Final Assignment
Thiago Luigi Gonçalves Lima - 201720364

In agent based modeling you can have two design decision methods to follow: phenomena-based and exploratory model. In this assignment I will be extending the wolf-sheep predation example model present on Netlogo. Because of this my model can be considered a phenomena-based one. As I'm extending the existing model I'll be working with a top-down approach. I start with the components that already exists on the example and add another one.

The wolf-sheep predation shows how the wolf agents depends on the number of sheep agents to be alive. It also shows how the sheep needs the grass to be able to reproduce more than the wolves predates thus keeping the specie alive. Starting from there I'll add an awareness factor on the wolves to make them reproduce less when there are less sheep.

To make this model I'll be using three agents. The wolf, the sheep and the bee. Below is a table showing all the properties of each agent:

Sheep	Wolf
Energy	Energy
Shape=sheep	Shape=wolf
Color=white	Color=black
Size=1.5	Size=2

The bee doesn't have any property because it only regrows the grass. These agents can have actions or behaviors. Below is a table showing the behavior each agent can have:

Sheep	Wolf	Bee
Move	Move	Move
Eat	Eat	Polinizacao
Death	Death	
Reproduce	Reproduce	

They can also interact with each other or with the environment. Below there are three tables showing how and with who each agent can interact:

Sheep	Interact with
Reproduce	Sheep
Eat	Grass

Wolf	Interact with
Reproduce	Wolf
Eat	Sheep

Bee	Interact with
Polinizacao	Grass

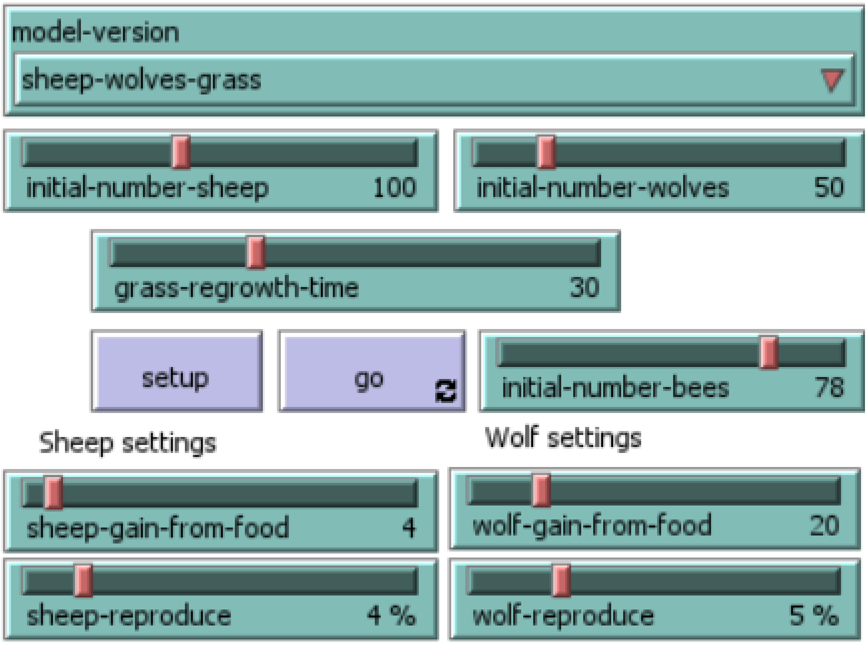
These agents will be living in a flat land. Below its foot will be either dirt or grass. The grass is an environmental agent. It will define how much the sheep reproduce and the bees will reproduce it.

In each time step the order of action would be first the grass, then the sheep and then the wolf. Firstly, if the floor has been dirt for more than two steps it would become grass again. Secondly comes the sheep, they would choose what action they would take based on their situation. Then the wolves would do the same. Then the bees will make its move.

With the proposed extension to the model, I hope to observe the wolves starting to choose exactly how much they will reproduce and the environment getting stabilized no matter what condition you put it in. If there is grass, there will be sheep. If there is sheep, there will be wolves.

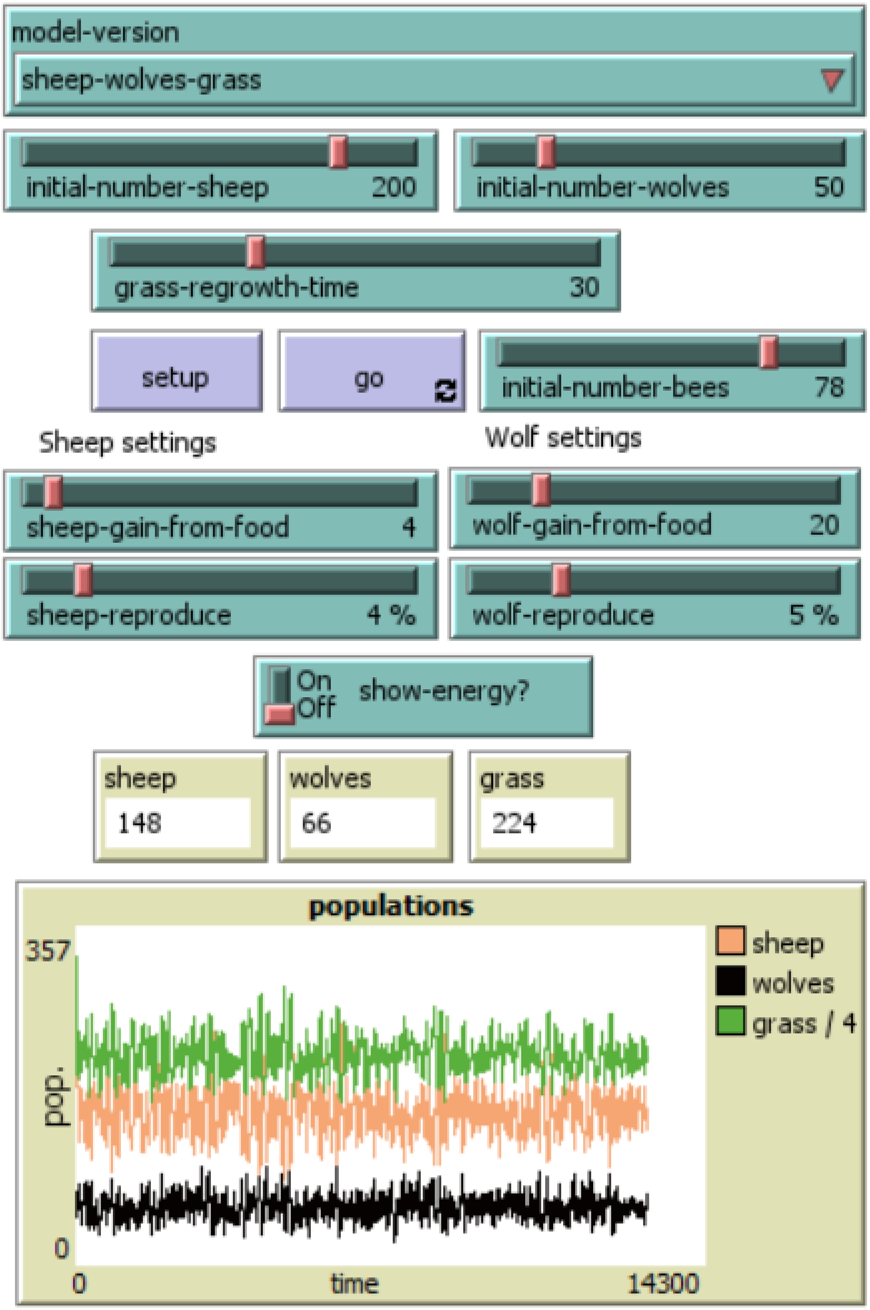
Analyzing the model's comportment

The default configuration provides a stable environment. But the purpose of this model is to be stressed in the search of a completely balanced ecosystem. This is the default configuration[1]:

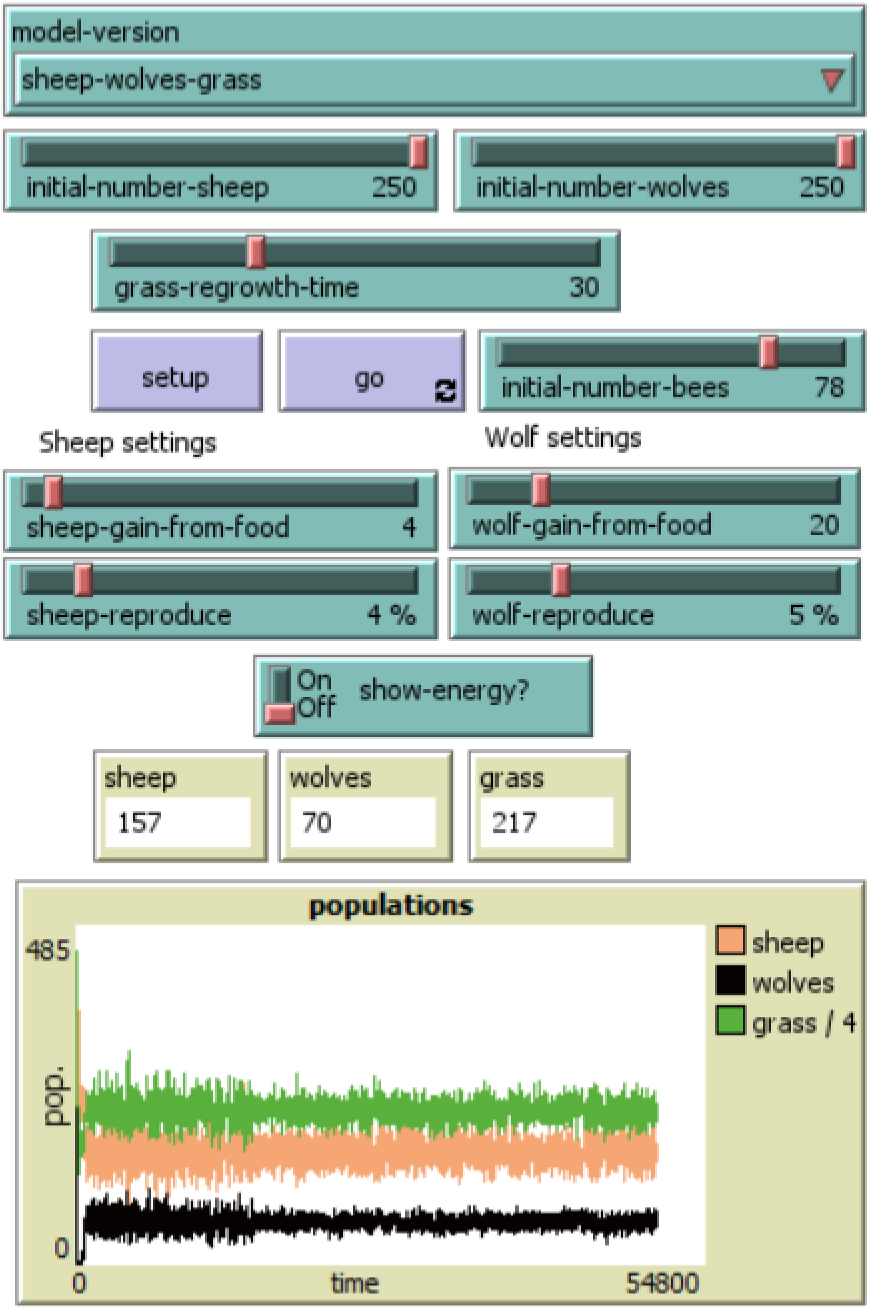


[1] Although there is a grass-regrowth-time slider its value isn't used.

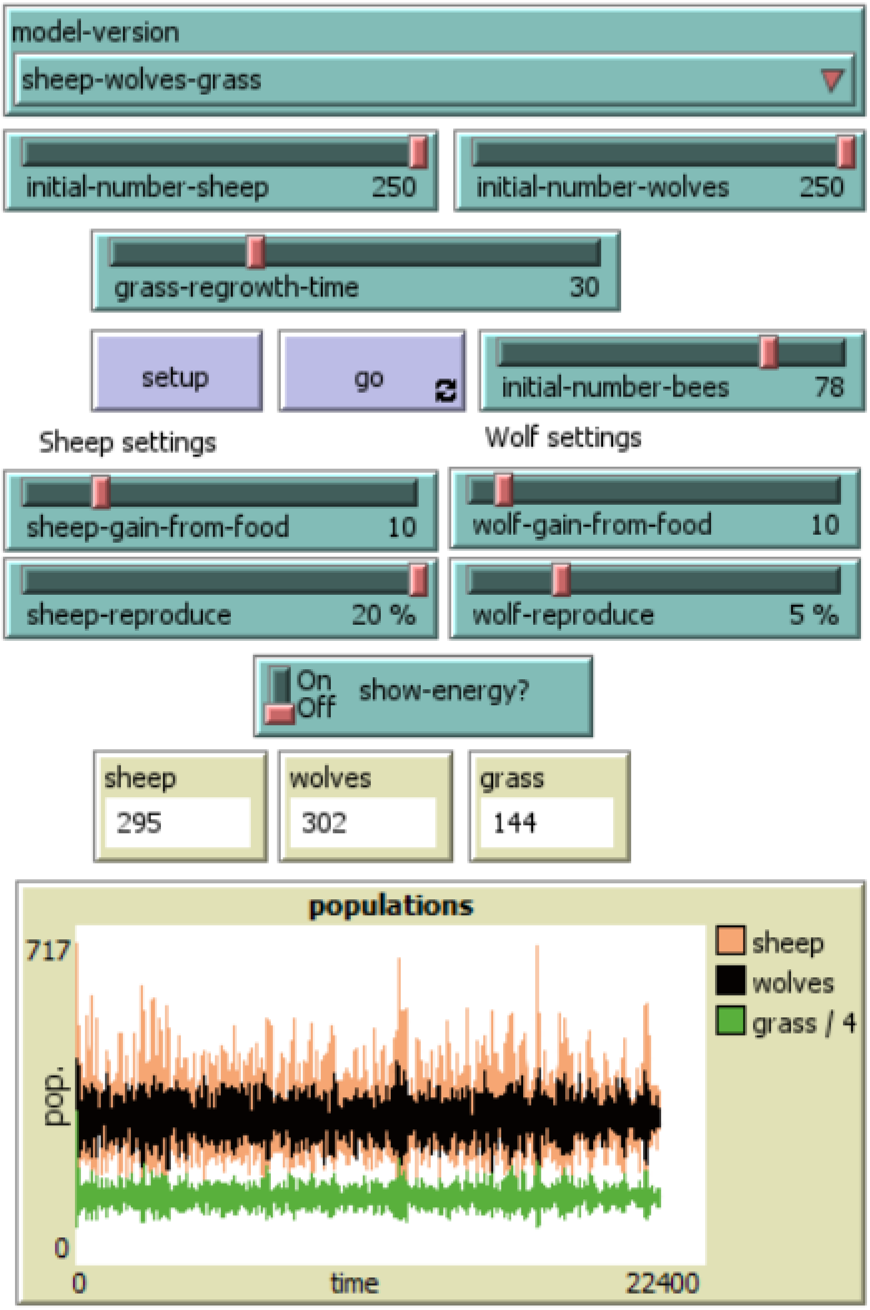
Using the following configuration, the model keeps stabilized.



Changing the number of wolves at the beginning doesn't destabilize the ecosystem:

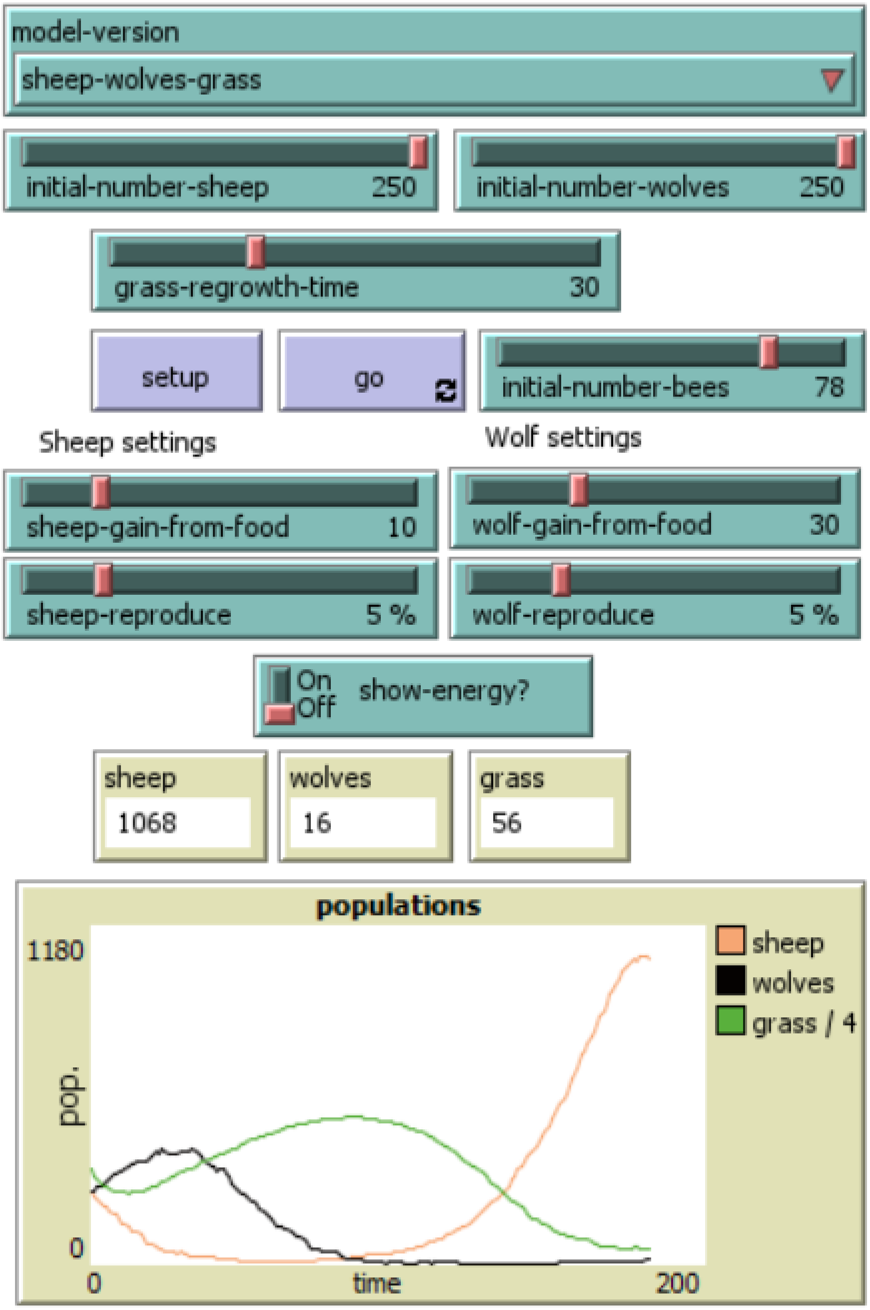


An interesting fact is that with the below configuration the number of sheep was higher than the number of grasses itself.

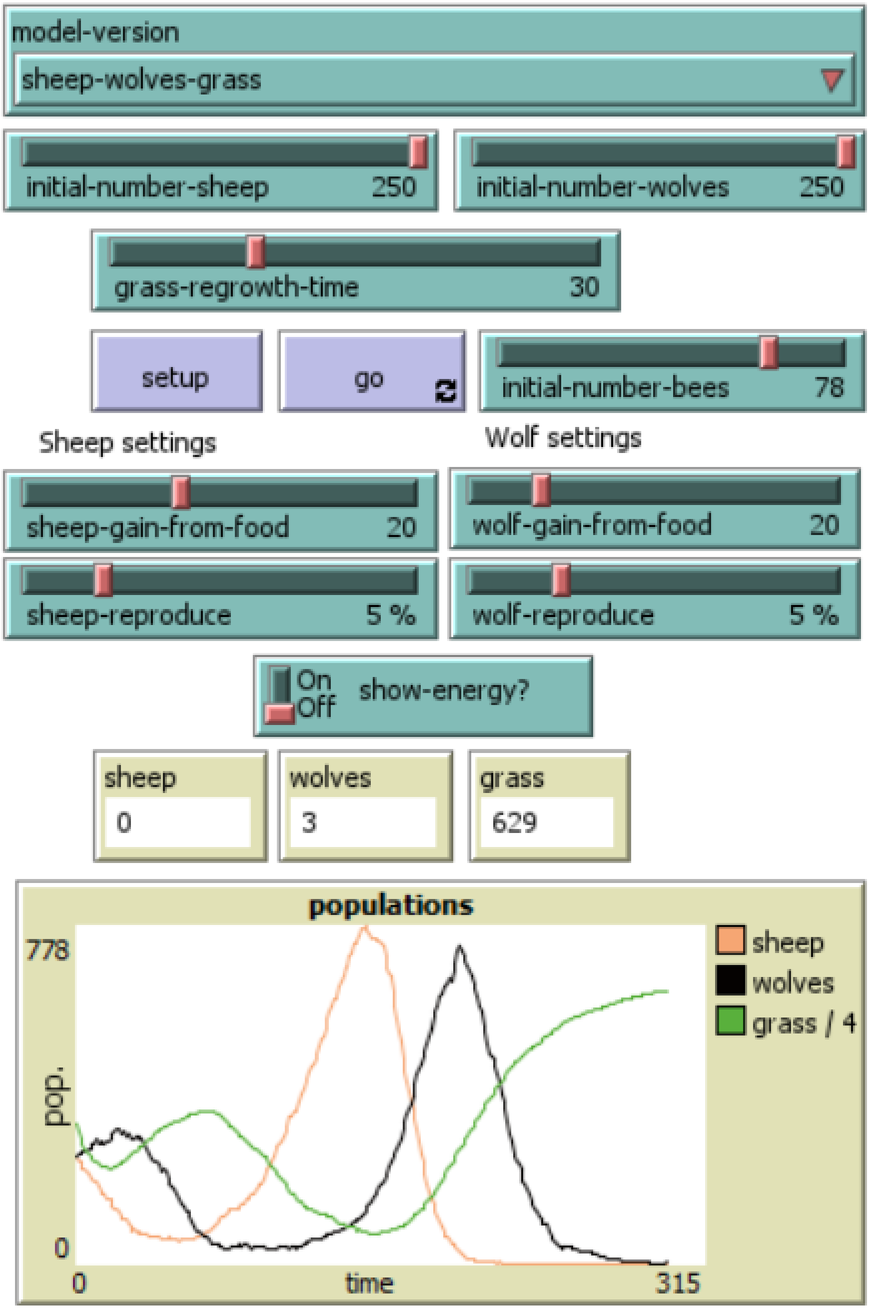


The only configuration that can destabilize the ecosystem is when you change how much they gain from food.

Increasing how much the wolves gain from 10% to 30%.



Increasing how much the sheep gain from 10 to 20%.



The model after adding this awareness system gets pretty robust. But it alone can't guarantee the robustness that I was searching for. The "food gain" factor still can destabilize the ecosystem.

In future researches the bees can be added to the predatory system somehow to see how a third element can interfere even more on the wolves decision.

The code to the model explained on this document can be found on:
[thiagoluigi7/IABM (github.com)](https://github.com/thiagoluigi7/IABM)