COYOTES and FOXES

Final Report

School Name – Melrose High School

Team Number – Melrose High 2

Project's area of Science – Ecology

Computer language used – NetLogo

Team numbers grades – 9th

Team member's email addresses –

- Chantilly Fulgham, Chantilly.fulgham@melrosechools.org
- Gracie Sanchez, Gracie.sanchez@melroseschools.org
- Deajha Downey, Deajha.downey@melroseschools.org

Sponsoring Teacher - Alan Daugherty

Executive Summary

Our team has decided to do our project on the ecology of foxes and coyotes, and how they have made their way into cities or areas with humans. With these predators moving into towns, they have gotten into dumpsters and have made messes. They have also been attacking house pets such as smaller dogs and cats with greater frequency. This has been irritating the locals in town and even out of town, making the peoples perspective on the predators have more hatred towards them. Even though foxes and coyotes have come into town to eat, they'll still eat wild foods, like grasshoppers, mice, and rabbits in the pastures.

We have made our model to show our town and the surrounding area. Along with the main roads, pastures, and with the foxes and coyotes. We have made it to where when a coyote or foxes gets inside the town or little farm houses, the house changes a color. Starting from white, to pink, to red, to black. The color represents people's animosity toward the predators. If the people start getting angry, they will take care of the animal problems themselves, shooting or trapping.

Energy level is a major factor in our model. Predators eat better when they scavenge around animal's reproduction. When walking through the pasture, they'll eat grasshopper, and other bugs and small game but, receive less energy. When energy levels reach a certain value, the animals reproduce. Every time a coyote or fox walks across the road, they have a chance of getting hit and dying. This, and losses form angered humans causes the population decrease. These reproduction levels are on a slider, so it can range from either 0 to 10.

Statement of Problem

The problem that we are investigating in is the population of foxes and coyotes in rural. We have been seeing more of them in town, and they have been trying to get into trash cans and have been blamed for eating smaller pets. We will model an area to show how populations of how coyotes and foxes affect humans. Humans provide several food sources for coyotes and foxes, but if they get too much of a problem, they can shoot them.

We are hoping to find a way to show how these predators are affected by the human populated areas, so that we can better understand the problem. Then we can turn to controlled solutions. We don't want to harm or kill them, but we don't want them to disturb our community either.

Method Used

The methods we've used to solve this problem is talking to our local dog catcher and animal control specialists. To find out how they see the problem, and to find the increase in calls they are getting from pets are getting lost. This gives us a reasonably sized area to work with. We're using a map of our town, variables that will be included: foxes and coyotes, the roads, barn houses, and pastures.

The agents are the foxes and coyotes, which are roaming around either dying or reproducing, do to with their energy levels. When they coyotes or foxes go on the road, they have a 2% chance of being ran over. The barn houses are the people who live more out into the

country and they are starting out white and will chance a color every time they get “angered”, we also have to where if there hasn’t been a coyote or fox by it, it goes back white. The pastures is where the foxes and coyotes are mainly found, but they slowly go into town, and when they go into town it will change color just like the barn houses. We also have sliders that are for the coyotes and foxes and the reduction rate.

Verified and Validated

We have talked to the local animal control specialist in our town for the amount of calls they have been getting. We found that there has been a slight increase in the number of pets lost, but it can’t be completely proven that it is because of the coyotes and foxes. Also we have talked to some of the local residents and found out how common complaints about having their garbage being gotten into.

It will help show much pets people are losing or just being messed with, and we can ask over how much calls they are getting in a certain amount of time. We can even figure what certain places or maybe a pattern to outsmart them and to get them to stop, or slowly just move them out.

Results and Conclusion

With our studies, we learned about coding and the behavior of coyotes and foxes, more what we already now. It's been hard and were still trying to get the numbers to level, and we do but at times the numbers of coyotes and foxes will increase.

The conclusions we have reached is analyzing the results are that the foxes and coyotes population can stay at level. We're trying to get it to where it will stay that way, because after a little bit, it either decreases or increases quite a bit. The houses and in town will stay at either white or pink, so that they coyotes aren't being much of a bother to the people.

Resources Used:

- Software: NetLogo
- References: Personal interviews, Melrose civilians.

Significant Achievement

The most significant achievement on our project is that we learned more about coding and the interacting of the variables. Coding has been difficult for us but we have been learning more about it and how do to it. With the interaction of the variables, they would communicate.

We aren't very familiar with coding and are having to learn more every day to work it, it may take us a while before we actually know how to do it. We've had quite a bit of help and still are, and it's helped us quite a bit.

We also achieved knowledge about the program by sitting down and having to run the program multiple times to get the right numbers to stabilize the coyotes and foxes. It took a lot of time but it was worth it because now we know more about the NetLogo software and could use it in real life with other problems.

Acknowledgment

The acknowledgments to the people and organization that helped are the dog catcher, people in town, our advisor, Alan Daugherty, and mentor, Dewayne Fulgham.

We were able to get with the dog catcher and find out something about the increase of phone calls about the predators. We talked with the people inside and out of town to see if they have messed with their animals and/or gotten into their trash. Our advisor, Mr. Daugherty has helped us with some knowledge and some of the coding. Our mentor, Dewayne Fulgham has also assisted us with other coding and with getting out group to our team meetings.

FOXES and COYOTES NetLogo Source Code:

```
globals [rkxval rkyval]                    ;;  This area sets up breeds of agents and variables
breed [coyotes coyote]
breed [foxes fox]
breed [road-makers road-maker]
breed [houses house]
foxes-own [energy]
coyotes-own [energy]
houses-own [tolerance]
patches-own [original-color roadkill-time]


to setup                                   ;; This sets up the program

 __clear-all-and-reset-ticks
  reset-ticks

  ask patches [set pcolor 57 ]                                    ;; pastures
  roads                                                ;; makes roads

  ask patches [if pxcor > -3 and pxcor < 4             ;; patches
              and pycor  > -10 and pycor < -1 [sprout 1 [set breed houses set color 19 set tolerance
19  set shape "square"]]]   ;;  town

  ask patches [if pxcor = -13 and pycor = 10 [sprout 1 [set breed houses set color 19 set
tolerance 19 set shape "square"]]]      ;; houses
  ask patches [if pxcor = 6 and pycor = 14 [sprout 1 [set breed houses set color 19 set tolerance
19 set shape "square"]]]
```

```
  ask patches [if pxcor = 13 and pycor = -14 [sprout 1 [set breed houses set color 19 set
tolerance 19 set shape "square"]]]
  ask patches [if pxcor = -16 and pycor = -14 [sprout 1 [set breed houses set color 19 set
tolerance 19 set shape "square"]]]
  ask patches [if pxcor = 12 and pycor = -4 [sprout 1 [set breed houses set color 19 set tolerance
19 set shape "square"]]]

  foxpack                ;; create wildlife
  coyotepack
end

to go                                                    ;; Makes action occur
 ask foxes [movement]
 ask foxes [feeding]
 ask coyotes [movement]
 ask coyotes [feeding]
 checktollerance
 If (count coyotes + count foxes)  < 1  [stop]
 roads
 tick
end

to movement                                        ;; movement of coyotes and foxes

  ask foxes [ rt random 180 lt random 180 fd 2
     set energy (energy - fox-movementcost) ]        ;;  Animals use energy as they move.
  ask coyotes [rt random 180 lt random 180 fd 2]
     set energy (energy - coyote-movementcost)

   ask houses [if any? foxes-here [ set tolerance (tolerance - 1)] tolerancecolor ] ;; mad!
```

```
  ask houses [if any? coyotes-here [ set tolerance (tolerance - 1)] tolerancecolor ]


  ask foxes  [if pcolor = grey [if random 100 < 3 [remains set roadkill-time ticks die set rkxval xcor
set rkyval ycor]]]        ;; % of animals crossing the roads will die

  ask coyotes  [if pcolor = grey  [if random 100 < 2 [remains set roadkill-time ticks die set rkxval
xcor set rkyval ycor]]]      ;; visible evidence of roadkill


end


to feeding                                   ;; feeding


  ask foxes [ if any? turtles-here with [breed = houses and tolerance  > 9 and tolerance < 14] [ if
random 100 - 20 < fox-reduction-rate [ die]]]    ;;   homeowners shoot / trap animals

  ask foxes [ if any? turtles-here with [breed = houses and tolerance  > 13 and tolerance < 17] [ if
random 100 - 10 < fox-reduction-rate [ die]]]

  ask foxes [ if any? turtles-here with [breed = houses and tolerance  > 16 and tolerance < 20] [ if
random 100 < fox-reduction-rate [ die]]]


  ask coyotes [ if any? turtles-here with [breed = houses and tolerance  > 9 and tolerance < 14] [
if random 100 - 35 < coyote-reduction-rate [ die]]]    ;;   homeowners shoot / trap animals

  ask coyotes [ if any? turtles-here with [breed = houses and tolerance  > 13 and tolerance < 17]
[ if random 100 - 20 < coyote-reduction-rate [ die]]]

  ask coyotes [ if any? turtles-here with [breed = houses and tolerance  > 16 and tolerance < 20]
[ if random 100 < coyote-reduction-rate [ die]]]


  ask foxes  [if any? turtles-here with [breed = houses] [ set energy (energy + humanfood)]]

  ask foxes  [if not any? other foxes in-radius fox-territory [if energy > reprolevel [ set energy 0
hatch 1 [set energy 0 ]]]]   ;; in town the animals eat better (can reproduce quickly)


  ask coyotes  [if any? turtles-here with [breed = houses] [ set energy (energy + humanfood)]]

  ask coyotes  [if not any? other coyotes in-radius coyote-territory [if energy > reprolevel [ set
energy 0 hatch 1 [set energy 0 ]]]]  ;; at farm houses animals eat better and reproduce more
```

```
  ask foxes  [if pcolor = 57   [set energy (energy + smallgamefood)]]

  ask foxes  [if not any? other foxes in-radius fox-territory [if energy > reprolevel [ set energy 0
hatch 1 [set energy 0 ]]]]       ;; animals eat less in the pasture (can reproduce less quickly)


  ask coyotes  [if pcolor = 57    [set energy (energy + smallgamefood)]]

  ask coyotes  [if not any? other coyotes in-radius coyote-territory [if energy > reprolevel [ set
energy 0 hatch 1 [set energy 0 ]]]]


end


to tolerancecolor                                   ;;  Keeps tolerances between 10 and 19

   ask houses [ if tolerance < 10  [set tolerance 10] ]

   ask houses [ if tolerance > 19  [set tolerance 19] ]

   ask houses [ set color tolerance]              ;;   Shows if people are upset about wildlife.


end

to checktolerance                                   ;; tolerance


  ask houses [if tolerance > 9 and tolerance < 20 [if not any? foxes  in-radius 3 [set color (color +
1)  set tolerance (tolerance + 1)]]]

  ask houses [if tolerance > 9 and tolerance < 20 [if not any? coyotes  in-radius 4 [set color (color
+ 1)  set tolerance (tolerance + 1)]]]

end


to roads                                            ;; roads

  crt 1 [set breed road-makers]

  ask road-makers [setxy -16 -10 set heading 90 repeat 33[set pcolor grey set original-color grey
fd 1]   ;; roads

    setxy 4 -2 set heading 180 repeat 15[set pcolor grey fd 1]
```

```
   setxy -3 -10 set heading 0 repeat 27[set pcolor grey fd 1]
   setxy -3 -1 set heading 90 repeat 8[set pcolor grey fd 1]  die]
end

to foxpack
  create-turtles foxesnumbers [set breed foxes set color 15 set shape "wolf" set size 1 setxy
random-pxcor random-pycor set energy 0]                    ;; foxes
end

to coyotepack
  create-turtles coyotesnumbers [ set breed coyotes set color 33 set shape "wolf" set size 1.5
setxy random-pxcor random-pycor set energy 0]              ;; coyotes
end

to remains          ;;  Allows us to see animals that are 'roadkill' by changing the road color.
  set pcolor 136
end
```