Leatherback Sea Turtles: A Step to Protection

New Mexico Supercomputing Challenge

Final Report

April 4, 2012

Team #60

Little Earth School

Team Members:

Rowan Dwyer

Fatima Gutierrez

Lynn Robey

Weston Smith

Teacher/Sponsor:

Juli Curtis

Team Mentor:

Tom Robey

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Executive Summary

Our project for the New Mexico Supercomputing Challenge was to learn about endangered sea turtles, and we hoped to learn how to protect them. We used Starlogo and information we found to create a model that shows how Leatherback sea turtles are born and get back to the sea. They face difficulties such as trash on the beach and in the water and predators. We modeled the beach, the ocean, the laying area, plus the predators (represented by green birds) and trash (flashing cylinders). The trash will occasionally kill the turtles, but will usually keep them at bay or from moving. We understand better now that the trash and the predators cause a big change in the turtles and their environment, and we now understand a first step to take to protect endangered sea turtles: reduce waste, try to go green and help the turtles as much as you can.

Introduction

Our project for the New Mexico Supercomputing Challenge was to learn about sea turtles. There are eight different kinds of sea turtle (Loggerhead, Green, Hawksbill, Kemps Ridley, Olive Ridley, Flatback, and Leatherback). We chose to study Leatherback sea turtles. Leatherback sea turtles are the only species of sea turtle that don't have a backbone and they grow to be six and a half feet long. They lay 80 fertilized eggs and up to 30 unfertilized eggs in each nest. It takes the eggs about 65 days for the baby turtles to hatch.

Leatherback turtles are found mostly in an area on the eastern Pacific shores of Panama to southern Mexico. They are very endangered, and there are only 1000 leatherbacks alive in the world today. Their numbers have decreased by 90% in the last two decades, and they are critically endangered. If we don't do something about it, they could all be dead (extinct) in five years.

Description

We wanted to see the effects of what happens when the sea turtles come out of the water onto the beach and they lay their eggs and they go back to the sea. The eggs hatch in about 65 days and the baby turtles try to go back to the sea but there are predators (such as Ghost Crabs, human poachers, sea birds, and others) that will eat them. We also modeled the effects of trash and a trash threat distance using sliders.

We created a Spaceland that has an ocean, a “danger zone” where the predators can eat the baby turtles, and a beach where the eggs are always layed. The agents in our program are adult sea turtles, predator birds, eggs that turn into baby sea turtles, and trash.

The adult turtles are programmed to come out of the water and lay an egg in the laying zone and return directly to the ocean. The baby turtles are programmed to hatch and return to the sea. The birds are programmed to catch the baby sea turtles if they are within “threat distance” which has a slider on the program. The trash also has a slider, and a threat distance which makes the killing range larger for adult and baby turtles.

Spaceland

As we said before, the Spaceland has a strip of ocean (blue), a strip of beach where the baby turtles can be eaten by birds (purple), and a laying zone where the adult turtles lay their eggs (red).

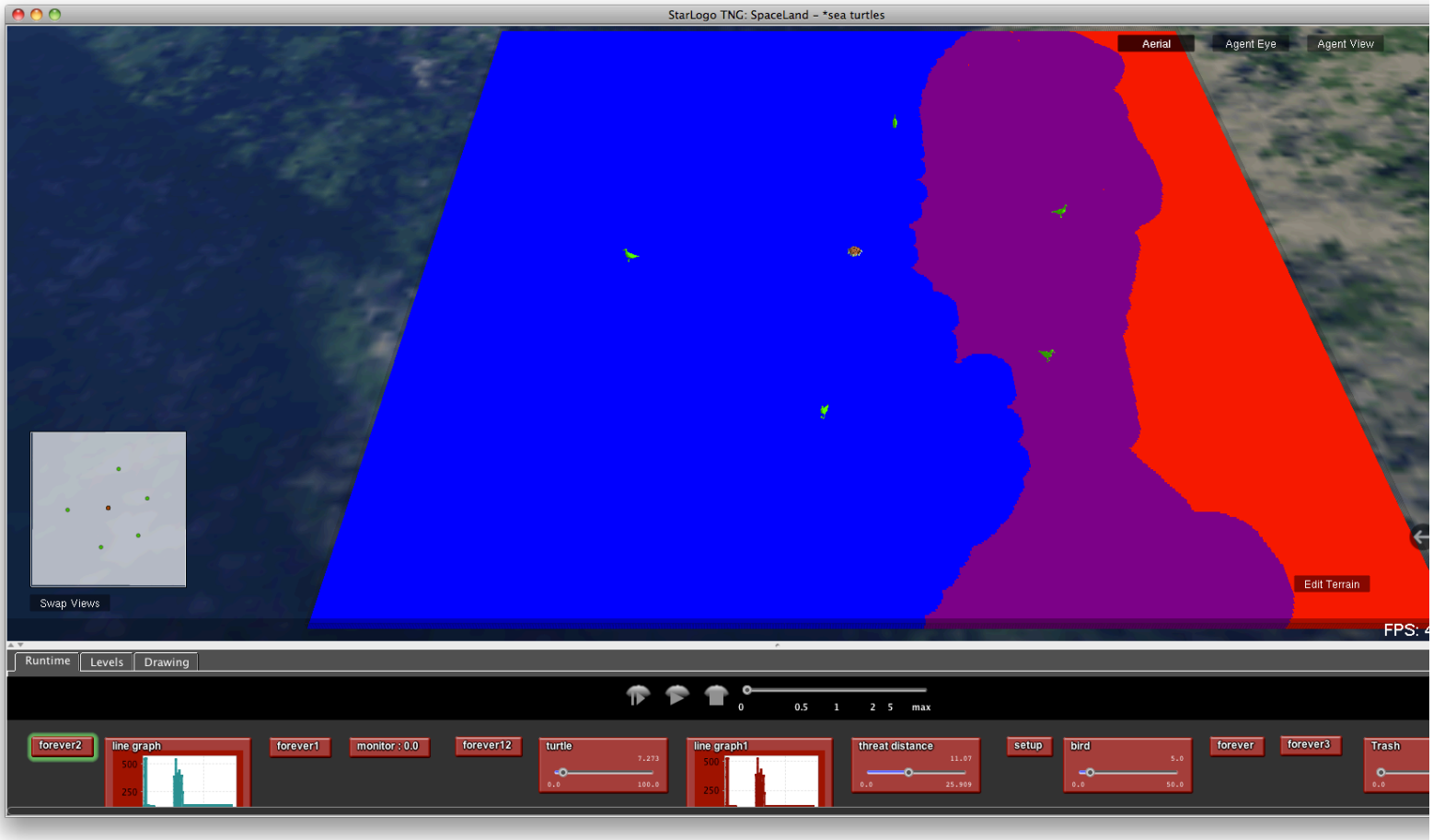


FIGURE 1: An image of the initial spaceland with seven birds and five adult turtles.

Leatherback Sea Turtle Threats and Life Cycle

The threats to sea turtles are:

1. Global warming. The turtles' food is dying because the coral is dying and the sea level is getting higher and the ocean temperature is rising.
2. Oil spills and ocean trash. These also kill sea turtles because plastic bags in trash are like jelly fish and can kill turtles that try to eat them.
3. Fishermen and poachers. Humans also catch sea turtles in their nets and kill them and disturb nesting sites.

4. Temperature changes. If the sea turtle eggs get too cold they will be male. If they get too hot, the eggs will be female.

Model Parameters

Initial conditions we calibrated to real world data:

Number turtles:

7 (can be changed with the slider)

Number of eggs layed in each turtle's nest

75 (is changed in the code)

Number of birds

5 (can be changed by a slider)

Number of trash items:

0-30 (can be changed by a slider)

Threat distance

0-25 (can be changed by a slider)

Number of survivors:

Amount we wanted to model to calibrate 115

Range we saw with these number of birds and turtles and eggs layed:

0 – 358, with the average in our 24 runs to be 188, a bit higher than the real world information told us it should be.

Screen shots of the model code is shown in Appendix A.

Results

We ran the model to calibrate it to the real world information we found about leatherback sea turtles. We read that the baby sea turtle survival rate is 22% (On the dispersal of leatherback turtle hatchlings from Mesoamerican nesting beaches George L. Shillinger1,2,*, Emanuele Di Lorenzo3, Hao Luo3, Steven J. Bograd4, Elliott L. Hazen4, Helen Bailey5 and James R. Spotila) so we used the sliders to set the number of adult turtles at seven, predator birds at 5. In the code we set the nest size at 75, which is close to the research number of 80 live eggs that are hatched.

After calibration of the model, we changed the number of trash items and the threat distance numbers to see what would happen. The threat distance variable had a similar affect on the model as the change in trash number but the turtle behavior is different. For example, at 0 threat distance and 30 trash item, it took the turtles longer to breed, because they were stuck in the ocean from the trash or the trash scares them. There were 346 survivors, so most eventually survived (the maximum number of survivors is 525). At a high threat level the turtles got stuck on the sides of the laying area and the birds ate them because they couldn't move. The survival rate for a 12 threat level and 30 items of trash was 0.

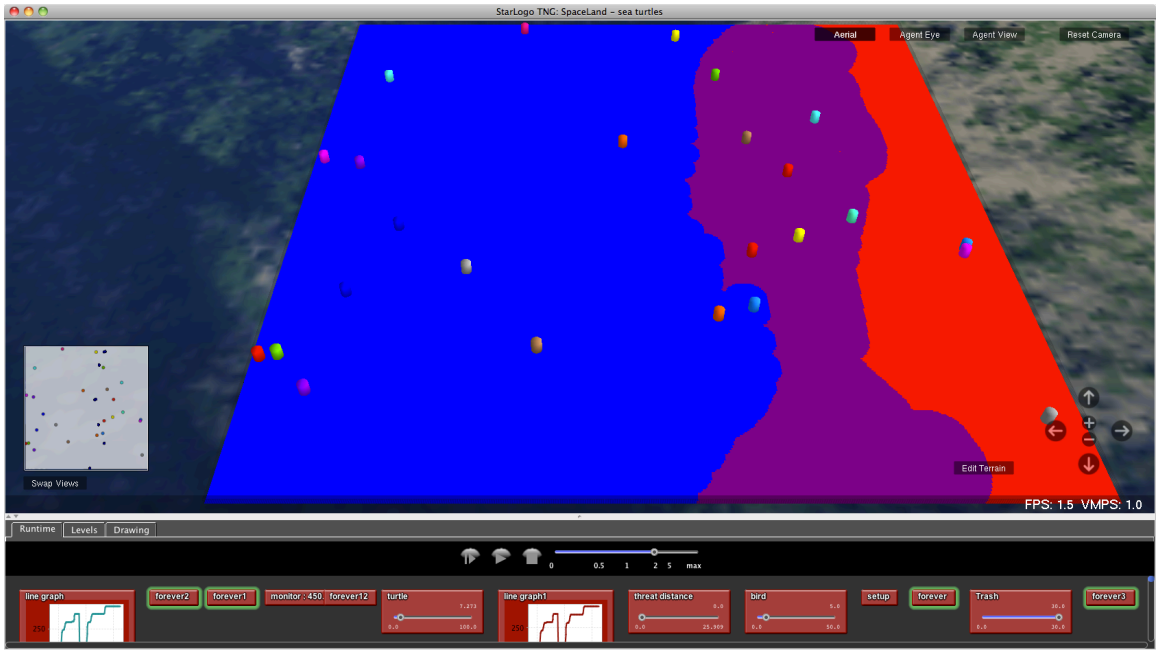


FIGURE 2: Number of baby turtle survivors 450, 75 nest size, 5 birds, 7 adult turtles, 0 threat distance, 30 trash items.

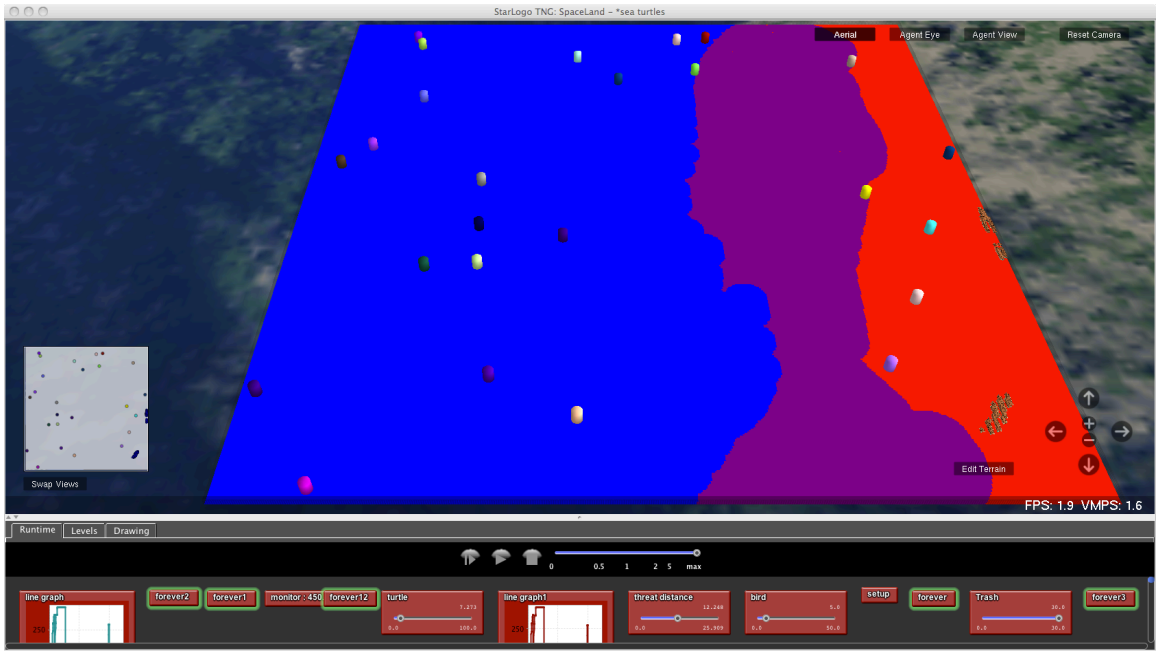


FIGURE 3 Number of baby turtle survivors 450, but they are stuck in the laying zone because of threat distance. 75 nest size, 5 birds, 7 adult turtles, 12.5 threat distance, 30 trash items.

Conclusions

We did a really good job getting a working model going, but we had less time to run enough sets of data through it and think about our data results. We waited too long to start testing and found ourselves in a crisis near the end. Luckily, we worked very hard to make a comeback. We were able to calibrate our model to make it fit real world numbers of Leatherback turtle survival rates, and we saw that trash does affect turtle behavior. Trash and predators did affect the sea turtles. We saw that they are easy to catch by predators when the sea turtles are stuck or can't move because of trash. This means that each piece of trash on a beach or in the ocean does make a big difference.

Recommendations

We think that the following changes would be useful for improving the model. We could find better information about the speed, direction, and threat distance of our agents. We could have variations in the landscape to better model plants that the turtles get stuck in before they reach land.

We could definitely do more runs of our model to find more data.

Recommendations to help sea turtles that we now understand are: the importance of recycling and not littering, plus reducing the human impact on the earth, such as global warming and polluting. We also believe it is important to protect the turtles when they are born, like in the Mexican and Florida turtle nurseries that we studied about.

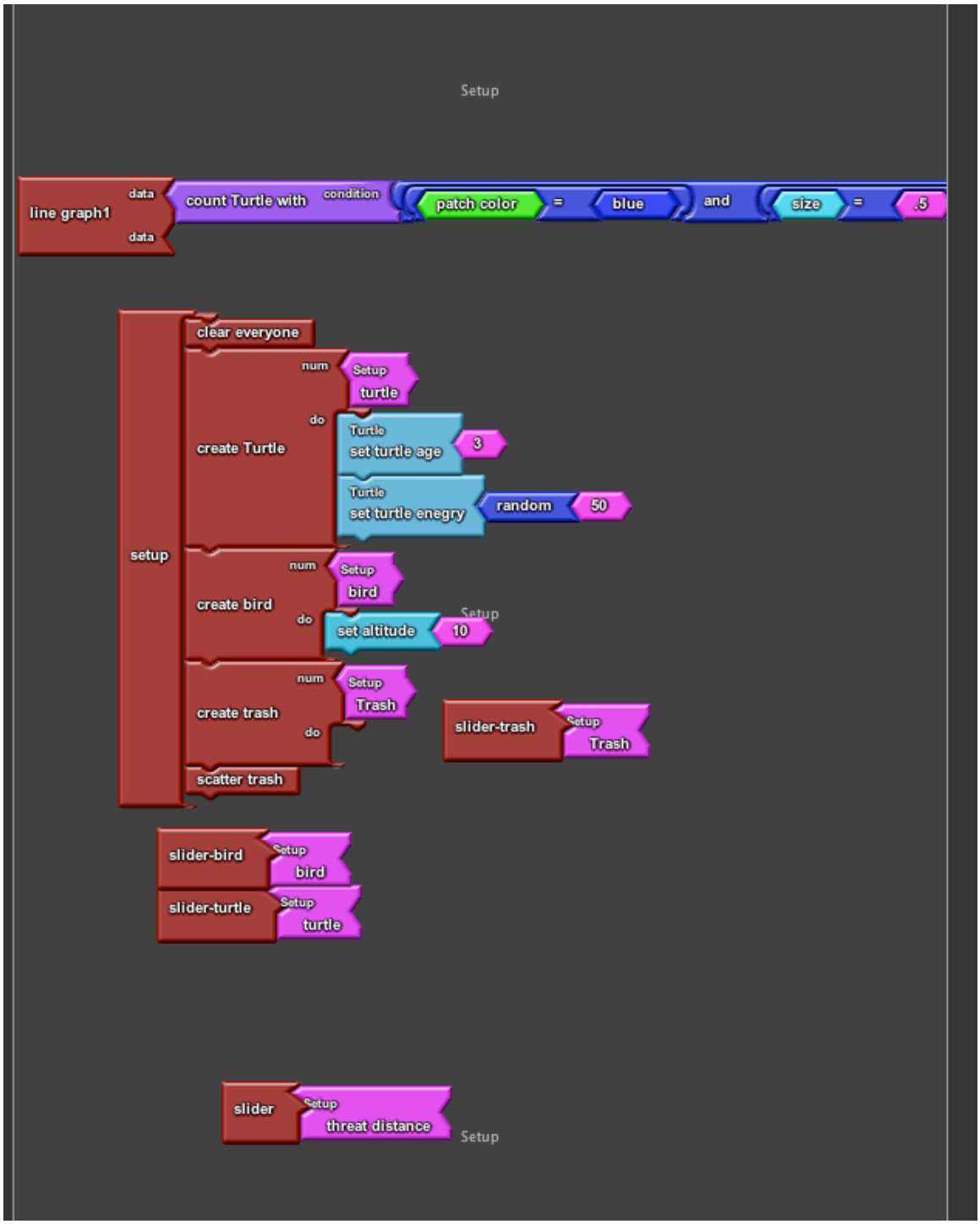
Acknowledgements

We would like to thank our parents, especially Dr. Tom Robey, Emily Dwyer, Claudia and Carlos Gutierrez, and Melanie and David Smith. We would also like thank the 2011 Supercomputing team #13 from Aspen Elementary School, whose final report template we used to write this report.

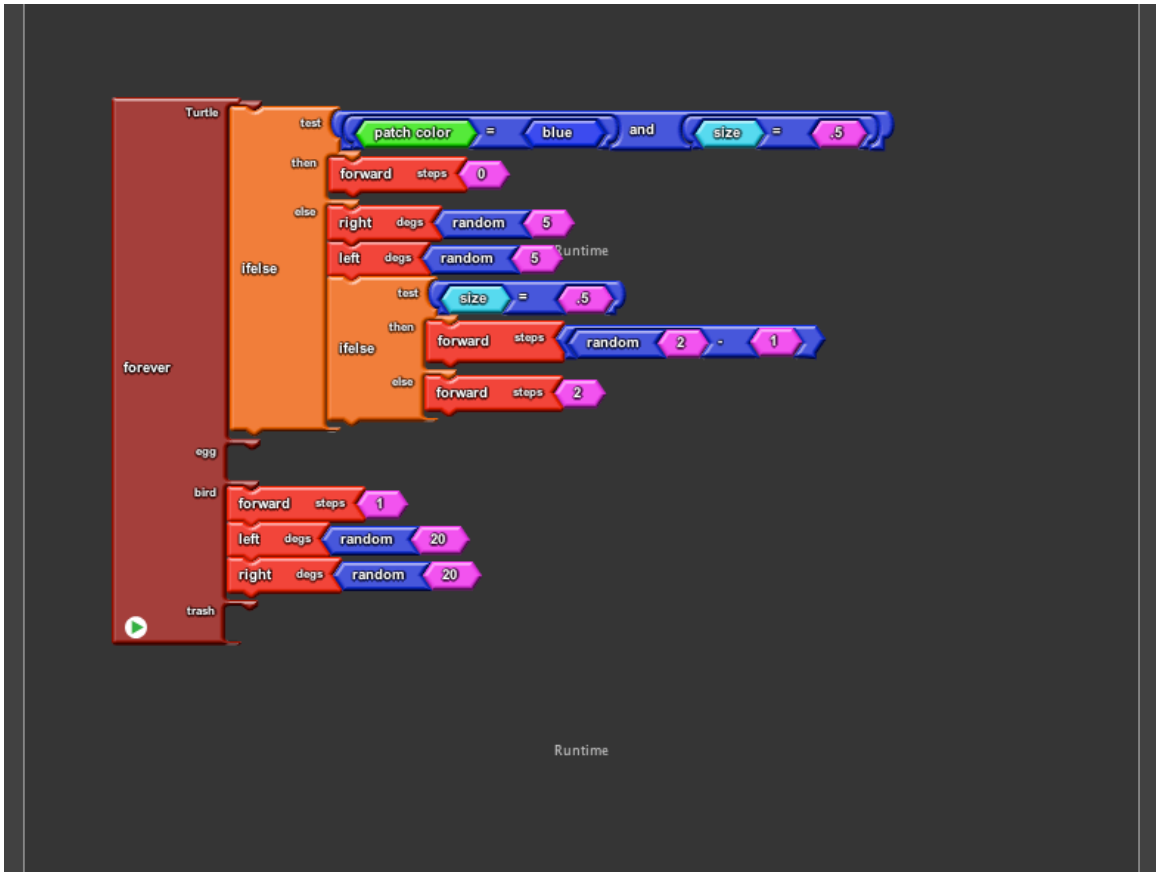
Appendix A

StarLogo TNG Code

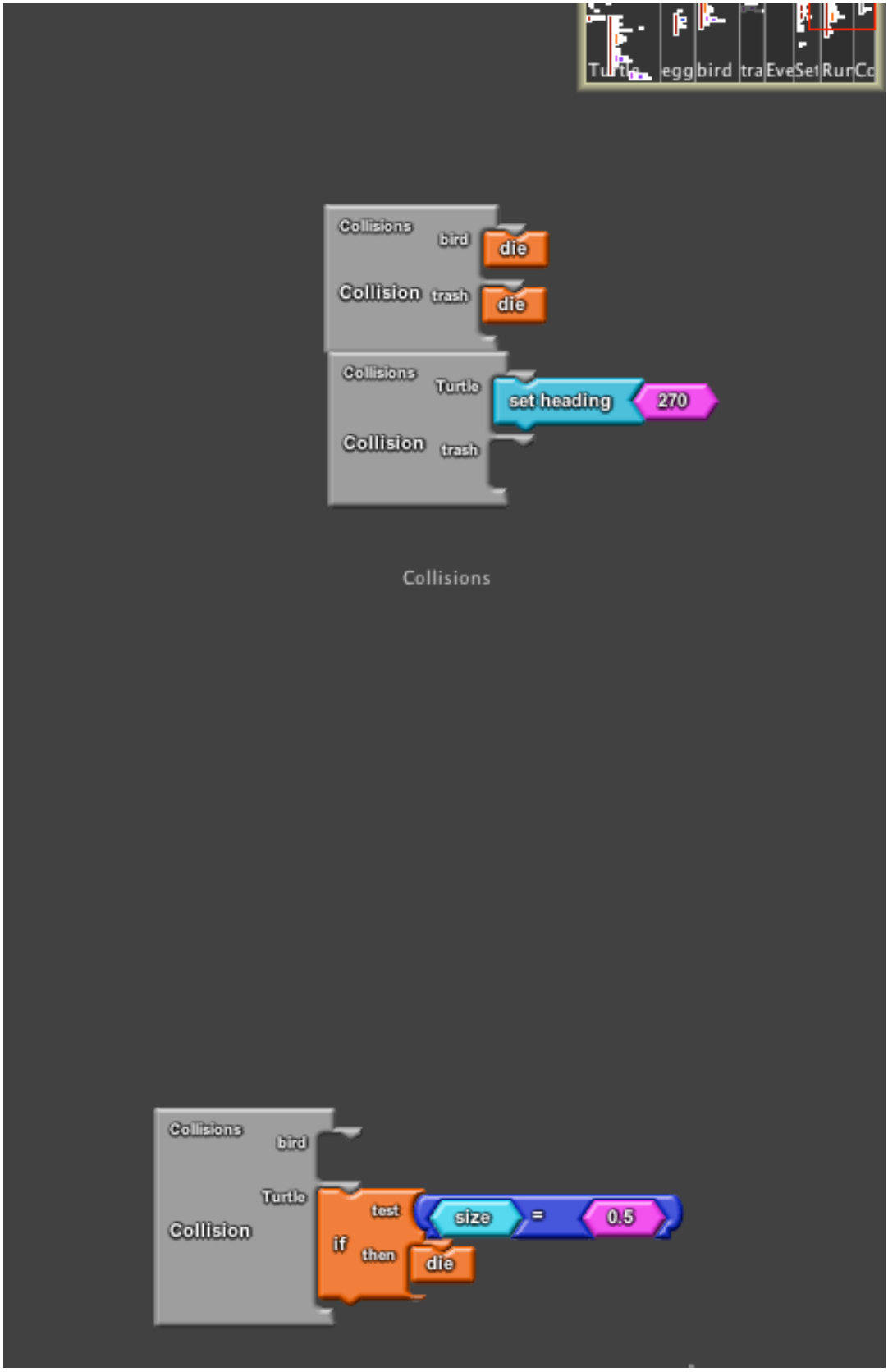
Setup



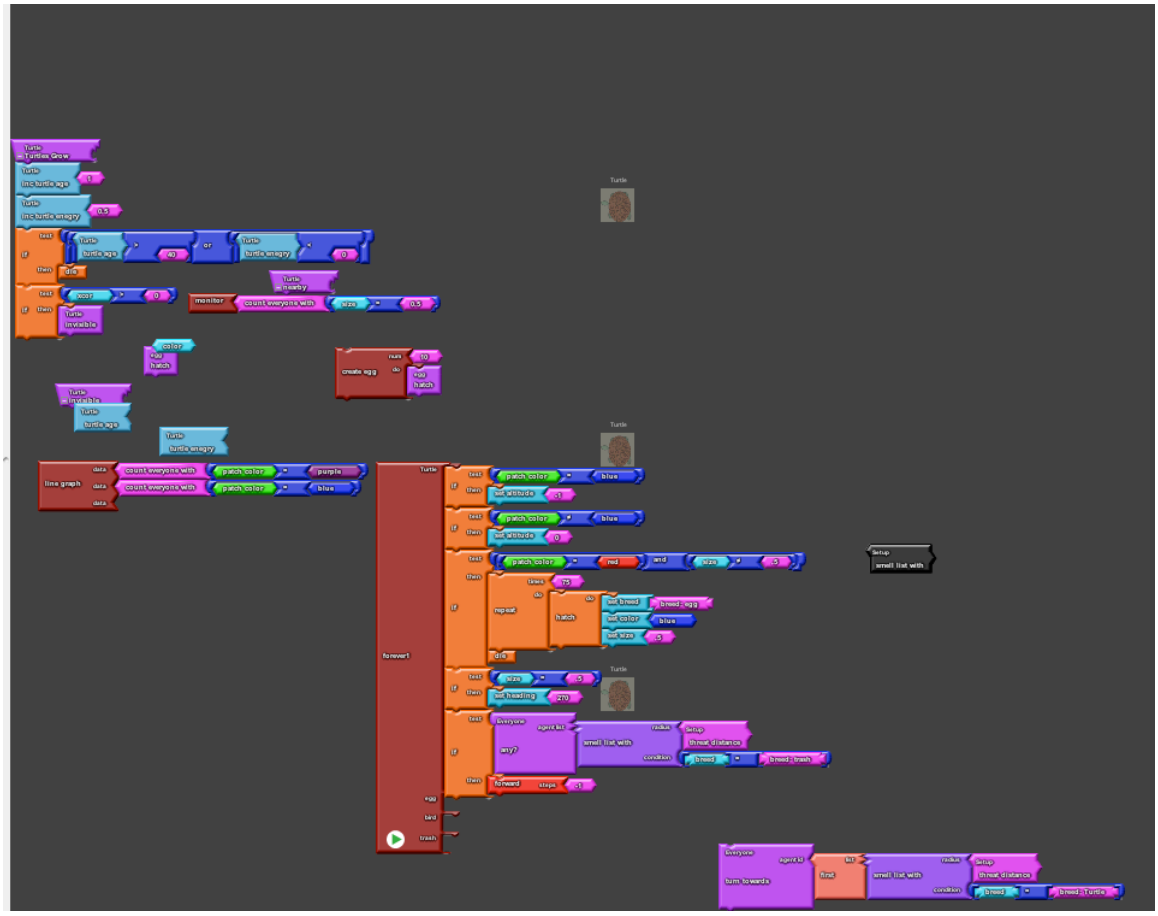
Runtime


Turtle
forever
test
patch color = blue and size = .5
then
forward steps 0
else
right degs random 5
left degs random 5
ifelse
test
size = .5
then
forward steps random 2 - 1
else
forward steps 2
ifelse
egg
bird
forward steps 1
left degs random 20
right degs random 20
trash
Runtime
Runtime

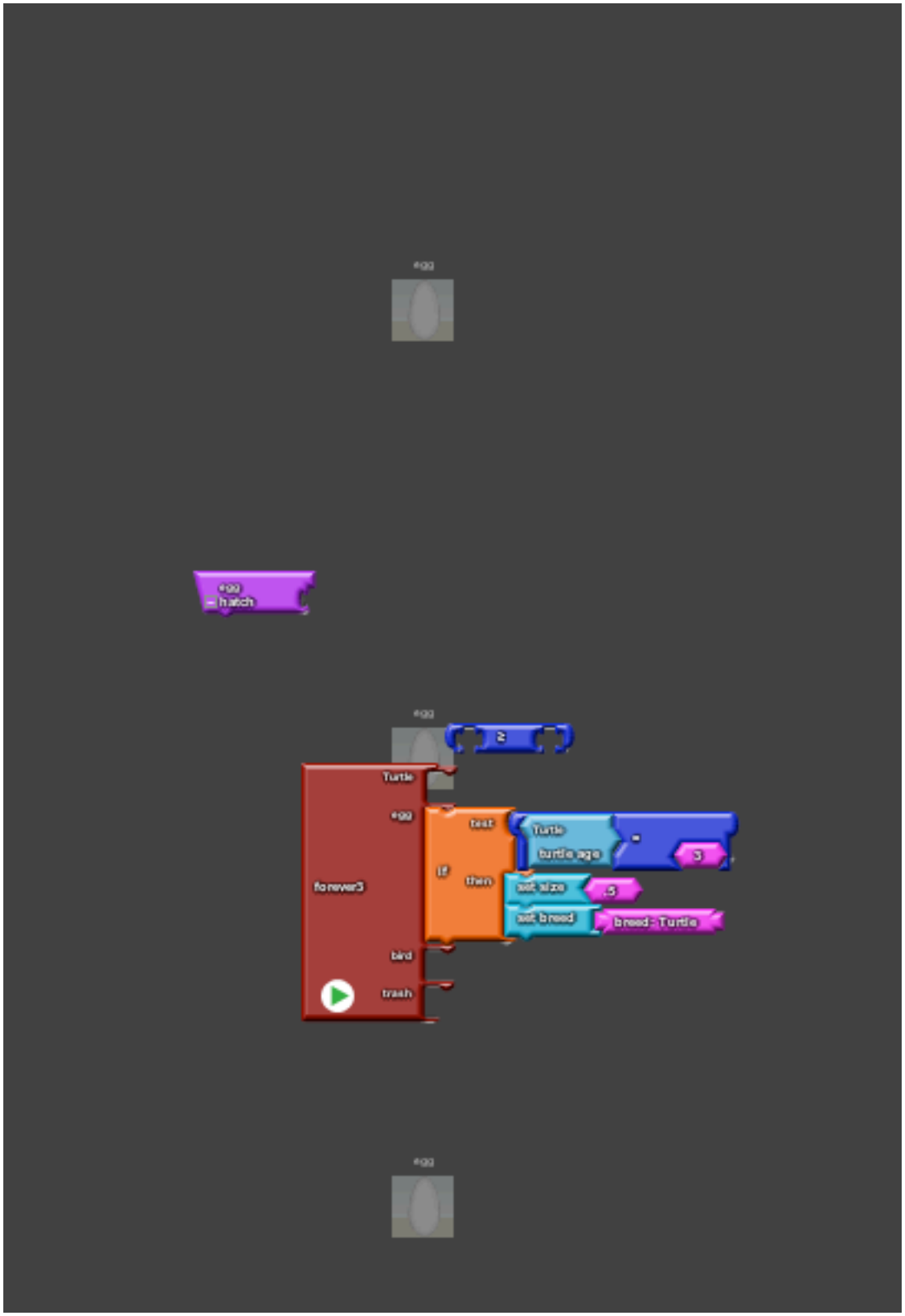
Collision Blocks



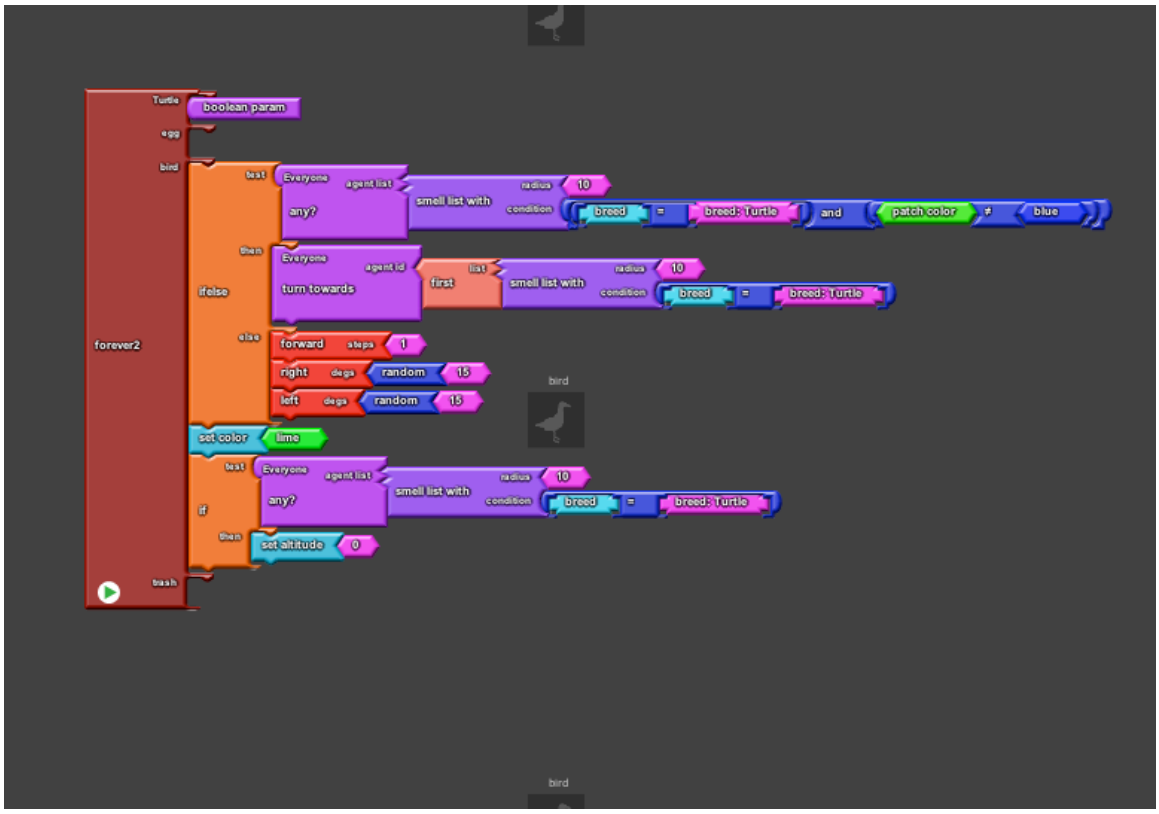
Sea turtles.



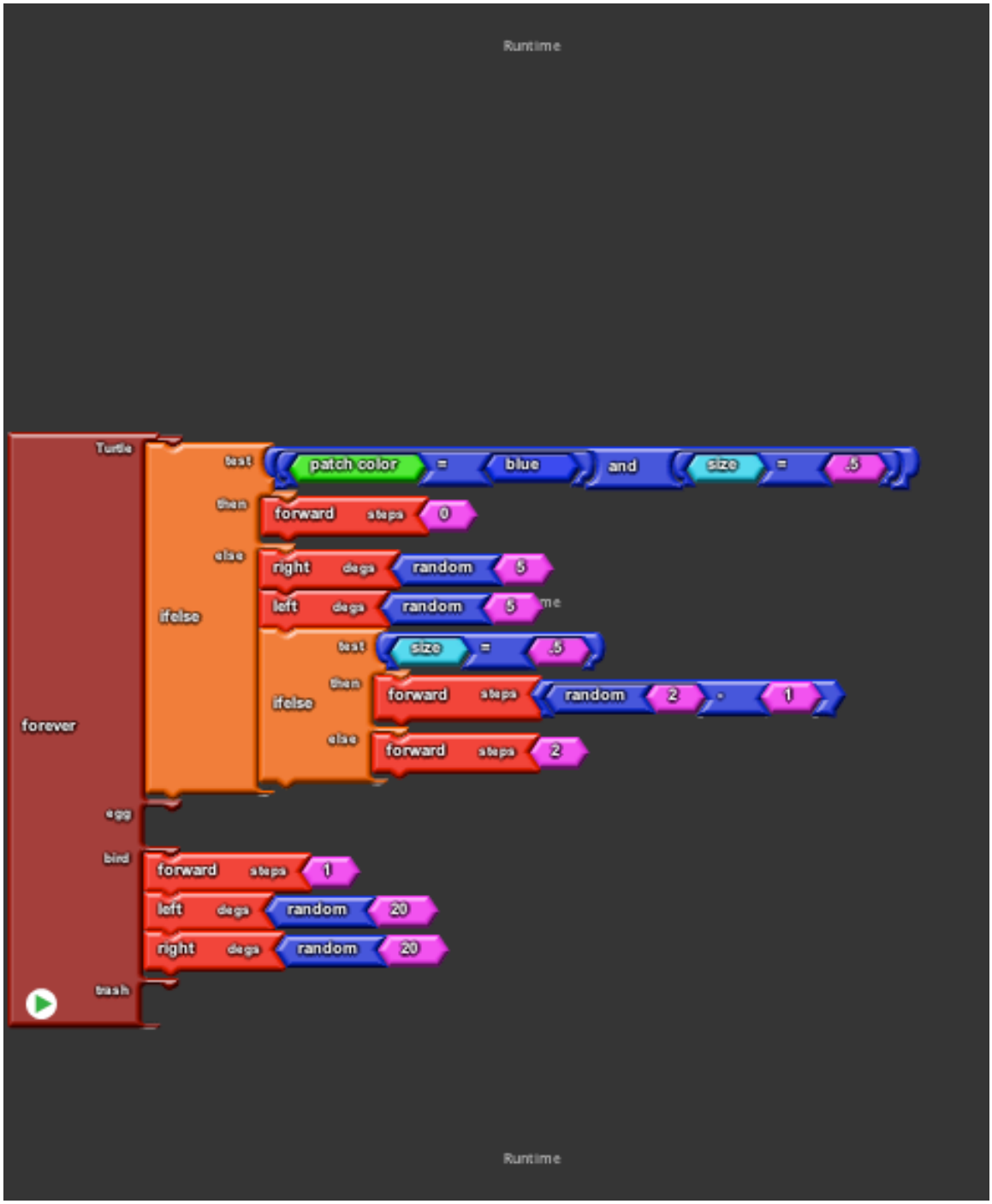
Egg


egg
hatch
egg
2
Turtle
egg
forever3
test
if
then
Turtle
turtle age
=
3
set size
.5
set breed
breed : Turtle
bird
trash
egg

Bird


Turtle
boolean param
egg
bird
forever2
test
Everyone
agent list
any?
smell list with
radius
10
condition
breed
=
breed: Turtle
and
patch color
≠
blue
then
ifelse
turn towards
agent id
first
list
else
forward
steps
1
right
degs
random
15
left
left
degs
random
15
bird
set color
lime
if
set altitude
0
trash

Runtime


Runtime
Turtle
forever
test
patch color = blue and size = .5
then
forward steps 0
else
ifelse
right degs random 5
left degs random 5
test
size = .5
then
ifelse
forward steps random 2 . 1
else
forward steps 2
egg
bird
forward steps 1
left degs random 20
right degs random 20
trash
Runtime

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On the dispersal of leatherback turtle hatchlings from Mesoamerican nesting beaches
Downloaded from rspb.royalsocietypublishing.org on March 24, 2012
George L. Shillinger1,2,*, Emanuele Di Lorenzo3, Hao Luo3, Steven
J. Bograd4, Elliott L. Hazen4, Helen Bailey5 and James R. Spotila