

# **The Curious Case of the Amur Leopard Sofiya**

Robert Schwartz

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Fairfield University  
Department of Biology  
1073 North Benson Road  
Fairfield, CT 06824

## **Abstract:**

The Amur leopard (*Panthera pardus orientalis*) is a critically endangered subspecies of leopard. One of these rare leopards resides at the Beardsley Zoo in Bridgeport, CT. In order to preserve rare species, zoos around the world have implemented the Species Survival Plan (SSP), which involves conservation and controlled breeding of critically endangered species. Sofiya, the female Amur Leopard at the CT Beardsley Zoo is a prospect for the SSP. However, it was observed that Sofiya displayed inexplicable and potentially nervous or anxious behaviors, such as staying indoors in her enclosure and excessive pacing. It was initially suspected that her behavior was prompted by some unknown environmental cue(s). With a wild and captive population of less than 300 individuals world wide, concerns about Sofiya's behavior resulted in my service learning research project. Data were collected from February to April 2014, largely through weekly observations from a hunter's blind set up across from the leopard's enclosure. We observed that Sofiya's anxious behavior typically stopped between the hours of 2:30 and 4:30 pm during which she emerged into the enclosure and displayed more social behavior. By integrating observational data with information from zoo staff and medical records, we suggest that Sofiya's behavior may not be influenced by external cues, as was initially hypothesized. Medical records and Sofiya's history indicate that a hormone imbalance may be at least partly responsible for her nervous behavior.

## **Introduction:**

The Amur Leopard (*Panthera pardus orientalis*) is an extremely rare, critically endangered species of big cat, with between 25 and 40 individuals remaining in the wild of the Russian Far East (Uphyrkina, et al 2002). There are approximately 200 Amur Leopards in

captivity across Europe, North America, and parts of the former Soviet Union. Sofiya is an Amur Leopard born on May 10, 2008 at the St. Louis Zoo. She moved in 2009 to the Fort Wayne Children's Zoo in Indiana. Since January 2013, she has resided at the Beardsley Zoo in Bridgeport, CT (Held 2008). Staff at the Beardsley Zoo noticed that Sofiya displays potentially problematic and unnatural behaviors. These behaviors include incessant, aggravated pacing, as well as staying indoors in her enclosure for the majority of the day. Pacing is considered a stereotypic behavior of animals in zoos, meaning that while not natural, it is not an uncommon behavior (Schaul 2012). However, the severity and relentlessness of the behaviors in question led the zoo staff to question the causes. These behaviors are especially problematic because Sofiya belongs to such a rare species. It will be very difficult to mate her if she keeps constantly displaying these behaviors. With this in mind, research was designed to identify the cause of these behaviors. The initial hypothesis of zoo staff and researchers was that there was an environmental cue or something external happening that was triggering her strange behaviors.

### **Methods:**

Starting on February 4, 2014, Sofiya was observed between the hours of 8:30 and 11:30 every Tuesday morning. Observations were made from a hunter's blind set up across the way



*Figure 1: Sofiya and her indoor enclosure*

from the leopard's enclosure. The purpose of the blind was to blend in with the surroundings and not alert Sofiya to our presence. The blind was left permanently as weather permitted so that Sofiya would acclimate to its presence. During observation periods, all environmental conditions were recorded, including weather,

temperature, noises, human interaction, animal interaction, and any other

activity at the zoo. All conditions and activities were recorded and placed into a composite calendar. As the experiment went on, observations were also taken outside of the designated period, during weekend afternoons between the hours of 2:00 and 4:30.

An ethogram was designed at the start of the experiment. As more observations were made, it was revised. Behaviors were noted and tallied on the ethogram during observation. The ethogram included the behavioral categories locomotion, aggression,

*Table 1: Ethogram*

defense, resting, and play (Table 1).

Eventually, other behaviors, such as “head poking out of indoor shelter” were also noted.

Additionally, a motion-activated camera trap was set up on a post directly outside of Sofiya’s enclosure. The time stamped photos from the trap were collected and examined at the start of each observation period.

Date	Time	
<b>LOCOMOTION</b>		
		pacing
<b>AGGRESSION</b>		
		glaring
		jumping
		running/sprinting
		pouncing
		crouching
		chasing
<b>DEFENSE</b>		
		fleeing
		growling/rasping
<b>RESTING</b>		
		sleeping
		eyes closed
		no action
		grooming
<b>PLAY</b>		
		tumbling
		chasing
		climbing

Data were also collected from medical observations and histories obtained from zoo staff, both from the CT Beardsley Zoo and the Fort Wayne Children’s Zoo in Indiana. Information about Sofiya’s medical history and life history, including where and how she was reared, medical procedures, and illnesses were collected from the zoos. Information about a specific drug she was given, Deslorelin, was collected mainly from veterinarians, and information about the effects of the drug was collected from veterinarians and zoo staff. Phone and e-mail interviews were conducted with Fort Wayne veterinary staff and CT Beardsley Zoo staff.

**Results:**

The Amur Leopard’s behaviors were observed and recorded in conjunction with the environmental conditions, including weather, temperature, human interactions, animal

interactions, and sounds. The goal of this process was to determine if there was some environmental cue triggering Sofiya's abnormal behavior. At the start of the experiment, every detail of her behavior was recorded. Any behavior other than pacing was noted, as pacing was completely incessant during most of the observation. However, no distinguishable pattern of her specific behaviors, such as times she would poke her head out of the door in her enclosure, or times she would step outside briefly only to go back in almost immediately, could be observed. All of her observed behaviors were entirely unpredictable. The camera trap, however, provided a few interesting results. Every afternoon the camera consistently caught pictures of Sofiya coming outdoors around 2:30, and staying active until the zoo closed around 4:30. Observations were then taken on two separate afternoon occasions, on which all behaviors and environmental conditions were noted. During these periods, Sofiya did not seem to have any exaggerated reaction to anything in her environment, including weather, temperature, sound, and interactions. Her behavior did not change at all with any change to the environment. All of her times of activity other than pacing and occasionally poking her head out of the door were recorded in conjunction with the environmental conditions, and placed into a composite calendar, Figure 1. Information in the calendar varies based on what was available: on some dates, zoo staff members were able to provide a detailed zoo schedule, while on some days, only the weather and times of activity were available. In addition, the camera trap was not installed until February 26.

Background research revealed that Sofiya was born in a litter of two at the St. Louis Zoo, but that the other cub was a stillborn. The same research also showed that Sofiya's mother did not provide any maternal care.

Results were also obtained from a medical history of Sofiya, which was acquired from the Fort Wayne Children's Zoo in Indiana. The medical report showed that on May 13, 2010,

Sofiya was immobilized to be given a contraceptive. An email correspondence with staff at Fort Wayne revealed that the contraceptive was an 18.8 mg dose of Deslorelin, a common contraceptive. The report revealed nine instances of vomiting, five of which contained blood, between March 7 and May 31, 2011. The report also revealed three instances of vomiting, one of which contained blood, between November 18 and December 21, 2011. Four instances of vomiting, one of which contained blood, were documented between February 13 and September 14, 2012.

Some results were obtained from staff at the Beardsley Zoo in Bridgeport, CT, as well. Interviews with the staff at the Beardsley Zoo revealed that an artificial insemination procedure was scheduled for March 2, 2013. These interviews also revealed that hormone treatments were given on February 26 and March 3, 2013, as well as February 3 and 6, 2014.

All of the results gathered from observations, interviews, research, and the medical history resulted in the formulation of multiple hypotheses. These hypotheses are described in

Table 2:

*Table 2: Hypotheses formed prior to and during the experiment, and observations pertaining to the hypotheses.*

Hypothesis	Observations pertaining to hypothesis
Some environmental cue is triggering Sofiya's behavior (initial hypothesis).	<ul style="list-style-type: none"> <li>• Conditions changed, behavior did not noticeably change</li> </ul>
Sofiya is suffering from some form of anxiety.	<ul style="list-style-type: none"> <li>• Hesitation to come outside/shyness</li> <li>• Incessant pacing</li> </ul>
The lack of maternal care resulted in some psychological trauma.	<ul style="list-style-type: none"> <li>• Mother gave birth to a stillborn in the same litter</li> <li>• Mother did not display maternal care- Sofiya was hand reared</li> </ul>
Some sort of hormone imbalance is causing Sofiya's strange behavior.	<ul style="list-style-type: none"> <li>• 18.8 mg of Contraceptive administered in 2010</li> <li>• Hormone therapy at the Beardsley zoo in 2013 and 2014</li> </ul>
Something in her internal biological clock prevents Sofiya from being active in the	<ul style="list-style-type: none"> <li>• Bulk of activity occurs after 2:30 pm</li> </ul>

mornings.	<ul style="list-style-type: none"> <li>• Changed to 1:30 pm after daylight savings time ended</li> </ul>
Trauma from being sick younger in life could have some sort of lasting psychological effect.	<ul style="list-style-type: none"> <li>• Multiple instances of bloody vomit and loose stool</li> </ul>

**Discussion/Conclusions**

The initial hypothesis that some environmental cue was triggering Sofiya’s strange behavior was one of the first to be disqualified. Observations were taken under all conditions: sunny, rainy, snowy, cold, warm, quiet, and loud. Even with all of this variation in environmental conditions, her behavior did not change. Her seemingly anxious behaviors remained the same. This led to the anxiety hypothesis. This is potentially valid, however, there is no real way of qualifying a leopard as having a chronic anxiety disorder. Nonetheless, because of the subjective nature of the hypothesis, it was not totally disregarded as more progress was made. The same is true of the hypothesis that trauma from sickness left some sort of psychological impact. Animals do often get sick, and there is little data to suggest that it could be a seriously traumatic event. The illness hypothesis was labeled as weak, but not totally thrown away.

One of the more probable initial hypotheses was that the lack of maternal care Sofiya received as a cub had some lasting psychological effect on her. This was supported by some previous research. Another study of zoo animals showed that animals that were hand-reared alone, like Sofiya was, were more prone to aggression toward conspecifics and humans than animals that were hand raised with a conspecific or maternally raised with a conspecific (Mellen 1992). Sofiya was actually characterized as somewhat aggressive toward the male conspecific she was with at the Fort Wayne Children’s Zoo, even though she was not characterized as aggressive toward the zookeepers. It seemed to make sense, then, that other strange behaviors

could be associated with a lack of maternal care. However, there was still the issue of why her behavior changed so suddenly in the afternoons.

The fact that the time of her behavior changed when daylight savings time ended even further negated the “environmental cues” hypothesis. The zoo schedule remained the same, and her behavior shifted. This led to the conclusion that whatever was causing her strange behavior must be internal. It was not until further investigation about her medical history revealed new information that the hormone imbalance was selected as the leading hypothesis.

Sofiya was five years old at the time of the artificial insemination procedure. When the procedure occurred, it had to be stopped midway through. The vet, upon examination, noticed that Sofiya’s reproductive tract was not fully mature. He estimated the reproductive tract to resemble the reproductive tract of a 5-6 month old cat. She was not even close to sexually mature. More investigation led to the realization that Sofiya had been given the contraceptive at too young an age. One of the staff at the Beardsley zoo, Rob Tomas, the animal health manager, mentioned that cats are usually allowed to complete at least one estrus cycle before they are given a contraceptive, but that Sofiya was not allowed to do so. We believe that this did serious damage to her reproductive tract. If her reproductive tract was not fully developed before it was essentially stopped, it had no chance to ever fully develop. Additionally, at the time of the research, the AZA discussed the contraceptive in question, Deslorelin, in a 4.7 mg dose, or a 9.4 mg dose (Saint Louis Zoo, 2003). The fact that Sofiya was given twice the larger dose discussed by the AZA could mean that the contraceptive would last for twice as long as it should. Because data are still being collected about the use of Deslorelin, there is no data to support or disprove the idea that a double dose would double the effective period of the drug, but it is still an important fact to remember, according to veterinarians Joe Smith and Timothy Plunkett.



Regardless, a reproductive tract that could not fully develop surely could not supply Sofiya's body with the hormones she needs to lead a normal lifestyle, including a normal diurnal pattern. The hormone treatments at the Beardsley zoo might have initially contributed to the hormone imbalance as well. There is no way to tell, other than that the first round of therapy seemed unsuccessful. The second round, however, seemed to induce estrus in Sofiya. This led us to the idea that the hormone therapy, at least the second time, was helping to restore Sofiya's hormone balance.

Currently, we believe that Sofiya's strange behavior was caused by a hormonal imbalance. We do not know specifically what aspects of the imbalance led to the behavior, but the importance of Sofiya's hormonal and reproductive health cannot be overstated, both in terms of her behavior and her potential to be part of the SSP. The hormone therapies started at Connecticut's Beardsley Zoo seem to be a step in the right direction. AZA recommendations for how much Deslorelin is necessary to administer for a certain amount of time of contraception can vary by species, and so reversal recommendations can vary by species. Clearly, incredibly careful attention needs to be paid to Sofiya, and her reproductive health needs to be monitored closely. It is our hope that hormone therapies will continue to be successful and allow Sofiya to enter estrus of her own accord, not just via chemical induction.

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### Veterinary Contacts:

Dr. Joe Smith, Fort Wayne Children's Zoo

Dr. Timothy J. Plunkett, Fairfield Veterinary Hospital

## *Reflections on Service Learning*

Robert Schwartz  
*Fairfield University*

In the spring semester of my sophomore year at Fairfield University, I was lucky enough to take Vertebrate Zoology with Dr. Ashley Byun. This class was not only a 300-level biology class, but also a service learning class. For the lab section of the class, we worked with Connecticut's Beardsley Zoo, down the road from Fairfield University in Bridgeport, Connecticut. Bridgeport is Connecticut's most populous city, and also one of its most economically disadvantaged. The Beardsley Zoo is Connecticut's only zoo, and offers a wide variety of activities for children and adults, from lectures to interactive programs and scavenger hunts both at the zoo and in local parks around Bridgeport. All of these programs are offered at low or no cost. The zoo provides both access to education and access to many animals that residents of the Bridgeport and Connecticut communities would not otherwise have.

The Beardsley Zoo is a small zoo, and as a result, the staff size is somewhat small. However, it is part of the Association of Zoos and Aquariums (AZA), a worldwide community, and so it often deals with very important projects and animals. The AZA works to care for, educate about, and conserve many of the world's most endangered species of animals. Research done by the AZA influences its Species Survival Plan (SSP) programs, which are long-term plans including research, education, habitat preservation, and species conservation efforts to benefit not only the species in question, but also the global zoological community. Because of the small staff size, it is hard for the Beardsley Zoo to have time to fully complete all of the research and collect all of the data it needs to. The service learning component of the Vertebrate Zoology lab allows students to work with zoo staff on research projects chosen by the managers at the Beardsley Zoo and Dr. Byun, thus exposing the students to hands-on research in the field of biology, and helping the Beardsley Zoo perform research that has the potential to not only help the animals, but to help the zoo itself in designing and managing exhibits.

The project I was specifically assigned involved the Amur leopard in residence at the Beardsley Zoo at the time, Sofiya. Amur leopards are classified as critically endangered, with a total captivity and wild population of fewer than 300. Sofiya, we were told, was displaying strange, antisocial behaviors, such as constantly pacing inside her indoor enclosure and rarely coming outside. We were also told that a veterinarian had deemed her potentially infertile. The Beardsley Zoo wanted to determine the cause of her strange behavior. This was important to the zoo because if we could determine the cause of the behavior, we could address the issue and potentially alter her behavior. This would be good for business for the zoo, and it would also provide easier observation and potentially more information to share with other zoos concerned with species survival and conservation.

As our research continued through the semester, we realized that Sofiya's infertility and strange behavior might be linked. By contacting other zoos where Sofiya had lived, we were able to obtain a medical history and determine that she might in fact be suffering from a hormonal imbalance as a result of a contraceptive administered at too young of an age. This idea corresponded with findings from the veterinarian at the Beardsley Zoo, who told us that Sofiya's reproductive tract was severely stunted in growth. As we were collecting data, the staff at the Beardsley Zoo could not have been more helpful or interested in what we were finding. Chris Barker and Bethany Baldwin, the animal trainers who work closely with the big cats including

Sofiya, made themselves easily available for questions and discussions about what we were finding.

I remember specifically discussing with Chris our hypothesis, and I remember his reaction when we told him about the early contraception and how it could have stunted her reproductive growth and potentially damaged her permanently. He was visibly angry, frustrated, and upset with the situation. I also remember completely sympathizing with him; he had obviously developed a personal, emotional attachment to Sofiya at work, and I was starting to develop one as well, even just researching for a few hours a week. This realization was incredibly insightful to me in realizing how important the work we were doing was for the Beardsley Zoo. I could really tell that Chris, and by extension the rest of the Beardsley Zoo, was deeply invested in solving the problem and trying to help Sofiya.

There were also other learning experiences involved along the way. In speaking with other professionals outside of the Beardsley Zoo involved in animal healthcare and management, I realized how strong of a force ego can be in the field of academia and research. My research led me to be in contact with a veterinarian, who I apparently inadvertently offended in my questioning, when we were discussing his treatment of Sofiya. Upon receiving a somewhat cold and defensive email, I spoke with Dr. Byun about what was the best course of action. With her advice and guidance, I replied, asking the veterinarian to understand that I was merely a sophomore undergraduate doing some research for a class and that I had certainly not meant to insinuate anything or accuse him of anything. However, that was the end of our correspondence.

We had a similar experience when my research partner and I went to Orlando, Florida this past fall to present our research at the annual Association of Zoos and Aquariums conference. Even though we were incredibly careful to present a statement of fact and not an opinion or an accusation, and we did not single out any zoo or person related to the case, some of the staff from a zoo where Sofiya had lived recognized Sofiya on our poster. When we presented our research, they felt offended (or guilty) and became very defensive, intensely questioning our findings and hypothesis. We again had to remind them that we were only undergraduates researching for a biology class.

Both of these were very important learning experiences not only in the field of academia and research, but also in communication and relationships. These experiences highlighted an ethical contradiction in the work of these scientists. The ultimate goal of this research is to help conserve a species with a wild population of fewer than 40. These dire circumstances, to me, allow no room for ego to impede progress, and yet this seemed to be exactly what was happening. Without a doubt, this sort of self-righteousness is potentially very harmful to the social justice dimension of our research, not only in terms of the well-being of Sofiya herself, but in terms of the consequences for the AZA, the Beardsley Zoo, and the Bridgeport and Connecticut communities. This experience, and the implications of the behavior I encountered, will certainly stay with me throughout the rest of my education and whatever profession I choose, scientific or otherwise.

The relationships that resulted from my service learning experience are invaluable. By collaborating on a project with a common goal, I developed a great relationship with the professor teaching the service learning class, and I realized that this field of biology is incredibly important and fascinating to me, and the importance of that is huge as a student who will finish undergraduate college in one year. I developed a relationship with an international organization, the Association of Zoos and Aquariums, and I will always have that relationship as a member and as a research presenter. Few undergraduates have the opportunity to work with such

organizations. I also developed a great working relationship with some of the staff at the Beardsley Zoo, one I was able to maintain after our semester of research ended. They are incredibly knowledgeable, kind, and passionate people, and I am proud to say I worked with them and honored to say I helped them. This is, in some sense, a microcosm of the relationship between Fairfield University and Connecticut's Beardsley Zoo. The more this particular service learning course is offered, the more students have a chance to build these relationships, the more the zoo can find help for research and projects, and the stronger the bond between the university and the zoo becomes. In this way, Fairfield University's service learning benefits not only the Beardsley Zoo community, but also the Bridgeport community, and the zoological community at large through the Association of Zoos and Aquariums. This has certainly proven to be a formative experience for me, and I am grateful to everyone involved.

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