Unwanted

New Mexico Adventures in SuperComputing Challenge

Final Report

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Team #101

Shiprock High School

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Executive Summary

Stray dogs are a part of the landscape on the Navajo Nation Reservation. They are not noticed by locals because there are so many and it is normal to dump litters of puppies at the side of the road when they are not wanted. While their presence may not seem like a problem, research shows they can be carriers of diseases and cause problems such as dog bites or traffic hazards.

Because of the lack of support for animal control, our project focuses on population growth. We wanted to create a model that would show the growth of a dog population and test if spaying females to prevent pregnancies would lower it. The factors we used can be found in real world situations, some of the factors are as follows. There are two different patches of places the mothers can have the puppies, both range in safety. Whatever patch the mothers can find to have their puppies in determines how many of the puppies will be born. There can be six puppies in a litter, three if they are born on an unsafe patch, all the females are set at different ages, die at a certain age, and carry puppies for a specific amount of time. We have also added in environmental controls such as weather, water, food, and overall health, into one slider.

The model is definitely scaled down, yet it is adequate enough to test the breeding of females. In our tests, we have found that spaying, to an extent, helps lower the population. In our program we can test the rise and fall of the population by spaying a percent of the females we start out with, or a certain percent out of every litter. One setback is that we only focused on the females; with all the puppies in each litter being female, each population count that our model comes up with could be doubled.

Introduction

Hypothesis

If female dogs are spayed, then there will be a significant reduction of the dog population.

Model

In selecting a project, we decided to focus on something close to us that we could relate to. Stray dogs are a problem on the Navajo Reservation. There are an estimated 3,000 dog attacks per year and there are only six animal control officers patrolling the entire reservation; roughly 52,000 square miles each. The estimated stray dog population is 200,000 or higher. Since the cut back of animal control officers in 1998, the population has been rising. There has also been a rise in animal abuse especially when dealing with strays and feral dogs. Sociologists believe that abusive behavior toward animals at a young or adolescent age can develop into abusive behavior later on in life toward others.

Many homeless dogs are domesticated strays or feral dogs. We didn't distinguish between the different kinds of dogs in our model because they don't differ when it comes to breeding in the wild. Domesticated dogs are dogs that have been owned and either lost or dumped. They are easier to find homes for because they are less wild and friendlier than the feral dogs, still, domesticated dogs can become more hostile the longer they are on their own. Feral dogs have had little or no contact with human and are the hardest to find homes for. Due to their lack of human relations, they are temperamental, untrusting, aggressive, and will either become introverted when caught or destructive. Many times domesticated strays join feral packs of dogs for survival. Feral dogs were mainly found

in the rural areas of the reservation or the open range areas; due to competition over resources (food, shelter, water, etc.) many are moving closer to suburban areas.

Safety issues arise because of this. The elderly and children are the main victims in dog attacks or bites, diseases like rabies or parvo can be passed to humans. Dogs on the road cause problems for motorists and many times they are hit crossing the roads or eating carcasses. Packs of dogs will attack people's pets, livestock, and if someone has a female dog who is in heat, male dogs will hang around the property in packs.

People contribute by not claiming dogs if they are impounded, not providing identification tags, letting their dogs roam, and dumping dogs when they can not care for them. To combat the stray dog problem, people need to be taught responsible pet ownership.

Project Description

Hypothesis

If female dogs are spayed, then there will be a significant reduction of the dog population.

Model

The goal of our model was to determine if spaying would significantly lower the stray dog population. Out model is fairly simplified and we added as many factors as we could. **See Appendix A**.

There are two different colored patches that represent places the pregnant dogs can have their puppies, The green are considered safe and all six puppies will be born, the red are unsafe and only half the litter is born. The dogs can only have puppies on the patches and only one dog is allowed on the patch at a time and they occupy the patch for six weeks or until the puppies can go off on their own. There are sliders for the percent of the females neutered in the beginning, percent of puppies neutered in each litter, number in the beginning population, and how harsh or friendly the environment is. The first sets of females are different ages and when they are one year old they can have their first litter.

We chose to use Starlogo because we thought it would be helpful to have the sliders and the fast visual aid, we also like how we could create our own environment. Creating and controlling our environment was important so that we could add factors and watch how they would affect the population. When we did our first model we worked with Netta Soft (Independent Computer Programmer), and did a basic outline of the

entire program. After that, we were able to work with a Los Alamos scientist Roger Chichlow.

The first problem we had was setting limits on age, pregnancy, whelping, and litters. After doing research we were able to set the limits. When we left out the limit factor, our dogs were breeding steadily and we noticed that even spayed females were having puppies. Next, we decided to factor in the environmental variables. We decided against creating separate food, water, and health variables because we thought it would be too many to work with. Instead we created an environment slider. At first we had problems, when we would test it out and put the slider on the lowest environmental scale (the worst), the dogs died off in a matter of seconds. We were able to change the scale so even at the lowest level, our dogs would still survive. When we set the environment on the highest setting, there is enough food, water, and shelter; the dogs are able to reproduce and live longer. One of the last sliders we added was the percent of puppies spayed. Where before we only spayed a certain number of females in the beginning now we are able to spay a percentage of their puppies.

The way the program is designed, there is room for adding in new factors and the ones already in place can be changed easily by the sliders. The further we research strays and problems they face, the more things we want to add to made our model more realistic. One thing we really wanted to add was the male dogs, but it was complex and we would have had to factor in the neutering of the beginning males and all the male puppies. That would have changed our overall aim to test the spaying of females. Our results are shown on a graph for each test run, the different types of dogs are counted and their population is placed in a line graph form. We have the number of overall dogs,

pregnant dogs, spayed, and whelped. All of the different kinds of dogs have a color assigned to them that is close to or the same color as the one's used in the model. Our program is run on a weekly cycle, every week our dogs move at random. The weeks are on the x-axis and the number of dogs is on the y-axis.

Results

We run multiple tests on each factor. For example: we will record what level all of the sliders are set at and record the amount of each type of dog after a certain amount of time, or we will record how long it will take for our dog population to reach a certain number. After we run several tests, we average the data out.

The data showed us that spaying does have an effect on the population when done in severe forms. When there is little or no spaying, the population rises steadily, If there is a large percentage spayed, our dogs tend to die off. Most of the time, spaying moderately maintains a stable population where the dogs do not die off but it do not continually keep reproducing.

A couple of the tests we ran were different percentages of the beginning females who were spayed and the percentage of puppies spayed in each litter. Our results showed that when 99% of the females were spayed in the beginning, there was a 69% drop in the number of puppies born than when the percentage was set at 10%. This was tested on the populations rise after one year. When we tested the puppies that were spayed, there was a 50% drop between only 10% of each litter spayed, the number of dogs would go down, in another test, the number would increase. After analyzing the data, we figured out that the less females who were breeding, the more safe places there would be to have puppies. The females that were able to breed would find the safe places and were able to have full litters.

The data does support our hypothesis, “If female dogs are spayed, then it will cause a decrease in the overall dog population.” The fact that we found out spaying helps fuels more questions and other hypothesis that are more specific.

Conclusion

Looking at the graphical output shows that when there is no spaying of either the puppies or beginning females, the population continually rises. There are many puppies that are born and since each puppy is a female, it causes some problems. The entire population is able to produce six offspring which in turn produce six offspring. Even when some dogs die or only half the litter is born, not enough of them die to change the growth rate.

If even 10% out of each litter is spayed, the dogs still reproduce but at a much slower rate.

The spaying of female dogs can help control the population just like gaming helps keep other animal populations from getting out of hand. More tests will have to be done on how many dogs need to be spayed to keep the population in check.

Spaying females will prevent the dog population from becoming too great. As a result of lowering the amount of unwanted dogs, other costs can be reduced. Like the amount of money spent of treating bite victims, euthanizing strays, the cost of food and housing in dog shelters, money spent on picking up hit dogs off the road, and damages to livestock. There will also be health benefits with more dogs being taken care of; they will not be as susceptible to diseases.

Recommendations

The program is very simple when taking into consideration all the factors that stray dogs face. If the modeling screen was expanded, testing the different effects of a growing population could be modeled more effectively over a longer period of time. Right now, the program is designed to create output based on a weekly scale, to better understand long term growth rates, we would need a bigger area for them to inhabit. Putting in a stopwatch to stop the growth after a certain number of weeks or when it reaches a certain population level could provide us with more accurate data opposed to stopping the program manually. Right now, the dog population steadily rises until there is no more room for the dogs. If we were to test it on a long term basis, maybe the population would begin to dwindle and drop as competition for food and shelter becomes more eminent.

Our program is set in an open range area and there are no suburban areas where we could model human confrontations. Another thing that could be tested is confrontations between the dogs themselves. Many times, dogs will attack other dogs if they are not in a pack or if they come into their territory. This of course would take away from our initial goal but it would be another testable project.

If more factors are added such as a road or packs of dogs fighting, the dogs' growth rate would be slower than it is now. It would be helpful to adding seasons because resources are less in the winter and higher in the summer. At the moment, our environment is usually kept at one level for the 52 weeks out of the year, a problem because with the changing of seasons, the number of dogs born could be changed in the cold or rainy season.

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Last but not least, our team mates who stuck with this from beginning to end, even when it felt like we could not do something. Their dedication and hard work has made this year one of the most fun and rewarding.

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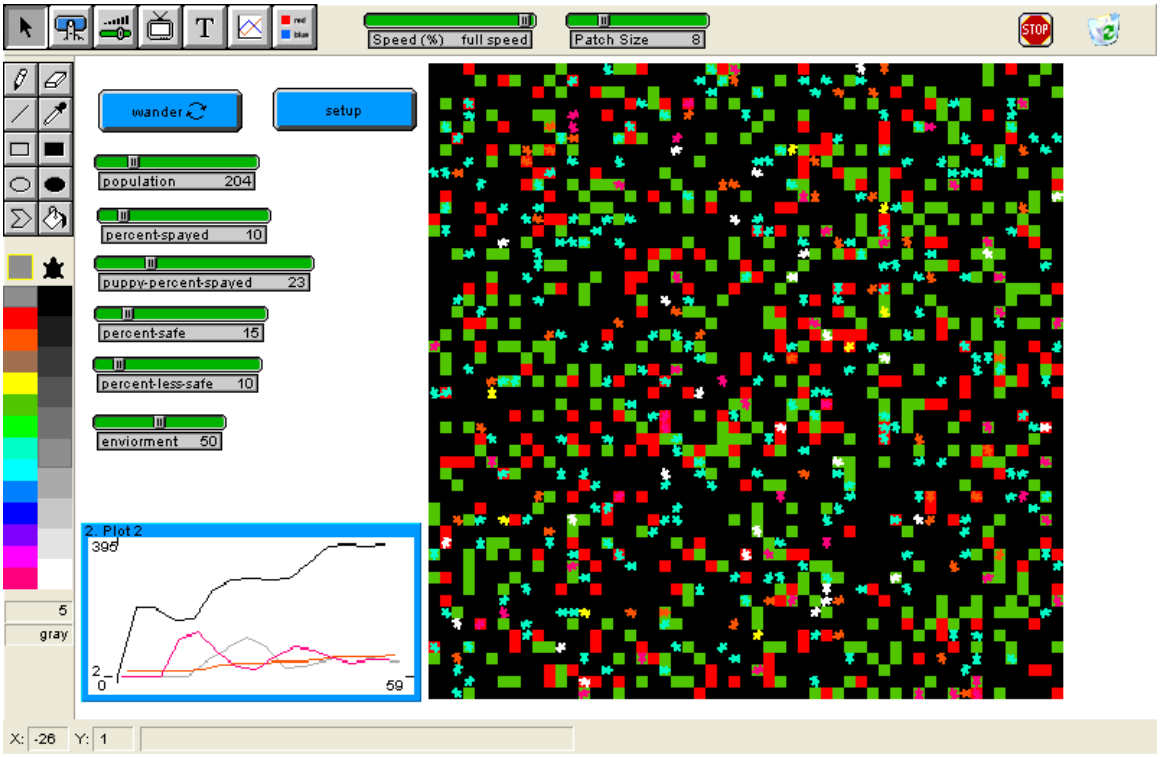
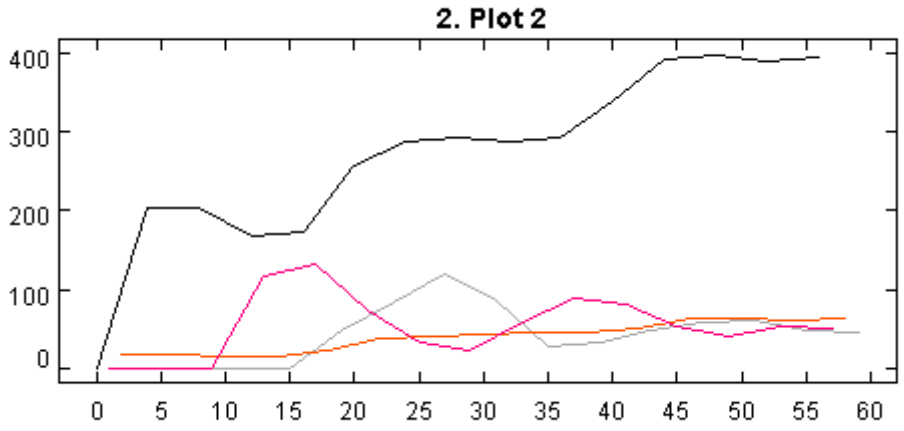
Interview

Daw, Stacey. Personal interview. 30, November 2005.

Appendix A:


Speed (%) full speed
Patch Size 8
STOP
wander
setup
population 204
percent-spayed 10
puppy-percent-spayed 23
percent-safe 15
percent-less-safe 10
enviorment 50
2. Plot 2
395
2
0
59
5
gray
X: -26
Y: 1


2. Plot 2
400
300
200
100
0
0
5
10
15
20
25
30
35
40
45
50
55
60

Appendix B:

Turtle Procedures:

```
turtles-own [ energy target age spayed pregnant whelped ]

to wander
  walk
end

to setup-spayed
ifelse (random 100 ) < percent-spayed
[set spayed true]
[set spayed false]
end

to setup
  setup-spayed
  ifelse spayed [setcolor yellow] [ setcolor turquoise ]
  setxy (random screen-width) (random screen-height)
  setenergy (random 10)
  settarget (random 100)
  setage (random 15 * 52)
  setwhelped 0
end

to walk

  rt (random 45) - 45 / 2
  setenergy (energy - ( enviorment / 1000))  ; play this to adjust death rate  IXI
  if energy < 1 [die]  ; IXI
  setage age + 1
  if age > 15 * 52 [die]
  if age < 52 [fd 1 stop]  ;too young
  if pregnant > 0 [
     setcolor pink
     if looks-good [ fd 1 ]
     setpregnant pregnant + 1
     if pregnant > 9 [
       setpregnant 0
       set whelped 1
       if pc = grass-color [whelp 3]
       if pc = less-safe-color [whelp random 3]
       ]
       stop
```

```
   ]
  if whelped > 0 [
    setcolor white
    if looks-good [ fd 1 ]
    setwhelped whelped + 1
    if whelped > 6 [
    setcolor turquoise
    setwhelped 0 ]
    stop
    ]
  if (random 100) < 25 and not spayed [ setpregnant 1]
end

to whelp :pups
  repeat :pups [
    hatch [puppy-setup setage 0]
    ]
end

to looks-good
  if pc = grass-color [ output false ]
  if (count-turtles-towards 0 1) > 0 [ output false ]
  if pc-ahead = grass-color [ output true ]
  if pc = less-safe-color [ output false ]
  if pc-ahead = less-safe-color [ output true ]
  output false
end

; IXI added  puppy code
to puppy-setup-spayed
ifelse (random 100 ) < puppy-percent-spayed
[set spayed true]
[set spayed false]
end

to puppy-setup
  puppy-setup-spayed
  ifelse spayed [setcolor orange] [ setcolor turquoise ]
  setxy (random screen-width) (random screen-height)
  setenergy (random 10)
  settarget (random 100)
  setage (random 15 * 52)
  setwhelped 0
end
```

Appendix C:

Observer Procedures:

```
globals [ grass-color less-safe-color]
patches-own [ neighbor-sum temp-pc ]

to grow
  ask-patches
    [if (random 100) < 50 [setpc grass-color]]
end

to setup
  ca
  set grass-color green
  set less-safe-color red
  create-turtles-and-do population [setup]

  ask-turtles
    [setxy (random screen-width) (random screen-height)]
  ask-patches
    [
   if (random 100) < percent-less-safe [ setpc less-safe-color ]
   if (random 100) < percent-safe [ setpc grass-color ]
      ]
end
```