Oryx Populations at White Sands Missile Range

New Mexico Supercomputing Challenge

Final Report

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Team 68

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Executive Summary

The oryx population at WSMR is in a steady decline and we have decided to investigate this problem to see if the population will decline suddenly to and ultimate. If this happens the hunting will be stopped or decreased dramatically. Then the population will jump to an ultimate high and the long process of decreasing the population to a manageable amount, which is about 1500 according to WSMR.

We have decided to model this on Star Logo TNG to see if we can come up with a happy medium between extinction and overpopulation of White Sands. We have been modeling this and we still have problems with the reproducing part of the code because the code is set up to have oryx reproduce if their number is less than 30 but these numbers decrease because hunters kill them and only they can reproduce in our code setup for now.

We still predict that the population will decline and then Game and Fish will have to find out how many hunters can go on oryx hunts a year. We are hoping we can find out what this number is and to save WSMR a lot of money by predicting the maximum number oryx that WSMR can support while still being able to function at their maximum capacity.

Introduction

This year our Super Computing project was about the Oryx populations at White Sands Missile Range. It had been brought to our attention that the population was decreasing and we wanted to know more. We decided to use StarLogo TNG as our computer model because it seemed easy to use, it is easier to control terrain variables, and we are familiar with the capabilities of the programming language StarLogo version 1.1, from which StarLogo TNG is based. Kyle Jacobs has been on Oryx hunts at White Sands twice. Once with his dad and once while he was hunting. We want to find the effect of hunting on oryx, how they will react to current management over a period of time, and

the correct hunting rate to maintain a healthy target population at White Sands Missile Range.

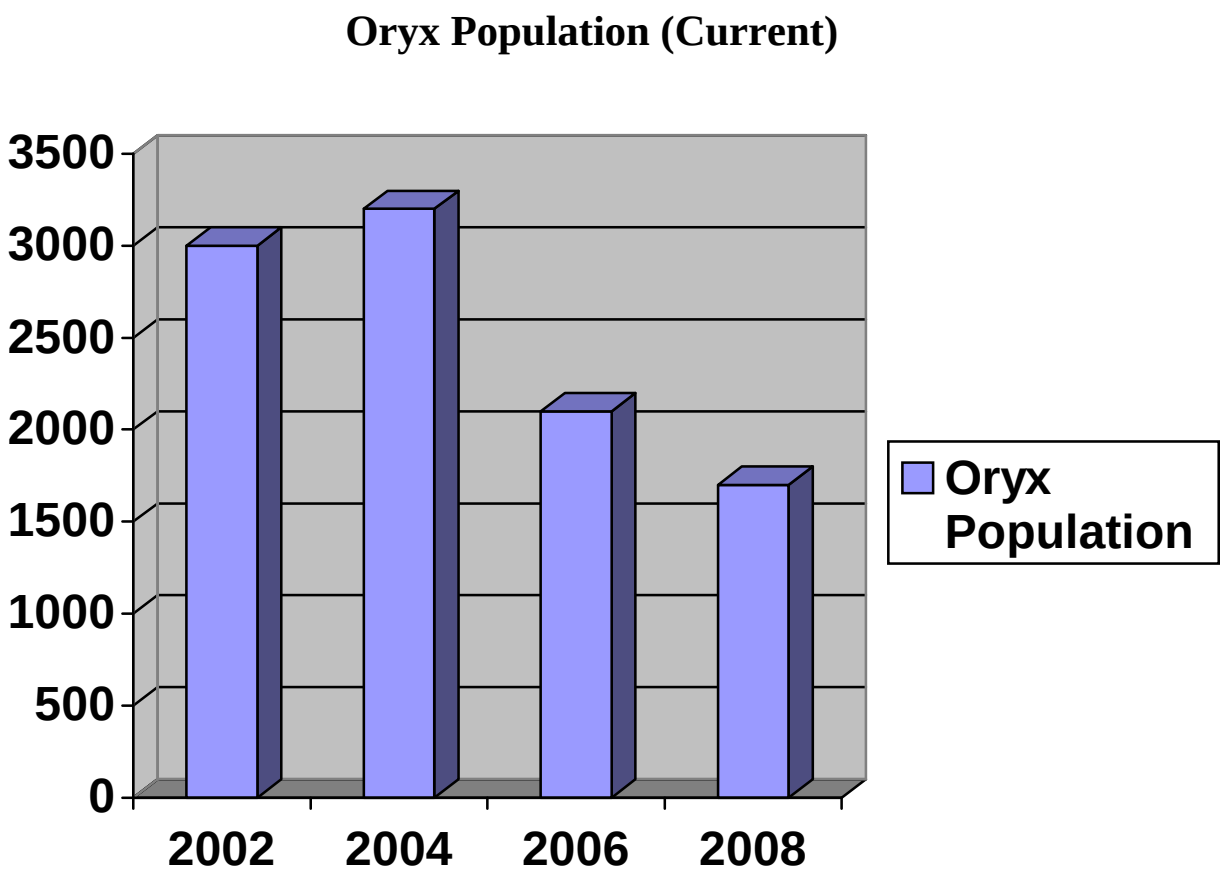
Research

We started our project with research of the Oryx population in White Sands Missile Range (WSMR) in past years, the basic life cycle and traits of Oryx, the terrain at WSMR verses their original habitat in Africa, and the hunting rate of Oryx in the White Sands area.

The species of Oryx brought to New Mexico was the Gemsbok, *Oryx Gazella*, that are native to eastern and southern Africa. They were introduced to New Mexico by an exotic animals program in which Ibex and Barbary sheep were relocated as well. Originally 93 animals were released between 1969 and 1977 by the New Mexico Department of Game and Fish. With a better climate including a higher average rainfall and lack of natural predators at White Sands the population boomed. The population has grown so that their have been reports of Gemsbok migrating up to 100 miles from White Sands Missile Range.

Due to over population there was both over grazing and property damage. Concern for native vegetation in the fragile desert habitat at WSMR has encouraged a goal of reducing the Oryx population to between 750-1,250 animals for the entire 2.2 million acre range.

Gemsbok are mainly desert animals and do not solely depend upon surface water for drinking needs. They can dig for ground water and obtain much of their liquid needs from the plants they eat. They also have special desert adaptations such as extra blood vessels around the nose to help cool the animal. They eat native grasses, flowers, leaves, and buds. Gemsbok feed mainly in the early morning and late afternoon. Males can weigh up to 500 pounds. They breed all year round and reproduce at an average of 1.3 calves per year. North American predators can prey upon oryx until they are about 14 days old. Adult males in Africa have been known to gore lions and kill them with their horns. Gemsbok can live between 18 and 28 years.


Oryx Population (Current)
3500
3000
2500
2000
1500
1000
500
0
2002
2004
2006
2008
Oryx Population

Math Models

Before we began programming we set up some basic mathematical models that would tell how the population of Gemsbok would be affected.

Population reduction due to hunting per year=
(number oryx) - (number hunters) x (95%success rate)

Population reduction due to disease per year =
(number oryx) - (number infected) x (% fatality) x (number of diseases)

Population increase due to reproduction per year=
(beginning oryx) x (1/2)(1.3) + (beginning oryx)

Total population for one year=
(Original population) – (Population reduction due to hunting) – (Population reduction due to disease) + (Population increase due to reproduction)

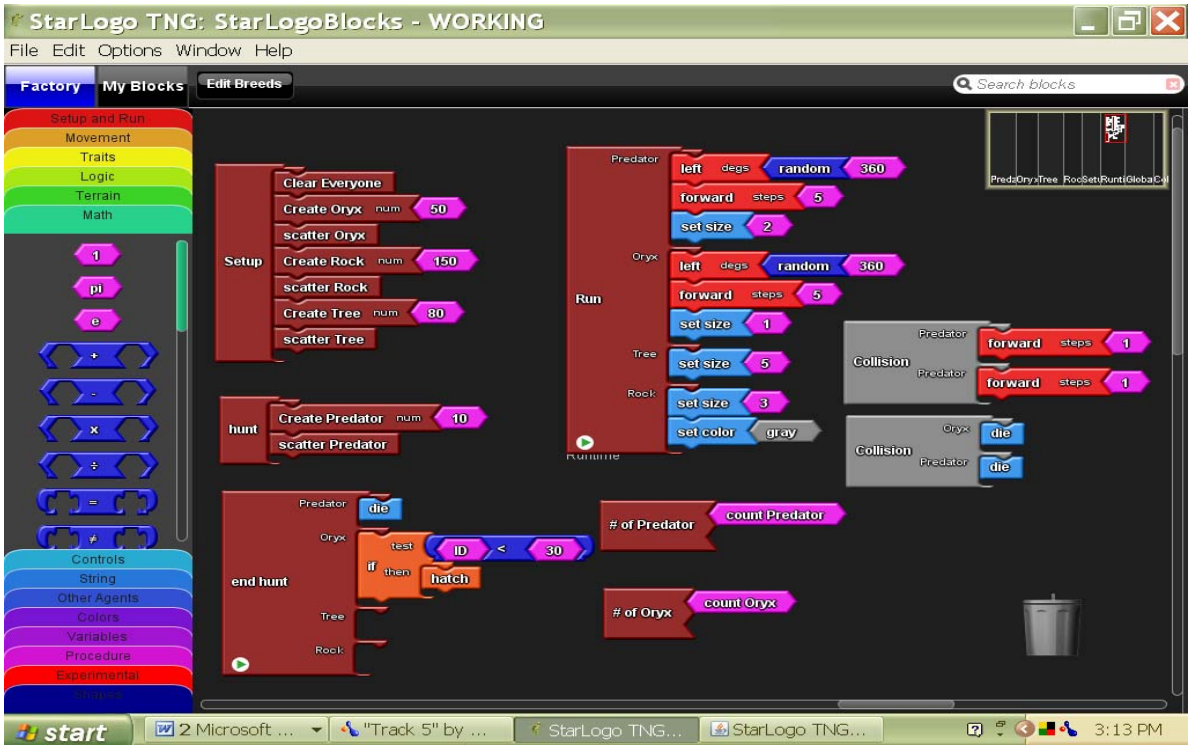
Preparing Code

Any biological scenario is very complex with any number of factors that can affect the population. Some of the major factors affecting our Oryx population would be: population density, cover, forage, water, terrain, weather, disease, calf survival rate, birth rate, number of hunting permits, hunter success rate, and old age. Our approach to model a population management system is to place major environmental factors in the equation and determine what outside forces (hunting) can be used to reach our target population in the code and add the other factors one at a time. Population density would affect the amount of grass and forage in the specific area. We will have difficulty in modeling this aspect of the scenario because our modeling language operates in a finite field and the oryx will not be able to move off of it as they have in real life, so this will not be factored in the model. Weather will only affect the population in extreme cases of drought when there will be limited food and the population will decrease. Likewise in a good year the

population of the oryx will increase. With a better model we might be able to factor this in later. Disease is a major factor in any population, even more so in the oryx population at White Sands because they have no natural predators in New Mexico. Even though diseases

Code

This is what our code looks like on StarLogo TNG:



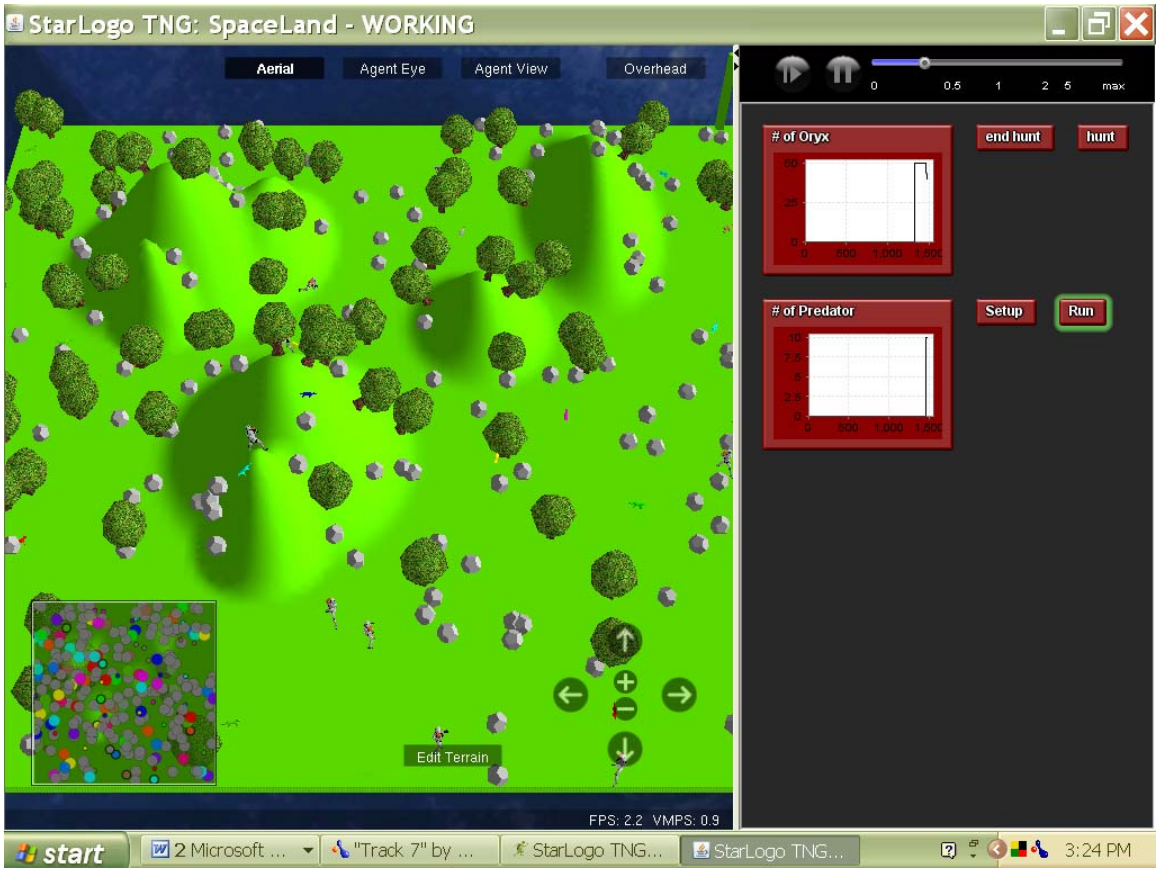
Our code in Java is 18 pages long, it should be obvious why we chose to use StarLogo TNG instead.

Our code sets up a new scenario each time you SETUP; 50 oryx, 150 rocks, and 80 trees randomly placed. The trees and rocks can be used as cover, forage, and obstacle variables later on. The RUN button sets the oryx and hunters in a random direction and sets sizes and colors. The HUNT button creates 10 hunters and randomly places them. Their movement code is already running with the Oryx's movement code. END HUNT will kill all hunters and causes all oryx with an ID number less than 30 to reproduce. Pressing the hunt and end hunt buttons can be viewed as the passing of one year. The

entire hunting season takes place and all reproduction takes place. The collision blocks show that if two hunters come in contact they will both move on and that if an oryx and a hunter collide they will both die because the hunter killed the oryx and hunter will leave because he has filled his bag limit. The # of Predator and # of Oryx commands are line graphs that will appear beside the running code.

Viewing and interpreting our code

When we run our code this is the information that will have to interpret. StarLogo will present information mainly in a visual manner with some graphs.



We can tell when we activated the set up code by the sharp increase in the oryx population on the graph. We can also tell when the hunt code was activated by the

increase in the number of hunters and the decrease in the number of oryx and when the oryx population remains stable.

Conclusion

Our conclusion to the results of our code is that the oryx population will increase until the hunters are inserted and then the population will slowly decrease. The population will then stabilize. Then the population will decrease because the TNG code is set so all the oryx with number under 30 reproduce, but the number of oryx under 30 will decrease because hunters are shooting these oryx. So after a few minutes of running the code the oryx become scarce and the hunters then over hunt the small population of oryx. Our code is still a little “buggy” but we should have all the bugs worked out shortly.

Reference

- http://en.wikipedia.org/wiki/Oryx
- Range Management Principles and Practices; Jerry L. Holechek, Rex D. Pieper, Carlton H. Herbel
- http://www.wackywildlifewonders.com/wackywildlifewonders/files/animals/gemsbok.html
- www.switcheroozoo.com/profiles/gemsbok.htm
- http://www.awf.org/content/wildlife/detail/oryx

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- Supercomputing Challenge
- Eastern New Mexico University