

Management Plan to Double the Oncilla (*Leopardus tigrinus*)
Population in South America



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Executive Summary

The oncilla (*Leopardus tigrinus*) is the smallest of eight neotropical cat species of South America. They have thick, short, light brown-grey fur that has spotted rosettes. The back of their ears also contains a white spot in the middle of the black fur. The average weight of the felid is 2.4 kg. Their main distribution is located in the northern part of South America. They tend to favor dense forests that have high cover. The oncilla diet consists of small mammals, birds, and reptiles. Some examples of the types of prey they consume include unidentifiable rodents (*Cricetidae*), the yellow pygmy rice rat (*Oligoryzomys flavescens*), grass mice (*Akodon sp.*), the rat-headed rice rat (*Sooretamys angouya*), and unidentified birds. They also depredate on poultry livestock in nearby villages. The oncilla has an average litter size of 1.5 kittens that become full grown by 11 months of age. They do not become reproductively mature until they reach an age of two. The IUCN Red List considers the oncilla to be a vulnerable species. The number of mature individuals is between 8,900-10,210. There is a projected decline in population by 36.8% over the next three generations. This management plan is focused on doubling the population of mature oncillas within the next 20 years in South America. The biggest ecological factor that is affecting populations is deforestation of their habitat. Oncillas are also hunted due to depredation on village livestock as well as for their skins and traditional medicinal purposes. First objective is to conduct a minimum of two studies improve understanding about the natural history aspects of the oncilla throughout the 20 years. Second, establish a minimum of three protected areas for the oncillas in the first ten years. Third, increase public knowledge of the oncilla by 50% throughout the 20 years. Finally, reduce the mortality of the oncilla by 75% in the first two years.

History

Species identification

The oncilla (*Leopardus tigrinus*) is the smallest and least known species of the eight neotropical felid species of Brazil. The native people have many names for the felid, including the little spotted cat (Tortato and Oliveria 2005), tigrina, tigrillo (Nascimento and Feijó 2017), and the northern tiger cat. It is a member of the lineage of ocelots (*Leopardus pardalis*) (Nascimento and Feijó 2017). The average weight of the cat is 2.4 kg (IUCN Red List). Oncillas have short, thick, light brown-grey fur with spotted rosettes that are dark brown and have a black outline. A distinguishing feature is that the back of the ears are black with a white dot in the middle of them. Being a part of the ocelot lineage, people commonly mistake them for margays (*Leopardus wiedii*) (Patel 2011).

Breeding and Diet

There are not enough studies done about wild oncilla reproduction. What is known is that they have an average litter size of about 1.5 kittens. In captive bred oncillas, they breed from early to late spring and tend to be monogamous. Gestation for the oncilla is about 75 days. Kittens start to wean from their parents around three months of age, become independent around 4 months, and are full grown by 11 months. They do not reach sexual maturity until they are about two years old. In captivity, oncillas can live a typical lifespan of 16 to 20 years while in the wild they live to be between 10 to 14 years old (Patel 2011).

Small mammals make up the majority of diets for small neotropical cats. There have been few papers regarding the diet of the oncilla. Most of the studies that have been done study the diet by looking at their scat. In scat remains, small mammals, birds, and reptiles were all present

(Tortato and Oliverira 2005). In the Silva-Pereira et al. study, they broke down the categories further by giving percentages of what was found in thirty scat samples. Unidentifiable rodents, *Cricetidae*, were found the most frequently (41.7%), followed by the yellow pygmy rice rat, *Oligoryzomys flavescens* (38.9%), grass mice, *Akodon sp.* (30.5%), unidentified birds (27.7%), and the rat headed rice rat *Sooretamys angouya* (27.7%). From this information, we can deduce that small mammals, rodents, and birds make up the majority of the oncilla's diet (Silva-Pereira et al. 2011).

Another study by Nagy-Reis et al. states that the oncilla is a generalist and was found to be cathemeral. Their results also showed that the oncilla's activity overlapped with the activity of their prey. Auditory and visual cues are important for hunting and hunting while the prey is active optimizes the outcomes of the hunt. The oncilla's mean weight of prey throughout the study was 23 grams (Nagy-Reis et al. 2019). They have never been sighted to predate on an animal that weighs near or over 1000 grams (Silva-Pereira et al. 2011). Nagy-Reis et al. states that prey availability to carnivores can influence abundance, occupancy, density, and habitat use (2017).

Habitat

The oncilla favors humid subtropical forests (Schreber 1986). They are most often found in densely forested or high cover sights. They tend to follow trails that are narrow instead of wide and well used to avoid interactions with competitors such as the ocelot (Goulart et al. 2009). Furthermore, oncillas have been sighted near beaches and villages, but tend to avoid human activity (Tortato and Oliverira 2005). Results of a study showed that an increase in habitat destruction, such as an increase in roads, negatively effects neotropical spotted cats, including the oncilla. In the area where they were observing the oncillas, a study found that the

cats spent most of their time in areas that are under some type of environmental protection, suggesting that small fields are sensitive to protection statuses of land areas (Nagy-Reis et al. 2017).

Distribution

The oncilla species can be located in the northern region of South America with a small population also being found in Costa Rica (Nascimento and Feijó 2017). More specifically, you can find sightings of the oncilla in Argentina, Brazil, Ecuador, French Guiana, Guyana, Peru, Suriname, and Venezuela (Schreber 1986). The southern regions for the oncilla's distribution are not well known due to little data collected in the area. The highest elevation that the Oncilla has been recorded is 4,800 m, but its normal distribution is from ocean level to a little over 3,000 m (IUCN Red List, 2016). The small felids are also submissive to bigger predatory cats; being found in higher abundances where there are no larger felids present (Oliveira-Santos et al. 2012).

Disease

In 2013, 50 percent of the oncilla population was found to have toxoplasmosis which is a pathogen that they can spread to humans through their feces (Berger 2019). Ticks and rabies are also a problem in carnivore populations within Brazil and the ticks can be a vector for Lyme disease (Labruna et al. 2005, Deem and Pacheco 2004). Heartworm disease is also found in the oncilla. It is caused by an intervascular nematode, *Dirofilaria immitis*, and is commonly found in dog and cat species. The disease can occur in humans, but it is rare that it does. The oncilla is considered as a host to the nematode, harboring the adult form in the chambers of their heart. There is no research done yet about how many oncillas are affected by the heartworm disease (Filoni et al. 2009).

Population Model

There is little to no data that is found on oncilla population dynamics. I used ocelot survivorship rates to create a population model for the oncilla. However, I was able to find fecundity data for the oncilla and that was used instead of ocelot data. Since there was only data for the range of the mature population size, I took the average of the two numbers to have the initial mature population size number (3+ years of age). Because there was no data on exact number counts for each age class, the data is based on the initial mature population number I came up with and when plugged into the table, I was able to find starting numbers for each age class. I also made a life cycle diagram to show what is happening in each age class (Appendix D). As it stands right now, if the population data was to stay unchanged, the population would be nonexistent in a century (Figure 1). While making the population model analysis, I also calculated models for elasticity and sensitivity (Appendix A and B). Graphs were made for a 35-year projection although this management plan is focusing on the first 20 years. The results showed that I needed to focus management efforts to the 3+ year age group, which are the mature individuals. Once I manipulated survivorship for the 3+ year age group, the population started to increase (Figure 1). Each age class started to steadily increase with the manipulated data, not just the 3+ year age class (Appendix C). Therefore, habitat for the oncilla is one of the most important factors in the conservation of this species.

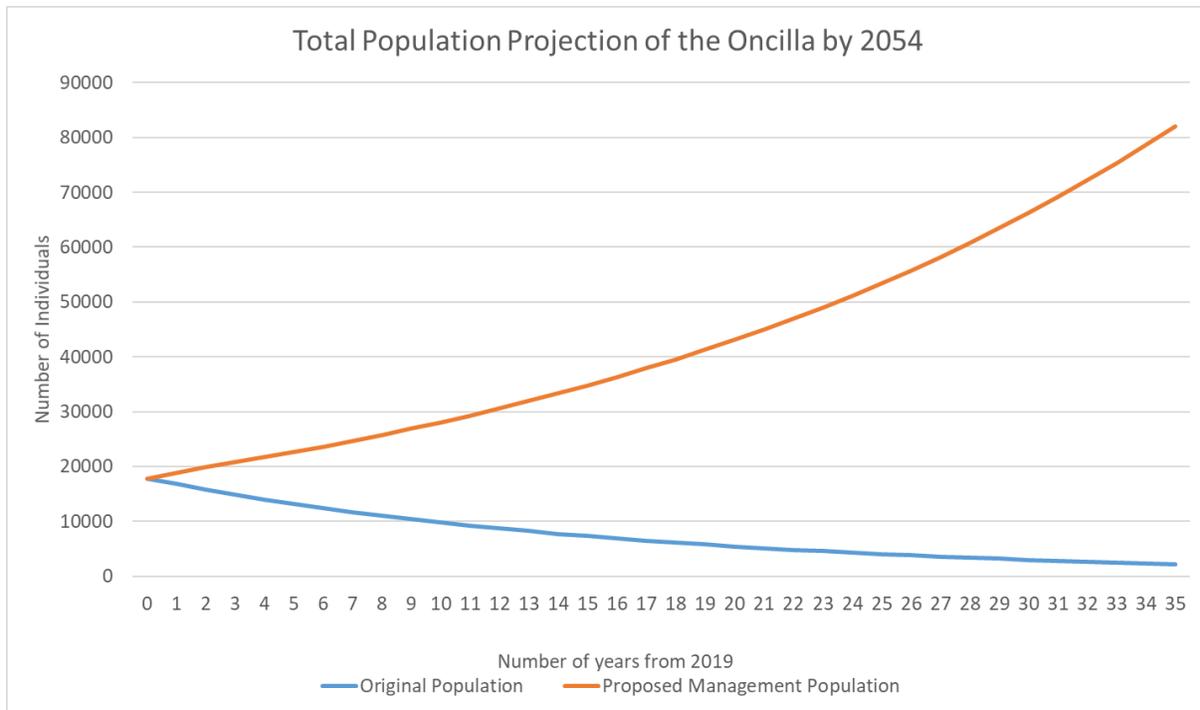


Figure 1. Total Population Projection for the oncilla (*Leopardus tigrinus*) by 2054 with and without management to the population.

Conservation Needs

Ecological Issues

The Amazon rainforest since the 1970’s has had drastic changes in the use and land cover type. Native vegetation has been replaced by family/ subsistence agriculture, cattle ranching, and large-scale agriculture such as the cultivation of soybean. Not only does deforestation destroy vegetation in the area, it also imperils thousands of species and adds carbon emissions into the atmosphere (Ometto et al. 2011). Deforestation also causes the landscape to be fragmented which causes populations to become more isolated (Chiarello 1998). The Amazon rainforest that is apart of Brazil is home to 25 million people. The increasing population is going to lead to more forest destruction in the years to come (Ometto et al. 2011). Because oncilla’s do not tend to be found near human development, the destruction and urban growth will negatively affect

their population (Goulart et al. 2009). Clear-cuts that are taken from the forests also do not provide the type of habitat that the oncilla's favor (Ometto et al. 2011).

Economic Issues

Predation from the oncilla has not been well documented, however they have been observed preying on domestic chickens in nearby towns (Tortato et al. 2013). Other predatory cats closely related to the oncilla have been documented preying on other domesticated livestock as well (Cunha et al. 2017). Hunting of the small cat is a factor in the decreasing population of the oncilla. Not only are they the most hunted species for the protection of domestic livestock but they are also hunted for their pelts (Souza and Alves 2014). Between 1960 and 1980, skins of the oncilla were heavily traded, effecting the population. Exports of the skins in different South American countries from 1980 to 1985 ranged from 1 to almost 84,500 skins (Schreber 1986). Juvenile oncilla's are also used in the pet trade, which makes them important income sources for some families (Souza and Alves 2014).

Sociocultural Issues and Policies

Oncilla's are used in traditional medicine in Brazil. Parts of their fat are used to remedy intestinal disorders (Souto et al. 2011). Skins of the oncilla are also used for decoration (Oliveira et al. 2017). Hunting of the oncilla is illegal in Brazil, French Guiana, Colombia, Venezuela, Suriname and Costa Rica (IUCN Red List 2016). Brazil has a legal domestic pet trade for wild animals within its borders. The wildlife trade is regulated by the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA), which allows animals bred by legal breeders to be sold (Kuhnen and Kanaan 2014). However, illegal trade of many wild animals, along with the oncilla, still occur today (Souza and Alves 2014). Brazil also has laws that protect

native wild animals within the borders of the country. Law 5,197 of January 3, 1967 states that any species that live free from captivity are government property and prohibits chasing, destruction, use, capture, or hunting of the species. Article 29 of Law 9605,98 states that chasing, killing, catching, hunting, or use of native wildlife without permission, a license, or authorization incurs penalties. Unauthorized breeding of wild animals is also prohibited (World Animal Protection).

Statement of need

According to the IUCN Red list, the number of mature individuals is between 8,900-10,210. The projected decline of the population was estimated at 36.8% over three generations. It is therefore listed as vulnerable and the population is continuing to decrease. Densities of the species is about one to five individuals per 100 km² (IUCN Red List 2016). Predatory cats can affect the function and structure of the ecosystem. They can affect or alter prey species and plant species directly and indirectly respectively. It is important to keep the population of this species from decreasing because it can affect the ecosystem in ways we do not know (Botelho et al. 2012). Habitat is going to be important for the oncilla for reproductive, dietary, and individual range reasons.

Management

Goal: To double the number of mature oncillas (*Leopardus tigrinus*) in South America in 20 years.

Objective 1: Conduct a minimum of two studies improve understanding about the natural history aspects of the oncilla throughout the 20 years.

Objective 2: Establish a minimum of three protected areas for the oncillas in the first ten years.

Objective 3: Increase public knowledge of the oncilla by 50% throughout the 20 years.

Objective 4: Reduce the mortality of the oncilla by 75% in the first two years.

Actions

Objective 1: Conduct a minimum of two studies to better understand the natural history aspects of the oncilla throughout the 20 years.

Action 1.1- Conduct a study to get an estimate on current population size of the oncilla.

We will capture individual oncillas and put radio collars on them to track their individual range size and calculate what the population size could potentially be. Also, while tracking individual distributions, look at the southern distribution to get a better understanding to where oncilla's native range ends. Furthermore, data captured from the collars can also give us a better understanding of how the oncillas are using their habitat along with when they are most active (Kolenosky and Johnston 1967). Outcomes of this study should also include calculating survivorship for different age classes for the oncilla to be used to get a better understanding of the current trend of the population. This study should be put into motion within the first five years of the management plan.

Action 1.2- Gather more information from the native people about how the oncilla is used throughout the community. Visit people in the communities that are involved with traditional style medicine to figure out which parts of the oncilla is used and for what reasons (Souto et al. 2011). Also, visit local traders to see if there is a demand for the skins and what they are being used for (Schreber 1986).

No Action- If there is no action taken, the scientific community will miss out on important information that could be detrimental to the protection and restoration of the oncilla population.

Final Action- 1.1, 1.2

Both actions will be used because there is limited amount of data collected for the oncilla regarding the topics listed above.

Assessment Protocol: Better understanding of the natural history aspects of the oncilla will be considered successful if both action 1.1 and 1.2 are completed. This will allow updated information that is specific to the oncilla instead of using a surrogate species. The new data can then be used to update, change, or add another objective. After both actions are done, more studies should also take place that further help in managing for the oncilla. If action 1.1 and 1.2 is not completed in the first five years of the management plan, the next step should be to determine why it was not completed. Money or a lack of data could be a problem as to why both actions were not completed.

Objective 2: Establish a minimum of three protected areas for the oncillas in the first ten years.

Action 2.1- Establish a protected area where there are only clear-cuts that happen every 20 to 30 years. Oncillas prefer habitat that has high vegetation for high cover (Goulart et al. 2009). This will allow for understory growth to be thick with lots of cover for the oncilla. The site's understory cover will be monitored to see when a clear cut needs to take place.

Action 2.2- Establish two protected areas of 200 km² where there is group selective harvesting that occurs every 40-50 years. Oncillas prefer habitat that has high cover and

thicker vegetation (Goulart et al. 2009). High understory can be found in early succession forests. By allowing group selective harvesting, it allows an area to be clear cut but on a small scale. This will create pockets of high cover areas for the oncilla and their prey (Forest Management Basics).

Action 2.3- Establish a protected area of 100 km² where there is not allowed to be any human development. Oncillas tend to avoid human activity (Tortato and Oliverira 2005). Therefore, having an area that does not have human activity will increase oncilla density in the area.

No Action- If no action is taken, there will not be suitable habitat for the oncilla where they are trying to live and reproduce. Without the high cover areas and less human interactions, the oncillas will not be able to interact with each other as much as they need to.

Final Course of Action: Actions 2.2, 2.3

The group selection method of forestry versus the clear-cut method will allow for less fragmentation to the landscape. This means there will be more continuous high cover areas for the oncilla along with cover for the prey the oncilla goes after. In the same area, not allowing human development of any kind will allow the oncillas to interact more with each other, increasing the probability of reproduction. Both actions 2.2 and 2.3 will be the driving factors in the increase of populations. Action 2.1 will not be used because it is less apt to have connective cover for small mammals and oncillas.

Assessment Protocol: Creating three protected areas, two group selection cuts and one no human development area, will be considered successful if actions 2.2 and 2.3 are met.

This objective is crucial to the success of the oncilla. It is the main driving factor to support the population model (Figure 1). If they are not met within the first ten years, the next step is to determine why the actions were not met. Solutions may include having a smaller area size for the protected areas or having one or two bigger areas instead of three smaller areas.

Objective 3: Increase public knowledge of the oncilla by 50% throughout the 20 years.

Action 3.1- Survey the public to assess public knowledge about the oncilla (Appendix E). This will be done at the beginning of the management plan and at the 19-year mark. Ask questions about habitat, diet, and general knowledge of the species. Also ask the participants how they feel about the oncilla and how they feel about the management plan wanting to increase their population. At the end of the 20 years, send out another survey and ask the same questions along with if they know what type of management has been put into place for the animal. Surveys are a good way to engage the public with what is going on in the area along with gaining knowledge of what they learn throughout the process (Chase et al. 2004).

Action 3.2- Conduct informational town meetings within the first year to get input about the management plan from the public. Address their concerns and work with them to come up with a plan that works for everyone. At the town hall and community places, have brochures or flyers available for the public throughout the management plan to allow people learn about the oncilla and management that is being implemented (Appendix F) (Taylor and Daniel 1984).

Action 3.3- Raise money for oncilla management by having a program where you adopt your own oncilla. A one-month donation to help fund habitat protection will get you a picture of an oncilla along with information about the management program being implemented. People will be able to learn about the oncilla and help fund conservation at any point throughout the 20-year management plan program (Adopt a jaguar).

No Action- If no information system is implemented, the public will never know what type of problems the oncilla population has. There will also be no support behind increasing the population size.

Final Action- 3.1, 3.2

Action one will be used to determine if we have met the objective. Action 3.2 will be used for a way for people to voluntarily be active in understanding what is happening within their community.

Assessment Protocol: Increasing public knowledge of the oncilla will be considered successful if action 3.1 is reached. If at the end of 20 years our surveys come back and 50% of the population is more knowledgeable, then we can also conclude that action 3.2 helped play a factor in an increase of knowledge. If action 3.1 is not reached within the first year of the study, action 3.3 will be implemented. This action has been used throughout the world to increase knowledge about endangered animals. Implementing the action will increase world awareness about the oncilla.

Objective 4: Reduce the mortality of the oncilla by 75% in the first two years.

Action 4.1- Secure funding to subsidize farmers for livestock enclosure construction. If poultry farmers do not have their livestock in a type of enclosure, funding can be given

to keep their livestock in enclosed fences. Enclosures should be made of a wooden fence at least 4 feet high with chicken wire to surround it. The chicken wire should also cover the top of the enclosure as well. Farmers who want to go a step ahead can also place an electric wire fence around the enclosure. Funds for the electric fence can also be given to pay for all or half of the enclosure (Tortato et al. 2013).

Action 4.2- Implement a type of sound or motion machine that will scare off predators. This will not harm any wildlife in the process. It can be set on a specific time during the day or be motion censored (Craven 2013).

Action 4.3- Establish an incentive program for farmers to reduce oncilla mortality. If there is a loss in poultry livestock on a farm from predation of oncillas, the farmer will be compensated for the loss of their livestock. It will either be replaced at no cost to the farmer or the farmer will be reimbursed. This is an incentive for farmers to not shoot the oncillas. Incentive programs for farmers have been implemented in other situations (Vermersch et al. 1993)

No Action- If no change is made in the villages, oncillas will keep being killed while going after domestic livestock. This decreases the oncilla population making it counterproductive to our goal.

Final Action: 4.1, 4.3

Action 4.1 will be introduced to farmers. If they are cooperative in building enclosures, action 4.3 will be available for them. If farmers are against action 4.1 then they will not be compensated for any livestock that is lost to the oncilla. Action 4.2 will not be used at first due to the cost and the uncertainty of if it will work or not.

Assessment Protocol: If there is a decrease of 75% of mortality for the oncilla because of livestock protection in the first two years, then we can consider this objective to be successful. Actions 4.1 and 4.3 are crucial to the objective, showing the farmers that they do not have to worry about money loss if any of their poultry livestock is killed. We will determine if the 75% threshold is reached by asking farmers to report when they have shot an oncilla. If actions 4.1 and 4.3 are not successful, then we can implement action 4.2. Action 4.2 should be implemented in a small area at first to see if it works so money is not wasted.

Conclusion

The oncilla is a keystone predator species to the South America region. They live in dense forest habitats with high cover. The oncilla population is declining and this management plan provides a way to help their population numbers. More research, public knowledge, and habitat protection and management are the main solutions to the problems that face the oncilla. If this management plan is a success, we could see double the oncilla's population in South America within the next 20 years.

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Appendix

Appendix A

Population Model Analysis for the original *Leopardus tigrinus* population data. Also included is the original population sensitivity and elasticity matrixes.

Species: Oncilla					
	<i>F(0-3)</i>	<i>F(3-6)</i>	<i>F(6m-2yrs)</i>	<i>F(2-3 yrs)</i>	<i>F(3+yrs)</i>
0-3 months	0	0	0	0.2925	0.27
3-6 months	0.785	0	0	0	0
6 months- 2 years	0	0.933	0	0	0
2-3 years	0	0	0.87	0	0
3+ years	0	0	0	0.78	0.72

Sensitivity matrix					
	<i>F(0-3)</i>	<i>F(3-6)</i>	<i>F(6m-2yrs)</i>	<i>F(2-3 yrs)</i>	<i>F(3+yrs)</i>
0-3 months	0.2001	0.1151	0.1139	0.1052	0.3686
3-6 months	0.1660	0.1382	0.1368	0.1263	0.4426
6 months- 2 years	0.1677	0.1396	0.1382	0.1276	0.4471
2-3 years	0.1816	0.1513	0.1497	0.1382	0.4844
3+ years	0.1677	0.1396	0.1382	0.1276	0.4471

Elasticity matrix					
	<i>F(0-3)</i>	<i>F(3-6)</i>	<i>F(6m-2yrs)</i>	<i>F(2-3 yrs)</i>	<i>F(3+yrs)</i>
0-3 months	0	0	0	0.032637014	0.105580265
3-6 months	0.138217278	0	0	0	0
6 months- 2 years	0	0.138217278	0	0	0
2-3 years	0	0	0.138217278	0	0
3+ years	0	0	0	0.105580265	0.341550622

Appendix B

Population Model Analysis for the manipulated 3+ year age group of the *Leopardus tigrinus*. Also included are the sensitivity and elasticity matrixes for the manipulated data.

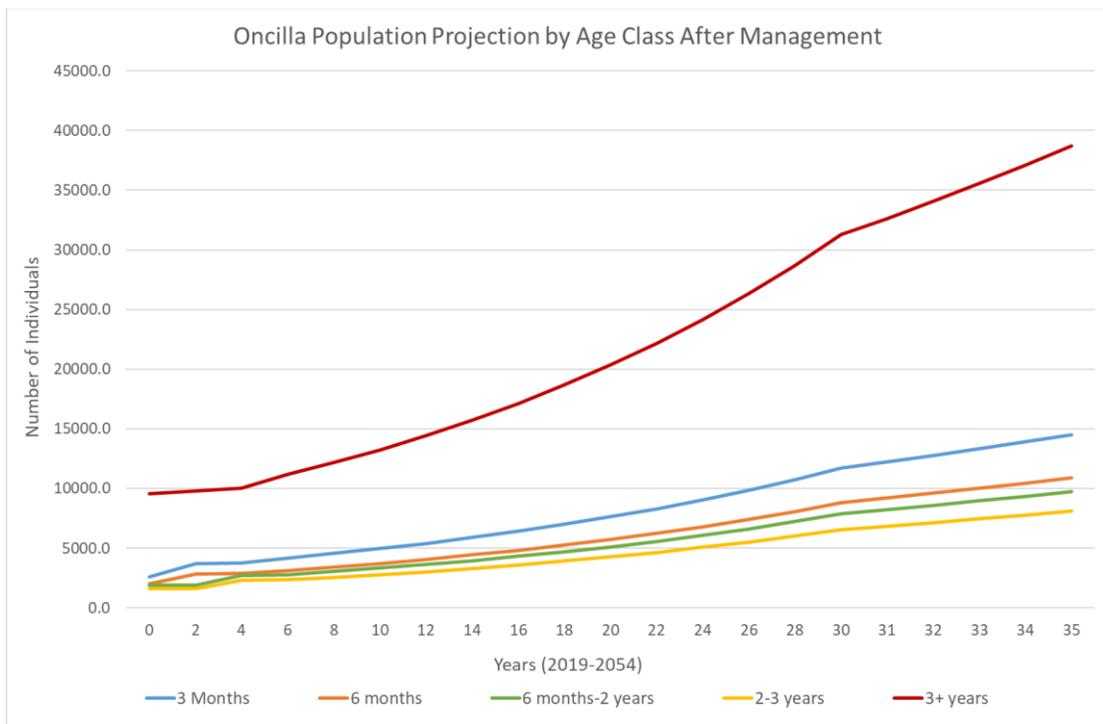
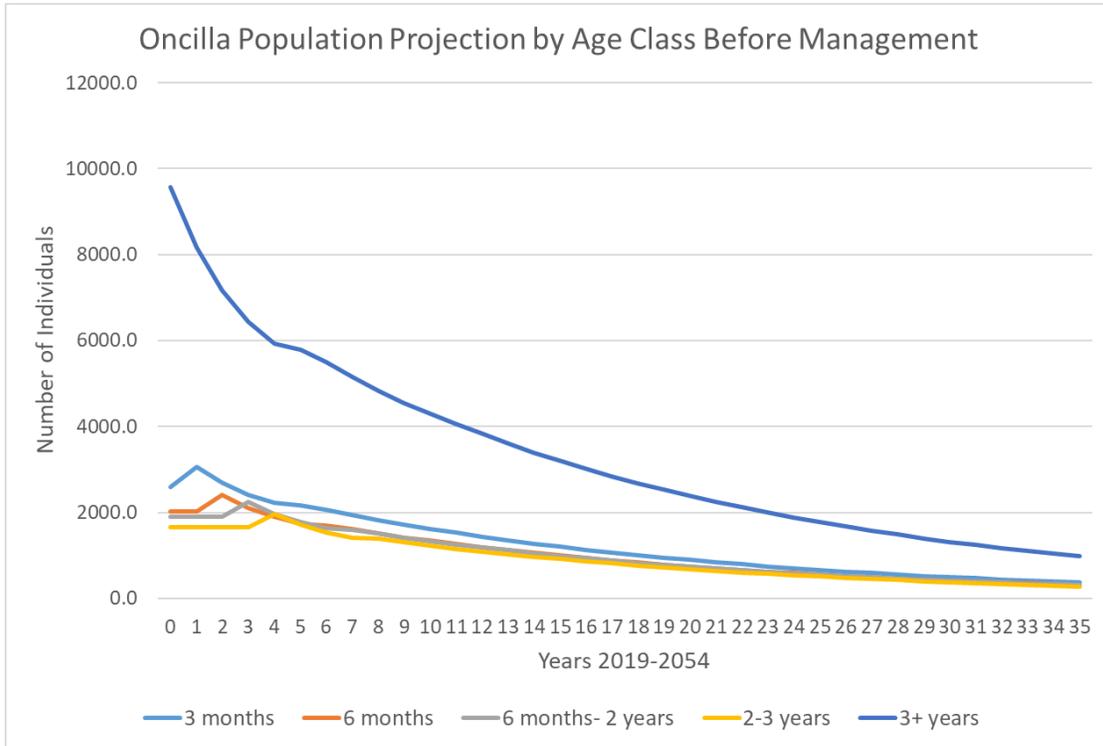
Species: Oncilla					
	<i>F(0-3)</i>	<i>F(3-6)</i>	<i>F(6m-2yrs)</i>	<i>F(2-3 yrs)</i>	<i>F(3+yrs)</i>
0-3 months	0	0	0	0.2925	0.33
3-6 months	0.785	0	0	0	0
6 months- 2 years	0	0.933	0	0	0
2-3 years	0	0	0.87	0	0
3+ years	0	0	0	0.78	0.88

Sensitivity matrix					
	<i>F(0-3)</i>	<i>F(3-6)</i>	<i>F(6m-2yrs)</i>	<i>F(2-3 yrs)</i>	<i>F(3+yrs)</i>
0-3 months	0.2177	0.0803	0.0717	0.0598	0.2846
3-6 months	0.1419	0.1067	0.0954	0.0795	0.3784
6 months- 2 years	0.1588	0.1194	0.1067	0.0889	0.4234
2-3 years	0.1905	0.1433	0.1280	0.1067	0.5080
3+ years	0.2149	0.1616	0.1445	0.1204	0.5731

Elasticity matrix					
	<i>F(0-3)</i>	<i>F(3-6)</i>	<i>F(6m-2yrs)</i>	<i>F(2-3 yrs)</i>	<i>F(3+yrs)</i>
0-3 months	0	0	0	0.016752037	0.089966243
3-6 months	0.10671828	0	0	0	0
6 months- 2 years	0	0.10671828	0	0	0
2-3 years	0	0	0.10671828	0	0
3+ years	0	0	0	0.089966243	0.483160638

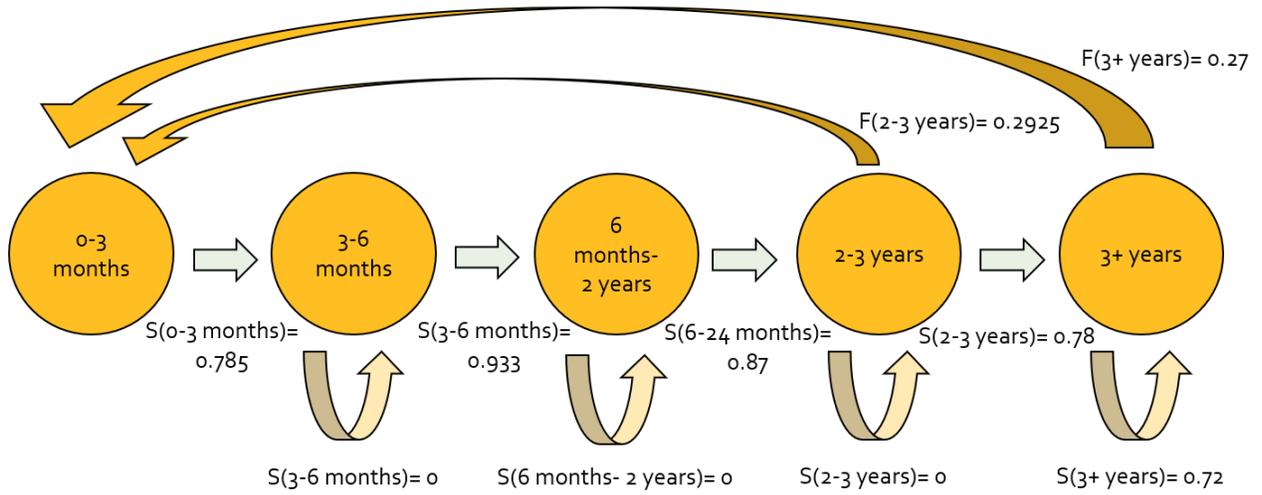
Appendix C

Population projection for *Leopardus tigrinus* in each age class before and after the data was manipulated.



Appendix D

Life cycle diagram of the *Leopardus tigrinus*.



Appendix E

General Survey of the Oncilla (*Leopardus tigrinus*)

There is a proposed management plan to increase the population size of the oncilla in South America. This survey's intended purpose is to get a general overview of what the surrounding communities know about the oncilla.

1. Where is the oncilla's natural home range?
 - A. Central America
 - B. South America
 - C. North America

2. What type of habitat does the oncilla prefer?
 - A. Open habitat, such as fields
 - B. Areas near human development
 - C. Densely vegetated areas away from human development

3. What type of animals are included in the diet of the oncilla? (circle all that apply)
 - A. Small mammals
 - B. Reptiles
 - C. Birds
 - D. Amphibians

4. How do you feel about management to increase the oncilla population?
 - A. I'm glad there is a plan to increase population.
 - B. I am neutral about the plan.
 - C. I do not want the oncilla population to increase

5. In the space provided below, please list any comments or concerns you may have about the survey or the management that is about to take place for the oncilla.



Oncilla

Leopardus tigrinus

About the Oncilla

- Species ID- Short, thick light brown- grey fur with dark brown rosettes with black outlines. Back side of the ear is black with a white spot.
- Habitat- Humid subtropical forests. Not seen around human development.
- Diet- Consists of small mammals, birds, and reptiles.
- Breeding- Become reproductively active after the age of two. Average litter size contains 1.5 offspring.

Management Plan

Goal: To double the number of mature oncillas (*Leopardus tigrinus*) in South America in 20 years.

Objective 1: Conduct a minimum of two studies to improve understanding about the natural history aspects of the oncilla throughout the 20 years.

Objective 2: Establish a minimum of three protected areas for the oncillas in the first ten years.

Objective 3: Increase public knowledge of the oncilla by 50% throughout the 20 years.

Objective 4: Reduce the mortality of the oncilla by 75% in the first two years.

For any information regarding the oncilla, please contact Sarah Vivlamore at svivlamore@paulsmiths.edu