 50.79 |
| | CRC | 61.15 | 38.07 | 72.42 | 33.87 | 53.64 | 41.85 |
| **ST** | KKOZ | 0.20 | 0.07 | 0.26 | 0.06 | 0.16 | 0.06 |
| | CRC | 0.19 | 0.10 | 0.15 | 0.06 | 0.21 | 0.12 |
| **STEREO** | KKOZ | 0.02 | 0.09 | 0.00 | 0.00 | 0.04 | 0.11 |
| | CRC | 0.27 | 0.57 | 0.00 | 0.00 | 0.45 | 0.70 |
| **TIA** | KKOZ | 231.28 | 165.30 | 161.56 | 122.75 | 270.01 | 179.29 |
| | CRC | 330.69 | 255.49 | 296.69 | 272.98 | 353.36 | 266.92 |
| **TSI** | KKOZ | 87.49 | 31.51 | 94.37 | 26.23 | 83.67 | 34.97 |
| | CRC | 44.28 | 42.65 | 58.35 | 54.58 | 34.91 | 34.97 |
| **TTS** | KKOZ | 90.99 | 104.09 | 64.71 | 70.69 | 105.59 | 120.15 |
| | CRC | 143.56 | 132.38 | 193.61 | 164.28 | 110.19 | 109.59 |
| **URINES** | KKOZ | 1.73 | 2.14 | 2.33 | 2.85 | 1.39 | 1.73 |
| | CRC | 5.12 | 14.15 | 0.71 | 0.77 | 8.06 | 18.28 |
| **URINEW** | KKOZ | 0.79 | 1.68 | 1.67 | 2.52 | 0.30 | 0.83 |
| | CRC | 0.07 | 0.16 | 0.04 | 0.09 | 0.08 | 0.20 |
| **URINtotal** | KKOZ | 1.23 | 1.15 | 1.60 | 1.38 | 1.02 | 1.03 |
| | CRC | 2.78 | 6.55 | 0.75 | 0.74 | 4.14 | 8.45 |
| **VOCtotal** | KKOZ | 12.24 | 18.47 | 10.43 | 9.19 | 13.24 | 22.56 |
| | CRC | 0.75 | 1.87 | 0.17 | 0.34 | 1.14 | 2.40 |
| **WA** | KKOZ | 0.06 | 0.04 | 0.04 | 0.02 | 0.07 | 0.05 |
| | CRC | 0.09 | 0.05 | 0.09 | 0.05 | 0.09 | 0.06 |

Logistical Regression Analysis of Behavioral Observations

Hypothesis 18: Clouded leopard behaviors vary during testing depending on reproductive success.

**A8-4: Results of Logistical Regression with "success" as dependant variable**

| | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|
| Step 0 | Constant | -1.335 | .503 | 7.055 | 1 | .008 | .263 |

| | | | **Score** | **df** | **Sig** |
|---|---|---|---|---|---|
| Step 0 | Variables | **LAT** | **4.438** | **1** | ***.035** |
| | | **TTS** | **3.930** | **1** | ***.047** |
| | | TIA | 2.167 | 1 | .141 |
| | | TSI | 3.766 | 1 | .052 |
| | | **LY** | **5.558** | **1** | ***.018** |
| | | **OOS** | **4.026** | **1** | ***.045** |
| | | PA | 1.431 | 1 | .232 |
| | | RU | .275 | 1 | .600 |
| | | SIT | 1.428 | 1 | .232 |
| | | ST | .579 | 1 | .447 |
| | | WA | 1.855 | 1 | .173 |
| | | **PAT** | **4.418** | **1** | ***.036** |
| | | AP | .102 | 1 | .750 |
| | | BI | .935 | 1 | .334 |
| | | CL | .626 | 1 | .429 |
| | | FLE | .234 | 1 | .628 |
| | | FLIN | 1.176 | 1 | .278 |
| | | GR | .483 | 1 | .487 |
| | | GH | .113 | 1 | .737 |
| | | LICK | .142 | 1 | .707 |
| | | **VOCtotal** | **6.017** | **1** | ***.014** |
| | | **RT** | **5.337** | **1** | ***.021** |
| | | ROL | 1.258 | 1 | .262 |
| | | RUBtotal | 1.447 | 1 | .229 |
| | | PS | .079 | 1 | .778 |
| | | SNIFFStotal | .544 | 1 | .461 |
| | | URINtotal | .004 | 1 | .948 |
| | | STEREO | .706 | 1 | .401 |
| | | **DEFAC** | **4.367** | **1** | ***.037** |
| | | MEOW | 2.691 | 1 | .101 |
| | | PRUSTEN | 10.073 | 1 | *.002 |
| | | RUBother | 1.134 | 1 | .287 |
| | | RUBtrial | 1.582 | 1 | .209 |
| | | **URINEW** | **5.268** | **1** | ***.022** |
| | | URINES | .004 | 1 | .947 |
| | | SNIFFtrial | .189 | 1 | .664 |
| | | SNIFFobject | .473 | 1 | .492 |

*** indicates p<0.05**

Hypothesis 19: Clouded leopard behaviors vary during testing depending on sex.

**A8-5: Results of Logistical Regression with "sex" as dependant variable**

| | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|
| Step 0 | Constant | .511 | .422 | 1.468 | 1 | .226 | 1.667 |

| | | | Score | df | Sig. |
|---|---|---|---|---|---|
| Step 0 | Variables | LAT | .001 | 1 | .972 |
| | | TTS | .091 | 1 | .763 |
| | | TIA | .902 | 1 | .342 |
| | | TSI | .677 | 1 | .411 |
| | | LY | .428 | 1 | .513 |
| | | OOS | .085 | 1 | .771 |
| | | PA | .710 | 1 | .399 |
| | | RU | .626 | 1 | .429 |
| | | **SIT** | **5.011** | **1** | ***.025** |
| | | ST | .857 | 1 | .355 |
| | | WA | .570 | 1 | .450 |
| | | **PAT** | **5.229** | **1** | ***.022** |
| | | AP | .635 | 1 | .426 |
| | | BI | .674 | 1 | .412 |
| | | CL | .075 | 1 | .784 |
| | | FLE | .232 | 1 | .630 |
| | | **FLIN** | **4.428** | **1** | ***.035** |
| | | GR | .202 | 1 | .653 |
| | | GH | .103 | 1 | .749 |
| | | LICK | .025 | 1 | .875 |
| | | VOCtotal | .165 | 1 | .685 |
| | | RT | .200 | 1 | .655 |
| | | ROL | 1.732 | 1 | .188 |
| | | RUBtotal | .156 | 1 | .692 |
| | | PS | .088 | 1 | .766 |
| | | SNIFFStotal | .005 | 1 | .946 |
| | | URINtotal | .352 | 1 | .553 |
| | | STEREO | 1.611 | 1 | .204 |
| | | DEFAC | 1.244 | 1 | .265 |
| | | MEOW | .370 | 1 | .543 |
| | | PRUSTEN | .056 | 1 | .814 |
| | | RUBother | .004 | 1 | .951 |
| | | RUBtrial | .384 | 1 | .535 |
| | | URINEW | 1.813 | 1 | .178 |
| | | URINES | .418 | 1 | .518 |
| | | SNIFFtrial | .090 | 1 | .764 |
| | | SNIFFobject | .001 | 1 | .973 |

*** indicates p<0.05**

Hypothesis 20: Clouded leopard behaviors vary during testing depending on whether they were MR versus HR-rearing.

**A8-6: Results of Logistical Regression with "rearing" as dependant variable**

| | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|
| Step 0 | Constant | -.336 | .414 | .660 | 1 | .416 | .714 |

| | | | Score | df | Sig. |
|---|---|---|---|---|---|
| Step 0 | Variables | **LAT** | **4.872** | **1** | ***.027** |
| | | TTS | 1.229 | 1 | .268 |
| | | TIA | 1.383 | 1 | .240 |
| | | **TSI** | **6.508** | **1** | ***.011** |
| | | **LY** | **8.252** | **1** | ***.004** |
| | | **OOS** | **3.913** | **1** | ***.048** |
| | | PA | .239 | 1 | .625 |
| | | RU | 1.461 | 1 | .227 |
| | | SIT | .469 | 1 | .493 |
| | | ST | .084 | 1 | .771 |
| | | WA | 2.825 | 1 | .093 |
| | | PAT | .143 | 1 | .705 |
| | | AP | .311 | 1 | .577 |
| | | BI | .239 | 1 | .625 |
| | | CL | .809 | 1 | .369 |
| | | FLE | .154 | 1 | .694 |
| | | FLIN | 1.783 | 1 | .182 |
| | | GR | .260 | 1 | .610 |
| | | GH | 6.352 | 1 | .012 |
| | | **LICK** | **5.179** | **1** | ***.023** |
| | | VOCtotal | 3.530 | 1 | .060 |
| | | RT | 2.143 | 1 | .143 |
| | | **ROL** | **5.087** | **1** | ***.024** |
| | | RUBtotal | 1.295 | 1 | .255 |
| | | PS | 2.168 | 1 | .141 |
| | | SNIFFStotal | 2.195 | 1 | .138 |
| | | URINtotal | .814 | 1 | .367 |
| | | STEREO | 2.474 | 1 | .116 |
| | | DEFAC | .098 | 1 | .754 |
| | | MEOW | 3.823 | 1 | .051 |
| | | PRUSTEN | 2.813 | 1 | .094 |
| | | RUBother | .792 | 1 | .373 |
| | | RUBtrial | .499 | 1 | .480 |
| | | URINEW | 1.805 | 1 | .179 |
| | | URINES | .835 | 1 | .361 |
| | | SNIFFtrial | 1.104 | 1 | .293 |
| | | **SNIFFobject** | **4.394** | **1** | ***.036** |

Hypothesis 21: Clouded leopard behaviors vary during testing depending on facility.

**A8-7: Results of Logistical Regression with "facility" as dependant variable**

| | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|
| Step 0 | Constant | .336 | .414 | .660 | 1 | .416 | 1.400 |

| | | | Score | df | Sig. |
|---|---|---|---|---|---|
| Step 0 | Variables | LAT | .585 | 1 | .444 |
| | | TTS | .398 | 1 | .528 |
| | | TIA | 1.977 | 1 | .160 |
| | | TSI | .065 | 1 | .799 |
| | | LY | .721 | 1 | .396 |
| | | OOS | .122 | 1 | .727 |
| | | PA | .006 | 1 | .937 |
| | | RU | .745 | 1 | .388 |
| | | SIT | .040 | 1 | .842 |
| | | ST | 1.530 | 1 | .216 |
| | | WA | 2.023 | 1 | .155 |
| | | PAT | 3.238 | 1 | .072 |
| | | AP | 2.142 | 1 | .143 |
| | | BI | .355 | 1 | .552 |
| | | CL | .025 | 1 | .875 |
| | | FLE | 2.177 | 1 | .140 |
| | | FLIN | 1.674 | 1 | .196 |
| | | GR | .806 | 1 | .369 |
| | | GH | .064 | 1 | .800 |
| | | LICK | .251 | 1 | .616 |
| | | VOCtotal | 1.452 | 1 | .228 |
| | | **RT** | **4.200** | **1** | ***.040** |
| | | ROL | 2.472 | 1 | .116 |
| | | RUBtotal | 1.559 | 1 | .212 |
| | | PS | .671 | 1 | .413 |
| | | URINtotal | .844 | 1 | .358 |
| | | STEREO | 1.039 | 1 | .308 |
| | | DEFAC | .098 | 1 | .754 |
| | | MEOW | .230 | 1 | .631 |
| | | PRUSTEN | .602 | 1 | .438 |
| | | RUBother | 2.527 | 1 | .112 |
| | | RUBtrial | 1.840 | 1 | .175 |
| | | URINEW | .574 | 1 | .449 |
| | | URINES | .722 | 1 | .395 |
| | | SNIFFtrial | .685 | 1 | .408 |
| | | **SNIFFobject** | **5.210** | **1** | ***.022** |

*** indicates p<0.05**

Hypothesis 22: Reproductively RS male clouded leopards exhibit specific behaviors during testing.

**A8-8: Results of Logistical Regression of male clouded leopards with "success" as dependant variable.**

| | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|
| Step 0 | Constant | -.693 | .707 | .961 | 1 | .327 | .500 |

| | | | Score | df | Sig. |
|---|---|---|---|---|---|
| Step 0 | Variables | LAT | 2.341 | 1 | .126 |
| | | TTS | 2.577 | 1 | .108 |
| | | TIA | 2.244 | 1 | .134 |
| | | TSI | 2.002 | 1 | .157 |
| | | LY | .715 | 1 | .398 |
| | | OOS | 1.580 | 1 | .209 |
| | | PA | 1.357 | 1 | .244 |
| | | SIT | 1.556 | 1 | .212 |
| | | ST | .843 | 1 | .359 |
| | | WA | 2.596 | 1 | .107 |
| | | **PAT** | **4.500** | **1** | ***.034** |
| | | AP | .213 | 1 | .644 |
| | | BI | 1.696 | 1 | .193 |
| | | CL | .756 | 1 | .385 |
| | | FLE | .034 | 1 | .854 |
| | | FLIN | 1.148 | 1 | .284 |
| | | GR | .618 | 1 | .432 |
| | | GH | .989 | 1 | .320 |
| | | LICK | 3.552 | 1 | .059 |
| | | VOCtotal | .795 | 1 | .373 |
| | | RT | .563 | 1 | .453 |
| | | ROL | 1.359 | 1 | .244 |
| | | RUBtotal | .760 | 1 | .383 |
| | | PS | .737 | 1 | .391 |
| | | SNIFFStotal | 1.794 | 1 | .180 |
| | | **URINtotal** | **5.576** | **1** | ***.018** |
| | | **DEFAC** | **5.143** | **1** | ***.023** |
| | | MEOW | .082 | 1 | .774 |
| | | PRUSTEN | 2.893 | 1 | .089 |
| | | RUBother | .506 | 1 | .477 |
| | | RUBtrial | 1.507 | 1 | .220 |
| | | **URINEW** | **4.360** | **1** | ***.037** |
| | | **URINES** | **4.250** | **1** | ***.039** |
| | | SNIFFtrial | .052 | 1 | .820 |
| | | SNIFFobject | 2.184 | 1 | .139 |

*** indicates p<0.05**

Hypothesis 23: Reproductively RS female clouded leopards exhibit specific behaviors during testing.

**A8-9: Results of Logistical Regression of female clouded leopards with "success" as dependant variable.**

| | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|
| Step 0 | Constant | -1.872 | .760 | 6.073 | 1 | ***.014** | .154 |

| | | | Score | df | Sig. |
|---|---|---|---|---|---|
| Step 0 | Variables | LAT | 2.066 | 1 | .151 |
| | | TTS | 1.724 | 1 | .189 |
| | | TIA | .146 | 1 | .702 |
| | | TSI | 1.337 | 1 | .248 |
| | | **LY** | **5.817** | **1** | ***.016** |
| | | OOS | 2.339 | 1 | .126 |
| | | PA | .024 | 1 | .876 |
| | | RU | .165 | 1 | .685 |
| | | **SIT** | **4.190** | **1** | ***.041** |
| | | ST | .004 | 1 | .948 |
| | | WA | .098 | 1 | .754 |
| | | PAT | .223 | 1 | .636 |
| | | AP | .044 | 1 | .833 |
| | | BI | .000 | 1 | 1.000 |
| | | CL | .239 | 1 | .625 |
| | | FLE | .736 | 1 | .391 |
| | | **FLIN** | **6.205** | **1** | ***.013** |
| | | GR | .021 | 1 | .886 |
| | | GH | .314 | 1 | .575 |
| | | LICK | 1.142 | 1 | .285 |
| | | **VOCtotal** | **7.871** | **1** | ***.005** |
| | | **RT** | **13.295** | **1** | ***.000** |
| | | ROL | .556 | 1 | .456 |
| | | RUBtotal | 1.008 | 1 | .315 |
| | | PS | .116 | 1 | .733 |
| | | SNIFFStotal | .070 | 1 | .791 |
| | | URINtotal | .199 | 1 | .656 |
| | | STEREO | .443 | 1 | .506 |
| | | DEFAC | .165 | 1 | .685 |
| | | **MEOW** | **5.018** | **1** | ***.025** |
| | | **PRUSTEN** | **9.560** | **1** | ***.002** |
| | | RUBother | .720 | 1 | .396 |
| | | RUBtrial | .603 | 1 | .438 |
| | | URINEW | .264 | 1 | .607 |
| | | URINES | .099 | 1 | .753 |
| | | SNIFFtrial | .279 | 1 | .597 |
| | | SNIFFobject | .012 | 1 | .914 |

Hypothesis 24: Male clouded leopards exhibit specific behaviors during testing depending on rearing.

**A8-10: Results of Logistical Regression of male clouded leopards with "rearing" as dependant variable**

| | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|
| Step 0 | Constant | 1.253 | .802 | 2.441 | 1 | .118 | 3.500 |

| | | | Score | df | Sig. |
|---|---|---|---|---|---|
| Step 0 | Variables | LAT | .581 | 1 | .446 |
| | | TTS | 1.392 | 1 | .238 |
| | | TIA | .033 | 1 | .857 |
| | | TSI | .251 | 1 | .617 |
| | | LY | 1.772 | 1 | .183 |
| | | OOS | .640 | 1 | .424 |
| | | PA | 2.992 | 1 | .084 |
| | | SIT | .011 | 1 | .915 |
| | | ST | .001 | 1 | .981 |
| | | WA | 1.161 | 1 | .281 |
| | | PAT | .492 | 1 | .483 |
| | | AP | .190 | 1 | .663 |
| | | BI | .509 | 1 | .476 |
| | | **CL** | **4.231** | **1** | ***.040** |
| | | FLE | 1.210 | 1 | .271 |
| | | FLIN | .794 | 1 | .373 |
| | | GR | .031 | 1 | .859 |
| | | GH | .873 | 1 | .350 |
| | | LICK | .415 | 1 | .519 |
| | | VOCtotal | .459 | 1 | .498 |
| | | **RT** | **3.937** | **1** | ***.047** |
| | | ROL | .651 | 1 | .420 |
| | | RUBtotal | .560 | 1 | .454 |
| | | PS | .387 | 1 | .534 |
| | | SNIFFStotal | .653 | 1 | .419 |
| | | URINtotal | .476 | 1 | .490 |
| | | DEFAC | .735 | 1 | .391 |
| | | MEOW | .229 | 1 | .632 |
| | | PRUSTEN | .414 | 1 | .520 |
| | | RUBother | .796 | 1 | .372 |
| | | RUBtrial | .231 | 1 | .631 |
| | | URINEW | .662 | 1 | .416 |
| | | URINES | .011 | 1 | .917 |
| | | SNIFFtrial | 1.573 | 1 | .210 |
| | | SNIFFobject | 2.010 | 1 | .156 |

*** indicates p<0.05**

Hypothesis 25: Female clouded leopards exhibit specific behaviors during testing depending on rearing.

**A8-11: Results of Logistical Regression on female clouded leopard behavioral observations with "rearing" as dependant variable.**

| | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|
| Step 0 | Constant | -.134 | .518 | .067 | 1 | .796 | .875 |

| | | | Score | df | Sig. |
|---|---|---|---|---|---|
| Step 0 | Variables | LAT | .172 | 1 | .678 |
| | | TTS | .025 | 1 | .874 |
| | | TIA | 2.213 | 1 | .137 |
| | | TSI | .102 | 1 | .749 |
| | | LY | .261 | 1 | .609 |
| | | OOS | 1.210 | 1 | .271 |
| | | PA | 1.918 | 1 | .166 |
| | | RU | 1.224 | 1 | .268 |
| | | SIT | 1.180 | 1 | .277 |
| | | ST | 1.310 | 1 | .252 |
| | | WA | 1.929 | 1 | .165 |
| | | PAT | 1.660 | 1 | .198 |
| | | AP | 1.468 | 1 | .226 |
| | | BI | .036 | 1 | .850 |
| | | CL | .760 | 1 | .383 |
| | | FLE | .901 | 1 | .343 |
| | | FLIN | .315 | 1 | .575 |
| | | GR | 1.260 | 1 | .262 |
| | | GH | 1.327 | 1 | .249 |
| | | LICK | .099 | 1 | .754 |
| | | VOCtotal | 1.782 | 1 | .182 |
| | | RT | 1.790 | 1 | .181 |
| | | ROL | 2.150 | 1 | .143 |
| | | RUBtotal | 1.269 | 1 | .260 |
| | | PS | 1.183 | 1 | .277 |
| | | URINtotal | 1.030 | 1 | .310 |
| | | STEREO | 2.072 | 1 | .150 |
| | | DEFAC | .938 | 1 | .333 |
| | | MEOW | 2.031 | 1 | .154 |
| | | PRUSTEN | 1.275 | 1 | .259 |
| | | RUBother | 2.008 | 1 | .156 |
| | | RUBtrial | 2.238 | 1 | .135 |
| | | URINEW | .449 | 1 | .503 |
| | | URINES | 1.141 | 1 | .285 |
| | | SNIFFtrial | 1.375 | 1 | .241 |
| | | **SNIFFobject** | **3.917** | **1** | ***.048** |

*** indicates p<0.05**

Hypothesis 26: Male clouded leopards exhibit specific behaviors during testing depending on facility.

**A8-12: Results of Logistical Regression on male clouded leopard behavioral observations with "facility" as dependant variable.**

| | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|
| Step 0 | Constant | -.223 | .671 | .111 | 1 | .739 | .800 |

| | | | Score | df | Sig. |
|---|---|---|---|---|---|
| Step 0 | Variables | **LAT** | **4.217** | **1** | ***.040** |
| | | TTS | 2.410 | 1 | .121 |
| | | TIA | 1.126 | 1 | .289 |
| | | TSI | 1.781 | 1 | .182 |
| | | **LY** | **4.139** | **1** | ***.042** |
| | | OOS | 3.368 | 1 | .066 |
| | | PA | .177 | 1 | .674 |
| | | SIT | .032 | 1 | .859 |
| | | **ST** | **4.462** | **1** | ***.035** |
| | | WA | 3.613 | 1 | .057 |
| | | PAT | .450 | 1 | .502 |
| | | AP | .189 | 1 | .664 |
| | | BI | 3.356 | 1 | .067 |
| | | CL | 1.672 | 1 | .196 |
| | | FLE | .021 | 1 | .884 |
| | | FLIN | .073 | 1 | .786 |
| | | GR | 1.835 | 1 | .176 |
| | | GH | 3.325 | 1 | .068 |
| | | LICK | 1.740 | 1 | .187 |
| | | VOCtotal | 3.681 | 1 | .055 |
| | | RT | .900 | 1 | .343 |
| | | ROL | 3.172 | 1 | .075 |
| | | RUBtotal | 2.271 | 1 | .132 |
| | | PS | 1.419 | 1 | .234 |
| | | URINtotal | 1.334 | 1 | .248 |
| | | DEFAC | 2.057 | 1 | .151 |
| | | MEOW | 2.341 | 1 | .126 |
| | | PRUSTEN | 1.276 | 1 | .259 |
| | | RUBother | 2.170 | 1 | .141 |
| | | RUBtrial | 2.456 | 1 | .117 |
| | | URINEW | 1.690 | 1 | .194 |
| | | URINES | 1.311 | 1 | .252 |
| | | SNIFFtrial | .042 | 1 | .838 |
| | | **SNIFFobject** | **3.917** | **1** | ***.048** |

*** indicates p<0.05**

Hypothesis 27: Female clouded leopards exhibit specific behaviors during testing depending on facility.

**A8-13: Results of Logistical Regression on female clouded leopard behavioral observations with "facility" as dependant variable.**

| | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|
| Step 0 | Constant | -.405 | .527 | .592 | 1 | .442 | .667 |

| | | | Score | df | Sig. |
|---|---|---|---|---|---|
| Step 0 | Variables | LAT | 1.070 | 1 | .301 |
| | | TTS | .007 | 1 | .936 |
| | | TIA | .588 | 1 | .443 |
| | | **TSI** | **5.250** | **1** | ***.022** |
| | | **LY** | **4.663** | **1** | ***.031** |
| | | OOS | .890 | 1 | .345 |
| | | PA | .106 | 1 | .745 |
| | | RU | 1.607 | 1 | .205 |
| | | SIT | 1.285 | 1 | .257 |
| | | ST | 1.069 | 1 | .301 |
| | | WA | .758 | 1 | .384 |
| | | PAT | 2.179 | 1 | .140 |
| | | AP | .126 | 1 | .723 |
| | | BI | 2.495 | 1 | .114 |
| | | CL | .228 | 1 | .633 |
| | | FLE | .520 | 1 | .471 |
| | | FLIN | 2.202 | 1 | .138 |
| | | GR | .056 | 1 | .812 |
| | | GH | 3.023 | 1 | .082 |
| | | LICK | 3.531 | 1 | .060 |
| | | VOCtotal | 1.710 | 1 | .191 |
| | | RT | 1.364 | 1 | .243 |
| | | ROL | 2.578 | 1 | .108 |
| | | RUBtotal | .112 | 1 | .737 |
| | | PS | 1.117 | 1 | .291 |
| | | URINtotal | 1.314 | 1 | .252 |
| | | STEREO | 2.879 | 1 | .090 |
| | | DEFAC | 1.607 | 1 | .205 |
| | | MEOW | 1.640 | 1 | .200 |
| | | PRUSTEN | 1.619 | 1 | .203 |
| | | RUBother | .019 | 1 | .891 |
| | | RUBtrial | .034 | 1 | .853 |
| | | URINEW | .419 | 1 | .517 |
| | | URINES | 1.295 | 1 | .255 |
| | | SNIFFtrial | 1.140 | 1 | .286 |
| | | SNIFFobject | 2.276 | 1 | .131 |

*** indicates p<0.05**

Hypothesis 28: Reproductively RS clouded leopards exhibit specific behaviors during testing regardless of facility.

**A8-14: Results of Logistical Regression on individuals at KKOZ from behavioral observations with "success" as dependant variable.**

| | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|
| Step 0 | Constant | -.588 | .558 | 1.111 | 1 | .292 | .556 |

| | | | Score | df | Sig. |
|---|---|---|---|---|---|
| Step 0 | Variables | **LAT** | **4.584** | **1** | ***.032** |
| | | TTS | 3.619 | 1 | .057 |
| | | TIA | 1.874 | 1 | .171 |
| | | TSI | 1.558 | 1 | .212 |
| | | LY | 1.745 | 1 | .186 |
| | | OOS | 2.848 | 1 | .091 |
| | | PA | .802 | 1 | .370 |
| | | SIT | 1.054 | 1 | .305 |
| | | ST | .688 | 1 | .407 |
| | | WA | .712 | 1 | .399 |
| | | **PAT** | **6.086** | **1** | ***.014** |
| | | AP | .587 | 1 | .444 |
| | | BI | 1.106 | 1 | .293 |
| | | CL | 1.098 | 1 | .295 |
| | | FLE | .281 | 1 | .596 |
| | | FLIN | .248 | 1 | .619 |
| | | GR | .264 | 1 | .608 |
| | | GH | 3.044 | 1 | .081 |
| | | LICK | .381 | 1 | .537 |
| | | VOCtotal | 2.277 | 1 | .131 |
| | | RT | 2.214 | 1 | .137 |
| | | ROL | 1.306 | 1 | .253 |
| | | RUBtotal | 1.788 | 1 | .181 |
| | | PS | 1.272 | 1 | .259 |
| | | URINtotal | 1.856 | 1 | .173 |
| | | STEREO | .598 | 1 | .439 |
| | | **DEFAC** | **4.200** | **1** | ***.040** |
| | | MEOW | .546 | 1 | .460 |
| | | **PRUSTEN** | **4.872** | **1** | ***.027** |
| | | RUBother | .745 | 1 | .388 |
| | | RUBtrial | 1.174 | 1 | .279 |
| | | URINEW | 2.293 | 1 | .130 |
| | | URINES | 2.528 | 1 | .112 |
| | | SNIFFtrial | .954 | 1 | .329 |
| | | SNIFFobject | .448 | 1 | .503 |

*** indicates p<0.05**

Hypothesis 29: Reproductively RS males exhibit specific behaviors during testing regardless of facility.

**A8-15: Results of Logistical Regression of males at KKOZ with "success" as dependant variable.**

| | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|
| Step 0 | Constant | .405 | .913 | .197 | 1 | .657 | 1.500 |

| | | | Score | df | Sig. |
|---|---|---|---|---|---|
| Step 0 | Variables | LAT | 2.292 | 1 | .130 |
| | | TTS | 2.483 | 1 | .115 |
| | | TIA | 3.409 | 1 | .065 |
| | | TSI | 1.598 | 1 | .206 |
| | | LY | .954 | 1 | .329 |
| | | OOS | 1.942 | 1 | .163 |
| | | PA | .833 | 1 | .361 |
| | | SIT | 2.059 | 1 | .151 |
| | | WA | 1.528 | 1 | .216 |
| | | **PAT** | **3.988** | **1** | ***.046** |
| | | AP | 1.363 | 1 | .243 |
| | | BI | 1.875 | 1 | .171 |
| | | CL | 3.246 | 1 | .072 |
| | | FLE | .033 | 1 | .857 |
| | | FLIN | 1.201 | 1 | .273 |
| | | GR | .064 | 1 | .801 |
| | | GH | 1.355 | 1 | .244 |
| | | LICK | 1.589 | 1 | .207 |
| | | VOCtotal | .163 | 1 | .687 |
| | | RT | 1.875 | 1 | .171 |
| | | ROL | 1.875 | 1 | .171 |
| | | RUBtotal | 1.439 | 1 | .230 |
| | | PS | 2.469 | 1 | .116 |
| | | URINtotal | 3.520 | 1 | .061 |
| | | DEFAC | 2.222 | 1 | .136 |
| | | MEOW | .581 | 1 | .446 |
| | | PRUSTEN | 1.050 | 1 | .306 |
| | | RUBother | 1.138 | 1 | .286 |
| | | RUBtrial | 1.875 | 1 | .171 |
| | | URINEW | 1.828 | 1 | .176 |
| | | URINES | 2.046 | 1 | .153 |
| | | SNIFFtrial | .503 | 1 | .478 |
| | | SNIFFobject | .394 | 1 | .530 |

*** indicates p<0.05**

Hypothesis 30: Reproductively RS female clouded leopards exhibit specific behaviors during testing regardless of facility.

**A8-16: Results of Logistical Regression from behavioral observations of females at KKOZ with "success" as dependant variable.**

| | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|
| Step 0 | Constant | -1.253 | .802 | 2.441 | 1 | .118 | .286 |

| | | | Score | df | Sig. |
|---|---|---|---|---|---|
| Step 0 | Variables | LAT | 2.444 | 1 | .118 |
| | | TTS | 1.684 | 1 | .194 |
| | | TIA | .031 | 1 | .860 |
| | | TSI | .298 | 1 | .585 |
| | | LY | 3.065 | 1 | .080 |
| | | OOS | 1.647 | 1 | .199 |
| | | PA | .057 | 1 | .812 |
| | | SIT | 3.002 | 1 | .083 |
| | | WA | .002 | 1 | .967 |
| | | AP | .016 | 1 | .899 |
| | | BI | .206 | 1 | .650 |
| | | CL | .296 | 1 | .586 |
| | | FLE | .981 | 1 | .322 |
| | | **FLIN** | **4.188** | **1** | ***.041** |
| | | GR | .042 | 1 | .838 |
| | | GH | 3.698 | 1 | .054 |
| | | LICK | 2.578 | 1 | .108 |
| | | **VOCtotal** | **4.329** | **1** | ***.037** |
| | | **RT** | **7.875** | **1** | ***.005** |
| | | ROL | .505 | 1 | .477 |
| | | RUBtotal | 1.343 | 1 | .246 |
| | | PS | 3.533 | 1 | .060 |
| | | URINtotal | .194 | 1 | .660 |
| | | STEREO | .321 | 1 | .571 |
| | | MEOW | 2.600 | 1 | .107 |
| | | **PRUSTEN** | **5.403** | **1** | ***.020** |
| | | RUBother | .747 | 1 | .387 |
| | | RUBtrial | .569 | 1 | .451 |
| | | URINEW | .371 | 1 | .542 |
| | | URINES | .127 | 1 | .722 |
| | | SNIFFtrial | .781 | 1 | .377 |
| | | SNIFFobject | 1.294 | 1 | .255 |

*** indicates p<0.05**

APPENDIX IX

Results of Behavioral observations grouped by specific treatment obtained from the total 18 different treatments of 24 individual clouded leopards

**A9-1: Mean and Standard Deviations of Behavioral Responses from control treatments on 24 clouded leopards grouped by "success".**

| | | CONTROL | | | | | |
|---|---|---|---|---|---|---|---|
| | | ALL CATS | | MALE | | FEMALE | |
| Behavioral Observation | Success | Mean | StDev | Mean | StDev | Mean | StDev |
| AP | RUS | 5.12 | 4.73 | 5.78 | 6.46 | 4.82 | 3.98 |
| | RS | 2.40 | 1.46 | 3.11 | 0.77 | 1.34 | 1.89 |
| BI | RUS | 0.21 | 0.50 | 0.22 | 0.54 | 0.20 | 0.50 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| CL | RUS | 0.35 | 0.98 | 0.22 | 0.54 | 0.41 | 1.14 |
| | RS | 0.27 | 0.59 | 0.44 | 0.77 | 0.00 | 0.00 |
| DEFAC | RUS | 0.07 | 0.31 | 0.00 | 0.00 | 0.10 | 0.37 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FLEH | RUS | 0.28 | 0.95 | 0.67 | 1.63 | 0.10 | 0.37 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FLIN | RUS | 0.07 | 0.31 | 0.00 | 0.00 | 0.10 | 0.37 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| GROOM | RUS | 5.96 | 5.36 | 3.34 | 3.35 | 7.18 | 5.77 |
| | RS | 9.07 | 4.46 | 8.00 | 5.33 | 10.67 | 3.77 |
| GROWL | RUS | 5.68 | 10.67 | 5.78 | 7.94 | 5.64 | 12.01 |
| | RS | 2.67 | 5.96 | 4.44 | 7.70 | 0.00 | 0.00 |
| LAT | RUS | 133.05 | 171.78 | 153.56 | 158.85 | 123.59 | 182.87 |
| | RS | 2.20 | 2.14 | 1.89 | 1.84 | 2.67 | 3.30 |
| LICK | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| LY | RUS | 0.36 | 0.26 | 0.36 | 0.33 | 0.36 | 0.24 |
| | RS | 0.73 | 0.16 | 0.66 | 0.18 | 0.84 | 0.05 |
| MEOW | RUS | 2.11 | 5.94 | 1.78 | 4.36 | 2.26 | 6.70 |
| | RS | 12.00 | 20.22 | 4.44 | 7.70 | 23.34 | 33.00 |
| OOS | RUS | 0.27 | 0.31 | 0.33 | 0.41 | 0.24 | 0.27 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PA | RUS | 0.02 | 0.05 | 0.03 | 0.08 | 0.01 | 0.03 |
| | RS | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 |

| Behavioral Observation | Success | Mean | StDev | Mean | StDev | Mean | StDev |
|---|---|---|---|---|---|---|---|
| PAT | RUS | 0.01 | 0.03 | 0.03 | 0.05 | 0.00 | 0.00 |
| | RS | 0.01 | 0.03 | 0.02 | 0.04 | 0.00 | 0.00 |
| PAW | RUS | 7.72 | 30.78 | 0.67 | 1.63 | 10.97 | 37.20 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PRUSTEN | RUS | 0.21 | 0.67 | 0.00 | 0.00 | 0.31 | 0.80 |
| | RS | 15.73 | 30.72 | 2.22 | 0.77 | 36.00 | 49.03 |
| RETREAT | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| ROLL | RUS | 0.21 | 0.67 | 0.00 | 0.00 | 0.31 | 0.80 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| RU | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| RUBother | RUS | 12.49 | 29.34 | 23.11 | 51.56 | 7.59 | 10.07 |
| | RS | 1.07 | 2.38 | 0.00 | 0.00 | 2.67 | 3.77 |
| RUBtotal | RUS | 12.56 | 29.31 | 23.33 | 51.45 | 7.59 | 10.07 |
| | RS | 1.07 | 2.38 | 0.00 | 0.00 | 2.67 | 3.77 |
| RUBtrial | RUS | 0.07 | 0.31 | 0.22 | 0.54 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SIT | RUS | 0.12 | 0.11 | 0.05 | 0.07 | 0.16 | 0.10 |
| | RS | 0.11 | 0.08 | 0.14 | 0.09 | 0.06 | 0.05 |
| SNIFFother | RUS | 67.16 | 102.64 | 118.00 | 161.26 | 43.69 | 55.47 |
| | RS | 18.93 | 22.34 | 12.44 | 4.28 | 28.67 | 40.54 |
| Snifftrial | RUS | 25.05 | 26.73 | 22.00 | 26.27 | 26.46 | 27.88 |
| | RS | 13.07 | 13.68 | 17.34 | 16.17 | 6.67 | 9.43 |
| ST | RUS | 0.13 | 0.11 | 0.10 | 0.08 | 0.14 | 0.12 |
| | RS | 0.12 | 0.05 | 0.14 | 0.06 | 0.08 | 0.01 |
| STEREO | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TIA | RUS | 393.08 | 245.13 | 404.39 | 309.76 | 387.86 | 223.74 |
| | RS | 497.67 | 265.33 | 328.45 | 106.60 | 751.50 | 210.01 |
| TSI | RUS | 7.17 | 7.41 | 7.39 | 9.31 | 7.06 | 6.80 |
| | RS | 3.07 | 2.76 | 4.45 | 2.67 | 1.00 | 1.41 |
| TTS | RUS | 171.51 | 196.00 | 246.28 | 224.72 | 137.00 | 180.26 |
| | RS | 21.66 | 23.15 | 24.89 | 29.61 | 16.83 | 17.68 |
| URINEs | RUS | 1.26 | 2.06 | 0.45 | 1.09 | 1.64 | 2.32 |
| | RS | 0.53 | 0.73 | 0.89 | 0.77 | 0.00 | 0.00 |
| URINEw | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| URINtotal | RUS | 1.26 | 2.06 | 0.45 | 1.09 | 1.64 | 2.32 |
| | RS | 0.53 | 0.73 | 0.89 | 0.77 | 0.00 | 0.00 |
| VOCAL | RUS | 2.32 | 6.53 | 1.78 | 4.36 | 2.56 | 7.47 |
| | RS | 27.73 | 50.47 | 6.67 | 8.11 | 59.33 | 82.02 |
| WA | RUS | 0.08 | 0.10 | 0.10 | 0.12 | 0.08 | 0.09 |
| | RS | 0.03 | 0.03 | 0.02 | 0.04 | 0.03 | 0.01 |

**A9-2: Mean and Standard Deviations of Behavioral Responses from blood treatments on 24 clouded leopards grouped by "success".**

| | | BLOOD | | | | | |
|---|---|---|---|---|---|---|---|
| | | ALL CATS | | MALE | | FEMALE | |
| Behavioral Observation | Success | Mean | StDev | Mean | StDev | Mean | StDev |
| AP | RUS | 7.02 | 4.82 | 7.11 | 6.18 | 6.97 | 4.36 |
| | RS | 6.14 | 3.07 | 7.11 | 3.36 | 4.67 | 2.83 |
| BI | RUS | 0.49 | 1.49 | 0.89 | 2.18 | 0.31 | 1.11 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| CL | RUS | 0.56 | 1.85 | 0.44 | 0.69 | 0.62 | 2.22 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| DEFAC | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.27 | 0.59 | 0.44 | 0.77 | 0.00 | 0.00 |
| FLEH | RUS | 0.49 | 1.11 | 0.22 | 0.54 | 0.62 | 1.29 |
| | RS | 0.27 | 0.59 | 0.44 | 0.77 | 0.00 | 0.00 |
| FLIN | RUS | 0.28 | 1.22 | 0.00 | 0.00 | 0.41 | 1.48 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| GROOM | RUS | 8.56 | 6.42 | 9.33 | 8.09 | 8.21 | 5.83 |
| | RS | 8.80 | 9.69 | 11.11 | 12.95 | 5.33 | 0.00 |
| GROWL | RUS | 3.44 | 7.73 | 6.67 | 12.16 | 1.95 | 4.51 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| LAT | RUS | 102.32 | 168.78 | 112.50 | 254.56 | 97.62 | 125.12 |
| | RS | 0.53 | 1.02 | 0.00 | 0.00 | 1.33 | 1.41 |
| LICK | RUS | 56.70 | 63.15 | 33.56 | 28.43 | 67.39 | 72.48 |
| | RS | 56.27 | 51.62 | 77.78 | 54.93 | 24.00 | 33.94 |
| LY | RUS | 0.37 | 0.22 | 0.48 | 0.26 | 0.32 | 0.19 |
| | RS | 0.67 | 0.15 | 0.59 | 0.15 | 0.78 | 0.00 |
| MEOW | RUS | 2.95 | 6.28 | 2.89 | 7.07 | 2.97 | 6.19 |
| | RS | 17.87 | 26.46 | 6.67 | 8.33 | 34.67 | 41.49 |
| OOS | RUS | 0.20 | 0.28 | 0.17 | 0.41 | 0.22 | 0.22 |
| | RS | 0.00 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 |
| PA | RUS | 0.01 | 0.02 | 0.00 | 0.00 | 0.01 | 0.02 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PAT | RUS | 0.02 | 0.04 | 0.04 | 0.07 | 0.01 | 0.02 |
| | RS | 0.01 | 0.03 | 0.02 | 0.04 | 0.00 | 0.00 |
| PAW | RUS | 10.88 | 38.05 | 6.44 | 15.14 | 12.92 | 45.41 |
| | RS | 0.27 | 0.59 | 0.44 | 0.77 | 0.00 | 0.00 |
| PRUSTEN | RUS | 1.61 | 6.40 | 0.00 | 0.00 | 2.36 | 7.72 |
| | RS | 12.80 | 18.59 | 5.78 | 8.88 | 23.34 | 29.22 |
| RETREAT | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| ROLL | RUS | 0.07 | 0.31 | 0.00 | 0.00 | 0.10 | 0.37 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | BLOOD | | | | | |
|---|---|---|---|---|---|---|---|
| | | ALL CATS | | MALE | | FEMALE | |
| Behavioral Observation | Success | Mean | StDev | Mean | StDev | Mean | StDev |
| RU | RUS | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| RUBother | RUS | 9.54 | 19.12 | 12.22 | 28.65 | 8.31 | 14.17 |
| | RS | 1.33 | 2.31 | 0.00 | 0.00 | 3.33 | 2.83 |
| RUBtotal | RUS | 10.74 | 23.38 | 16.00 | 37.90 | 8.31 | 14.17 |
| | RS | 1.33 | 2.31 | 0.00 | 0.00 | 3.33 | 2.83 |
| RUBtrial | RUS | 1.19 | 5.20 | 3.78 | 9.25 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SIT | RUS | 0.17 | 0.11 | 0.08 | 0.08 | 0.21 | 0.09 |
| | RS | 0.15 | 0.08 | 0.17 | 0.10 | 0.12 | 0.01 |
| SNIFFobject | RUS | 75.02 | 93.41 | 82.22 | 83.18 | 71.69 | 100.83 |
| | RS | 37.60 | 13.31 | 30.67 | 13.13 | 48.00 | 1.88 |
| SNIFFtrial | RUS | 60.56 | 44.42 | 53.11 | 49.96 | 64.00 | 43.35 |
| | RS | 37.60 | 16.04 | 37.33 | 19.64 | 38.00 | 16.02 |
| ST | RUS | 0.14 | 0.10 | 0.13 | 0.08 | 0.15 | 0.11 |
| | RS | 0.13 | 0.13 | 0.17 | 0.16 | 0.06 | 0.01 |
| STEREO | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TIA | RUS | 269.68 | 289.08 | 342.00 | 351.62 | 236.31 | 264.61 |
| | RS | 190.40 | 165.57 | 107.11 | 169.75 | 315.34 | 0.47 |
| TSI | RUS | 27.82 | 23.48 | 25.17 | 21.75 | 29.05 | 24.99 |
| | RS | 33.77 | 14.34 | 34.33 | 20.08 | 32.92 | 3.66 |
| TTS | RUS | 123.97 | 219.86 | 161.61 | 361.93 | 106.60 | 129.98 |
| | RS | 27.00 | 49.76 | 39.89 | 65.63 | 7.67 | 6.60 |
| URINES | RUS | 2.60 | 8.01 | 0.22 | 0.54 | 3.69 | 9.59 |
| | RS | 1.33 | 1.63 | 1.78 | 2.04 | 0.67 | 0.94 |
| URINEW | RUS | 0.07 | 0.31 | 0.22 | 0.54 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| URINtotal | RUS | 2.67 | 8.00 | 0.45 | 1.09 | 3.69 | 9.59 |
| | RS | 1.33 | 1.63 | 1.78 | 2.04 | 0.67 | 0.94 |
| VOCAL | RUS | 4.56 | 9.24 | 2.89 | 7.07 | 5.33 | 10.26 |
| | RS | 30.67 | 43.49 | 12.44 | 6.16 | 58.00 | 70.71 |
| WA | RUS | 0.09 | 0.07 | 0.10 | 0.07 | 0.09 | 0.08 |
| | RS | 0.05 | 0.03 | 0.05 | 0.04 | 0.05 | 0.01 |

**A9-3: Mean and Standard Deviations of Behavioral Responses from estrus treatments on 24 clouded leopards grouped by "success".**

| | | ESTRUS | | | | | |
|---|---|---|---|---|---|---|---|
| | | ALL CATS | | MALE | | FEMALE | |
| Behavioral Observation | Success | Mean | StDev | Mean | StDev | Mean | StDev |
| AP | RUS | 4.77 | 2.49 | 4.45 | 3.00 | 4.92 | 2.33 |
| | RS | 5.33 | 2.83 | 7.11 | 2.04 | 2.67 | 0.00 |
| BI | RUS | 1.47 | 6.42 | 0.00 | 0.00 | 2.15 | 7.77 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| CL | RUS | 0.42 | 1.09 | 0.22 | 0.54 | 0.51 | 1.28 |
| | RS | 0.27 | 0.59 | 0.44 | 0.77 | 0.00 | 0.00 |
| DEFAC | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FLEH | RUS | 1.26 | 1.75 | 0.67 | 0.73 | 1.54 | 2.03 |
| | RS | 2.93 | 1.46 | 3.11 | 2.04 | 2.67 | 0.00 |
| FLIN | RUS | 0.21 | 0.92 | 0.67 | 1.63 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| GROOM | RUS | 7.44 | 6.07 | 8.22 | 7.32 | 7.08 | 5.69 |
| | RS | 7.20 | 6.08 | 8.44 | 7.81 | 5.34 | 3.77 |
| GROWL | RUS | 6.39 | 9.18 | 8.67 | 8.46 | 5.33 | 9.63 |
| | RS | 0.53 | 0.73 | 0.44 | 0.77 | 0.67 | 0.94 |
| LAT | RUS | 56.17 | 79.60 | 28.89 | 60.02 | 68.77 | 86.37 |
| | RS | 2.13 | 2.50 | 2.00 | 2.65 | 2.34 | 3.30 |
| LICK | RUS | 1.54 | 4.83 | 0.00 | 0.00 | 2.26 | 5.77 |
| | RS | 2.13 | 2.42 | 2.22 | 2.77 | 2.00 | 2.83 |
| LY | RUS | 0.44 | 0.27 | 0.48 | 0.28 | 0.42 | 0.28 |
| | RS | 0.58 | 0.18 | 0.46 | 0.07 | 0.77 | 0.11 |
| MEOW | RUS | 2.81 | 8.40 | 0.00 | 0.00 | 4.10 | 10.00 |
| | RS | 6.93 | 9.11 | 4.00 | 2.31 | 11.34 | 16.03 |
| OOS | RUS | 0.19 | 0.26 | 0.16 | 0.31 | 0.20 | 0.25 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PA | RUS | 0.00 | 0.02 | 0.00 | 0.00 | 0.01 | 0.02 |
| | RS | 0.03 | 0.06 | 0.04 | 0.08 | 0.00 | 0.00 |
| PAT | RUS | 0.00 | 0.01 | 0.01 | 0.02 | 0.00 | 0.00 |
| | RS | 0.10 | 0.13 | 0.17 | 0.12 | 0.00 | 0.00 |
| PAW | RUS | 11.72 | 50.44 | 0.22 | 0.54 | 17.03 | 60.99 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PRUSTEN | RUS | 0.21 | 0.92 | 0.00 | 0.00 | 0.31 | 1.11 |
| | RS | 6.13 | 5.78 | 5.78 | 4.69 | 6.67 | 9.43 |
| RETREAT | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| ROLL | RUS | 0.35 | 1.24 | 0.89 | 2.18 | 0.10 | 0.37 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| RU | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | ESTRUS | | | | | |
|---|---|---|---|---|---|---|---|
| | | ALL CATS | | MALE | | FEMALE | |
| Behavioral Observation | Success | Mean | StDev | Mean | StDev | Mean | StDev |
| RUBother | RUS | 8.56 | 16.04 | 14.22 | 25.52 | 5.95 | 9.55 |
| | RS | 1.87 | 4.17 | 3.11 | 5.39 | 0.00 | 0.00 |
| RUBtotal | RUS | 9.05 | 16.05 | 15.11 | 25.46 | 6.26 | 9.45 |
| | RS | 1.87 | 4.17 | 3.11 | 5.39 | 0.00 | 0.00 |
| RUBtrial | RUS | 0.49 | 1.49 | 0.89 | 2.18 | 0.31 | 1.11 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SIT | RUS | 0.16 | 0.13 | 0.13 | 0.13 | 0.18 | 0.13 |
| | RS | 0.07 | 0.06 | 0.05 | 0.02 | 0.10 | 0.11 |
| SNIFFobject | RUS | 54.39 | 72.26 | 65.56 | 91.09 | 49.23 | 65.46 |
| | RS | 17.87 | 11.14 | 24.89 | 3.08 | 7.34 | 10.37 |
| SNIFFtrial | RUS | 37.61 | 21.28 | 34.45 | 19.18 | 39.08 | 22.77 |
| | RS | 42.40 | 15.95 | 52.00 | 8.74 | 28.00 | 13.19 |
| ST | RUS | 0.13 | 0.08 | 0.14 | 0.08 | 0.13 | 0.08 |
| | RS | 0.16 | 0.11 | 0.23 | 0.05 | 0.06 | 0.08 |
| STEREO | RUS | 0.21 | 0.92 | 0.00 | 0.00 | 0.31 | 1.11 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TIA | RUS | 282.51 | 237.46 | 276.67 | 274.93 | 285.21 | 230.35 |
| | RS | 257.20 | 270.16 | 83.11 | 75.87 | 518.33 | 230.52 |
| TSI | RUS | 12.53 | 14.78 | 9.45 | 6.90 | 13.95 | 17.35 |
| | RS | 13.33 | 9.73 | 18.22 | 9.90 | 6.00 | 1.88 |
| TTS | RUS | 99.07 | 147.82 | 133.94 | 238.13 | 82.98 | 90.87 |
| | RS | 26.67 | 30.82 | 30.78 | 42.25 | 20.50 | 10.14 |
| URINES | RUS | 0.91 | 1.61 | 0.67 | 1.12 | 1.02 | 1.82 |
| | RS | 1.87 | 1.52 | 2.67 | 1.34 | 0.67 | 0.94 |
| URINEW | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 1.07 | 1.74 | 1.78 | 2.04 | 0.00 | 0.00 |
| URINtotal | RUS | 0.91 | 1.61 | 0.67 | 1.12 | 1.02 | 1.82 |
| | RS | 2.93 | 2.19 | 4.44 | 0.77 | 0.67 | 0.94 |
| VOCAL | RUS | 3.02 | 8.82 | 0.00 | 0.00 | 4.41 | 10.49 |
| | RS | 13.07 | 14.03 | 9.78 | 5.39 | 18.00 | 25.46 |
| WA | RUS | 0.07 | 0.05 | 0.09 | 0.07 | 0.06 | 0.05 |
| | RS | 0.06 | 0.05 | 0.04 | 0.03 | 0.08 | 0.08 |

**A9-4: Mean and Standard Deviations of Behavioral Responses from nonestrus treatments on 24 clouded leopards grouped by "success".**

| | | NONESTRUS | | | | | |
|---|---|---|---|---|---|---|---|
| | | ALL CATS | | MALE | | FEMALE | |
| Behavioral Observation | Success | Mean | StDev | Mean | StDev | Mean | StDev |
| AP | RUS | 5.19 | 3.74 | 5.11 | 3.90 | 5.23 | 3.83 |
| | RS | 4.80 | 1.19 | 4.89 | 1.54 | 4.67 | 0.94 |
| BI | RUS | 1.75 | 7.01 | 0.44 | 0.69 | 2.36 | 8.51 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| CL | RUS | 0.49 | 1.27 | 0.44 | 0.69 | 0.51 | 1.49 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| DEFAC | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FLEH | RUS | 1.61 | 2.65 | 2.44 | 3.99 | 1.23 | 1.84 |
| | RS | 2.40 | 1.74 | 2.67 | 1.34 | 2.00 | 2.83 |
| FLIN | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| GROOM | RUS | 7.30 | 4.81 | 4.22 | 3.62 | 8.72 | 4.73 |
| | RS | 5.33 | 2.11 | 4.89 | 2.77 | 6.00 | 0.95 |
| GROWL | RUS | 7.30 | 12.21 | 6.89 | 7.80 | 7.49 | 14.07 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| LAT | RUS | 100.74 | 138.57 | 127.22 | 149.97 | 88.51 | 137.54 |
| | RS | 1.47 | 1.52 | 1.56 | 1.90 | 1.33 | 1.41 |
| LICK | RUS | 2.46 | 8.53 | 0.67 | 1.63 | 3.28 | 10.28 |
| | RS | 3.20 | 5.04 | 4.89 | 6.30 | 0.67 | 0.94 |
| LY | RUS | 0.39 | 0.24 | 0.39 | 0.28 | 0.39 | 0.23 |
| | RS | 0.77 | 0.25 | 0.71 | 0.34 | 0.86 | 0.02 |
| MEOW | RUS | 5.47 | 19.85 | 14.45 | 35.38 | 1.33 | 3.27 |
| | RS | 14.93 | 33.39 | 0.00 | 0.00 | 37.34 | 52.80 |
| OOS | RUS | 0.21 | 0.25 | 0.31 | 0.36 | 0.16 | 0.17 |
| | RS | 0.03 | 0.06 | 0.04 | 0.08 | 0.00 | 0.00 |
| PA | RUS | 0.02 | 0.07 | 0.01 | 0.03 | 0.03 | 0.08 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PAT | RUS | 0.01 | 0.03 | 0.03 | 0.05 | 0.00 | 0.01 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PAW | RUS | 12.49 | 51.90 | 0.45 | 1.09 | 18.05 | 62.72 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PRUSTEN | RUS | 0.70 | 1.74 | 0.67 | 1.63 | 0.72 | 1.86 |
| | RS | 14.40 | 27.80 | 2.67 | 2.31 | 32.00 | 45.25 |
| RETREAT | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| ROLL | RUS | 0.98 | 2.81 | 2.22 | 4.82 | 0.41 | 1.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| RU | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | NONESTRUS | | | | | |
|---|---|---|---|---|---|---|---|
| | | ALL CATS | | MALE | | FEMALE | |
| Behavioral Observation | Success | Mean | StDev | Mean | StDev | Mean | StDev |
| RUBother | RUS | 11.23 | 20.28 | 15.33 | 32.04 | 9.33 | 13.30 |
| | RS | 2.13 | 3.35 | 0.44 | 0.77 | 4.67 | 4.72 |
| RUBtotal | RUS | 11.58 | 20.18 | 15.33 | 32.04 | 9.85 | 13.15 |
| | RS | 2.13 | 3.35 | 0.44 | 0.77 | 4.67 | 4.72 |
| RUBtrial | RUS | 0.35 | 1.07 | 0.00 | 0.00 | 0.51 | 1.28 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SIT | RUS | 0.14 | 0.12 | 0.07 | 0.08 | 0.17 | 0.13 |
| | RS | 0.06 | 0.07 | 0.08 | 0.09 | 0.03 | 0.01 |
| SNIFFobject | RUS | 81.19 | 90.71 | 113.33 | 112.32 | 66.36 | 79.57 |
| | RS | 49.07 | 52.72 | 36.89 | 45.69 | 67.33 | 76.37 |
| SNIFFtrial | RUS | 42.32 | 36.54 | 36.67 | 24.38 | 44.92 | 41.61 |
| | RS | 46.93 | 26.00 | 45.78 | 29.38 | 48.67 | 31.11 |
| ST | RUS | 0.16 | 0.10 | 0.15 | 0.09 | 0.16 | 0.11 |
| | RS | 0.10 | 0.09 | 0.12 | 0.11 | 0.08 | 0.05 |
| STEREO | RUS | 0.28 | 1.22 | 0.00 | 0.00 | 0.41 | 1.48 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TIA | RUS | 346.35 | 299.95 | 362.72 | 282.21 | 338.79 | 318.71 |
| | RS | 191.67 | 167.29 | 107.11 | 170.51 | 318.50 | 12.97 |
| TSI | RUS | 10.00 | 9.12 | 11.67 | 11.29 | 9.23 | 8.34 |
| | RS | 17.53 | 7.25 | 17.89 | 8.52 | 17.00 | 8.02 |
| TTS | RUS | 129.19 | 160.28 | 170.50 | 163.55 | 110.13 | 161.68 |
| | RS | 64.00 | 133.80 | 103.89 | 172.74 | 4.17 | 1.65 |
| URINES | RUS | 1.82 | 4.81 | 0.45 | 1.09 | 2.46 | 5.73 |
| | RS | 0.53 | 0.73 | 0.44 | 0.77 | 0.67 | 0.94 |
| URINEW | RUS | 0.07 | 0.31 | 0.00 | 0.00 | 0.10 | 0.37 |
| | RS | 0.27 | 0.59 | 0.44 | 0.77 | 0.00 | 0.00 |
| URINtotal | RUS | 1.89 | 4.79 | 0.45 | 1.09 | 2.56 | 5.69 |
| | RS | 0.80 | 0.73 | 0.89 | 0.77 | 0.67 | 0.94 |
| VOCAL | RUS | 6.18 | 20.74 | 15.11 | 37.02 | 2.05 | 3.99 |
| | RS | 29.33 | 61.15 | 2.67 | 2.31 | 69.34 | 98.05 |
| WA | RUS | 0.07 | 0.07 | 0.04 | 0.02 | 0.09 | 0.08 |
| | RS | 0.04 | 0.05 | 0.04 | 0.06 | 0.04 | 0.05 |

**A9-5: Mean and Standard Deviations of Behavioral Responses from male treatments on 24 clouded leopards grouped by "success".**

| | | MALE | | | | | |
|---|---|---|---|---|---|---|---|
| | | ALL CATS | | MALE | | FEMALE | |
| Behavioral Observation | Success | Mean | StDev | Mean | StDev | Mean | StDev |
| AP | RUS | 6.67 | 3.82 | 7.78 | 5.43 | 6.15 | 2.96 |
| | RS | 4.80 | 1.19 | 4.44 | 0.77 | 5.34 | 1.89 |
| BI | RUS | 3.58 | 6.93 | 5.56 | 9.41 | 2.67 | 5.68 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| CL | RUS | 0.07 | 0.31 | 0.22 | 0.54 | 0.00 | 0.00 |
| | RS | 0.53 | 0.73 | 0.44 | 0.77 | 0.67 | 0.94 |
| DEFAC | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.27 | 0.59 | 0.44 | 0.77 | 0.00 | 0.00 |
| FLEH | RUS | 1.54 | 1.42 | 1.56 | 1.56 | 1.54 | 1.42 |
| | RS | 1.60 | 1.74 | 1.33 | 1.34 | 2.00 | 2.83 |
| FLIN | RUS | 0.07 | 0.31 | 0.00 | 0.00 | 0.10 | 0.37 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| GROOM | RUS | 8.35 | 6.93 | 5.56 | 8.06 | 9.64 | 6.26 |
| | RS | 6.13 | 4.07 | 3.56 | 2.78 | 10.00 | 0.95 |
| GROWL | RUS | 7.72 | 22.62 | 2.67 | 3.67 | 10.05 | 27.26 |
| | RS | 1.87 | 4.17 | 3.11 | 5.39 | 0.00 | 0.00 |
| LAT | RUS | 92.53 | 169.34 | 120.22 | 240.23 | 79.74 | 135.68 |
| | RS | 1.07 | 1.52 | 0.56 | 0.51 | 1.84 | 2.60 |
| LICK | RUS | 4.91 | 12.87 | 1.78 | 3.23 | 6.36 | 15.39 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| LY | RUS | 0.36 | 0.24 | 0.42 | 0.32 | 0.34 | 0.20 |
| | RS | 0.71 | 0.17 | 0.71 | 0.21 | 0.70 | 0.17 |
| MEOW | RUS | 2.32 | 7.63 | 6.44 | 13.34 | 0.41 | 0.84 |
| | RS | 10.67 | 19.68 | 2.67 | 4.62 | 22.67 | 32.05 |
| OOS | RUS | 0.22 | 0.28 | 0.23 | 0.37 | 0.22 | 0.25 |
| | RS | 0.01 | 0.02 | 0.01 | 0.02 | 0.00 | 0.00 |
| PA | RUS | 0.00 | 0.02 | 0.01 | 0.03 | 0.00 | 0.01 |
| | RS | 0.01 | 0.02 | 0.00 | 0.00 | 0.02 | 0.03 |
| PAT | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PAW | RUS | 15.30 | 53.53 | 2.45 | 3.81 | 21.23 | 64.59 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PRUSTEN | RUS | 0.56 | 1.90 | 0.00 | 0.00 | 0.82 | 2.28 |
| | RS | 18.13 | 28.79 | 7.56 | 13.09 | 34.00 | 46.20 |
| RETREAT | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| ROLL | RUS | 3.44 | 7.13 | 7.56 | 11.27 | 1.54 | 3.31 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| RU | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | MALE | | | | | |
|---|---|---|---|---|---|---|---|
| | | ALL CATS | | MALE | | FEMALE | |
| Behavioral Observation | Success | Mean | StDev | Mean | StDev | Mean | StDev |
| RUBother | RUS | 9.40 | 12.27 | 14.22 | 15.84 | 7.18 | 10.21 |
| | RS | 2.67 | 1.63 | 1.78 | 1.54 | 4.00 | 0.00 |
| RUBtotal | RUS | 14.46 | 15.30 | 14.89 | 16.28 | 14.26 | 15.51 |
| | RS | 2.67 | 1.63 | 1.78 | 1.54 | 4.00 | 0.00 |
| RUBtrial | RUS | 5.05 | 12.06 | 0.67 | 1.63 | 7.08 | 14.25 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SIT | RUS | 0.16 | 0.13 | 0.07 | 0.09 | 0.20 | 0.12 |
| | RS | 0.06 | 0.05 | 0.05 | 0.04 | 0.09 | 0.06 |
| SNIFFobject | RUS | 45.62 | 48.96 | 68.67 | 47.83 | 34.98 | 47.49 |
| | RS | 49.87 | 42.01 | 48.00 | 44.38 | 52.67 | 55.63 |
| SNIFFtrial | RUS | 89.82 | 72.40 | 107.11 | 77.47 | 81.85 | 71.73 |
| | RS | 43.20 | 35.97 | 32.00 | 22.74 | 60.00 | 56.57 |
| ST | RUS | 0.17 | 0.11 | 0.20 | 0.14 | 0.16 | 0.10 |
| | RS | 0.16 | 0.11 | 0.20 | 0.14 | 0.11 | 0.00 |
| STEREO | RUS | 0.14 | 0.61 | 0.00 | 0.00 | 0.21 | 0.74 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TIA | RUS | 325.24 | 225.68 | 274.28 | 218.20 | 348.77 | 233.80 |
| | RS | 46.47 | 34.99 | 56.89 | 44.89 | 30.84 | 7.30 |
| TSI | RUS | 49.72 | 57.27 | 54.83 | 58.08 | 47.36 | 59.12 |
| | RS | 17.33 | 15.53 | 14.67 | 11.47 | 21.33 | 25.46 |
| TTS | RUS | 129.83 | 181.86 | 174.17 | 244.03 | 109.36 | 152.83 |
| | RS | 8.60 | 10.17 | 3.89 | 1.58 | 15.67 | 15.56 |
| URINES | RUS | 1.96 | 4.96 | 1.56 | 2.59 | 2.15 | 5.82 |
| | RS | 0.53 | 0.73 | 0.89 | 0.77 | 0.00 | 0.00 |
| URINEW | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| URINtotal | RUS | 1.96 | 4.96 | 1.56 | 2.59 | 2.15 | 5.82 |
| | RS | 0.53 | 0.73 | 0.89 | 0.77 | 0.00 | 0.00 |
| VOCAL | RUS | 2.88 | 7.84 | 6.44 | 13.34 | 1.23 | 2.96 |
| | RS | 28.53 | 47.57 | 10.22 | 11.50 | 56.00 | 79.20 |
| WA | RUS | 0.08 | 0.07 | 0.08 | 0.07 | 0.08 | 0.07 |
| | RS | 0.04 | 0.05 | 0.02 | 0.02 | 0.08 | 0.08 |

**A9-6: Mean and Standard Deviations of Behavioral Responses from choice treatments on 24 clouded leopards grouped by "success".**

| | | CHOICE | | | | | |
|---|---|---|---|---|---|---|---|
| | | ALL CATS | | MALE | | FEMALE | |
| Behavioral Observation | Success | Mean | StDev | Mean | StDev | Mean | StDev |
| AP | RUS | 37.89 | 33.92 | 48.67 | 38.82 | 32.92 | 31.84 |
| | RS | 32.00 | 18.55 | 41.33 | 18.90 | 18.00 | 2.83 |
| BI | RUS | 0.84 | 2.85 | 2.00 | 4.90 | 0.31 | 1.11 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| CL | RUS | 4.21 | 10.71 | 3.33 | 8.16 | 4.62 | 11.98 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| DEFAC | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FLEH | RUS | 2.11 | 6.31 | 3.33 | 8.16 | 1.54 | 5.55 |
| | RS | 2.40 | 2.19 | 1.33 | 2.31 | 4.00 | 0.00 |
| FLIN | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| GROOM | RUS | 46.32 | 49.46 | 53.33 | 35.02 | 43.08 | 55.88 |
| | RS | 22.40 | 43.51 | 4.00 | 4.00 | 50.00 | 70.71 |
| GROWL | RUS | 2.32 | 6.44 | 4.00 | 9.80 | 1.54 | 4.48 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| LAT | RUS | 183.00 | 344.50 | 228.00 | 369.09 | 160.50 | 346.18 |
| | RS | 1.00 | 1.22 | 0.33 | 0.58 | 2.00 | 1.41 |
| LICK | RUS | 31.16 | 30.80 | 34.00 | 32.17 | 29.85 | 31.39 |
| | RS | 50.40 | 53.49 | 84.00 | 38.57 | 0.00 | 0.00 |
| LY | RUS | 0.36 | 0.33 | 0.38 | 0.32 | 0.35 | 0.34 |
| | RS | 0.45 | 0.45 | 0.16 | 0.27 | 0.90 | 0.04 |
| MEOW | RUS | 6.32 | 27.53 | 20.00 | 48.99 | 0.00 | 0.00 |
| | RS | 24.00 | 43.36 | 40.00 | 52.92 | 0.00 | 0.00 |
| OOS | RUS | 0.27 | 0.41 | 0.29 | 0.40 | 0.27 | 0.43 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PA | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.11 | 0.24 | 0.18 | 0.31 | 0.00 | 0.00 |
| PAT | RUS | 0.02 | 0.09 | 0.00 | 0.00 | 0.03 | 0.11 |
| | RS | 0.13 | 0.14 | 0.22 | 0.08 | 0.00 | 0.00 |
| PAW | RUS | 0.51 | 1.85 | 1.33 | 3.27 | 0.12 | 0.44 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PRUSTEN | RUS | 1.05 | 4.59 | 0.00 | 0.00 | 1.54 | 5.55 |
| | RS | 40.00 | 69.28 | 53.33 | 92.38 | 20.00 | 28.28 |
| RETREAT | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| ROLL | RUS | 0.42 | 1.26 | 1.33 | 2.07 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| RU | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | CHOICE | | | | | |
|---|---|---|---|---|---|---|---|
| | | ALL CATS | | MALE | | FEMALE | |
| **Behavioral Observation** | **Success** | **Mean** | **StDev** | **Mean** | **StDev** | **Mean** | **StDev** |
| RUBother | RUS | 38.95 | 79.57 | 20.00 | 25.30 | 47.69 | 94.71 |
| | RS | 16.00 | 35.78 | 26.67 | 46.19 | 0.00 | 0.00 |
| RUBtotal | RUS | 7.87 | 15.88 | 4.00 | 5.06 | 9.66 | 18.88 |
| | RS | 3.20 | 7.16 | 5.33 | 9.24 | 0.00 | 0.00 |
| RUBtrial | RUS | 0.42 | 1.84 | 0.00 | 0.00 | 0.62 | 2.22 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SIT | RUS | 0.08 | 0.10 | 0.04 | 0.07 | 0.10 | 0.11 |
| | RS | 0.01 | 0.03 | 0.02 | 0.04 | 0.00 | 0.00 |
| SNIFFobject | RUS | 450.53 | 705.95 | 356.67 | 459.81 | 493.85 | 808.10 |
| | RS | 384.00 | 166.37 | 306.67 | 162.89 | 500.00 | 113.14 |
| SNIFFtrial | RUS | 144.63 | 138.63 | 152.67 | 118.75 | 140.92 | 151.34 |
| | RS | 120.80 | 79.37 | 160.00 | 82.07 | 62.00 | 14.14 |
| ST | RUS | 0.18 | 0.18 | 0.19 | 0.16 | 0.18 | 0.19 |
| | RS | 0.25 | 0.18 | 0.35 | 0.17 | 0.10 | 0.04 |
| STEREO | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TIA | RUS | 234.16 | 368.58 | 238.00 | 372.09 | 232.38 | 382.21 |
| | RS | 9.20 | 17.30 | 2.00 | 2.00 | 20.00 | 28.28 |
| TSI | RUS | 42.84 | 46.83 | 38.50 | 28.42 | 44.85 | 54.21 |
| | RS | 38.40 | 24.02 | 54.00 | 15.39 | 15.00 | 2.83 |
| TTS | RUS | 179.63 | 334.75 | 229.83 | 368.25 | 156.46 | 331.27 |
| | RS | 8.40 | 9.32 | 5.33 | 4.16 | 13.00 | 15.56 |
| URINES | RUS | 13.68 | 55.00 | 0.00 | 0.00 | 20.00 | 66.33 |
| | RS | 16.00 | 16.73 | 20.00 | 20.00 | 10.00 | 14.14 |
| URINEW | RUS | 1.05 | 4.59 | 0.00 | 0.00 | 1.54 | 5.55 |
| | RS | 12.00 | 17.89 | 20.00 | 20.00 | 0.00 | 0.00 |
| URINtotal | RUS | 2.95 | 10.98 | 0.00 | 0.00 | 4.31 | 13.21 |
| | RS | 5.60 | 4.56 | 8.00 | 4.00 | 2.00 | 2.83 |
| VOCAL | RUS | 1.47 | 5.53 | 4.00 | 9.80 | 0.31 | 1.11 |
| | RS | 12.80 | 13.08 | 18.67 | 14.05 | 4.00 | 5.66 |
| WA | RUS | 0.08 | 0.10 | 0.10 | 0.11 | 0.07 | 0.10 |
| | RS | 0.04 | 0.06 | 0.07 | 0.07 | 0.00 | 0.00 |

**A9-10: Mean and Standard Deviations of Behavioral Responses from MIS on 24 clouded leopards grouped by "success".**

| | | MIS | | | | | |
|---|---|---|---|---|---|---|---|
| | | ALL CATS | | MALE | | FEMALE | |
| **Behavioral Observation** | **Success** | **Mean** | **StDev** | **Mean** | **StDev** | **Mean** | **StDev** |
| AP | RUS | 19.58 | 20.30 | 11.33 | 13.25 | 23.38 | 22.26 |
| | RS | 38.40 | 28.09 | 38.67 | 20.53 | 38.00 | 48.08 |
| BI | RUS | 3.58 | 15.60 | 11.33 | 27.76 | 0.00 | 0.00 |
| | RS | 3.20 | 7.16 | 0.00 | 0.00 | 8.00 | 11.31 |
| CL | RUS | 0.42 | 1.26 | 0.67 | 1.63 | 0.31 | 1.11 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| DEFAC | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FLEH | RUS | 0.21 | 0.92 | 0.00 | 0.00 | 0.31 | 1.11 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FLIN | RUS | 6.95 | 8.73 | 4.00 | 5.06 | 8.31 | 9.86 |
| | RS | 15.20 | 20.86 | 1.33 | 2.31 | 36.00 | 16.97 |
| GROOM | RUS | 5.68 | 9.46 | 4.00 | 6.69 | 6.46 | 10.65 |
| | RS | 6.40 | 8.29 | 8.00 | 10.58 | 4.00 | 5.66 |
| GROWL | RUS | 50.53 | 124.45 | 108.00 | 204.85 | 24.00 | 57.74 |
| | RS | 72.00 | 123.00 | 25.33 | 43.88 | 142.00 | 200.82 |
| LAT | RUS | 79.42 | 203.99 | 40.33 | 43.62 | 97.46 | 245.99 |
| | RS | 2.00 | 2.55 | 2.00 | 3.46 | 2.00 | 1.41 |
| LICK | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 2.40 | 5.37 | 4.00 | 6.93 | 0.00 | 0.00 |
| LY | RUS | 0.16 | 0.22 | 0.32 | 0.30 | 0.09 | 0.13 |
| | RS | 0.03 | 0.06 | 0.04 | 0.08 | 0.00 | 0.00 |
| MEOW | RUS | 3.79 | 10.87 | 1.33 | 3.27 | 4.92 | 12.98 |
| | RS | 4.80 | 7.16 | 8.00 | 8.00 | 0.00 | 0.00 |
| OOS | RUS | 0.24 | 0.39 | 0.17 | 0.38 | 0.27 | 0.41 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PA | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PAT | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PAW | RUS | 37.68 | 128.99 | 97.33 | 228.68 | 10.15 | 23.87 |
| | RS | 39.20 | 85.44 | 1.33 | 2.31 | 96.00 | 135.76 |
| PRUSTEN | RUS | 1.47 | 6.42 | 0.00 | 0.00 | 2.15 | 7.77 |
| | RS | 17.60 | 30.67 | 2.67 | 4.62 | 40.00 | 45.25 |
| RETREAT | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 1.60 | 2.19 | 0.00 | 0.00 | 4.00 | 0.00 |
| ROLL | RUS | 0.21 | 0.92 | 0.00 | 0.00 | 0.31 | 1.11 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| RU | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | MIS | | | | | |
|---|---|---|---|---|---|---|---|
| | | ALL CATS | | MALE | | FEMALE | |
| **Behavioral Observation** | **Success** | **Mean** | **StDev** | **Mean** | **StDev** | **Mean** | **StDev** |
| RUBother | RUS | 1.68 | 3.07 | 1.33 | 2.07 | 1.85 | 3.51 |
| | RS | 0.80 | 1.79 | 1.33 | 2.31 | 0.00 | 0.00 |
| RUBtotal | RUS | 1.68 | 3.07 | 1.33 | 2.07 | 1.85 | 3.51 |
| | RS | 0.80 | 1.79 | 1.33 | 2.31 | 0.00 | 0.00 |
| RUBtrial | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SIT | RUS | 0.14 | 0.20 | 0.09 | 0.12 | 0.17 | 0.22 |
| | RS | 0.24 | 0.26 | 0.38 | 0.25 | 0.04 | 0.05 |
| SNIFFobject | RUS | 65.47 | 79.68 | 65.33 | 70.87 | 65.54 | 86.20 |
| | RS | 41.60 | 48.22 | 32.00 | 34.18 | 56.00 | 79.20 |
| SNIFFtrial | RUS | 108.63 | 171.04 | 88.00 | 90.12 | 118.15 | 200.47 |
| | RS | 136.00 | 74.99 | 149.33 | 102.79 | 116.00 | 5.66 |
| ST | RUS | 0.40 | 0.31 | 0.42 | 0.33 | 0.40 | 0.32 |
| | RS | 0.64 | 0.26 | 0.55 | 0.24 | 0.77 | 0.33 |
| STEREO | RUS | 0.63 | 2.75 | 0.00 | 0.00 | 0.92 | 3.33 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TIA | RUS | 306.95 | 366.91 | 234.67 | 330.67 | 340.31 | 390.59 |
| | RS | 16.80 | 15.96 | 5.67 | 1.53 | 33.50 | 9.19 |
| TSI | RUS | 266.84 | 261.82 | 339.50 | 353.53 | 233.31 | 216.54 |
| | RS | 657.60 | 201.37 | 662.67 | 192.09 | 650.00 | 296.98 |
| TTS | RUS | 177.37 | 298.85 | 72.33 | 63.94 | 225.85 | 352.43 |
| | RS | 16.00 | 11.70 | 14.00 | 16.09 | 19.00 | 0.00 |
| URINES | RUS | 2.11 | 6.58 | 0.00 | 0.00 | 3.08 | 7.86 |
| | RS | 0.80 | 1.79 | 1.33 | 2.31 | 0.00 | 0.00 |
| URINEW | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| URINtotal | RUS | 2.11 | 6.58 | 0.00 | 0.00 | 3.08 | 7.86 |
| | RS | 0.80 | 1.79 | 1.33 | 2.31 | 0.00 | 0.00 |
| VOCAL | RUS | 5.26 | 14.49 | 1.33 | 3.27 | 7.08 | 17.29 |
| | RS | 22.40 | 29.07 | 10.67 | 12.22 | 40.00 | 45.25 |
| WA | RUS | 0.06 | 0.09 | 0.00 | 0.00 | 0.08 | 0.10 |
| | RS | 0.09 | 0.17 | 0.02 | 0.04 | 0.20 | 0.28 |

**A9-11: Mean and Standard Deviations of Behavioral Responses from novel object on 24 clouded leopards grouped by "success".**

| | | NOVEL OBJECT | | | | | |
|---|---|---|---|---|---|---|---|
| | | ALL CATS | | MALE | | FEMALE | |
| **Behavioral Observation** | **Success** | **Mean** | **StDev** | **Mean** | **StDev** | **Mean** | **StDev** |
| AP | RUS | 8.42 | 7.04 | 12.00 | 7.16 | 6.77 | 6.61 |
| | RS | 8.80 | 5.22 | 9.33 | 6.11 | 8.00 | 5.66 |
| BI | RUS | 0.42 | 1.84 | 1.33 | 3.27 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| CL | RUS | 1.05 | 2.93 | 1.33 | 2.07 | 0.92 | 3.33 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| DEFAC | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FLEH | RUS | 0.63 | 1.50 | 1.33 | 2.07 | 0.31 | 1.11 |
| | RS | 0.80 | 1.79 | 0.00 | 0.00 | 2.00 | 2.83 |
| FLIN | RUS | 1.89 | 4.29 | 0.00 | 0.00 | 2.77 | 5.00 |
| | RS | 1.60 | 3.58 | 0.00 | 0.00 | 4.00 | 5.66 |
| GROOM | RUS | 10.32 | 11.95 | 10.00 | 12.33 | 10.46 | 12.28 |
| | RS | 12.00 | 15.75 | 18.67 | 18.04 | 2.00 | 2.83 |
| GROWL | RUS | 19.37 | 66.03 | 6.00 | 14.70 | 25.54 | 79.49 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| LAT | RUS | 68.42 | 203.55 | 159.17 | 363.32 | 26.54 | 33.65 |
| | RS | 0.80 | 1.30 | 0.33 | 0.58 | 1.50 | 2.12 |
| LICK | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| LY | RUS | 0.42 | 0.24 | 0.41 | 0.33 | 0.43 | 0.20 |
| | RS | 0.73 | 0.07 | 0.73 | 0.07 | 0.74 | 0.09 |
| MEOW | RUS | 2.95 | 8.42 | 1.33 | 3.27 | 3.69 | 9.99 |
| | RS | 1.60 | 2.19 | 1.33 | 2.31 | 2.00 | 2.83 |
| OOS | RUS | 0.12 | 0.25 | 0.19 | 0.40 | 0.09 | 0.15 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PA | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PAT | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PAW | RUS | 2.11 | 8.26 | 0.00 | 0.00 | 3.08 | 9.95 |
| | RS | 26.40 | 56.82 | 1.33 | 2.31 | 64.00 | 90.51 |
| PRUSTEN | RUS | 0.63 | 1.50 | 0.67 | 1.63 | 0.62 | 1.50 |
| | RS | 8.80 | 17.53 | 1.33 | 2.31 | 20.00 | 28.28 |
| RETREAT | RUS | 0.21 | 0.92 | 0.67 | 1.63 | 0.00 | 0.00 |
| | RS | 0.80 | 1.79 | 0.00 | 0.00 | 2.00 | 2.83 |
| ROLL | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| RU | RUS | 0.00 | 0.02 | 0.00 | 0.00 | 0.01 | 0.02 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | NOVEL OBJECT | | | | | | |
|---|---|---|---|---|---|---|---|
| | | ALL CATS | | MALE | | FEMALE | |
| **Behavioral Observation** | **Success** | **Mean** | **StDev** | **Mean** | **StDev** | **Mean** | **StDev** |
| RUBother | RUS | 5.47 | 10.68 | 8.00 | 14.09 | 4.31 | 9.16 |
| | RS | 3.20 | 7.16 | 5.33 | 9.24 | 0.00 | 0.00 |
| RUBtotal | RUS | 5.68 | 10.61 | 8.67 | 13.72 | 4.31 | 9.16 |
| | RS | 3.20 | 7.16 | 5.33 | 9.24 | 0.00 | 0.00 |
| RUBtrial | RUS | 0.21 | 0.92 | 0.67 | 1.63 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SIT | RUS | 0.18 | 0.21 | 0.03 | 0.06 | 0.25 | 0.22 |
| | RS | 0.07 | 0.12 | 0.09 | 0.16 | 0.04 | 0.05 |
| SNIFFobject | RUS | 53.05 | 83.96 | 120.00 | 123.24 | 22.15 | 31.14 |
| | RS | 4.00 | 5.66 | 2.67 | 4.62 | 6.00 | 8.49 |
| SNIFFtrial | RUS | 73.89 | 91.73 | 108.67 | 124.97 | 57.85 | 72.33 |
| | RS | 74.40 | 32.45 | 80.00 | 28.84 | 66.00 | 48.08 |
| ST | RUS | 0.16 | 0.14 | 0.23 | 0.20 | 0.12 | 0.10 |
| | RS | 0.16 | 0.09 | 0.16 | 0.08 | 0.17 | 0.14 |
| STEREO | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TIA | RUS | 275.42 | 386.01 | 176.50 | 355.60 | 321.08 | 404.56 |
| | RS | 15.40 | 8.32 | 10.00 | 3.00 | 23.50 | 6.36 |
| TSI | RUS | 72.47 | 201.97 | 33.00 | 31.18 | 90.69 | 244.22 |
| | RS | 27.60 | 16.52 | 35.33 | 16.50 | 16.00 | 9.90 |
| TTS | RUS | 82.74 | 207.28 | 162.00 | 361.88 | 46.15 | 72.75 |
| | RS | 8.20 | 7.85 | 4.00 | 1.00 | 14.50 | 10.61 |
| URINES | RUS | 1.26 | 1.91 | 1.33 | 2.07 | 1.23 | 1.92 |
| | RS | 1.60 | 2.19 | 1.33 | 2.31 | 2.00 | 2.83 |
| URINEW | RUS | 0.21 | 0.92 | 0.00 | 0.00 | 0.31 | 1.11 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| URINtotal | RUS | 1.47 | 1.98 | 1.33 | 2.07 | 1.54 | 2.03 |
| | RS | 1.60 | 2.19 | 1.33 | 2.31 | 2.00 | 2.83 |
| VOCAL | RUS | 3.58 | 8.63 | 2.00 | 4.90 | 4.31 | 9.99 |
| | RS | 10.40 | 18.89 | 2.67 | 2.31 | 22.00 | 31.11 |
| WA | RUS | 0.11 | 0.10 | 0.13 | 0.08 | 0.10 | 0.11 |
| | RS | 0.04 | 0.04 | 0.02 | 0.04 | 0.07 | 0.00 |

Hypothesis 31: Reproductively RS individuals' exhibit different behaviors during control treatments.

**A9-12: Results of Logistical Regression of clouded leopard behavioral observations during control treatments "success" as dependant variable.**

| | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|
| Step 0 | Constant | -1.335 | .503 | 7.055 | 1 | .008 | .263 |

| = | | | Score | df | Sig. |
|---|---|---|---|---|---|
| Step 0 | Variables | AP | 1.596 | 1 | .206 |
| | | BI | .902 | 1 | .342 |
| | | CL | .036 | 1 | .849 |
| | | DEFAC | .275 | 1 | .600 |
| | | FLEH | .451 | 1 | .502 |
| | | FLIN | .275 | 1 | .600 |
| | | GROOM | 1.440 | 1 | .230 |
| | | GROWL | .389 | 1 | .533 |
| | | LAT | 2.716 | 1 | .099 |
| | | **LY** | **6.994** | **1** | ***.008** |
| | | MEOW | 3.500 | 1 | .061 |
| | | OOS | 3.423 | 1 | .064 |
| | | PA | .214 | 1 | .643 |
| | | PAT | .101 | 1 | .751 |
| | | PAW | .327 | 1 | .567 |
| | | **PRUSTEN** | **4.834** | **1** | ***.028** |
| | | ROLL | .512 | 1 | .474 |
| | | RUBother | .773 | 1 | .379 |
| | | RUBtotal | .784 | 1 | .376 |
| | | RUBtrial | .275 | 1 | .600 |
| | | SIT | .129 | 1 | .719 |
| | | SNIFFother | 1.100 | 1 | .294 |
| | | Snifftrial | .963 | 1 | .327 |
| | | ST | .091 | 1 | .763 |
| | | TIA | .739 | 1 | .390 |
| | | TSI | 1.468 | 1 | .226 |
| | | TTS | 2.726 | 1 | .099 |
| | | URINEs | .630 | 1 | .427 |
| | | URINtotal | .630 | 1 | .427 |
| | | **VOCAL** | **4.541** | **1** | ***.033** |
| | | WA | 1.734 | 1 | .188 |

***indicates p<0.05**

Hypothesis 32: Reproductively RS individuals' exhibit different behaviors during blood treatments.

**A9-13: Results of Logistical Regression of clouded leopard behavioral observations during blood treatment and "success" as dependant variable.**

| | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|
| Step 0 | Constant | -1.335 | .503 | 7.055 | 1 | .008 | .263 |

| | | | Score | df | Sig. |
|---|---|---|---|---|---|
| Step 0 | Variables | LAT | 1.777 | 1 | .182 |
| | | TTS | .974 | 1 | .324 |
| | | TIA | .364 | 1 | .546 |
| | | TSI | .308 | 1 | .579 |
| | | **LY** | **6.236** | **1** | ***.013** |
| | | OOS | 2.363 | 1 | .124 |
| | | PA | .531 | 1 | .466 |
| | | RU | .275 | 1 | .600 |
| | | SIT | .187 | 1 | .666 |
| | | ST | .075 | 1 | .784 |
| | | WA | 1.993 | 1 | .158 |
| | | PAT | .004 | 1 | .950 |
| | | AP | .161 | 1 | .688 |
| | | BI | .562 | 1 | .454 |
| | | CL | .476 | 1 | .490 |
| | | FLEH | .203 | 1 | .652 |
| | | FLIN | .275 | 1 | .600 |
| | | GROOM | .005 | 1 | .945 |
| | | GROWL | 1.001 | 1 | .317 |
| | | LICK | .000 | 1 | .988 |
| | | **VOCAL** | **5.486** | **1** | ***.019** |
| | | ROLL | .275 | 1 | .600 |
| | | RUBtotal | .823 | 1 | .364 |
| | | PAW | .404 | 1 | .525 |
| | | URINtotal | .145 | 1 | .704 |
| | | **DEFAC** | **3.965** | **1** | ***.046** |
| | | **MEOW** | **4.816** | **1** | ***.028** |
| | | **PRUSTEN** | **4.546** | **1** | ***.033** |
| | | RUBother | .933 | 1 | .334 |
| | | RUBtrial | .275 | 1 | .600 |
| | | URINEW | .275 | 1 | .600 |
| | | URINES | .130 | 1 | .719 |
| | | SNIFFtrial | 1.297 | 1 | .255 |
| | | SNIFFobject | .814 | 1 | .367 |

*** indicates p<0.05**

Hypothesis 33: Reproductively RS individuals' exhibit different behaviors during treatments with domestic cat estrus urine.

**A9-14: Results of Logistical Regression of clouded leopard behavioral observations during treatments and female domestic cat estrus urine with "success" as dependant variable.**

| | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|
| Step 0 | Constant | -1.335 | .503 | 7.055 | 1 | .008 | .263 |

| | | | Score | df | Sig. |
|---|---|---|---|---|---|
| Step 0 | Variables | AP | .207 | 1 | .649 |
| | | BI | .275 | 1 | .600 |
| | | CL | .099 | 1 | .753 |
| | | FLEH | 3.555 | 1 | .059 |
| | | FLIN | .275 | 1 | .600 |
| | | GROOM | .007 | 1 | .935 |
| | | GROWL | 1.968 | 1 | .161 |
| | | LAT | 2.208 | 1 | .137 |
| | | LICK | .074 | 1 | .786 |
| | | LY | 1.190 | 1 | .275 |
| | | MEOW | .969 | 1 | .325 |
| | | OOS | 2.411 | 1 | .121 |
| | | PA | 2.350 | 1 | .125 |
| | | **PAT** | **8.868** | **1** | ***.003** |
| | | PAW | .282 | 1 | .596 |
| | | **PRUSTEN** | **11.580** | **1** | ***.001** |
| | | ROLL | .412 | 1 | .521 |
| | | RUBother | .873 | 1 | .350 |
| | | RUBtotal | .999 | 1 | .317 |
| | | RUBtrial | .562 | 1 | .454 |
| | | SIT | 2.398 | 1 | .122 |
| | | SNIFFobject | 1.270 | 1 | .260 |
| | | SNIFFtrial | .235 | 1 | .628 |
| | | ST | .528 | 1 | .467 |
| | | STEREO | .275 | 1 | .600 |
| | | TIA | .046 | 1 | .829 |
| | | TSI | .014 | 1 | .905 |
| | | TTS | 1.192 | 1 | .275 |
| | | URINES | 1.459 | 1 | .227 |
| | | **URINEW** | **6.509** | **1** | ***.011** |
| | | **URINtotal** | **4.741** | **1** | ***.029** |
| | | VOCAL | 3.710 | 1 | .054 |
| | | WA | .326 | 1 | .568 |

*** indicates p<0.05**

Hypothesis 34: Reproductively RS individuals exhibit different behaviors during treatments with domestic cat non-estrus urine.

**A9-15: Results of Logistical Regression of clouded leopard behavioral observations during treatments with female domestic cat non-estrus urine and "success" as dependant variable.**

| | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|
| Step 0 | Constant | -1.335 | .503 | 7.055 | 1 | .008 | .263 |

| | | | Score | df | Sig. |
|---|---|---|---|---|---|
| Step 0 | Variables | AP | .057 | 1 | .812 |
| | | BI | .326 | 1 | .568 |
| | | CL | .760 | 1 | .383 |
| | | FLEH | .417 | 1 | .519 |
| | | GROOM | .814 | 1 | .367 |
| | | GROWL | 1.749 | 1 | .186 |
| | | LAT | 2.434 | 1 | .119 |
| | | LICK | .037 | 1 | .847 |
| | | **LY** | **7.345** | **1** | ***.007** |
| | | MEOW | .714 | 1 | .398 |
| | | OOS | 2.514 | 1 | .113 |
| | | PA | .565 | 1 | .452 |
| | | PAT | .781 | 1 | .377 |
| | | PAW | .302 | 1 | .583 |
| | | **PRUSTEN** | **4.584** | **1** | ***.032** |
| | | ROLL | .630 | 1 | .427 |
| | | RUBother | 1.011 | 1 | .315 |
| | | RUBtotal | 1.097 | 1 | .295 |
| | | RUBtrial | .550 | 1 | .458 |
| | | SIT | 1.709 | 1 | .191 |
| | | SNIFFobject | .600 | 1 | .438 |
| | | SNIFFtrial | .076 | 1 | .783 |
| | | ST | 1.257 | 1 | .262 |
| | | STEREO | .275 | 1 | .600 |
| | | TIA | 1.245 | 1 | .265 |
| | | TSI | 2.793 | 1 | .095 |
| | | TTS | .733 | 1 | .392 |
| | | URINES | .373 | 1 | .542 |
| | | URINEW | 1.125 | 1 | .289 |
| | | URINtotal | .271 | 1 | .602 |
| | | VOCAL | 2.052 | 1 | .152 |
| | | WA | .918 | 1 | .338 |

Hypothesis 35: Reproductively RS individuals exhibit different behaviors during treatments with domestic cat male urine.

**A9-16: Results of Logistical Regression of clouded leopard behavioral observations during treatments with female domestic cat male urine and "success" as dependant variable.**

| | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|
| Step 0 | Constant | -1.335 | .503 | 7.055 | 1 | .008 | .263 |

| | | | Score | df | Sig. |
|---|---|---|---|---|---|
| Step 0 | Variables | AP | 1.172 | 1 | .279 |
| | | BI | 1.330 | 1 | .249 |
| | | **CL** | **4.367** | **1** | ***.037** |
| | | **DEFAC** | **3.965** | **1** | ***.046** |
| | | FLEH | .006 | 1 | .937 |
| | | FLIN | .275 | 1 | .600 |
| | | GROOM | .492 | 1 | .483 |
| | | GROWL | .346 | 1 | .556 |
| | | LAT | 1.447 | 1 | .229 |
| | | LICK | .745 | 1 | .388 |
| | | **LY** | **6.991** | **1** | ***.008** |
| | | MEOW | 2.305 | 1 | .129 |
| | | OOS | 2.735 | 1 | .098 |
| | | PA | .163 | 1 | .686 |
| | | PAW | .423 | 1 | .515 |
| | | **PRUSTEN** | **6.372** | **1** | ***.012** |
| | | ROLL | 1.168 | 1 | .280 |
| | | RU | .275 | 1 | .600 |
| | | RUBother | 1.487 | 1 | .223 |
| | | RUBtotal | 2.767 | 1 | .096 |
| | | RUBtrial | .892 | 1 | .345 |
| | | SIT | 2.685 | 1 | .101 |
| | | SNIFFobject | .034 | 1 | .853 |
| | | SNIFFtrial | 1.910 | 1 | .167 |
| | | ST | .009 | 1 | .926 |
| | | STEREO | .275 | 1 | .600 |
| | | **TIA** | **6.006** | **1** | ***.014** |
| | | TSI | 1.553 | 1 | .213 |
| | | TTS | 2.135 | 1 | .144 |
| | | URINES | .431 | 1 | .512 |
| | | URINtotal | .431 | 1 | .512 |
| | | **VOCAL** | **4.900** | **1** | ***.027** |
| | | WA | 1.206 | 1 | .272 |

*** indicates p<0.05**

Hypothesis 36: RS individuals exhibit different behaviors during Choice test.

**A9-17: Results of Logistical Regression of clouded leopard behavioral observations during treatments for Choice test with all five scents and "success" as dependant variable.**

| | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|
| Step 0 | Constant | -1.281 | .506 | 6.420 | 1 | .011 | .278 |

| | | | Score | df | Sig. |
|---|---|---|---|---|---|
| Step 0 | Variables | AP | .157 | 1 | .692 |
| | | BI | .478 | 1 | .489 |
| | | CL | .608 | 1 | .435 |
| | | FLEH | .004 | 1 | .950 |
| | | GROOM | .711 | 1 | .399 |
| | | GROWL | .704 | 1 | .401 |
| | | LAT | 1.388 | 1 | .239 |
| | | LICK | 1.229 | 1 | .268 |
| | | LY | .424 | 1 | .515 |
| | | MEOW | 1.213 | 1 | .271 |
| | | OOS | 2.334 | 1 | .127 |
| | | PA | 3.764 | 1 | .052 |
| | | **PAT** | **4.120** | **1** | ***.042** |
| | | PAW | .409 | 1 | .522 |
| | | **PRUSTEN** | **5.339** | **1** | **.021** |
| | | ROLL | .608 | 1 | .435 |
| | | RUBother | .135 | 1 | .714 |
| | | RUBtotal | .153 | 1 | .696 |
| | | RUBtrial | .290 | 1 | .590 |
| | | SIT | 2.063 | 1 | .151 |
| | | SNIFFobject | .056 | 1 | .814 |
| | | SNIFFtrial | .107 | 1 | .744 |
| | | ST | .552 | 1 | .457 |
| | | TIA | 1.914 | 1 | .167 |
| | | TSI | .050 | 1 | .823 |
| | | TTS | 1.366 | 1 | .243 |
| | | URINES | .012 | 1 | .915 |
| | | **URINEW** | **5.029** | **1** | ***.025** |
| | | URINtotal | .290 | 1 | .590 |
| | | **VOCAL** | **6.585** | **1** | ***.010** |
| | | WA | .741 | 1 | .389 |

*** indicates p<0.05**

Hypothesis 37: Reproductively RS individuals exhibit different behaviors during the Mirror Image Stimulation test.

**A9-18: Results of Logistical Regression of clouded leopard behavioral observations during the Mirror Image Stimulation and "success" as dependant variable.**

| | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|
| Step 0 | Constant | -1.335 | .503 | 7.055 | 1 | .008 | .263 |

| | | | Score | df | Sig. |
|---|---|---|---|---|---|
| Step 0 | Variables | AP | 2.809 | 1 | .094 |
| | | BI | .003 | 1 | .957 |
| | | CL | .574 | 1 | .449 |
| | | FLEH | .275 | 1 | .600 |
| | | FLIN | 1.913 | 1 | .167 |
| | | GROOM | .026 | 1 | .872 |
| | | GROWL | .128 | 1 | .720 |
| | | LAT | .737 | 1 | .391 |
| | | **LICK** | **3.965** | **1** | ***.046** |
| | | LY | 1.768 | 1 | .184 |
| | | MEOW | .042 | 1 | .839 |
| | | OOS | 1.739 | 1 | .187 |
| | | PAW | .001 | 1 | .979 |
| | | **PRUSTEN** | **4.463** | **1** | ***.035** |
| | | **RETREAT** | **8.291** | **1** | ***.004** |
| | | ROLL | .275 | 1 | .600 |
| | | RUBother | .399 | 1 | .527 |
| | | RUBtotal | .399 | 1 | .527 |
| | | SIT | .901 | 1 | .342 |
| | | SNIFFobject | .430 | 1 | .512 |
| | | SNIFFtrial | .129 | 1 | .720 |
| | | ST | 2.324 | 1 | .127 |
| | | STEREO | .275 | 1 | .600 |
| | | TIA | 2.900 | 1 | .089 |
| | | **TSI** | **7.251** | **1** | ***.007** |
| | | TTS | 1.446 | 1 | .229 |
| | | URINES | .202 | 1 | .653 |
| | | URINtotal | .202 | 1 | .653 |
| | | VOCAL | 3.353 | 1 | .067 |
| | | WA | .514 | 1 | .474 |

*** indicates p<0.05**

Hypothesis 38: Reproductively RS individuals exhibit different behaviors during the Novel Object test.

**A9-19: Results of Logistical Regression of clouded leopard behavioral observations during the Novel Object test and "success" as dependant variable.**

| | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|
| Step 0 | Constant | -1.335 | .503 | 7.055 | 1 | .008 | .263 |

| | | | Score | df | Sig. |
|---|---|---|---|---|---|
| Step 0 | Variables | LAT | .569 | 1 | .451 |
| | | TTS | .663 | 1 | .415 |
| | | TIA | 2.177 | 1 | .140 |
| | | TSI | .257 | 1 | .612 |
| | | **LY** | **6.518** | **1** | ***.011** |
| | | OOS | 1.208 | 1 | .272 |
| | | RU | .275 | 1 | .600 |
| | | SIT | 1.348 | 1 | .246 |
| | | ST | .003 | 1 | .956 |
| | | WA | 2.156 | 1 | .142 |
| | | AP | .014 | 1 | .907 |
| | | BI | .275 | 1 | .600 |
| | | CL | .661 | 1 | .416 |
| | | FLEH | .051 | 1 | .822 |
| | | FLIN | .022 | 1 | .883 |
| | | GROOM | .075 | 1 | .784 |
| | | GROWL | .446 | 1 | .504 |
| | | VOCAL | 1.497 | 1 | .221 |
| | | RETREAT | 1.125 | 1 | .289 |
| | | RUBtotal | .260 | 1 | .610 |
| | | PAW | 3.403 | 1 | .065 |
| | | URINtotal | .017 | 1 | .897 |
| | | MEOW | .133 | 1 | .716 |
| | | **PRUSTEN** | **4.134** | **1** | ***.042** |
| | | RUBother | .215 | 1 | .643 |
| | | RUBtrial | .275 | 1 | .600 |
| | | URINEW | .275 | 1 | .600 |
| | | URINES | .126 | 1 | .722 |
| | | SNIFFtrial | .000 | 1 | .990 |
| | | SNIFFobject | 1.674 | 1 | .196 |

*** indicates p ≤ 0.05**

**A9-20: Scent treatments for male and female RS and RUS clouded leopards.**

| | | TREATMENT | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CONTROL | | BLOOD | | ESTRUS | | NONESTRUS | | MALE | |
| **Behav Observ** | **Succ** | ♂ | ♀ | ♂ | ♀ | ♂ | ♀ | ♂ | ♀ | ♂ | ♀ |
| AP | RUS | 5.78 | 4.82 | 7.11 | 6.97 | 4.45 | 4.92 | 5.11 | 5.23 | 7.78 | 6.15 |
| | RS | 3.11 | 1.34 | 7.11 | 4.67 | 7.11 | 2.67 | 4.89 | 4.67 | 4.44 | 5.34 |
| | Pval | 0.45 | 0.23 | 1.00 | 0.45 | 0.17 | 0.18 | 0.92 | 0.83 | 0.28 | 0.69 |
| BI | RUS | 0.22 | 0.20 | 0.89 | 0.31 | 0.00 | 2.15 | 0.44 | 2.36 | 5.56 | 2.67 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Pval | 0.45 | 0.55 | 0.45 | 0.68 | | 0.68 | 0.26 | 0.69 | 0.29 | 0.50 |
| CL | RUS | 0.22 | 0.41 | 0.44 | 0.62 | 0.22 | 0.51 | 0.44 | 0.51 | 0.22 | 0.00 |
| | RS | 0.44 | 0.00 | 0.00 | 0.00 | 0.44 | 0.00 | 0.00 | 0.00 | 0.44 | **0.67** |
| | Pval | 0.57 | 0.60 | 0.26 | 0.68 | 0.57 | 0.56 | 0.26 | 0.62 | 0.57 | ***.008** |
| DEFAC | RUS | 0.00 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.44 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.44 | 0.00 |
| | Pval | | 0.69 | | | | | | | | |
| FLEH | RUS | 0.67 | 0.10 | 0.22 | 0.62 | 0.67 | 1.54 | 2.44 | 1.23 | 1.56 | 1.54 |
| | RS | 0.00 | 0.00 | 0.44 | 0.00 | **3.11** | 2.67 | 2.67 | 2.00 | 1.33 | 2.00 |
| | Pval | 0.45 | 0.69 | 0.57 | 0.49 | ***0.030** | 0.42 | 0.92 | 0.58 | 0.81 | 0.68 |
| FLIN | RUS | 0.00 | 0.10 | 0.00 | 0.41 | 0.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Pval | | 0.69 | | 0.68 | 0.45 | | | | | 0.69 |
| GROOM | RUS | 3.34 | 7.18 | 9.33 | 8.21 | 8.22 | 7.08 | 4.22 | 8.72 | 5.56 | 9.64 |
| | RS | 8.00 | 10.67 | 11.11 | 5.33 | 8.44 | 5.34 | 4.89 | 6.00 | 3.56 | 10.00 |
| | Pval | 0.11 | 0.39 | 0.77 | 0.48 | 0.96 | 0.66 | 0.75 | 0.41 | 0.65 | 0.93 |
| GROWL | RUS | 5.78 | 5.64 | 6.67 | 1.95 | 8.67 | 5.33 | 6.89 | 7.49 | 2.67 | 10.05 |
| | RS | 4.44 | 0.00 | 0.00 | 0.00 | 0.44 | 0.67 | 0.00 | 0.00 | 3.11 | 0.00 |
| | Pval | 0.79 | 0.50 | 0.33 | 0.53 | 0.12 | 0.48 | 0.14 | 0.44 | 0.87 | 0.59 |
| LAT | RUS | 153.56 | 123.59 | 112.50 | 97.62 | 28.89 | 68.77 | 127.22 | 88.51 | 120.22 | 79.74 |
| | RS | 1.89 | 2.67 | 0.00 | 1.33 | 2.00 | 2.34 | 1.56 | 1.33 | 0.56 | 1.84 |
| | Pval | 0.12 | 0.35 | 0.42 | 0.28 | 0.41 | 0.28 | 0.16 | 0.36 | 0.37 | 0.41 |
| LICK | RUS | 0.00 | 0.00 | 33.56 | 67.39 | 0.00 | 2.26 | 0.67 | 3.28 | 1.78 | 6.36 |
| | RS | 0.00 | 0.00 | 77.78 | 24.00 | 2.22 | 2.00 | 4.89 | 0.67 | 0.00 | 0.00 |
| | Pval | | | 0.11 | 0.39 | 0.06 | 0.95 | 0.11 | 0.71 | 0.32 | 0.55 |
| LY | RUS | 0.36 | 0.36 | 0.48 | 0.32 | 0.48 | 0.42 | 0.39 | 0.39 | 0.42 | 0.34 |
| | RS | 0.66 | **0.84** | 0.59 | **0.78** | 0.46 | 0.77 | 0.71 | **0.86** | 0.71 | **0.70** |
| | Pval | 0.15 | ***.019** | 0.45 | **0.01** | 0.89 | 0.11 | 0.13 | ***.018** | 0.16 | ***.031** |
| MEOW | RUS | 1.78 | 2.26 | 2.89 | 2.97 | 0.00 | 4.10 | 14.45 | 1.33 | 6.44 | 0.41 |
| | RS | 4.44 | **23.34** | 6.67 | **34.67** | 4.00 | 11.34 | 0.00 | **37.34** | 2.67 | **22.67** |
| | Pval | 0.45 | ***.028** | 0.43 | **0.01** | 0.01 | 0.35 | 0.45 | ***.011** | 0.61 | ***.009** |

| | | TREATMENT | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CONTROL | | BLOOD | | ESTRUS | | NONESTRUS | | MALE | |
| **Behav Observ** | **Succ** | ♂ | ♀ | ♂ | ♀ | ♂ | ♀ | ♂ | ♀ | ♂ | ♀ |
| OOS | RUS | 0.33 | 0.24 | 0.17 | 0.22 | 0.16 | 0.20 | 0.31 | 0.16 | 0.23 | 0.22 |
| | RS | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 | 0.01 | 0.00 |
| | Pval | 0.18 | 0.21 | 0.47 | 0.17 | 0.36 | 0.26 | 0.21 | 0.20 | 0.31 | 0.21 |
| PA | RUS | 0.03 | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.03 | 0.01 | 0.00 |
| | RS | 0.01 | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | **0.02** |
| | Pval | 0.65 | 0.59 | | 0.57 | 0.13 | 0.68 | 0.45 | 0.62 | 0.45 | ***.025** |
| PAT | RUS | 0.03 | 0.00 | 0.04 | 0.01 | 0.01 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 |
| | RS | 0.02 | 0.00 | 0.02 | 0.00 | **0.17** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Pval | 0.82 | | 0.74 | 0.68 | ***0.018** | | 0.26 | 0.69 | | |
| PAW | RUS | 0.67 | 10.97 | 6.44 | 12.92 | 0.22 | 17.03 | 0.45 | 18.05 | 2.45 | 21.23 |
| | RS | 0.00 | 0.00 | 0.44 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Pval | 0.45 | 0.67 | 0.47 | 0.68 | 0.45 | 0.68 | 0.45 | 0.67 | 0.26 | 0.63 |
| PRUSTEN | RUS | 0.00 | 0.31 | 0.00 | 2.36 | 0.00 | 0.31 | 0.67 | 0.72 | 0.00 | 0.82 |
| | RS | **2.22** | **36.00** | 5.78 | 23.34 | **5.78** | **6.67** | 2.67 | **32.00** | 7.56 | **34.00** |
| | Pval | ***.005** | ***.007** | 0.10 | **0.03** | ***0.020** | ***0.014** | 0.13 | ***.010** | 0.13 | ***.008** |
| RETREAT | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Pval | | | | | | | | | | |
| ROLL | RUS | 0.00 | 0.31 | 0.00 | 0.10 | 0.89 | 0.10 | 2.22 | 0.41 | 7.56 | 1.54 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Pval | | 0.58 | | 0.68 | 0.45 | 0.68 | 0.40 | 0.55 | 0.24 | 0.50 |
| RU | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Pval | | | | | | | | | | 0.69 |
| RUBother | RUS | 23.11 | 7.59 | 12.22 | 8.31 | 14.22 | 5.95 | 15.33 | 9.33 | 14.22 | 7.18 |
| | RS | 0.00 | 2.67 | 0.00 | 3.33 | 3.11 | 0.00 | 0.44 | 4.67 | 1.78 | 4.00 |
| | Pval | 0.41 | 0.48 | 0.43 | 0.61 | 0.43 | 0.37 | 0.40 | 0.61 | 0.18 | 0.65 |
| RUBtotal | RUS | 23.33 | 7.59 | 16.00 | 8.31 | 15.11 | 6.26 | 15.33 | 9.85 | 14.89 | 14.26 |
| | RS | 0.00 | 2.67 | 0.00 | 3.33 | 3.11 | 0.00 | 0.44 | 4.67 | 1.78 | 4.00 |
| | Pval | 0.41 | 0.48 | 0.44 | 0.61 | 0.40 | 0.34 | 0.40 | 0.57 | 0.17 | 0.35 |
| RUBtrial | RUS | 0.22 | 0.00 | 3.78 | 0.00 | 0.89 | 0.31 | 0.00 | 0.51 | 0.67 | 7.08 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Pval | 0.45 | | 0.45 | | 0.45 | 0.68 | | 0.56 | 0.45 | 0.47 |
| SIT | RUS | 0.05 | 0.16 | 0.08 | 0.21 | 0.13 | 0.18 | 0.07 | 0.17 | 0.07 | 0.20 |
| | RS | 0.14 | 0.06 | 0.17 | 0.12 | 0.05 | 0.10 | 0.08 | 0.03 | 0.05 | 0.09 |
| | Pval | 0.13 | 0.18 | 0.17 | 0.18 | 0.32 | 0.37 | 0.76 | 0.14 | 0.72 | 0.17 |

| | | TREATMENT | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **CONTROL** | | **BLOOD** | | **ESTRUS** | | **NONESTRUS** | | **MALE** | |
| **Behav Observ** | **Succ** | ♂ | ♀ | ♂ | ♀ | ♂ | ♀ | ♂ | ♀ | ♂ | ♀ |
| SNIFFother | RUS | 118.00 | 43.69 | 82.22 | 71.69 | 65.56 | 49.23 | 113.33 | 66.36 | 68.67 | 34.98 |
| | RS | 12.44 | 28.67 | 30.67 | 48.00 | 24.89 | 7.34 | 36.89 | 67.33 | 48.00 | 52.67 |
| | Pval | 0.25 | 0.70 | 0.28 | 0.73 | 0.42 | 0.36 | 0.25 | 0.99 | 0.49 | 0.61 |
| SNIFFtrial | RUS | 22.00 | 26.46 | 53.11 | 64.00 | 34.45 | 39.08 | 36.67 | 44.92 | 107.11 | 81.85 |
| | RS | 17.34 | 6.67 | 37.33 | 38.00 | 52.00 | 28.00 | 45.78 | 48.67 | 32.00 | 60.00 |
| | Pval | 0.76 | 0.32 | 0.57 | 0.39 | 0.14 | 0.49 | 0.58 | 0.90 | 0.12 | 0.66 |
| ST | RUS | 0.10 | 0.14 | 0.13 | 0.15 | 0.14 | 0.13 | 0.15 | 0.16 | 0.20 | 0.16 |
| | RS | 0.14 | 0.08 | 0.17 | 0.06 | 0.23 | 0.06 | 0.12 | 0.08 | 0.20 | 0.11 |
| | Pval | 0.39 | 0.44 | 0.57 | 0.28 | 0.09 | 0.23 | 0.62 | 0.29 | 0.96 | 0.48 |
| STEREO | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.31 | 0.00 | 0.41 | 0.00 | 0.21 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Pval | | | | | | 0.68 | | 0.69 | | 0.69 |
| TIA | RUS | 404.39 | 387.86 | 342.00 | 236.31 | 276.67 | 285.21 | 362.72 | 338.79 | 274.28 | 348.77 |
| | RS | 328.45 | **751.50** | 107.11 | 315.34 | 83.11 | 518.33 | 107.11 | 318.50 | 56.89 | 30.84 |
| | Pval | 0.65 | ***.047** | 0.26 | 0.66 | 0.23 | 0.18 | 0.16 | 0.93 | 0.11 | 0.08 |
| TSI | RUS | 7.39 | 7.06 | 25.17 | 29.05 | 9.45 | 13.95 | 11.67 | 9.23 | 54.83 | 47.36 |
| | RS | 4.45 | 1.00 | 34.33 | 32.92 | 18.22 | 6.00 | 17.89 | 17.00 | 14.67 | 21.33 |
| | Pval | 0.56 | 0.22 | 0.50 | 0.82 | 0.12 | 0.51 | 0.37 | 0.21 | 0.23 | 0.53 |
| TTS | RUS | 246.28 | 137.00 | 161.61 | 106.60 | 133.94 | 82.98 | 170.50 | 110.13 | 174.17 | 109.36 |
| | RS | 24.89 | 16.83 | 39.89 | 7.67 | 30.78 | 20.50 | 103.89 | 4.17 | 3.89 | 15.67 |
| | Pval | 0.11 | 0.34 | 0.54 | 0.28 | 0.43 | 0.33 | 0.53 | 0.35 | 0.23 | 0.38 |
| URINES | RUS | 0.45 | 1.64 | 0.22 | 3.69 | 0.67 | 1.02 | 0.45 | 2.46 | 1.56 | 2.15 |
| | RS | 0.89 | 0.00 | 1.78 | 0.67 | **2.67** | 0.67 | 0.44 | 0.67 | 0.89 | 0.00 |
| | Pval | 0.49 | 0.32 | 0.08 | 0.64 | ***0.044** | 0.77 | 1.00 | 0.65 | 0.64 | 0.59 |
| URINEW | RUS | 0.00 | 0.00 | 0.22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 | 0.00 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | **1.78** | 0.00 | 0.44 | 0.00 | 0.00 | 0.00 |
| | Pval | | | 0.45 | | ***0.049** | | 0.13 | 0.69 | | |
| URINtotal | RUS | 0.45 | 1.64 | 0.45 | 3.69 | 0.67 | 1.02 | 0.45 | 2.56 | 1.56 | 2.15 |
| | RS | 0.89 | 0.00 | 1.78 | 0.67 | **4.44** | 0.67 | 0.89 | 0.67 | 0.89 | 0.00 |
| | Pval | 0.49 | 0.32 | 0.18 | 0.64 | ***0.008** | 0.77 | 0.49 | 0.63 | 0.64 | 0.59 |
| VOCAL | RUS | 1.78 | 2.56 | 2.89 | 5.33 | 0.00 | 4.41 | 15.11 | 2.05 | 6.44 | 1.23 |
| | RS | 6.67 | **59.33** | 12.44 | **58.00** | **9.78** | 18.00 | 2.67 | **69.34** | 10.22 | **56.00** |
| | Pval | 0.21 | ***.011** | 0.07 | **0.01** | ***0.009** | 0.15 | 0.53 | **0.01** | 0.64 | ***.009** |
| WA | RUS | 0.10 | 0.08 | 0.10 | 0.09 | 0.09 | 0.06 | 0.04 | 0.09 | 0.08 | 0.08 |
| | RS | 0.02 | 0.03 | 0.05 | 0.05 | 0.04 | 0.08 | 0.04 | 0.04 | 0.02 | 0.08 |
| | Pval | 0.29 | 0.43 | 0.18 | 0.41 | 0.23 | 0.71 | 1.00 | 0.39 | 0.17 | 0.97 |

*** indicates $p \leq 0.05$**

**A9-21: Mean and P values for choice, mirror image stimulation and novel object treatments for male and female clouded leopards when comparing RS and RUS individuals.**

| | | **TREATMENTS** | | | | | |
|---|---|---|---|---|---|---|---|
| | | **CHOICE** | | **MIS** | | **NOVEL OBJECT** | |
| **Behavioral Observation** | **Success** | ♂ | ♀ | ♂ | ♀ | ♂ | ♀ |
| AP | RUS | 48.67 | 32.92 | 11.33 | 23.38 | 12.000 | 6.769 |
| | RS | 41.33 | 18.00 | **38.67** | 38.00 | 9.333 | 8.000 |
| | Pvalue | 0.73 | 0.51 | ***0.041** | 0.42 | 0.540 | 0.790 |
| BI | RUS | 2.00 | 0.31 | 11.33 | 0.00 | 1.333 | 0.000 |
| | RS | 0.00 | 0.00 | 0.00 | **8.00** | 0.000 | 0.000 |
| | Pvalue | 0.45 | 0.67 | 0.45 | ***0.008** | 0.450 | |
| CL | RUS | 3.33 | 4.62 | 0.67 | 0.31 | 1.333 | 0.923 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 | 0.000 |
| | Pvalue | 0.45 | 0.67 | 0.45 | 0.69 | 0.257 | 0.685 |
| DEFAC | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 | 0.000 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 | 0.000 |
| | Pvalue | | | | | | |
| FLEH | RUS | 3.33 | 1.54 | 0.00 | 0.31 | 1.333 | 0.308 |
| | RS | 1.33 | 4.00 | 0.00 | 0.00 | 0.000 | 2.000 |
| | Pvalue | 0.65 | 0.56 | | 0.69 | 0.257 | 0.101 |
| FLIN | RUS | 0.00 | 0.00 | 4.00 | 8.31 | 0.000 | 2.769 |
| | RS | 0.00 | 0.00 | 1.33 | **36.00** | 0.000 | 4.000 |
| | Pvalue | | | 0.36 | ***0.007** | | 0.732 |
| GROOM | RUS | **53.33** | 43.08 | 4.00 | 6.46 | 10.000 | 10.462 |
| | RS | 4.00 | 50.00 | 8.00 | 4.00 | 18.667 | 2.000 |
| | Pvalue | ***0.046** | 0.63 | 0.44 | 0.74 | 0.352 | 0.327 |
| GROWL | RUS | 4.00 | 1.54 | 108.00 | 24.00 | 6.000 | 25.538 |
| | RS | 0.00 | 0.00 | 25.33 | 142.00 | 0.000 | 0.000 |
| | Pvalue | 0.45 | 0.60 | 0.46 | 0.06 | 0.453 | 0.639 |
| LAT | RUS | 228.00 | 160.50 | 40.33 | 97.46 | 159.167 | 26.538 |
| | RS | 0.33 | 2.00 | 2.00 | 2.00 | 0.333 | 1.500 |
| | Pvalue | 0.28 | 0.51 | 0.15 | 0.57 | 0.424 | 0.292 |
| LICK | RUS | 34.00 | 29.85 | 0.00 | 0.00 | 0.000 | 0.000 |
| | RS | 84.00 | 0.00 | 4.00 | 0.00 | 0.000 | 0.000 |
| | Pvalue | 0.06 | 0.22 | 0.13 | | | |
| LY | RUS | 0.38 | 0.35 | 0.32 | 0.09 | 0.410 | 0.431 |
| | RS | 0.16 | **0.90** | 0.04 | 0.00 | 0.733 | 0.735 |
| | Pvalue | 0.28 | ***0.038** | 0.13 | 0.35 | 0.113 | 0.052 |

| | | TREATMENTS | | | | | |
|---|---|---|---|---|---|---|---|
| | | CHOICE | | MIS | | NOVEL OBJECT | |
| **Behavioral Observation** | **Success** | ♂ | ♀ | ♂ | ♀ | ♂ | ♀ |
| MEOW | RUS | 20.00 | 0.00 | 1.33 | 4.92 | 1.333 | 3.692 |
| | RS | 40.00 | 0.00 | 8.00 | 0.00 | 1.333 | 2.000 |
| | Pvalue | 0.53 | | 0.09 | 0.58 | 1.000 | 0.804 |
| OOS | RUS | 0.29 | 0.27 | 0.17 | 0.27 | 0.188 | 0.092 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 | 0.000 |
| | Pvalue | 0.21 | 0.35 | 0.42 | 0.36 | 0.393 | 0.387 |
| PA | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 | 0.000 |
| | RS | 0.18 | 0.00 | 0.00 | 0.00 | 0.000 | 0.000 |
| | Pvalue | 0.13 | | | | | |
| PAT | RUS | 0.00 | 0.03 | 0.00 | 0.00 | 0.000 | 0.000 |
| | RS | **0.22** | 0.00 | 0.00 | 0.00 | 0.000 | 0.000 |
| | Pvalue | ***0.005** | 0.67 | | | | |
| PAW | RUS | 1.33 | 0.12 | 97.33 | 10.15 | 0.000 | 3.077 |
| | RS | 0.00 | 0.00 | 1.33 | **96.00** | 1.333 | **64.000** |
| | Pvalue | 0.45 | 0.67 | 0.44 | ***0.025** | 0.134 | ***0.014** |
| PRUSTEN | RUS | 0.00 | 1.54 | 0.00 | 2.15 | 0.667 | 0.615 |
| | RS | 53.33 | **20.00** | 2.67 | **40.00** | 1.333 | **20.000** |
| | Pvalue | 0.13 | ***0.031** | 0.13 | **0.01** | 0.571 | ***0.010** |
| RETREAT | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.667 | 0.000 |
| | RS | 0.00 | 0.00 | 0.00 | **4.00** | 0.000 | **2.000** |
| | Pvalue | | | | ***.000** | 0.453 | ***0.008** |
| ROLL | RUS | 1.33 | 0.00 | 0.00 | 0.31 | 0.000 | 0.000 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 | 0.000 |
| | Pvalue | 0.26 | | 0.21 | 0.69 | | 0.707 |
| RU | RUS | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 | 0.005 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 | 0.000 |
| | Pvalue | | | | | | 0.685 |
| RUBother | RUS | 20.00 | 47.69 | 1.33 | 1.85 | 8.000 | 4.308 |
| | RS | 26.67 | 0.00 | 1.33 | 0.00 | 5.333 | 0.000 |
| | Pvalue | 0.74 | 0.47 | 1.00 | 0.45 | 0.742 | 0.495 |
| RUBtotal | RUS | 4.00 | 9.66 | 1.33 | 1.85 | 8.667 | 4.308 |
| | RS | 5.33 | 0.00 | 1.33 | 0.00 | 5.333 | 0.000 |
| | Pvalue | 0.74 | 0.45 | 1.00 | 0.45 | 0.675 | 0.495 |
| RUBtrial | RUS | 0.00 | 0.62 | 0.00 | 0.00 | 0.667 | 0.000 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 | 0.000 |
| | Pvalue | | 0.67 | | | 0.453 | |
| SIT | RUS | 0.04 | 0.10 | 0.09 | 0.17 | 0.033 | 0.247 |
| | RS | 0.02 | 0.00 | 0.38 | 0.04 | 0.090 | 0.035 |
| | Pvalue | 0.60 | 0.22 | 0.06 | 0.38 | 0.364 | 0.180 |

| | | TREATMENTS | | | | | |
|---|---|---|---|---|---|---|---|
| | | CHOICE | | MIS | | NOVEL OBJECT | |
| **Behavioral Observation** | **Success** | ♂ | ♀ | ♂ | ♀ | ♂ | ♀ |
| SNIFFother | RUS | 356.67 | 493.85 | 65.33 | 65.54 | 120.000 | 22.154 |
| | RS | 306.67 | 500.00 | 32.00 | 56.00 | 2.667 | 6.000 |
| | Pvalue | 0.84 | 0.99 | 0.46 | 0.85 | 0.122 | 0.455 |
| SNIFFtrial | RUS | 152.67 | 140.92 | 88.00 | 118.15 | 108.667 | 57.846 |
| | RS | 160.00 | 62.00 | 149.33 | 116.00 | 80.000 | 66.000 |
| | Pvalue | 0.91 | 0.49 | 0.32 | 0.99 | 0.670 | 0.871 |
| ST | RUS | 0.19 | 0.18 | 0.42 | 0.40 | 0.233 | 0.124 |
| | RS | 0.35 | 0.10 | 0.55 | 0.77 | 0.157 | 0.170 |
| | Pvalue | 0.15 | 0.54 | 0.51 | 0.13 | 0.494 | 0.541 |
| STEREO | RUS | 0.00 | 0.00 | 0.00 | 0.92 | 0.000 | 0.000 |
| | RS | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 | 0.000 |
| | Pvalue | | | | 0.69 | 0.630 | 0.707 |
| TIA | RUS | 238.00 | 232.38 | 234.67 | 340.31 | 176.500 | 321.077 |
| | RS | 2.00 | 20.00 | 5.67 | 33.50 | 10.000 | 23.500 |
| | Pvalue | 0.26 | 0.40 | 0.23 | 0.27 | 0.394 | 0.297 |
| TSI | RUS | 38.50 | 44.85 | 339.50 | 233.31 | 33.000 | 90.692 |
| | RS | 54.00 | 15.00 | 662.67 | **650.00** | 35.333 | 16.000 |
| | Pvalue | 0.35 | 0.43 | 0.15 | ***0.029** | 0.893 | 0.655 |
| TTS | RUS | 229.83 | 156.46 | 72.33 | 225.85 | 162.000 | 46.154 |
| | RS | 5.33 | 13.00 | 14.00 | 19.00 | 4.000 | 14.500 |
| | Pvalue | 0.28 | 0.52 | 0.14 | 0.40 | 0.425 | 0.528 |
| URINES | RUS | 0.00 | 20.00 | 0.00 | 3.08 | 1.333 | 1.231 |
| | RS | **20.00** | 10.00 | 1.33 | 0.00 | 1.333 | 2.000 |
| | Pvalue | ***0.034** | 0.83 | 0.13 | 0.57 | 1.000 | 0.591 |
| URINEW | RUS | 0.00 | 1.54 | 0.00 | 0.00 | 0.000 | 0.308 |
| | RS | **20.00** | 0.00 | 0.00 | 0.00 | 0.000 | 0.000 |
| | Pvalue | ***0.034** | 0.67 | | | 0.680 | |
| URINtotal | RUS | 0.00 | 4.31 | 0.00 | 3.08 | 1.333 | 1.538 |
| | RS | **8.00** | 2.00 | 1.33 | 0.00 | 1.333 | 2.000 |
| | Pvalue | ***0.007** | 0.80 | 0.13 | 0.57 | 1.000 | 0.756 |
| VOCAL | RUS | 4.00 | 0.31 | 1.33 | 7.08 | 2.000 | 4.308 |
| | RS | **18.67** | **4.00** | 10.67 | **40.00** | 2.667 | 22.000 |
| | Pvalue | ***0.085** | ***0.031** | 0.08 | ***0.053** | 0.805 | 0.083 |
| WA | RUS | 0.10 | 0.07 | 0.00 | 0.08 | 0.133 | 0.103 |
| | RS | 0.07 | 0.00 | 0.02 | 0.20 | 0.023 | 0.070 |
| | Pvalue | 0.58 | 0.34 | 0.13 | 0.19 | 0.062 | 0.671 |

Hypothesis 39: Male RS clouded leopards exhibit different behaviors during the control tests.
Hypothesis 40: Female RS clouded leopards exhibit different behaviors during the control tests.

**A9-22: Results of Logistical Regression of male and female clouded leopard behavioral observations during the control treatments and "success" as dependant variable**

| Sex | | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|---|
| male | Step 0 | Constant | -.693 | .707 | .961 | 1 | .327 | .500 |
| female | Step 0 | Constant | -1.872 | .760 | 6.073 | 1 | .014 | .154 |

| | | | Sex | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | **male** | | | **female** | | |
| | | | Score | df | Sig. | Score | df | Sig. |
| Step 0 | Variables | AP | .571 | 1 | .450 | 1.469 | 1 | .225 |
| | | BI | .563 | 1 | .453 | .355 | 1 | .551 |
| | | CL | .321 | 1 | .571 | .275 | 1 | .600 |
| | | FLEH | .563 | 1 | .453 | .165 | 1 | .685 |
| | | GROOM | 2.505 | 1 | .113 | .726 | 1 | .394 |
| | | GROWL | .073 | 1 | .787 | .463 | 1 | .496 |
| | | LAT | 2.405 | 1 | .121 | .891 | 1 | .345 |
| | | **LY** | 2.106 | 1 | .147 | **5.460** | **1** | **.019** |
| | | **MEOW** | .562 | 1 | .454 | **4.819** | **1** | **.028** |
| | | OOS | 1.817 | 1 | .178 | 1.598 | 1 | .206 |
| | | PA | .209 | 1 | .647 | .284 | 1 | .594 |
| | | PAT | .053 | 1 | .817 | | | |
| | | PAW | .563 | 1 | .453 | .186 | 1 | .666 |
| | | **PRUSTEN** | **8.028** | **1** | **.005** | **7.170** | **1** | **.007** |
| | | RUBother | .669 | 1 | .413 | .495 | 1 | .482 |
| | | RUBtotal | .684 | 1 | .408 | .495 | 1 | .482 |
| | | RUBtrial | .563 | 1 | .453 | | | |
| | | SIT | 2.270 | 1 | .132 | 1.772 | 1 | .183 |
| | | SNIFFother | 1.316 | 1 | .251 | .151 | 1 | .698 |
| | | Snifftrial | .097 | 1 | .755 | 1.010 | 1 | .315 |
| | | ST | .727 | 1 | .394 | .609 | 1 | .435 |
| | | **TIA** | .202 | 1 | .653 | **3.934** | **1** | **.047** |
| | | TSI | .334 | 1 | .563 | 1.539 | 1 | .215 |
| | | TTS | 2.504 | 1 | .114 | .904 | 1 | .342 |
| | | URINEs | .468 | 1 | .494 | 1.011 | 1 | .315 |
| | | URINtotal | .468 | 1 | .494 | 1.011 | 1 | .315 |
| | | **VOCAL** | 1.568 | 1 | .210 | **6.453** | **1** | **.011** |
| | | WA | 1.118 | 1 | .290 | .613 | 1 | .434 |
| | | DEFAC | | | | .165 | 1 | .685 |
| | | FLIN | | | | .165 | 1 | .685 |
| | | ROLL | | | | .314 | 1 | .575 |

*** indicates $p \leq 0.05$**

Hypothesis: 41: Male RS clouded leopards exhibit different behavioral observations during blood treatments.
Hypothesis 42: Female RS clouded leopards exhibit different behavioral observations during blood treatments

**A9-23: Results of Logistical Regression of male and female clouded leopard behavioral observations during the blood treatments and "success" as dependant variable.**

| Sex | | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|---|
| male | Step 0 | Constant | -.288 | .764 | .142 | 1 | .706 | .750 |
| female | Step 0 | Constant | -2.015 | .753 | 7.164 | 1 | .007 | .133 |

| | | | Sex | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | male | | | female | | |
| | | | Score | df | Sig. | Score | df | Sig. |
| Step 0 | Variables | AP | .003 | 1 | .955 | .555 | 1 | .456 |
| | | BI | .875 | 1 | .350 | .142 | 1 | .707 |
| | | CL | .875 | 1 | .350 | .191 | 1 | .662 |
| | | DEFAC | 1.556 | 1 | .212 | | | |
| | | FLEH | 1.556 | 1 | .212 | .539 | 1 | .463 |
| | | GROOM | .080 | 1 | .777 | .674 | 1 | .412 |
| | | GROWL | .875 | 1 | .350 | .517 | 1 | .472 |
| | | LAT | .902 | 1 | .342 | 1.036 | 1 | .309 |
| | | LICK | 1.518 | 1 | .218 | .610 | 1 | .435 |
| | | **LY** | .663 | 1 | .416 | **6.309** | **1** | **.012** |
| | | **MEOW** | .175 | 1 | .676 | **7.698** | **1** | **.006** |
| | | OOS | .834 | 1 | .361 | 1.473 | 1 | .225 |
| | | PAT | .199 | 1 | .656 | .279 | 1 | .598 |
| | | PAW | .873 | 1 | .350 | .149 | 1 | .699 |
| | | **PRUSTEN** | 1.864 | 1 | .172 | **5.717** | **1** | **.017** |
| | | RUBtrial | .875 | 1 | .350 | | | |
| | | **SIT** | **3.830** | **1** | **.050** | 1.895 | 1 | .169 |
| | | SNIFFobject | .914 | 1 | .339 | .151 | 1 | .698 |
| | | ST | .115 | 1 | .734 | 1.202 | 1 | .273 |
| | | TIA | .963 | 1 | .326 | .115 | 1 | .735 |
| | | TSI | .051 | 1 | .822 | .131 | 1 | .717 |
| | | TTS | .647 | 1 | .421 | 1.019 | 1 | .313 |
| | | URINES | 1.896 | 1 | .169 | .169 | 1 | .681 |
| | | URINEW | .875 | 1 | .350 | | | |
| | | URINtotal | .937 | 1 | .333 | .169 | 1 | .681 |
| | | **VOCAL** | 1.907 | 1 | .167 | **7.538** | **1** | **.006** |
| | | WA | 1.150 | 1 | .284 | .855 | 1 | .355 |
| | | FLIN | | | | .142 | 1 | .707 |
| | | PA | | | | .279 | 1 | .598 |
| | | ROLL | | | | .142 | 1 | .707 |
| | | RU | | | | .142 | 1 | .707 |

*** indicates $p \leq 0.05$**

Hypothesis: 43: Male RS clouded leopards exhibit different behavioral observations during estrus treatments.
Hypothesis 44: Female RS clouded leopards exhibit different behavioral observations during estrus treatments

**A9-24: Results of Logistical Regression of female clouded leopard behavioral observations during the estrus treatments and "success" as dependant variable.**

| sex | | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|---|
| male | Step 0 | Constant | -.288 | .764 | .142 | 1 | .706 | .750 |
| female | Step 0 | Constant | -2.015 | .753 | 7.164 | 1 | .007 | .133 |

| | | | Sex | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | male | | | female | | |
| | | | Score | df | Sig. | Score | df | Sig. |
| Step 0 | Variables | AP | 1.468 | 1 | .226 | 1.530 | 1 | .216 |
| | | CL | .058 | 1 | .809 | .289 | 1 | .591 |
| | | FLEH | 3.533 | 1 | .060 | .861 | 1 | .353 |
| | | GROOM | .000 | 1 | .984 | .254 | 1 | .614 |
| | | GROWL | 1.153 | 1 | .283 | .782 | 1 | .376 |
| | | LAT | 1.189 | 1 | .276 | 1.275 | 1 | .259 |
| | | LICK | 2.481 | 1 | .115 | .000 | 1 | .990 |
| | | LY | .062 | 1 | .804 | 2.968 | 1 | .085 |
| | | **MEOW** | **5.038** | **1** | **.025** | 1.140 | 1 | .286 |
| | | OOS | .875 | 1 | .350 | 1.223 | 1 | .269 |
| | | PA | 1.556 | 1 | .212 | .142 | 1 | .707 |
| | | **PAT** | **4.027** | **1** | **.045** | | | |
| | | **PRUSTEN** | **3.960** | **1** | **.047** | **6.977** | **1** | **.008** |
| | | RUBtotal | .845 | 1 | .358 | .988 | 1 | .320 |
| | | SIT | .000 | 1 | 1.000 | 1.093 | 1 | .296 |
| | | **SNIFFtrial** | **4.072** | **1** | **.044** | .350 | 1 | .554 |
| | | ST | 1.681 | 1 | .195 | 1.569 | 1 | .210 |
| | | TIA | 1.241 | 1 | .265 | 1.662 | 1 | .197 |
| | | TSI | 1.171 | 1 | .279 | .341 | 1 | .559 |
| | | TTS | .638 | 1 | .425 | 1.020 | 1 | .312 |
| | | URINES | 3.043 | 1 | .081 | .070 | 1 | .792 |
| | | URINEW | 2.763 | 1 | .096 | | | |
| | | **URINtotal** | **5.525** | **1** | **.019** | .070 | 1 | .792 |
| | | **VOCAL** | **5.170** | **1** | **.023** | 2.559 | 1 | .110 |
| | | WA | .829 | 1 | .363 | .057 | 1 | .811 |
| | | BI | | | | .142 | 1 | .707 |
| | | FLIN | | | | .142 | 1 | .707 |
| | | PAW | | | | .145 | 1 | .703 |
| | | ROLL | | | | .215 | 1 | .643 |
| | | RUBtrial | | | | .295 | 1 | .587 |
| | | STEREO | | | | .142 | 1 | .707 |

*** indicates $p \leq 0.05$**

Hypothesis: 45: Male RS clouded leopards exhibit different behavioral observations during nonestrus treatments.
Hypothesis 46: Female RS clouded leopards exhibit different behavioral observations during nonestrus treatments

**A9-25: Results of Logistical Regression of female clouded leopard behavioral observations during the nonestrus treatments and "success" as dependant variable.**

| Sex | | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|---|
| male | Step 0 | Constant | -.693 | .707 | .961 | 1 | .327 | .500 |
| female | Step 0 | Constant | -1.872 | .760 | 6.073 | 1 | .014 | .154 |

| | | | Sex | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | male | | | female | | |
| | | | Score | df | Sig. | Score | df | Sig. |
| Step 0 | Variables | AP | .011 | 1 | .917 | .047 | 1 | .828 |
| | | BI | 1.286 | 1 | .257 | .165 | 1 | .685 |
| | | CL | 1.286 | 1 | .257 | .251 | 1 | .617 |
| | | FLEH | .011 | 1 | .917 | .309 | 1 | .578 |
| | | GROOM | .098 | 1 | .754 | .679 | 1 | .410 |
| | | GROWL | 2.143 | 1 | .143 | .589 | 1 | .443 |
| | | LAT | 1.973 | 1 | .160 | .823 | 1 | .364 |
| | | LICK | 2.500 | 1 | .114 | .139 | 1 | .709 |
| | | **LY** | 2.278 | 1 | .131 | **5.566** | **1** | **.018** |
| | | **MEOW** | .563 | 1 | .453 | **6.528** | **1** | **.011** |
| | | OOS | 1.605 | 1 | .205 | 1.649 | 1 | .199 |
| | | PA | .563 | 1 | .453 | .248 | 1 | .618 |
| | | PAT | 1.269 | 1 | .260 | .165 | 1 | .685 |
| | | PAW | .563 | 1 | .453 | .177 | 1 | .674 |
| | | **PRUSTEN** | 2.250 | 1 | .134 | **6.721** | **1** | **.010** |
| | | ROLL | .705 | 1 | .401 | .355 | 1 | .551 |
| | | RUBother | .715 | 1 | .398 | .260 | 1 | .610 |
| | | RUBtotal | .715 | 1 | .398 | .326 | 1 | .568 |
| | | SIT | .096 | 1 | .757 | 2.231 | 1 | .135 |
| | | SNIFFtrial | .307 | 1 | .580 | .017 | 1 | .897 |
| | | ST | .254 | 1 | .615 | 1.129 | 1 | .288 |
| | | TIA | 2.003 | 1 | .157 | .009 | 1 | .925 |
| | | TSI | .810 | 1 | .368 | 1.565 | 1 | .211 |
| | | TTS | .395 | 1 | .530 | .876 | 1 | .349 |
| | | URINES | .000 | 1 | .998 | .209 | 1 | .647 |
| | | URINEW | 2.250 | 1 | .134 | .165 | 1 | .685 |
| | | URINtotal | .468 | 1 | .494 | .236 | 1 | .627 |
| | | **VOCAL** | .389 | 1 | .533 | **6.668** | **1** | **.010** |
| | | WA | .000 | 1 | 1.000 | .728 | 1 | .394 |
| | | RUBtrial | | | | .339 | 1 | .560 |
| | | STEREO | | | | .165 | 1 | .685 |

*** indicates p ≤ 0.05**

Hypothesis: 47: Male RS clouded leopards exhibit different behavioral observations during male treatments.
Hypothesis 48: Female RS clouded leopards exhibit different behavioral observations during male treatments

**A9-26: Results of Logistical Regression of female clouded leopard behavioral observations during the male treatments and "success" as dependant variable.**

| Sex | | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|---|
| male | Step 0 | Constant | -.693 | .707 | .961 | 1 | .327 | .500 |
| female | Step 0 | Constant | -1.872 | .760 | 6.073 | 1 | .014 | .154 |

| | | | Sex | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | male | | | female | | |
| | | | Score | df | Sig. | Score | df | Sig. |
| Step 0 | Variables | AP | 1.173 | 1 | .279 | .159 | 1 | .690 |
| | | BI | 1.102 | 1 | .294 | .462 | 1 | .496 |
| | | **CL** | .321 | 1 | .571 | **6.964** | **1** | **.008** |
| | | DEFAC | 2.250 | 1 | .134 | | | |
| | | FLEH | .056 | 1 | .813 | .170 | 1 | .680 |
| | | GROOM | .206 | 1 | .650 | .007 | 1 | .933 |
| | | GROWL | .028 | 1 | .867 | .289 | 1 | .591 |
| | | LAT | .813 | 1 | .367 | .682 | 1 | .409 |
| | | LICK | .973 | 1 | .324 | .361 | 1 | .548 |
| | | **LY** | 1.977 | 1 | .160 | **4.650** | **1** | **.031** |
| | | **MEOW** | .267 | 1 | .605 | **6.798** | **1** | **.009** |
| | | OOS | 1.042 | 1 | .307 | 1.563 | 1 | .211 |
| | | **PA** | .563 | 1 | .453 | **5.035** | **1** | **.025** |
| | | PAW | 1.272 | 1 | .259 | .231 | 1 | .631 |
| | | **PRUSTEN** | 2.250 | 1 | .134 | **6.972** | **1** | **.008** |
| | | ROLL | 1.371 | 1 | .242 | .455 | 1 | .500 |
| | | RUBother | 1.776 | 1 | .183 | .207 | 1 | .649 |
| | | RUBtotal | 1.849 | 1 | .174 | .892 | 1 | .345 |
| | | RUBtrial | .563 | 1 | .453 | .516 | 1 | .473 |
| | | SIT | .129 | 1 | .720 | 1.860 | 1 | .173 |
| | | SNIFFtrial | 2.399 | 1 | .121 | .189 | 1 | .664 |
| | | ST | .003 | 1 | .955 | .497 | 1 | .481 |
| | | TIA | 2.527 | 1 | .112 | 3.162 | 1 | .075 |
| | | TSI | 1.427 | 1 | .232 | .402 | 1 | .526 |
| | | TTS | 1.467 | 1 | .226 | .772 | 1 | .380 |
| | | URINES | .226 | 1 | .635 | .290 | 1 | .590 |
| | | URINtotal | .226 | 1 | .635 | .290 | 1 | .590 |
| | | **VOCAL** | .217 | 1 | .641 | **6.737** | **1** | **.009** |
| | | WA | 1.904 | 1 | .168 | .002 | 1 | .969 |
| | | FLIN | | | | .165 | 1 | .685 |
| | | RU | | | | .165 | 1 | .685 |
| | | STEREO | | | | .165 | 1 | .685 |

*** indicates p ≤ 0.05**

Hypothesis: 49: Male RS clouded leopards exhibit different behavioral observations during choice treatment.
Hypothesis 50: Female RS clouded leopards exhibit different behavioral observations during choice treatment.

**A9-27: Results of Logistical Regression of female clouded leopard behavioral observations during the choice treatment and "success" as dependant variable.**

| Sex | | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|---|
| male | Step 0 | Constant | -.288 | .764 | .142 | 1 | .706 | .750 |
| female | Step 0 | Constant | -1.946 | .756 | 6.626 | 1 | .010 | .143 |

| | | | Sex | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | male | | | female | | |
| | | | Score | df | Sig. | Score | df | Sig. |
| Step 0 | Variables | AP | .661 | 1 | .416 | .794 | 1 | .373 |
| | | CL | .875 | 1 | .350 | .152 | 1 | .696 |
| | | FLEH | 1.556 | 1 | .212 | .053 | 1 | .818 |
| | | GROOM | 2.517 | 1 | .113 | .120 | 1 | .729 |
| | | LAT | 1.809 | 1 | .179 | .384 | 1 | .535 |
| | | LICK | 2.645 | 1 | .104 | 1.746 | 1 | .186 |
| | | **LY** | 1.601 | 1 | .206 | **4.817** | **1** | **.028** |
| | | MEOW | .072 | 1 | .788 | | | |
| | | OOS | 1.777 | 1 | .183 | .863 | 1 | .353 |
| | | PA | 1.556 | 1 | .212 | | | |
| | | **PAT** | **6.072** | **1** | **.014** | .152 | 1 | .696 |
| | | **PRUSTEN** | 1.556 | 1 | .212 | **5.441** | **1** | **.020** |
| | | ROLL | .875 | 1 | .350 | .152 | 1 | .696 |
| | | RUBother | .227 | 1 | .634 | .645 | 1 | .422 |
| | | RUBtotal | .227 | 1 | .634 | .681 | 1 | .409 |
| | | SIT | 1.556 | 1 | .212 | 1.901 | 1 | .168 |
| | | SNIFFobject | 1.828 | 1 | .176 | .011 | 1 | .916 |
| | | SNIFFtrial | .502 | 1 | .479 | .734 | 1 | .392 |
| | | ST | 3.022 | 1 | .082 | .614 | 1 | .433 |
| | | TIA | 1.843 | 1 | .175 | .585 | 1 | .444 |
| | | TSI | 3.389 | 1 | .066 | .840 | 1 | .359 |
| | | TTS | 1.790 | 1 | .181 | .359 | 1 | .549 |
| | | URINES | 3.231 | 1 | .072 | .027 | 1 | .871 |
| | | URINEW | 3.231 | 1 | .072 | .152 | 1 | .696 |
| | | **URINtotal** | **5.419** | **1** | **.020** | .038 | 1 | .845 |
| | | **VOCAL** | 1.748 | 1 | .186 | **5.441** | **1** | **.020** |
| | | WA | .000 | 1 | .988 | 1.173 | 1 | .279 |
| | | BI | | | | .254 | 1 | .614 |
| | | GROWL | | | | .380 | 1 | .537 |
| | | PAW | | | | .217 | 1 | .642 |
| | | RUBtrial | | | | .152 | 1 | .696 |

*** indicates p ≤ 0.05**

Hypothesis: 51: Male RS clouded leopards exhibit different behavioral observations during mirror image stimulation treatment.
Hypothesis 52: Female RS clouded leopards exhibit different behavioral observations during mirror image stimulation treatment.

**A9-28: Results of Logistical Regression of female clouded leopard behavioral observations during the mirror image stimulation treatment and "success" as dependant variable.**

| Sex | | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|---|
| male | Step 0 | Constant | -.288 | .764 | .142 | 1 | .706 | .750 |
| female | Step 0 | Constant | -2.015 | .753 | 7.164 | 1 | .007 | .133 |

| | | | Sex | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | male | | | female | | |
| | | | Score | df | Sig. | Score | df | Sig. |
| Step 0 | Variables | AP | 2.703 | 1 | .100 | .938 | 1 | .333 |
| | | **BI** | .875 | 1 | .350 | **7.969** | **1** | **.005** |
| | | CL | .875 | 1 | .350 | .142 | 1 | .707 |
| | | **FLIN** | 1.138 | 1 | .286 | **8.228** | **1** | **.004** |
| | | GROOM | 2.301 | 1 | .129 | .205 | 1 | .650 |
| | | **GROWL** | 1.006 | 1 | .316 | **4.084** | **1** | **.043** |
| | | LAT | 1.123 | 1 | .289 | .332 | 1 | .564 |
| | | LICK | 1.556 | 1 | .212 | | | |
| | | LY | 1.114 | 1 | .291 | .950 | 1 | .330 |
| | | MEOW | 1.817 | 1 | .178 | .261 | 1 | .610 |
| | | OOS | .875 | 1 | .350 | .741 | 1 | .389 |
| | | **PAW** | .934 | 1 | .334 | **5.869** | **1** | **.015** |
| | | **PRUSTEN** | 1.556 | 1 | .212 | **8.160** | **1** | **.004** |
| | | RUBother | .058 | 1 | .809 | .646 | 1 | .422 |
| | | RUBtotal | .058 | 1 | .809 | .646 | 1 | .422 |
| | | SIT | 3.632 | 1 | .057 | .770 | 1 | .380 |
| | | SNIFFobject | .535 | 1 | .464 | .036 | 1 | .849 |
| | | SNIFFStotal | .002 | 1 | .961 | .000 | 1 | .995 |
| | | SNIFFtrial | .136 | 1 | .713 | .009 | 1 | .925 |
| | | ST | .000 | 1 | .986 | 2.820 | 1 | .093 |
| | | **TIA** | **3.866** | **1** | **.049** | 1.334 | 1 | .248 |
| | | **TSI** | .846 | 1 | .358 | **5.484** | **1** | **.019** |
| | | TTS | 1.754 | 1 | .185 | .647 | 1 | .421 |
| | | URINES | 1.556 | 1 | .212 | .277 | 1 | .599 |
| | | URINtotal | 1.556 | 1 | .212 | .277 | 1 | .599 |
| | | **VOCAL** | 1.896 | 1 | .169 | **4.441** | **1** | **.035** |
| | | WA | 1.556 | 1 | .212 | 2.165 | 1 | .141 |
| | | FLEH | | | | .142 | 1 | .707 |
| | | **RETREAT** | | | | **17.000** | **1** | **.000** |
| | | ROLL | | | | .142 | 1 | .707 |
| | | STEREO | | | | .142 | 1 | .707 |

*** indicates p ≤ 0.05**

Hypothesis: 53: Male RS clouded leopards exhibit different behavioral observations during novel object treatment.
Hypothesis 54: Female RS clouded leopards exhibit different behavioral observations during novel object treatment.

**A9-29: Results of Logistical Regression of female clouded leopard behavioral observations during the novel object treatment and "success" as dependant variable.**

| Sex | | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|---|
| male | Step 0 | Constant | -.288 | .764 | .142 | 1 | .706 | .750 |
| female | Step 0 | Constant | -2.015 | .753 | 7.164 | 1 | .007 | .133 |

| | | | Sex | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | male | | | female | | |
| | | | Score | df | Sig. | Score | df | Sig. |
| Step 0 | Variables | AP | 1.361 | 1 | .243 | .050 | 1 | .824 |
| | | BI | .875 | 1 | .350 | | | |
| | | CL | 2.100 | 1 | .147 | .142 | 1 | .707 |
| | | FLEH | 2.100 | 1 | .147 | 3.192 | 1 | .074 |
| | | GROOM | .514 | 1 | .473 | .958 | 1 | .328 |
| | | LAT | 1.018 | 1 | .313 | .272 | 1 | .602 |
| | | LY | 2.573 | 1 | .109 | 3.180 | 1 | .075 |
| | | MEOW | .090 | 1 | .765 | .035 | 1 | .852 |
| | | OOS | .875 | 1 | .350 | .583 | 1 | .445 |
| | | **PAW** | 1.556 | 1 | .212 | **7.038** | **1** | ***008** |
| | | **PRUSTEN** | .058 | 1 | .809 | **7.597** | **1** | ***.006** |
| | | **RETREAT** | .875 | 1 | .350 | **7.969** | **1** | ***005** |
| | | RUBother | .350 | 1 | .554 | .456 | 1 | .499 |
| | | RUBtotal | .509 | 1 | .475 | .456 | 1 | .499 |
| | | RUBtrial | .875 | 1 | .350 | | | |
| | | SIT | .304 | 1 | .581 | 1.309 | 1 | .253 |
| | | SNIFFobject | 3.229 | 1 | .072 | .637 | 1 | .425 |
| | | SNIFFtrial | .739 | 1 | .390 | .053 | 1 | .817 |
| | | ST | 1.878 | 1 | .171 | .532 | 1 | .466 |
| | | TIA | .850 | 1 | .356 | 1.215 | 1 | .270 |
| | | TSI | .235 | 1 | .628 | .168 | 1 | .682 |
| | | TTS | 1.127 | 1 | .288 | .292 | 1 | .589 |
| | | URINES | .194 | 1 | .659 | .463 | 1 | .496 |
| | | URINtotal | .194 | 1 | .659 | .215 | 1 | .643 |
| | | VOCAL | .011 | 1 | .916 | 3.591 | 1 | .058 |
| | | **WA** | **4.836** | **1** | ***028** | .140 | 1 | .708 |
| | | FLIN | | | | .219 | 1 | .640 |
| | | GROWL | | | | .233 | 1 | .630 |
| | | RU | | | | .142 | 1 | .707 |
| | | URINEW | | | | .142 | 1 | .707 |

*** indicates p ≤ 0.05**

# APPENDIX X
## Comparison of the treatment means

**A10-1 P values from paired samples t-tests comparing behavioral observations during treatments**

| Behavioral Observation | Control Blood | Control Estrus | Control Non estrus | Control Male | Control Choice | Control MIS | Control NO |
|---|---|---|---|---|---|---|---|
| **LAT** | 0.499 | 0.075 | 0.392 | 0.376 | 0.422 | 0.405 | 0.205 |
| **TTS** | 0.448 | 0.165 | 0.513 | 0.314 | 0.953 | 0.960 | **0.048** |
| **TIA** | **0.009** | **0.008** | 0.094 | **0.030** | **0.008** | **0.029** | 0.032 |
| **TSI** | **0.000** | 0.041 | **0.008** | **0.002** | **0.000** | **0.000** | 0.135 |
| **LY** | 0.858 | 0.503 | 0.389 | 0.926 | 0.381 | **0.000** | 0.341 |
| **OOS** | 0.241 | 0.178 | 0.244 | 0.498 | 0.970 | 0.712 | 0.072 |
| **PA** | 0.168 | 0.447 | 0.924 | 0.287 | 0.818 | 0.089 | 0.089 |
| **RU** | 0.328 | | | 0.328 | | | 0.328 |
| **SIT** | **0.022** | 0.397 | 0.971 | 0.457 | 0.059 | 0.329 | 0.335 |
| **ST** | 0.564 | 0.615 | 0.297 | 0.098 | 0.073 | **0.000** | 0.346 |
| **WA** | 0.436 | 0.817 | 0.746 | 0.848 | 1.000 | 0.743 | 0.356 |
| **PAT** | 0.534 | 0.395 | 1.000 | 0.094 | 0.152 | 0.094 | 0.094 |
| **AP** | **0.009** | 0.689 | 0.279 | 0.052 | **0.000** | **0.001** | **0.003** |
| **BI** | 0.382 | 0.381 | 0.351 | 0.047 | 0.345 | 0.252 | 0.641 |
| **CL** | 0.575 | 0.664 | 0.714 | 0.377 | 0.113 | 1.000 | 0.214 |
| **FLE** | 0.328 | **0.003** | **0.003** | **0.001** | 0.078 | 0.824 | 0.246 |
| **FLI** | 0.479 | 0.539 | 0.328 | 1.000 | 0.328 | **0.002** | **0.045** |
| **GR** | 0.208 | 0.606 | 0.801 | 0.314 | **0.002** | 0.706 | 0.124 |
| **GH** | 0.315 | 0.921 | 0.579 | 0.643 | 0.088 | 0.055 | 0.345 |
| **LICK** | **0.000** | 0.076 | 0.116 | 0.113 | **0.000** | 0.328 | |
| **VOCTOTAL** | 0.190 | 0.501 | 0.359 | 0.699 | 0.452 | 0.839 | 0.479 |
| **RT** | | | | | | 0.162 | 0.162 |
| **ROL** | 0.162 | 0.679 | 0.246 | 0.065 | 0.543 | 1.000 | 0.185 |
| **RUBTOTAL** | 0.479 | 0.364 | 0.819 | 0.738 | 0.569 | 0.126 | 0.229 |
| **PS** | 0.177 | 0.386 | 0.338 | 0.173 | 0.320 | 0.222 | 0.880 |
| **URINETOTAL** | 0.300 | 0.590 | 0.410 | 0.441 | 0.207 | 0.493 | 0.484 |
| **ST** | | 0.328 | 0.328 | 0.328 | | 0.328 | |
| **DEFEC** | 1.000 | 0.328 | 0.328 | 1.000 | 0.328 | 0.328 | 0.328 |
| **MEOW** | 0.132 | 0.773 | 0.362 | 0.937 | 0.363 | 0.953 | 0.571 |
| **P** | 0.777 | 0.419 | 0.811 | 0.397 | 0.407 | 0.742 | 0.408 |
| **RO** | 0.410 | 0.304 | 0.747 | 0.678 | 0.118 | 0.129 | 0.219 |
| **RUBTRIAL** | 0.358 | 0.247 | 0.295 | 0.089 | 0.423 | 0.328 | 0.539 |

| Behavioral Observation | Control Blood | Control Estrus | Control Non estrus | Control Male | Control Choice | Control MIS | Control NO |
|---|---|---|---|---|---|---|---|
| **UW** | 0.328 | 0.213 | 0.162 | | 0.103 | | 0.328 |
| **US** | 0.320 | 1.000 | 0.511 | 0.441 | 0.196 | 0.493 | 0.676 |
| **ST** | **0.000** | **0.003** | **0.007** | **0.000** | **0.000** | **0.007** | **0.007** |
| **SO** | 0.496 | 0.431 | 0.160 | 0.496 | **0.006** | 0.848 | 0.499 |

**A10-2: P values from paired samples t-tests comparing behavioral observations during treatments cont.**

| Behavioral Observation | Blood Estrus | Blood Non estrus | Blood Male | Blood Choice | Blood MIS | Blood NO | Estrus Non estrus | Estrus Male | Estrus Choice | Estrus MIS | Estrus NO |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **LAT** | 0.315 | 0.979 | 0.863 | 0.293 | 0.649 | 0.587 | 0.221 | 0.335 | 0.171 | 0.645 | 0.790 |
| **TTS** | 0.703 | 0.779 | 0.989 | 0.443 | 0.538 | 0.508 | 0.472 | 0.534 | 0.416 | 0.325 | 0.701 |
| **TIA** | 0.665 | 0.211 | 0.825 | 0.219 | 0.922 | 0.654 | 0.484 | 0.836 | 0.232 | 0.634 | 0.423 |
| **TSI** | **0.000** | **0.001** | 0.245 | 0.170 | **0.000** | 0.338 | 0.746 | **0.010** | **0.003** | **0.000** | 0.175 |
| **LY** | 0.313 | 0.341 | 0.949 | 0.450 | **0.000** | 0.315 | 0.982 | 0.465 | 0.125 | **0.000** | 0.773 |
| **OOS** | 0.600 | 0.861 | 0.791 | 0.438 | 0.682 | 0.361 | 0.602 | 0.539 | 0.331 | 0.428 | 0.466 |
| **PA** | 0.567 | 0.188 | 0.840 | 0.445 | 0.170 | 0.170 | 0.506 | 0.689 | 0.423 | 0.185 | 0.185 |
| **RU** | 0.328 | 0.328 | 1.000 | 0.328 | 0.328 | 0.539 | | 0.328 | | | 0.328 |
| **SIT** | 0.459 | 0.118 | 0.432 | **0.001** | 0.975 | 0.857 | 0.231 | 0.914 | **0.012** | 0.694 | 0.802 |
| **ST** | 0.919 | 0.771 | 0.259 | 0.067 | **0.000** | 0.562 | 0.711 | 0.223 | 0.098 | **0.000** | 0.509 |
| **WA** | 0.336 | 0.124 | 0.322 | 0.565 | 0.430 | 0.624 | 0.914 | 0.940 | 0.847 | 0.820 | 0.193 |
| **PAT** | 0.590 | 0.410 | 0.084 | 0.179 | 0.084 | 0.084 | 0.406 | 0.112 | 0.244 | 0.112 | 0.112 |
| **AP** | **0.046** | **0.014** | 0.581 | **0.000** | **0.002** | 0.225 | 0.736 | **0.036** | **0.000** | **0.001** | **0.004** |
| **BI** | 0.528 | 0.454 | 0.076 | 0.651 | 0.258 | 0.901 | 0.901 | 0.154 | 0.664 | 0.469 | 0.504 |
| **CL** | 0.802 | 0.747 | 0.435 | 0.101 | 0.664 | 0.148 | 1.000 | 0.295 | 0.121 | 0.802 | 0.286 |
| **FLE** | **0.013** | **0.007** | **0.002** | 0.110 | 0.260 | 0.590 | 0.779 | 0.898 | 0.646 | **0.001** | 0.060 |
| **FLI** | 0.846 | 0.328 | 0.479 | 0.328 | **0.003** | **0.028** | 0.328 | 0.539 | 0.328 | **0.002** | 0.067 |
| **GR** | 0.178 | 0.206 | 0.607 | **0.002** | 0.098 | 0.427 | 0.678 | 0.735 | **0.002** | 0.356 | 0.219 |
| **GH** | 0.171 | 0.169 | 0.346 | 0.391 | **0.049** | 0.306 | 0.667 | 0.683 | **0.037** | 0.058 | 0.367 |
| **LICK** | **0.000** | **0.000** | **0.000** | 0.051 | **0.000** | **0.000** | 0.619 | 0.378 | **0.000** | 0.271 | 0.076 |
| **VOCTOTAL** | 0.171 | 0.799 | 0.333 | 0.184 | 0.844 | 0.156 | 0.333 | 0.430 | 0.620 | 0.375 | 0.963 |
| **RT** | | | | | 0.162 | 0.162 | | | | 0.162 | 0.162 |
| **ROL** | 0.357 | 0.168 | 0.054 | 0.260 | 0.328 | 0.328 | 0.107 | **0.049** | 0.770 | 0.704 | 0.233 |
| **RUBTOTAL** | 0.474 | 0.568 | 0.499 | 0.676 | 0.104 | 0.219 | 0.160 | 0.217 | 0.853 | 0.051 | 0.201 |
| **PS** | 0.833 | 0.697 | 0.345 | 0.247 | 0.269 | 0.850 | 0.126 | **0.041** | 0.344 | 0.292 | 0.827 |
| **URINETOTAL** | 0.407 | 0.293 | 0.306 | 0.197 | 0.318 | 0.535 | 0.639 | 0.645 | 0.230 | 0.625 | 0.709 |
| **ST** | 0.328 | 0.328 | 0.328 | | 0.328 | | 0.328 | 0.788 | 0.328 | 0.539 | 0.328 |
| **DEFEC** | 0.328 | 0.328 | 1.000 | 0.328 | 0.328 | 0.328 | | 0.328 | | | |
| **MEOW** | 0.258 | 0.668 | 0.210 | 0.556 | 0.556 | 0.289 | 0.411 | 0.869 | 0.352 | 0.896 | 0.676 |

| Behavioral Observation | Blood Estrus | Blood Non estrus | Blood Male | Blood Choice | Blood MIS | Blood NO | Estrus Non estrus | Estrus Male | Estrus Choice | Estrus MIS | Estrus NO |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **PRUS** | 0.179 | 0.809 | 0.855 | 0.397 | 0.816 | 0.168 | 0.339 | 0.253 | 0.251 | 0.296 | 0.479 |
| **RO** | 0.558 | 0.266 | 0.964 | 0.073 | 0.083 | 0.199 | 0.118 | 0.774 | 0.070 | 0.067 | 0.229 |
| **RUBTRIAL** | 0.583 | 0.502 | 0.230 | 0.553 | 0.328 | 0.429 | 0.753 | 0.122 | 0.901 | 0.166 | 0.504 |
| **UW** | 0.377 | 0.575 | 0.328 | 0.110 | 0.328 | 0.539 | 0.426 | 0.213 | 0.099 | 0.213 | 0.824 |
| **US** | 0.327 | 0.248 | 0.341 | 0.184 | 0.362 | 0.481 | 0.514 | 0.413 | 0.195 | 0.468 | 0.583 |
| **ST** | **0.043** | 0.114 | 0.094 | **0.003** | 0.075 | 0.290 | 0.510 | **0.007** | **0.001** | **0.022** | **0.031** |
| **SO** | 0.120 | 0.513 | 0.169 | **0.004** | 0.646 | 0.290 | **0.029** | 0.974 | **0.006** | 0.350 | 0.823 |

**A10-3: P value from paired samples t-tests comparing behavioral observations during treatments cont.**

| Behavioral Observation | Non estrus Male | Non estrus Choice | Non estrus MIS | Non estrus NO | Male Choice | Male MIS | Male NO | Choice MIS | Choice NO | MIS NO |
|---|---|---|---|---|---|---|---|---|---|---|
| **LAT** | 0.846 | 0.280 | 0.719 | 0.467 | 0.400 | 0.832 | 0.392 | 0.328 | 0.276 | 0.862 |
| **TTS** | 0.768 | 0.555 | 0.600 | 0.250 | 0.585 | 0.493 | 0.172 | 0.998 | 0.319 | 0.268 |
| **TIA** | 0.428 | **0.021** | 0.191 | 0.115 | 0.339 | 0.748 | 0.367 | 0.404 | 0.686 | 0.688 |
| **TSI** | **0.007** | **0.001** | **0.000** | 0.180 | 0.937 | **0.000** | 0.614 | **0.000** | 0.595 | **0.001** |
| **LY** | 0.461 | 0.199 | **0.000** | 0.702 | 0.441 | **0.001** | 0.324 | **0.006** | 0.116 | **0.000** |
| **OOS** | 0.861 | 0.405 | 0.768 | 0.172 | 0.665 | 0.919 | 0.039 | 0.598 | 0.161 | 0.292 |
| **PA** | 0.363 | 0.861 | 0.169 | 0.169 | 0.470 | 0.110 | 0.110 | 0.328 | 0.328 | |
| **RU** | 0.328 | | | 0.328 | 0.328 | 0.328 | 0.539 | | 0.328 | 0.328 |
| **SIT** | 0.412 | **0.035** | 0.311 | 0.253 | **0.028** | 0.639 | 0.751 | 0.065 | 0.030 | 0.881 |
| **ST** | 0.217 | 0.107 | **0.000** | 0.669 | 0.373 | **0.000** | 0.744 | **0.001** | 0.381 | **0.000** |
| **WA** | 0.841 | 0.804 | 0.915 | 0.244 | 0.887 | 0.798 | 0.165 | 0.755 | 0.387 | 0.243 |
| **PAT** | 0.102 | 0.164 | 0.102 | 0.102 | 0.057 | | | 0.057 | 0.057 | |
| **AP** | 0.131 | **0.000** | **0.000** | **0.009** | **0.000** | **0.001** | 0.057 | 0.104 | **0.000** | **0.004** |
| **BI** | 0.453 | 0.607 | 0.512 | 0.437 | 0.074 | 0.841 | 0.079 | 0.349 | 0.604 | 0.289 |
| **CL** | 0.405 | 0.117 | 0.714 | 0.213 | 0.119 | 0.524 | 0.228 | 0.119 | 0.118 | 0.185 |
| **FLE** | 0.583 | 0.718 | **0.005** | 0.028 | 0.613 | **0.000** | **0.010** | 0.103 | 0.233 | 0.185 |
| **FLI** | 0.328 | | **0.002** | **0.038** | 0.328 | **0.002** | **0.045** | **0.002** | **0.038** | **0.010** |
| **GR** | 0.362 | **0.001** | 0.586 | 0.181 | **0.002** | 0.315 | 0.282 | **0.001** | **0.008** | 0.090 |
| **GH** | 0.833 | **0.029** | 0.058 | 0.357 | 0.251 | 0.071 | 0.444 | **0.044** | 0.246 | 0.167 |
| **LICK** | 0.389 | **0.000** | 0.229 | 0.116 | **0.000** | 0.179 | 0.113 | **0.000** | **0.000** | 0.328 |
| **VOCTOTAL** | 0.333 | 0.264 | 0.782 | 0.263 | 0.332 | 0.921 | 0.360 | 0.256 | 0.669 | 0.413 |
| **RT** | | | 0.162 | 0.162 | | 0.162 | 0.162 | 0.162 | 0.162 | 1.000 |
| **ROL** | 0.073 | 0.257 | 0.246 | 0.143 | 0.066 | 0.063 | 0.051 | 0.575 | 0.162 | 0.328 |
| **RUBTOTAL** | 0.541 | 0.523 | **0.038** | 0.114 | 0.229 | **0.002** | 0.051 | 0.071 | 0.512 | 0.104 |
| **PS** | 0.089 | 0.326 | 0.305 | 0.783 | 0.243 | 0.347 | 0.629 | 0.137 | 0.231 | 0.205 |
| **URINETOTAL** | 1.000 | 0.155 | 0.734 | 0.848 | 0.167 | 0.768 | 0.848 | 0.096 | 0.317 | 0.775 |
| **ST** | 0.664 | 0.328 | 0.622 | 0.328 | 0.328 | 0.459 | 0.328 | 0.328 | | 0.328 |

| Behavioral Observation | Non estrus Male | Non estrus Choice | Non estrus MIS | Non estrus NO | Male Choice | Male MIS | Male NO | Choice MIS | Choice NO | MIS NO |
|---|---|---|---|---|---|---|---|---|---|---|
| **DEFEC** | 0.328 | | | | 0.328 | 0.328 | 0.328 | | | |
| **MEOW** | 0.198 | 0.650 | 0.500 | 0.305 | 0.304 | 0.985 | 0.596 | 0.343 | 0.267 | 0.616 |
| **P** | 0.480 | 0.410 | 0.756 | 0.263 | 0.412 | 0.884 | 0.176 | 0.578 | 0.306 | 0.482 |
| **RO** | 0.705 | 0.097 | **0.045** | 0.120 | 0.087 | **0.009** | 0.255 | **0.036** | **0.047** | 0.121 |
| **RUBTRIAL** | 0.097 | 0.890 | 0.170 | 0.679 | 0.088 | 0.085 | 0.100 | 0.328 | 0.664 | 0.328 |
| **UW** | 0.162 | 0.108 | 0.162 | 0.770 | 0.103 | | 0.328 | 0.103 | 0.124 | 0.328 |
| **US** | 0.739 | 0.183 | 0.564 | 0.796 | 0.187 | 0.768 | 0.695 | 0.178 | 0.209 | 0.664 |
| **ST** | **0.011** | **0.001** | **0.041** | 0.084 | 0.062 | 0.295 | 0.764 | 0.522 | **0.020** | 0.236 |
| **SO** | **0.047** | **0.007** | 0.292 | 0.133 | **0.006** | 0.344 | 0.809 | **0.005** | **0.007** | 0.418 |

**A10-4: Paired samples t-test comparing "Time spent investigating" (TSI) during the MIS to other seven treatments.**

| | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|
| | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | Lower | Upper | | | |
| MIS-NO | 285.12500 | 375.91700 | 76.73374 | 126.38917 | 443.86083 | 3.716 | 23 | ***.001** |
| MIS-NON | 336.68083 | 293.32791 | 59.87531 | 212.81932 | 460.54234 | 5.623 | 23 | ***.000** |
| MIS-MALE | -305.27833 | 303.01951 | 61.85360 | -433.23225 | -177.32442 | -4.935 | 23 | ***.000** |
| MIS-ESTRUS | -335.55583 | 290.80830 | 59.36100 | -458.35341 | -212.75826 | -5.653 | 23 | ***.000** |
| MIS-CONTROL | -341.93792 | 295.26074 | 60.26985 | -466.61559 | -217.26024 | -5.673 | 23 | ***.000** |
| MIS-CHOICE | -306.33333 | 293.79979 | 59.97163 | -430.39411 | -182.27256 | -5.108 | 23 | ***.000** |
| MIS-BLOOD | -319.18750 | 289.36335 | 59.06605 | -441.37493 | -197.00007 | -5.404 | 23 | ***.000** |

*** indicates $p \leq 0.05$**

**A10-5: Mean and Stdev of "growl/hiss" during MIS trial**
**Wilcoxon signed ranks for "paw/swat"**

| Treatement | Mean | Std. Deviation |
|---|---|---|
| Blood | 2.72 | 6.98 |
| MIS | 55.00 | 121.79 |
| Male | 6.50 | 20.23 |
| Estrus | 5.17 | 8.48 |
| Choice | 1.83 | 5.78 |
| Control | 5.06 | 9.84 |
| NO | 15.33 | 58.96 |
| Nonestrus | 5.78 | 11.22 |

| TRIALS | | |
|---|---|---|
| Treatement | | Std. Deviation |
| MIS - Blood | Z | -2.159 |
| | Asymp. Sig. (2-tailed) | **0.031** |
| MIS-NO | Z | -1.478 |
| | Asymp. Sig. (2-tailed) | 0.139 |
| MIS-Nonestrus | Z | -1.836 |
| | Asymp. Sig. (2-tailed) | 0.066 |
| MIS - Male | Z | -2.095 |
| | Asymp. Sig. (2-tailed) | **0.036** |
| MIS - Estrus | Z | -1.896 |
| | Asymp. Sig. (2-tailed) | 0.058 |
| MIS - Choice | Z | -2.703 |
| | Asymp. Sig. (2-tailed) | **0.007** |
| MIS - Control | Z | -2.198 |
| | Asymp. Sig. (2-tailed) | **0.028** |

**A10-6: Mean and Stdev of "paw/swat" during MIS trial**
**Wilcoxon signed ranks for "paw/swat"**

| Treatment | Mean | Std. Deviation |
|---|---|---|
| Male | 12.11 | 47.78 |
| Control | 6.11 | 27.42 |
| Estrus | 9.28 | 44.89 |
| Choice | 0.40 | 1.65 |
| Blood | 8.67 | 33.95 |
| MIS | 38.00 | 119.55 |
| NO | 7.17 | 26.77 |
| Nonestrus | 9.89 | 46.21 |
| MIS - Male | Z | -1.157(a) |
| | Asymp. Sig. (2-tailed) | .247 |
| **MIS - Control** | Z | -2.103(a) |
| | Asymp. Sig. (2-tailed) | ***.035** |
| **MIS - Estrus** | Z | -2.135(a) |
| | Asymp. Sig. (2-tailed) | ***.033** |
| **MIS - Choice** | Z | -2.451(a) |
| | Asymp. Sig. (2-tailed) | ***.014** |
| MIS - Blood | Z | -1.575(a) |
| | Asymp. Sig. (2-tailed) | .115 |
| **NO - MIS** | Z | -2.075(b) |
| | Asymp. Sig. (2-tailed) | ***.038** |
| Nonestrus - MIS | Z | -1.857(b) |
| | Asymp. Sig. (2-tailed) | .063 |

**A10-7: Analysis of temperament using one-way ANOVA to determine differences in behavioral observations of 24 clouded leopards.**

| Behavioral Observation | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| AP | Between Groups | 459.290 | 3 | 153.097 | .899 | .442 |
| | Within Groups | 72868.486 | 428 | 170.253 | | |
| | Total | 73327.775 | 431 | | | |
| BI | Between Groups | 203.182 | 3 | 67.727 | 1.051 | .370 |
| | Within Groups | 27575.871 | 428 | 64.430 | | |
| | Total | 27779.053 | 431 | | | |
| **CL** | Between Groups | 147.262 | 3 | 49.087 | 6.928 | **.000** |
| | Within Groups | 3032.590 | 428 | 7.085 | | |
| | Total | 3179.852 | 431 | | | |
| DEFA | Between Groups | .402 | 3 | .134 | 1.772 | .152 |
| | Within Groups | 32.410 | 428 | .076 | | |
| | Total | 32.813 | 431 | | | |
| FLEH | Between Groups | 43.636 | 3 | 14.545 | 1.969 | .118 |
| | Within Groups | 3161.438 | 428 | 7.387 | | |
| | Total | 3205.074 | 431 | | | |
| FLIN | Between Groups | 24.560 | 3 | 8.187 | .621 | .601 |
| | Within Groups | 5639.107 | 428 | 13.175 | | |
| | Total | 5663.667 | 431 | | | |
| GROOM | Between Groups | 1716.064 | 3 | 572.021 | 2.272 | .080 |
| | Within Groups | 107740.416 | 428 | 251.730 | | |
| | Total | 109456.479 | 431 | | | |
| GROWL | Between Groups | 5977.871 | 3 | 1992.624 | 1.449 | .228 |
| | Within Groups | 588530.127 | 428 | 1375.070 | | |
| | Total | 594507.998 | 431 | | | |
| **LAT** | **Between Groups** | **513484.098** | **3** | **171161.366** | **3.757** | **.011** |
| | **Within Groups** | **19272415.078** | **423** | **45561.265** | | |
| | **Total** | **19785899.176** | **426** | | | |
| **LICK** | **Between Groups** | **5560.170** | **3** | **1853.390** | **6.849** | **.000** |
| | **Within Groups** | **115828.309** | **428** | **270.627** | | |
| | **Total** | **121388.479** | **431** | | | |
| LY | Between Groups | 13.493 | 3 | 4.498 | .491 | .688 |
| | Within Groups | 3917.451 | 428 | 9.153 | | |
| | Total | 3930.944 | 431 | | | |
| MEO | Between Groups | 14.554 | 3 | 4.851 | .013 | .998 |
| | Within Groups | 157431.166 | 428 | 367.830 | | |
| | Total | 157445.720 | 431 | | | |
| OOS | Between Groups | 31.245 | 3 | 10.415 | 2.118 | .097 |
| | Within Groups | 2104.930 | 428 | 4.918 | | |
| | Total | 2136.175 | 431 | | | |

| Behavioral Observation | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| PA | Between Groups | .081 | 3 | .027 | .817 | .485 |
| | Within Groups | 14.062 | 428 | .033 | | |
| | Total | 14.143 | 431 | | | |
| PAT | Between Groups | .264 | 3 | .088 | .469 | .704 |
| | Within Groups | 80.288 | 428 | .188 | | |
| | Total | 80.552 | 431 | | | |
| **PAW** | **Between Groups** | **34070.986** | **3** | **11356.995** | **3.057** | **.028** |
| | **Within Groups** | **1590112.123** | **428** | **3715.215** | | |
| | **Total** | **1624183.110** | **431** | | | |
| **PRUST** | **Between Groups** | **2151.609** | **3** | **717.203** | **3.264** | **.021** |
| | **Within Groups** | **94050.944** | **428** | **219.745** | | |
| | **Total** | **96202.553** | **431** | | | |
| RETREAT | Between Groups | .334 | 3 | .111 | .756 | .519 |
| | Within Groups | 63.073 | 428 | .147 | | |
| | Total | 63.407 | 431 | | | |
| ROLL | Between Groups | 90.885 | 3 | 30.295 | 1.802 | .146 |
| | Within Groups | 7193.928 | 428 | 16.808 | | |
| | Total | 7284.812 | 431 | | | |
| RU | Between Groups | .006 | 3 | .002 | .870 | .456 |
| | Within Groups | 1.001 | 428 | .002 | | |
| | Total | 1.007 | 431 | | | |
| RUBOthe | Between Groups | 2178.976 | 3 | 726.325 | 1.063 | .365 |
| | Within Groups | 292539.837 | 428 | 683.504 | | |
| | Total | 294718.813 | 431 | | | |
| RUBtotal | Between Groups | 1442.274 | 3 | 480.758 | 1.160 | .325 |
| | Within Groups | 177439.056 | 428 | 414.577 | | |
| | Total | 178881.330 | 431 | | | |
| **RUBtria** | **Between Groups** | **867.834** | **3** | **289.278** | **7.645** | **.000** |
| | **Within Groups** | **16193.979** | **428** | **37.836** | | |
| | **Total** | **17061.812** | **431** | | | |
| SIT | Between Groups | 3.531 | 3 | 1.177 | .686 | .561 |
| | Within Groups | 734.862 | 428 | 1.717 | | |
| | Total | 738.394 | 431 | | | |
| Sniffobj | Between Groups | 23731.738 | 3 | 7910.579 | .963 | .410 |
| | Within Groups | 3514601.512 | 428 | 8211.686 | | |
| | Total | 3538333.250 | 431 | | | |

| Behavioral Observation | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| **SniffTria** | **Between Groups** | **58485.503** | **3** | **19495.168** | **2.894** | **.035** |
| | **Within Groups** | **2883384.164** | **428** | **6736.879** | | |
| | **Total** | **2941869.667** | **431** | | | |
| ST | Between Groups | 5.491 | 3 | 1.830 | 1.307 | .271 |
| | Within Groups | 599.190 | 428 | 1.400 | | |
| | Total | 604.681 | 431 | | | |
| STERE | Between Groups | 6.444 | 3 | 2.148 | 1.542 | .203 |
| | Within Groups | 596.222 | 428 | 1.393 | | |
| | Total | 602.667 | 431 | | | |
| **TIA** | **Between Groups** | **4246588.733** | **3** | **1415529.578** | **10.670** | **.000** |
| | **Within Groups** | **56515113.874** | **426** | **132664.587** | | |
| | **Total** | **60761702.607** | **429** | | | |
| TSI | Between Groups | 29288.587 | 3 | 9762.862 | .709 | .547 |
| | Within Groups | 5869980.132 | 426 | 13779.296 | | |
| | Total | 5899268.719 | 429 | | | |
| **TTS** | **Between Groups** | **875305.105** | **3** | **291768.368** | **4.759** | **.003** |
| | **Within Groups** | **25996625.706** | **424** | **61312.796** | | |
| | **Total** | **26871930.811** | **427** | | | |
| URINS | Between Groups | 1043.380 | 3 | 347.793 | 2.263 | .081 |
| | Within Groups | 65784.166 | 428 | 153.701 | | |
| | Total | 66827.546 | 431 | | | |
| **Urinstotal** | **Between Groups** | **385.536** | **3** | **128.512** | **5.729** | **.001** |
| | **Within Groups** | **9601.017** | **428** | **22.432** | | |
| | **Total** | **9986.553** | **431** | | | |
| **URINW** | **Between Groups** | **99.149** | **3** | **33.050** | **5.849** | **.001** |
| | **Within Groups** | **2418.349** | **428** | **5.650** | | |
| | **Total** | **2517.498** | **431** | | | |
| VOCAL | Between Groups | 1926.513 | 3 | 642.171 | .891 | .446 |
| | Within Groups | 308320.153 | 428 | 720.374 | | |
| | Total | 310246.667 | 431 | | | |
| WA | Between Groups | 2.171 | 3 | .724 | 1.486 | .218 |
| | Within Groups | 208.381 | 428 | .487 | | |
| | Total | 210.552 | 431 | | | |

**A10-8: Analysis of temperament using Kruskal-Wallis to determine differences in behavioral observations of 24 clouded leopards.**

| Behavior observ | Temp1 - Highstrung | | Temp 2 - Active | | Temp 3 - Aggressive | | Temp 4 - Calm | | |
|---|---|---|---|---|---|---|---|---|---|
| | MEAN | STDEV | MEAN | STDEV | MEAN | STDEV | MEAN | STDEV | Pvalue |
| LAT | 129.46 | 86.93 | 26.70 | 28.71 | 154.71 | 150.36 | 49.79 | 34.26 | 0.239 |
| TTS | 353.04 | 223.79 | 105.28 | 65.89 | 329.61 | 217.23 | 118.78 | 26.46 | 0.201 |
| TIA | 57.13 | 40.64 | 80.16 | 26.12 | 64.43 | 49.23 | 100.96 | 28.74 | 0.05 |
| TSI | 0.42 | 0.17 | 0.45 | 0.12 | 0.36 | 0.24 | 0.49 | 0.13 | 0.469 |
| LY | 0.17 | 0.16 | 0.04 | 0.04 | 0.27 | 0.27 | 0.03 | 0.03 | 0.72 |
| OOS | 0.01 | 0.02 | 0.01 | 0.02 | 0.01 | 0.03 | 0.00 | 0.00 | 0.288 |
| PA | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.774 |
| RU | 0.13 | 0.10 | 0.16 | 0.05 | 0.12 | 0.09 | 0.15 | 0.08 | 0.488 |
| SIT | 0.19 | 0.11 | 0.22 | 0.09 | 0.17 | 0.07 | 0.23 | 0.06 | 0.772 |
| ST | 0.06 | 0.03 | 0.12 | 0.07 | 0.07 | 0.04 | 0.07 | 0.04 | 0.69 |
| WA | 0.01 | 0.02 | 0.00 | 0.00 | 0.01 | 0.02 | 0.04 | 0.04 | 0.388 |
| PAT | 11.50 | 8.26 | 15.21 | 7.01 | 10.70 | 5.45 | 13.56 | 4.76 | 0.178 |
| AP | 0.69 | 1.09 | 2.08 | 3.11 | 1.43 | 3.01 | 1.28 | 2.21 | 0.65 |
| BI | 1.12 | 1.45 | 0.04 | 0.08 | 0.10 | 0.16 | 3.22 | 5.58 | 0.698 |
| CL | 1.12 | 1.56 | 1.04 | 0.64 | 0.90 | 1.24 | 1.61 | 0.67 | 0.46 |
| FLE | 0.90 | 1.00 | 2.50 | 1.87 | 1.47 | 2.15 | 0.67 | 0.76 | 0.473 |
| FLI | 9.50 | 4.41 | 17.00 | 10.74 | 11.22 | 8.76 | 13.00 | 11.50 | 0.418 |
| GR | 12.12 | 23.08 | 7.04 | 12.77 | 16.97 | 21.94 | 3.17 | 5.48 | 0.651 |
| GH | 6.79 | 6.70 | 26.00 | 17.14 | 10.62 | 10.48 | 14.56 | 7.62 | 0.43 |
| LICK | 3.74 | 9.16 | 8.79 | 6.04 | 9.37 | 22.14 | 7.94 | 5.88 | 0.141 |
| VOCTOTAL | 0.07 | 0.19 | 0.00 | 0.00 | 0.15 | 0.34 | 0.00 | 0.00 | 0.128 |
| RT | 1.14 | 2.15 | 0.33 | 0.67 | 0.40 | 0.79 | 0.06 | 0.10 | 0.68 |
| ROL | 5.31 | 8.32 | 9.43 | 7.23 | 8.42 | 16.64 | 8.67 | 11.28 | 0.904 |
| RUBTOTAL | 2.14 | 1.97 | 3.55 | 5.58 | 24.10 | 43.36 | 1.56 | 2.14 | 0.528 |
| PS | 3.62 | 7.82 | 0.42 | 0.63 | 0.93 | 0.89 | 2.89 | 0.59 | 0.986 |
| URINETOTAL | 0.17 | 0.44 | 0.46 | 0.71 | 0.00 | 0.00 | 0.00 | 0.00 | 0.06 |
| STEREO | 0.02 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.11 | 0.10 | 0.082 |
| **DEFEC** | 5.17 | 13.38 | 6.00 | 4.56 | 4.63 | 10.06 | **6.56** | **10.21** | ***0.022** |
| MEOW | 5.17 | 13.38 | 6.00 | 4.56 | 4.63 | 10.06 | 6.56 | 10.21 | 0.2 |
| PRUSTEN | 0.29 | 0.44 | 3.29 | 3.72 | 5.35 | 13.68 | 10.06 | 14.63 | 0.49 |
| RO | 7.19 | 12.73 | 7.46 | 8.78 | 10.32 | 17.74 | 22.00 | 27.91 | 0.582 |
| **RUBTRIAL** | 0.40 | 0.40 | **3.17** | **2.64** | 0.30 | 0.89 | 0.00 | 0.00 | ***0.004** |
| UW | 0.07 | 0.19 | 0.67 | 1.22 | 0.02 | 0.05 | 2.78 | 2.83 | 0.074 |
| US | 6.98 | 16.92 | 0.25 | 0.40 | 1.32 | 1.40 | 4.11 | 3.15 | 0.193 |
| SniffTrial | 70.21 | 48.89 | 100.67 | 55.07 | 58.38 | 27.23 | 75.67 | 24.35 | 0.359 |

LIST OF REFERENCES

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Alberts, A.C. (1992). Constraints on the design of chemical communication systems in terrestrial vertebrates. *American Naturalist* 139: S62-S89.

Austin, S. C. (2002). *Ecology of sympatric carnivores in Khao Yai. National Park, Thailand.* Ph.D. dissertation. Texas A&M University, Kingsville and Texas A&M University.

Baudy, R.E. (1971). Notes on breeding felids at the Rare Feline Breeding Center. *International Zoological Yearbook* 11: 121-123.

Both, C., Dingemanse, J.J., Drent, P.J., Tinbergen, J.M. (2005). Pairs of extreme avian personalities have highest reproductive success. *Journal of Animal Ecology* 74: 667-674.

Brown, J.L., Wasser, S.K., Wildt, D.E., Graham, L.H. (1994). Comparative aspects of steroid hormone metabolism and ovarian activity in felids, measured noninvasively in feces. *Biological Reproduction* 51: 776-789.

Buckley-Beason, V.A., Johnson, W.E., Nash, W.G., Stanyon, R., Menninger, J.C., Driscoll, C.A., Howard, J.G., Bush, M., Page, J.E., Roelke, M.E., Stone, G., Martelli, P.P., Wen, C., Ling, L., Duraisingam, R.K., Lam, P.V., O'Brien, S.J. (2006). Molecular evidence for species-level distinctions in clouded leopards. *Current Biology* 16: 2371-2376.

Buss, I.O. and Smith, N.S. (1966). Observations on Reproduction and Breeding Behavior of the African elephant. *The Journal of Wildlife Management* 30: 375-388.

Byrne, G. and Suomi, S.J. (2002). Cortisol reactivity and its relation to homecage behavior and personaility ratings in tufted capuchin (*Cebus paella*) juveniles from birth to six years of age. *Psychoneuroendocrinology* 27:139-154.

Carlstead, K. and Brown, J.L. (2005). Relationships between patterns of fecal corticoid excretion and behavior, reproduction, and environmental factors in captive Black (*Diceros bicornis*) and White (*Ceratotherium simum*) Rhinoceros. *Zoo Biology* 24: 215-232.

Carlstead, K., Brown, J.L., Monfort, S.L., Killens, Rl, Wildt, D.E. (1992). Urinary monitoring of adrenal reponses to psychological stressors in domestic and nondomestic felids. *Zoo Biology* 11: 165-176.

Carlstead, K., Fraser, J., Bennett, C., Kleiman, D.G. (1999b). Black Rhinoceros (*Diceros bicornis*) in U.S. Zoos: II Behavior, Breeding success, and mortality in relation to housing facilities. *Zoo Biology* 18: 35-52.

Carlstead, K., Mellen, J., Kleiman, D.G. (1999a). Black Rhinoceros (*Diceros bicornis*) in U.S. Zoos: I Individual behavioral profiles and their relationship to breeding success. *Zoo Biology* 18:17-34

Cavigelli, S.A. (2005). Animal personality and health. *Behavior* 142: 1223-1244.

Chiang, P. (2007). Ecology and Conservation of Formosan clouded leopards, its prey, and other sympatric carnivores in southern Taiwan. Doctoral dissertation, Virginia Polytechnic Institue and State University.

Collins, L. (1987). Clouded leopard. *Zoogoer* 16:13.

Dall, S.R.X., Houston, A.I., McNamara, J.M. (2004). The behavioral ecology of personality: consistent individual differences from an adaptive perspective. *Ecology Letters* 7:734-739.

Feaver, J., Mendl, M. Bateson, P. (1986). A method for rating individual distinctiveness of domestic cats. *Animal Behavior* 34:1016-1025.

Field, A. (2002). *Discovering Statistics using SPSS for Windows.* Cromwell Press, Trowbridge, UK.

Fletchall, N. (April 11 2007). Clouded Leopard (*Neofelis nebulosa*) Species Survival Plan Masterplan 2007. Clouded Leopard (*Neofelis nebulosa*) Species Survival Plan Masterplanning meeting; In: Felid Taxon Advisory Group (TAG) Association of Zoos and Aquariums 2007 Annual Report. Ed. Jason Herrick, Norah Fletchall and William Swanson. Nashville Zoo, Tennessee.

Fletchall, N. (2008). Felid Taxon Advisory Group Mid-year meeting; In: Felid Taxon Advisory Group (TAG) Association of Zoos and Aquariums 2009 Annual Report. Ed. Norah Fletchall and William Swanson. Point Defiance Zoo, Washington.

Gallup, G.G. Jr. (1968). Mirror-image stimulation. *Psychology Bulletin* 70: 782-793.

Geidel, B. and Gensch, W. (1976). The rearing of clouded leopards in the presence of the male. *International Zoo Yearbook* 5: 111-113.

Gold, K.C. and Maple T.L. (1994). Personality assessment in the gorilla and its utility as a management tool. *Zoo Biology* 13: 509-22.

Gosling, S.D. (1998). Personality dimensions in the spotted hyena (*Crocuta crocuta*). *Journal of Comparative Psychology* 112: 107-118.

Gosling, S.D. and John, O.P. (1999). Personality dimensions in Nonhuman Animals: A cross-species review. *American Psychological Society* 8: 69-75.

Grassman, L.I. J., Micheal E. Tewes, Nova J. Silvy, and Kitty Kreetiyutanont (2005). Ecology of three sympatric felids in a mixed evergreen forest in north-central Thailand. *Journal of Mammology* 86: 29-38.

Hansen, S.W., and Moller, S.H. (2001). The application of a temperament test to on-farm selection of mink. *Acta Agriculturae Scandinavica 30*: 93-98.

Harrison, R.L. (1997) Chemical Attractants for Central American Felids. *Wildlife Society Bulletin*: 25(1): 93-97.

Hearn, A., Sanderson, J., Ross, J., Wilting, A. & Sunarto, S. (2008). *Neofelis diardi*. In: *IUCN 2009. IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>. Downloaded on 01 February 2010.

Howard, J.G., Byers, A.P., Brown, J.L., Barrett, S.J., Evans, M.Z., Schwartz, R.J., Wildt, D.E. (1996). RS ovulation induction and laparoscopic intrauterine artificial insemination in the clouded leopard (*Neofelis nebulosa*). *Zoo Biology* 15: 55-69.

Howard, Y. (2002). Saving the Sahel. *Zoogoer* 31(3).

IUCN 2010. IUCN Red List of Threatened Species. Version 2010.1. <www.iucnredlist.org>. Downloaded on **16 March 2010**.

Iyengar, A., Gilbert, T. Woodfine, T., Knowles, J.M., Diniz, F.M., Brenneman, R.A., Louis, E.E. and Maclean, N. (2007). Remnants of ancient genetic diversity preserved within captive groups of scimitar-horned oryx (*Oryx dammah*). *Molecular Ecology* 16: 2436-2449.

John, O.P., and Srivastava, S. (1999). The Big-Five trait taxonmony: History, measurement, and theoretical perspectives. In L.A. Pervin and O.P. John (Eds.). *Handbook of personality: Theory and research* 2:102-138. New York: Guilford Press

Kaiser, H.F. (1960). The application of electronic computers to factor analysis. *Educational and Psychological Measurement* 20: 141-151.

Kitchner, A.C., Beaumont, M.A., Richardson, D. (2006). Geographical Variation in the Clouded Leopard, *Neofelis nebulosa*, Reveals Two Species. *Current Biology* 16: 2377-2383.

Leyhausen, P. (1963) Uber sudamerikanische Pardelkatzen. *Zoological Tierpsychology*. 20: 627-640.

Low, J. (1991). The smuggling of endangered wildlife across the Taiwan Strait. TRAFFIC International, Cambridge.

MacKinnon, KM. (2008). *Pairing clouded leopards (Neofelis nebulosa) in a captive breeding program*. Master's Thesis, Washington State University.

Mallinson, J.J.C. (1995). Conservation breeding programmes: an important ingredient for species survival. *Biodiversity and Conservation* 4:617-635.

Manteca, X. and Deag, J.M. (1993). Individual differences in temperament of domestic animals: a review of methodology. *Animal Welfare* 2:247-268.

Mellen, J.D. (1989). Reproductive behavior of small captive exotic cats (*Felis spp*.). Ph.D. Dissertation, University of California at Davis.

Mellen, J.D. (1992). Effects of early rearing experience on subsequent adult sexual behavior using domestic cats (*Felis catus*) as a model for exotic small felids. *Zoobiology* 10:95-110.

Mellen, J.D. (1993). A comparative analysis of scent-marking, social and reproductive behavior in 20 species of small cats (*Felis*). *American Zoologist* 33(2): 151-166.

Nowell, K. and Jackson, P. (compilers and editors) (1996). *Wild Cats. Status Survey and Conservation Action Plan.* IUCN, Gland, Switzerland.

Pelican, K.M., Wildt, D.E., Howard, J.G. (2006). The GnRH agonist Lurpon (leuprolide acetate), prevents ovulation following gonadotropin stimulation in the clouded leopard (*Neofelis nebulosa*). *Theriogenology* 66: 1768-1777.

Plotnick, J.M., de Waal, F.B.M, Reiss, D. (2006). Self-recognition in an Asian elephant. *Proceedings of the National Academy of Sciences.* USA 103: 17053-17057.

Povinelli, D.J., Rulf, A.B, Landau, K.R., Bierschwale, D.T. (1993). Self-Recognition in Chimpanzees (*Pan-troglodytes*) distribution, ontogeny, and patterns of emergence. *Journal of Comparative Psychology* 107 (4): 347-372.

Powell, D.M. (2005). Giant Panda Temperament: insights from interaction with novel enrichment and keeper evaluations. *Proceedings of the 7th International Conference on Environmental Enrichment*, pp. 264-270. WildlifeConservation Society. New York.

Powell, D. M., Hong, L., Kleiman, D. G., Zhang, H., Zhang, G., Yu, J., Zhang, J., Yanping, L., Snyder, R. (2002) Factors associated with normal breeding behavior in male giant pandas (*Ailuropoda melanoleuca*) in Chinese breeding centers. *Advances in Ethology* 37: 185.

Pukazhenthi, B. S., Howard, J. G. & Wildt, D. E. (2000). Current knowledge about the reproductive biology of the clouded leopard. In: *Clouded Leopard Species Survival Plan (SSP) Husbandry Guidelines* (Ed. by N. Fletchall), pp. 22-23. American Zoo and Aquarium Association. Bethesda, MD.

Pukazhenthi, B.S., Laroe, D., Crosier, A.E., Bush, L.M., Spindler, R., Palican, K., Bush, M. Howard, J.G., & Wildt, D.E. (2006). Challenges in cryopreservation of clouded leopard (*Neofelis nebulosa*) spermatozoa. *Theriogenology* 66(6): 1790-1796.

Rabinowitz, A., P. Andua, & Chai P.P.K. (1987). The clouded leopard in Malaysian Borneo. *Oryx* 21: 107-111.

Rabinowitz, A.R. and Walker, S.R. (1991). The carnivore community in a dry tropical forest mosaic in Huai Kha Khaeng Wildlife Sanctuary, Thailand. *Journal of Tropical Ecology*. 7(1): 37-47.

Ralls, K. (1971). Mammalian scent marking. *Science* 171:443-449.

Reiss, D. and Marino L. (2001). Mirror self-recognition in the bottlenose dolphin: A case of cognitive convergence. *Proceedings of the National Academy of Sciences of the United States of America* 98 (10): 5937-5942.

Russelo, M.A., Amato, G. (2007). On the horns of a dilemma; molecular approaches refine ex situ conservation in crisis. *Molecular Ecology* 16(12): 2405-2406.

Sanderson, J., Khan, J., Grassman, L. & Mallon, D.P. (2008). *Neofelis nebulosa*. In: IUCN 2009. IUCN Red List of Threatened Species. IUCN 2009. IUCN Red List of Threatened Species. Version 2009.1. <www.iucnredlist.org>. Downloaded on **26 October 2009**.

Sargeant, G.A., Johnson, D.H., Berg, W.E. (2003). Sampling designs for carnivore scent-station surveys. Journal of Wildlife Management 67(2):289-298.

Scolan, N.L., Hausberger, M., Wolff, A. (1997). Stability over situations in temperamental traits of horses as revealed by experimental and scoring approaches. Behavioral Processes 41:257-266.

Seager, S.W.J., and Demorest, C.N. (1978). Reproduction of captive wild carnivores. In *Zoo and wild animal medicine*, ed. M.E. Fowler, pp. 667-706. W.B. Saunders, Philadelphia.

Shepardson, D. (2004). Behavior Management: Presentation Summaries. *International Polar Bear Husbandry Conference Proceedings.* San Diego

Smith, B.R. and Blumstein, D.T. (2008). Fitness consequences of personality: a meta-analysis. *Behavioral Ecology Advance Access*. Downloaded from http://beheco.oxfordjournals.org on March 21, 2010.

Snyder, F.R., Derrickson, S.R., Beissinger, S.R., Wiley, J.W., Smith, T.B., Toone, W.D., Miller, B. (1996). Limitations of captive breeding in endangered species recovery. *Conservation Biology.* 10(2): 338-348.

Stevenson-Hinde, J., Stillwell-Barnes, R., Zunz, M. (1980). Subjective assessment of rhesus monkeys over four successive years. *Primates* 21(1): 66-82.

Sunquist, M., Sunquist, F. (2002). *Wild Cats of the World*. The University of Chicago Press, Chicago.

Suomi, S.J., (1997). Long-term effects of different early rearing experiences on social, emotional, and physiological development in non human primates. In: *Neurodevelopment and adult psychopathology*. Cambridge University Press, U.K.

Suomi, S.J., Novak, M.A., and Well, A. (1996). Aging in rhesus monkeys: Different windows on behavioral continuity and change. *Developmental Psychology* 32: 1116-1128.

Svendsen, G.E. and Armitage, D.B. (1973). Mirror-image stimulation applied to field behavioral studies. *Ecology* 54:623-627.

Terio, K., Wielebnowski, N., Carlstead, K. (2005). *Stress-related Pathology in Clouded Leopards – Preliminary Report.*

Weissengruber, G.E., Forstenpointner, G., Peters, G., Kübber-Heiss, A., Fitch, W.T. (2002). Hyoid apparatus and pharynx in the lion (*Panthera leo*), jaguar (*Panthera onca*), tiger (*Panthera tigris*), cheetah (*Acinonyx jubatus*) and domestic cat (*Felis silvestris f. catus*). *Journal of Anatomy* 201(3):195-209.

Wells, A., Terio, K.A., Ziccardi, M.H., Munson, L. (2004) The stress response to environmental change in captive cheetahs (*Acinonyx jubatus*). *Journal of Zoo and Wildlife Medicin*e 35(1): 8-14.

Wielebnowski, N. (1999). Behavioral Differences as Predictors of Breeding Status in Captive Cheetahs. *Zoo Biology* 18:335-349.

Wielebnowski, N. (2002). Adrenal activity in relation to subjective temperament assessment in clouded leopard, *Neofelis nebulosa* In: *Felid Taxonomy Advisory Group Action Plan* (Ed. By D.E. Wildt, J.D. Mellen and J.L. Brown): 74-75. Disney's Animal Kingdom, Orlando, Florida.

Wielebnowski, N., Fletchall, N., Carlstead, K., Busso, J.M., Brown, J.L. (2002). Noninvasive assessment of adrenal activity associated with husbandry and behavioral factors in the North American clouded leopard population. *Zoo Biology* 21: 77-98.

Wildt, D.E., Comizzoli, P., Pukazhenthi, B., Songsasen, N. (2009). Lessons from biodiversity – the value of nontraditional species to advance reproductive science, conservation, and human health. *Molecular Reproduction and Development* (In press).

Wilting, A., Buckley-Beason, V.A., Feldhaar, H., Gadau, J., O'Brien, S.J., Linsenmair, K.E. (2007). Clouded Leopard phylogeny revisited: support for species recognition and population division between Borneo and Sumatra. *Frontiers in Zoology* 4:15

Wilting, A., Fischer, F., Abu Bakar, S., Linsenmair, K.E. (2006). Clouded leopards, the secretive top-carnivore of South-East Asian ranforests: their distribution, status and conservation needs in Sabah, Malaysia. *BMC Ecology (BioMed Central)* 6(16): 1-13.

Wisely, S.M., McDonald, D.B., Buskirk, S.W. (2003). Evaluation of the genetic management of the endangered black-footed ferret (*Mustela nigripes*). *Zoobiology* 22:287-298.

Yamada, J.K. and Durrant, B.S. (1989). Reproductive parameters of clouded leopards (*Neofelis nebulosa*). *Zoobiology* 8:223-231.

UNEP-WCMC. (2009). *UNEP-WCMC Species Database: CITES-Listed Species* www.cites.org/eng/resources/species.html

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