# *The Disappearing Honeybees*

**_Supercomputing Challenge_**

**_Final Report_**

**_April 7, 2010_**

**_<u>Team #18</u>_**

**_<u>Aspen Elementary</u>_**

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***Project Summary:***

We are studying what would happen if the honeybees went extinct. We have created a simulation to test our problem on Starlogo TNG, an agent based program. In our simulation, we have bees, other insects, plants only pollinated by bees or P1, plants only pollinated by other insects or P2, and plants pollinated by both or P3.

We have set up the simulation so that the bees will pollinate P1 and P3, and the other insects will pollinate P2 and P3. The insects need the nectar from the plants to survive, so if there aren't any plants from which to pollinate and get nectar from, they would die. Also, the plants need to be pollinated by the insect in order to repopulate. There forth, without any insects to pollinate them, the plants would go extinct. Also, we have disease that can also kill the bees. This "disease" can also affect the honeybee population. As you can see, the survival of all the agents is based on each other.

Our results show that the more disease, the less the bees. The graphs show that if you raised the disease, the honeybee population would go down. When the bee population went down, other insect species went up. This was most likely due to the lack of competition. Also the plants pollinated by the bees went down, and their competitors went up. In conclusion, there would still be about the same number of insects and plants, but some of the species that we used to have would be extinct.

***Problem Statement:***

The main problem that we are studying is what would happen if the honeybees went extinct. Today, honeybees all over the world are dying. If the bee population keeps decreasing, it is very likely that the honeybees will go extinct. What would happen then? We are testing to see how big of a change it would make if the honeybees went extinct. How many crops would die if the population was wiped out? How many animals would die? We are working to answer these questions.

***The Method:***

In our research, we learned that honeybees pollinate 15% of worldwide crops. Based on this information, we set the parameters for our project. Assuming that all the insects pollinated the same number of plants, we made 15 honeybees and 85 other insects, adding up to 100 insects in all. Since the honeybees pollinate 15% of the worldwide crops, we decided that they pollinated both P1 and P3. We had 10 P1 plants, 40 P2 plants, and 50 P3 plants, adding up to 100 plants.

We have set a limit to how many insects and plants there can be. There will always be 100 insects total and 100 plants total. This creates a type of competition. If the bee population decreases, it leaves more room for the other insects, and vice versa. It's also the same for the plants. Also, this keeps the number of agents low and stops the computer from freezing.

We also added age to the agents so that all of them will die in some point in time. Then, new agents can be born to take the place of the ones that have died. All the agents start out at a different age so that they don't all die at the same time. This is just like in real life.

All the species have a birth and death rate. These are the rates of which the population increases and decreases. The rates depend on the number of the population of a species and on the population of other species that affect it. They can also be affected by the disease.

## ***Variables:***

### ***Honeybees***

We start with 15 honeybees out of 100 insects in all to get 15% of honeybees. The honeybees only pollinate the P1 and P3 plants. When they pollinate the plants, the bees get some nectar, which they eat. If they don't get to a flower in an amount of time, they will die of the lack of nectar.

### ***Other Insects***

These agents are the bees' competitors. We start out with 85 of these for 85%. These pollinate the P2 and P3 plants. Other insects need nectar like the bees to survive. The bees and other insects compete for food and plants to pollinate. With less bees, there will be more other insects and vice versa.

### ***P1 plants***

These are the plants pollinated by bees. Not all insects pollinate the same types of plants and we show that in our model. Our P1 plants are only pollinated by bees. We start out with only ten of these for 10%. In our research, we learned that bees pollinate 15% of worldwide crops. We know that some of these crops would be pollinated by both honeybees and other insects, so only part of the 15% would be P1s.

### ***P2 plants***

These plants are only pollinated by the other insects. We start out with 40 of these, making it 40% of P2 plants. When plants are pollinated, they are able to reproduce. If they are not pollinated, then the population will not grow.

***P3 plants***

These plants are pollinated by both honeybees and other insects. We start with 50 P3 plants. All the plants added together always equals to 100, making the P3 population 50% at the beginning. Because of this, there will be a competition between the plants. If any plant population goes down, it is likely that another one will go up.

***Disease***

This variable helps kill the bees. It is controlled with a slide that shows the percent of the bees that are sick. If the bees get sick, it is likely that the sick bees will die. This also controls the rate of the bee’s death.

***What We Have Accomplished:***

We have created a smooth running model in which agents react with each other on Starlogo TNG. We've added age to our program and the death and birth of agents to make it more lifelike. There are graphs to show the data from the program, and these are quite helpful. These graphs show the insect and plant population over a period of time. Figures 1, 2, and 3 show the insect and plant populations as a function of time when the disease parameter is set at 0, 10, and 50%, respectively.

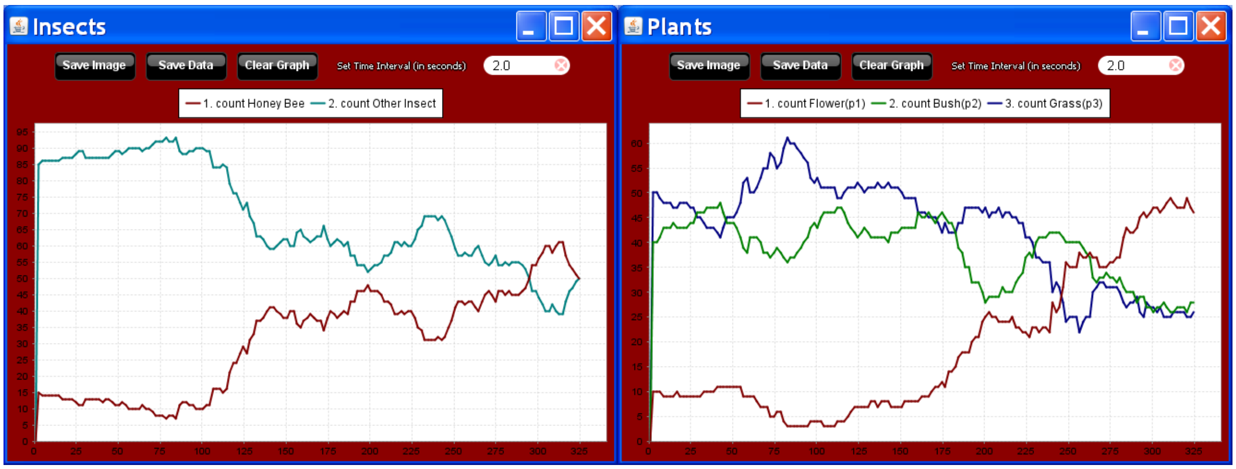


**Figure 1: Insect and plant populations as a function of time for 0% disease.**

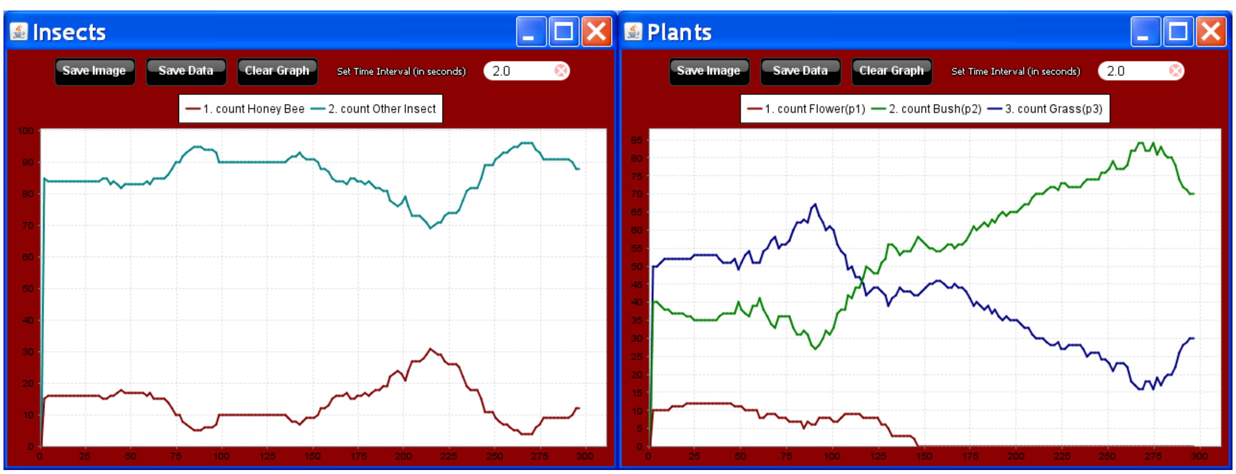


**Figure 2: Insect and plant populations as a function of time for 10% disease.**

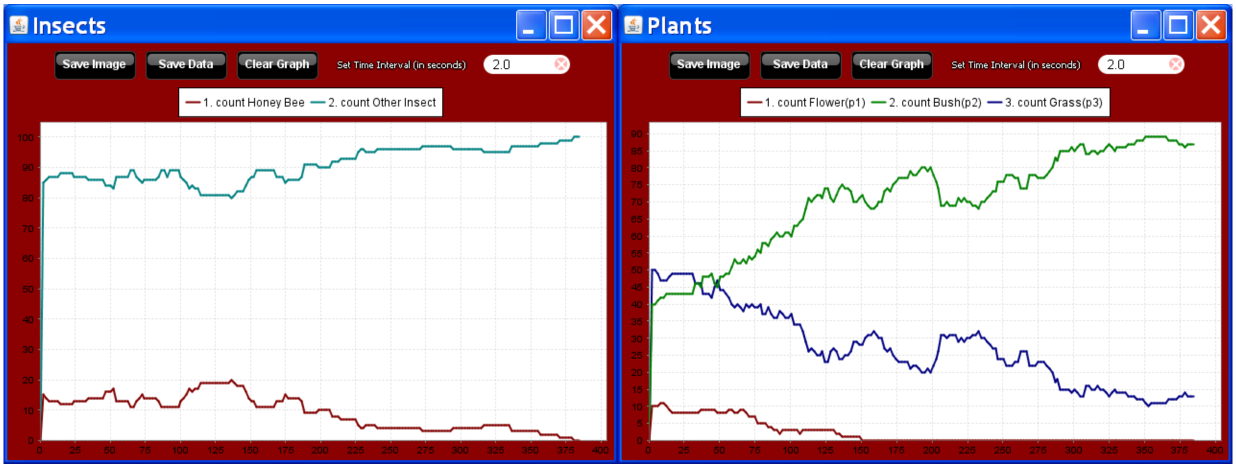


**Figure 3: Insect and plant populations as a function of time for 50% disease.**

These figures show the results from one set of our runs. For another set of run with these same percents of disease the results would be different, due to the randomness of nature and our program.  In general, when we set the disease to be 0 then the plant type P1 population will gradually increase as shown in figure 1, or if it dies out, it does so very slowly. When we set the disease to be 10% or more, then the P1 population would die out quickly. The honeybee population still might survive because even if the P1 population goes extinct, they can still pollinate the P3 plants, but the population still goes down.

## ***Conclusions:***

We have gotten pretty successful results and have fixed some earlier problems, such as getting the insects to move onto a different flower instead of just staying on the same one until it dies. This is one problem that we have solved.

We have tried to change the various parameters in our program, such as the total amount of allowable insects and plants, or the allowable ages for the insects and plants, or the radii of which the insects can smell and find the plants. We found that there are relationships between these parameters and changing one even so slightly can greatly affect the results.

Despite our effort, we still don't think our model is lifelike enough. We think this because we did not actually find out what percentage of the world's pollinating insects were bees, which plants they pollinated, and other reasons. We feel that these would have been important in our program. If we work on this in the future, we will probably try to include these things.

***Software:***


**Figure 4: Honeybee model.**

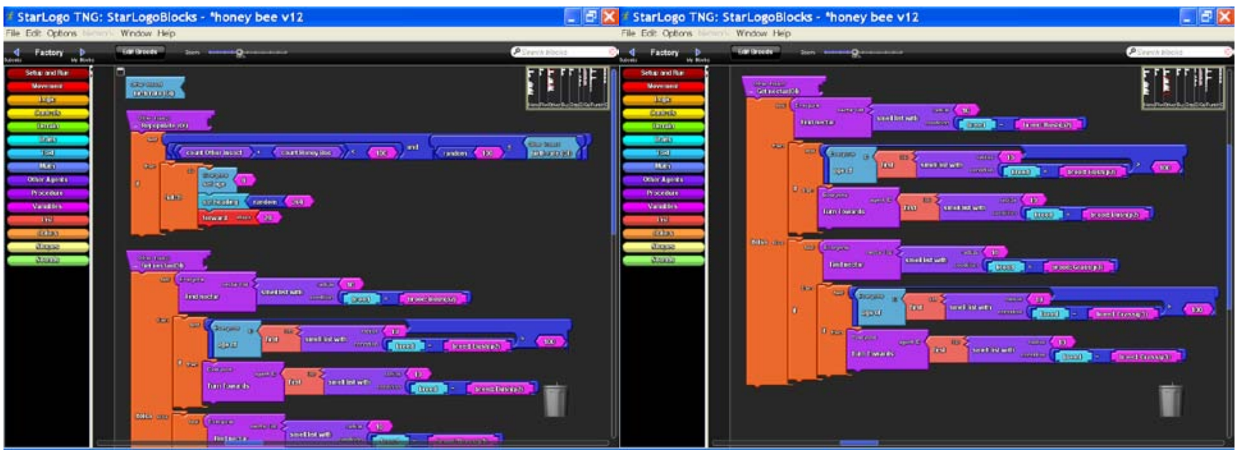


**Figure 5: Other Insect model.**

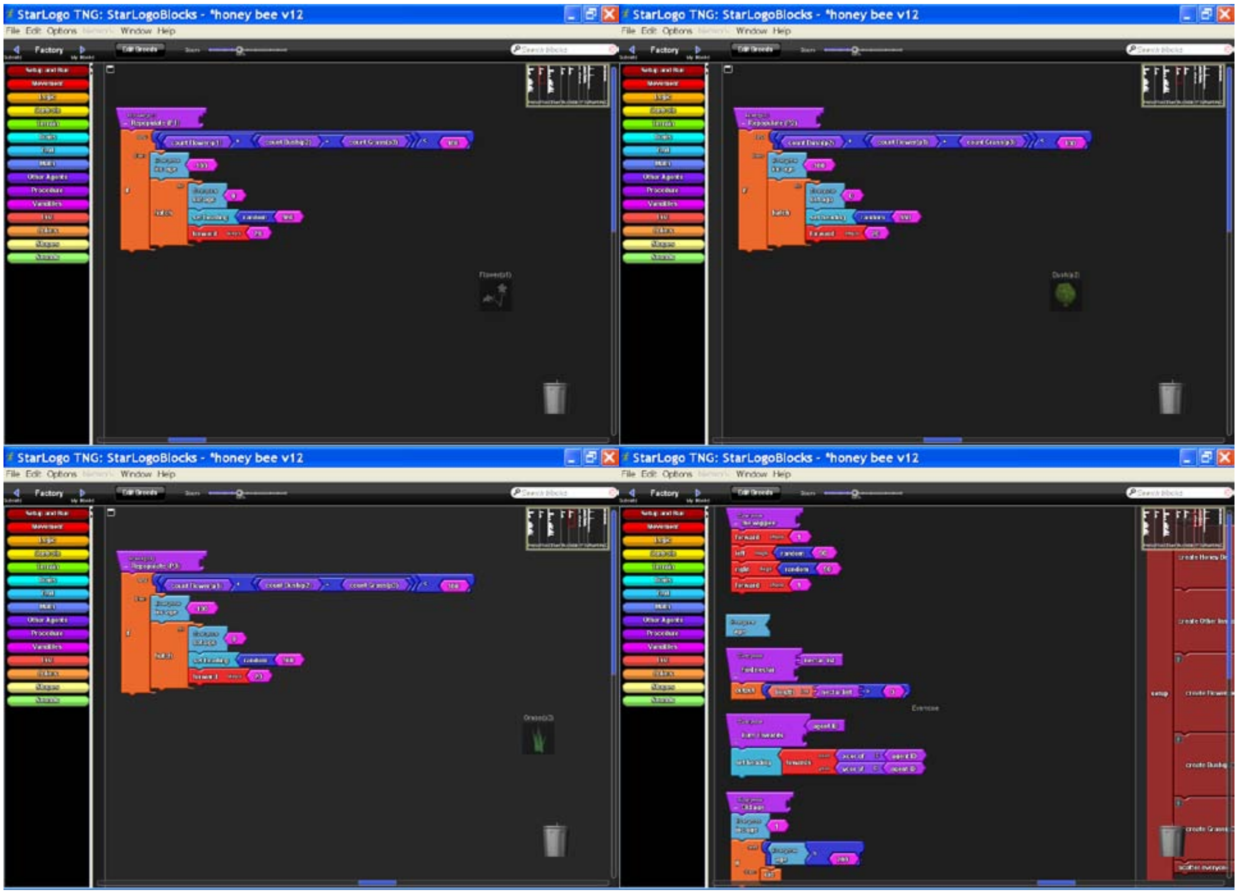


**Figure 6: Plants and everyone model.**

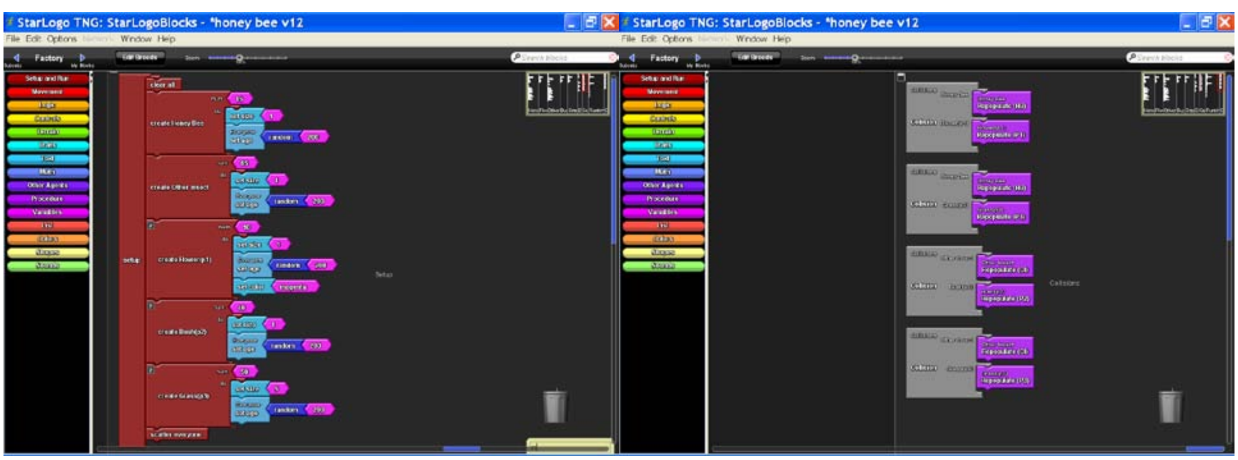


**Figure 7: Setup and collision.**

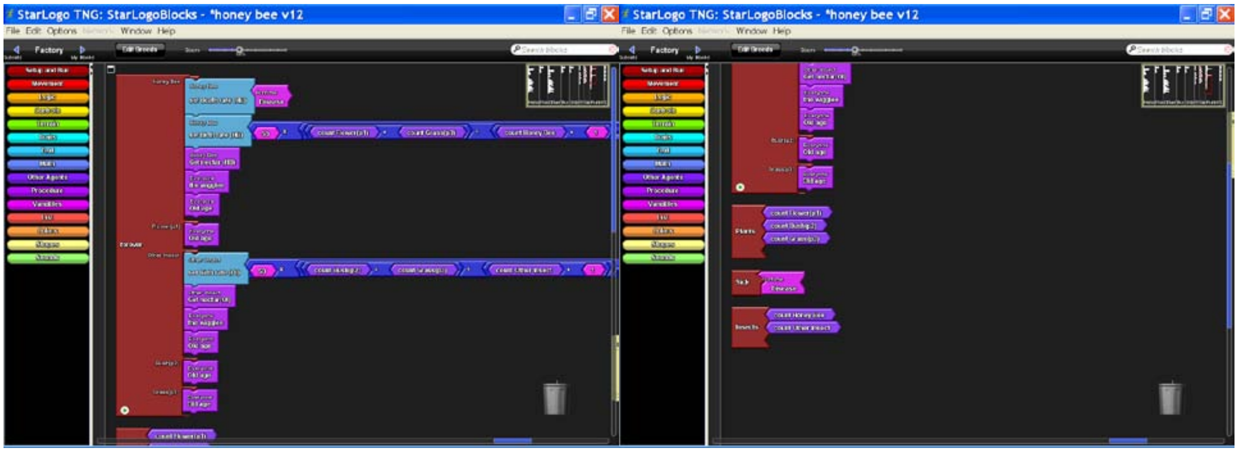

**Figure 8: Runtime.**

## ***References:***

http://www.vegetus.honey/ecology.htm

www.google.com

Colony Collapse disorder-Wikipedia

## ***Acknowledgment***

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