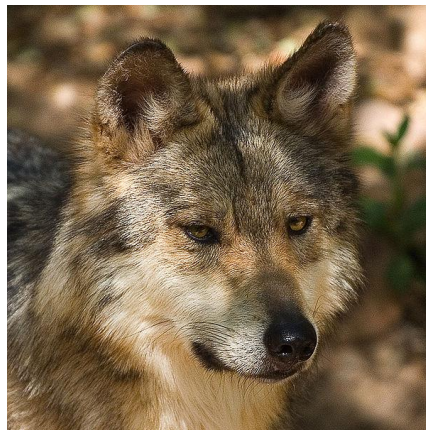# Mexican Gray Wolf
Endangered Population Modeling in the
Blue Range Wolf Recovery Area

New Mexico
Super Computing Challenge
Final Report
April 3, 2012

Team 61

Little Earth School

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Executive Summary

In the 1900s, the Mexican Gray Wolf (*Canis lupus baileyi*), was intentionally wiped out in the southwestern United States. The wolves were exterminated because they were killing livestock. Many techniques were used to exterminate them including: trapping, shooting, and poisoning with strychnine, arsenic, or sodium cyanide. The illegal killing of Gray wolves became a major threat to their survival.

In addition to the extermination tactics mentioned above, human invasion into wolf territory, lead to habitat loss for wolves. Other issues threatening wolf survival were: population decline of wildlife like deer and elk, which were their prey. By the end of the 1950s the Mexican Gray Wolf was mostly gone from the wild, and they could only be found in zoos and other facilities.

In 1976, the Mexican gray wolf was declared an endangered species under The Endangered Species Act. In 1997, the United States Secretary of the Interior authorized the U.S. Fish and Wildlife Service to begin the reintroduction of the species in the Blue Ridge Wolf Reintroduction Areas of Arizona and New Mexico and 11 wolves were reintroduced to the wild in New Mexico and Arizona beginning in 1998. The main objectives of the Recovery Plan were to maintain a captive population and re-establish a viable, self-sustaining wild population of Mexican wolves. Unfortunately, at the end of 2010 there were only approximately 50 wolves in the Blue Range Wolf Recovery Area.

Our Project simulates the Mexican Gray Wolf into the Blue Range Recovery Area. To the best of our ability we have created a program that represents the Mexican Gray Wolf's life and survival in the Blue Range Recovery including the basic elements of their habitat: trees, shrubs, grass, rocks, prey and predators.

Statement of the Problem

Mexican Gray Wolves are an endangered species. What few remaining Mexican wolves there ar either live in captivity or have been reintroduced into an area called the Blue Range Wolf Recovery Area (BRWRA), which is a protected area for the wolves to breed and live. The BRWRA includes all of the Apache and Gila National Forests in east-central Arizona and west-central New Mexico, encompassing 17,775 km² (6,845 mi²) (USFWS 1996). In addition, the White Mountain Apache Tribe has developed a management plan for wolves that adds 6,475 km² (2,500 mi²) to an area adjacent to the BRWRA, for wolf reintroduction. The area includes the Mogollon Mountains and the San Francisco River. There are mixed conifer forests at the higher elevations and semi-desert grasslands at the lower elevations. The area includes wild populations of elk, mule deer, white tailed deer, and domestic populations of cattle and sheep.
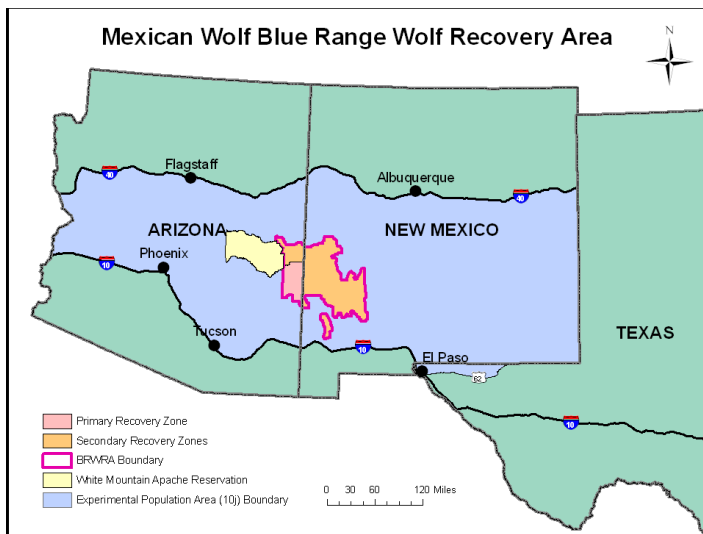
In order to keep the wolves from becoming extinct, scientists need to understand how they can survive, thrive and reproduce in the wild. Minimizing threats to their survival is a crucial part of ensuring that this species does not become extinct.

Methodology

In an effort to understand what would support Mexican Gray Wolf survival in the Blue Range Wolf Recovery Area, we built a Star Logo Model computer program that simulates their daily life. In order to build our model accurately, we investigated the Recovery Area's typography, wild life and threats to wolves. Then we researched how successful the reintroduction program had been up until 2010.

In addition we participated in the New Mexico Super Computing Challenge opening weekend and took advantage of the classes available that would teach us about Star Logo. We were fortunate to have a programming mentor for the first third of our time working on this project as well as the last 6 weeks.

We built our program in the following order:
- ✓ wolves
- ✓ elk
- ✓ grass
- ✓ cows
- ✓ landscape

We then programmed the wolves to eat the elk, the elk to eat the grass, the cows to eat the grass and a wolf to die whenever it ate a cow (livestock)- to represent the actions of livestock owners.

The main variables impacting the wolf population, in our model, are: **Wolves,** E**lk/D**eer**, Cows, Grass,** and **Rancher/Hunters**. Defined below:

Wolves: Number or population of Mexico Gray Wolves in the BRRA. Wolves will eat elk, deer, and cows.

Elk/Deer: Number of deer and elk in the BRRA. Elk and deer provide food for the wolves.

Cows: Number of cows in the BRRA. Cows provide food for the wolves and the ranchers.

Rancher/Hunters: Number of ranchers with cows in the BRRA. Ranchers will shot the wolves, if the wolves eat their cows.

Grass: Number of individual plants of grass or shrubs in the BRRA. Grass provides food for the elk, deer, and cows.

The model allows for the following assumptions:

1. Wolves have litters once every 6 months, there are 5 pups per litter.
2. Each pack has 6 wolves.
3. The model will run for 5 year increments.
4. One wolf is removed for every two cows eaten (called depredation) by wolves.
5. Rancher/Hunters are restricted from shooting wolves, unless the wolves are eating cows.
6. Elk/Deer and Cows can reproduce every year, one for every deer or elk.
7. Rancher/Hunter population remains the same.
8. Grass or individual plants reproduce every 6 months unless eaten by an elk or deer.

Results & Conclusions

Research related to the Blue Range Wolf Recovery Area, to this date, indicates that wolf mortality is mostly human caused. We wanted to create a model ecosystem representative of long-term wolf survival, in the Blue Range Recovery Area. We built a program to show what happens over a given time period, as the wolves interact with the elk, deer, vegetation, cows and ranchers, and the variables change.

Our model taught us that the balance of nature is very delicate and that just one mistake in the program -or variation in the wolves' environment -can drastically impact wolf survival.

Our conclusion is that the reintroduction of the wolves is still in progress and has not reached its optimal level because the wolves ecosystem may need to undergo further changes in order to support their population growth and long-term rate of survival.

Achievements & Acknowledgements

Our finest achievement was building our very first Star Logo program. We struggled with stabilizing the variables in our ecosystem and had to learn how to make a slider and how to reduce and increase the agents' energy. We also had to learn how to keep track of each agent's age and how to program its reproduction rate. It was a major struggle learning how to get the eco-system to balance out. We also started this project as members of an 8 person team, which split in two, and ultimately completed our project as a two person team. Together the two of us managed to create our very first Star Logo project. We did this mostly without the help of a mentor or Star Logo expert. Our interest in programming continues to grow and we are hoping to become knowledgeable enough to share what we know with other kids our age.

We are grateful for Tom Robey who invited us to participate in this project and served as our start-up mentor. We are also grateful for Susan Gibbs who provided mentoring for our two-person team during the last 6 weeks of this project. She helped us learn how to implement programming improvements that we wanted to make but couldn't. Thanks to the Little Earth School for hosting our meetings and sponsoring our participation in this challenge. Thanks to Emily Dwyer for organizing the logistics and making sure we stayed on schedule. Lastly, we are thankful to our parents who knew very little about computer programming and nothing about Star Logo, but encouraged us to remain a team and to build our program to the best of our ability.

Glossary

Blue Range Wolf Recovery Area - An area in southern New Mexico and Arizona, established to protect and support the reintroduction and growth in numbers of the Mexican Gray Wolf.

Cow – Domestic animal prey for the Mexican Gray Wolf.

Ecosystem – A system formed by the interaction of organisms and their environment, in this model wolves, elk, cows, grass and hunter/ranchers.

Elk – Wild animal and prey for the Mexican Gray Wolf.

Endangered - A distinct species that is close to extinction because of the loss of significant numbers of its kind.

Endangered Species Act – Federal Act passed in 1976 to protect species on the verge of extinction.

Grass – Food and energy source for Elk and Cows, and part of the ecosystem for Mexican Gray Wolf.

Hunter/Rancher – Predator of the Mexican Gray Wolf.   In this model hunters will shoot the wolf, if one eats a cow.

Mexican Gray Wolf – An endangered species, that is a predator and eats elk and cows in this model.

Recovery Area – A natural area where a population of a given species is protected and allowed to expand and thrive.   Elements that might otherwise contribute to the mortality of individuals within the population are controlled.

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