CSCI 190: HW6: *Life, Death, and Consumption*

Due on **Wednesday, March 23 at 8:00am** (before the start of class.) Your solution must be submitted to the CSCI 190 drop box on middfiles. Your program must be named as follows**: YourName-HW6.nlogo.** Programs will be graded on:

1. correctness (70pts)
2. structure (10pts)
3. style (10pts)
4. interface (10pts).

Overview: Predator-prey models and models of creatures' life spans that include consumption (and possible starvation) and breeding are notoriously difficult to write and get running in a steady state. In this assignment we will work with some of the basics of a very simple life-span model of a fictional creature called a warg. The time fram is 1 tick = 1 day.

Wargs move around the world eating and breeding, with death resulting from either starvation or old age. They have an average life span and average size with some variance from individual to individual. A warg's energy needs depends on the square of it size. If it doesn't eat enough, it dies. There is also a breeding season, and females that breed will have a litter of warg pups. Larger wargs are more successful at breeding. Predator-prey models will not be explicitly represented; wargs are the only species, and units of food will appear at random around the world. The goal is to set the parameters for all these values so that the population achieves some sort of steady state (with periodic fluxuations).

The basic model will be worth full credit, with extensions possible for those seeking extra credit.

Further Instructions and Details:

Look over the following lists. Keep them in mind as you design sliders, globals, and wargs-own variables. Try to code and test one behavior (or feature) at a time, and slowly add features until the model is complete. Do not get overwhelmed with all the details. Scan through the lists below, think about what goes into the design, but then implement one thing at a time.

Wargs: Should have the following features:

- An average life span of 10 years, with a variance among individuals up to 2 years.
- An average adult size of 2.5, with a variance among individuals up to 0.5. *The genetic size potential of each warg is determined at birth.*
- Different fur colors among males and females.
- A travel speed of 0.5 units per tick.
- A current amount of stored energy. (See below for how much energy is available in food, and how much gets used per day.)
- A sex (with probability distribution controlled by a slider)
- A warg can sense food or other wargs within a radius of 5.

The World: … doesn't offer much variety, but it is capable of producing warg food.

- A slider should control the probability of a single meal of food being produced in a day on a random patch.
- Each meal of food is worth 2 energy units when consumed by a warg.

Breeding: A year lasts 365 days. The last 65 days of each year are breeding season. A female should breed only once. If it breeds, it gives birth to a litter of 3 to 6 puppies on

the first day of the following year.

The Daily Lives, Life-Cycles, and Energy Needs of a Warg:

- A warg does not reach reproductive maturity until it is 2 years old.
- A warg does not reach its full genetic size until it is 2 years old. A warg should have size 1.0 when it is first born, and its size should grow steadily and proportionally until it is 2 years old, at which point it should be it's full genetic size.
- On each day (tick) a warg uses an amount of energy proportional to its present size. If s represents its current size, on each day it should cs^2 energy units per day. (I suggest c = 0.02 as an appropriate value, but you can experiment.)
- A warg that runs out of energy dies. Wargs also die if they reach their personal life span.
- A warg may never have more than $2s^2$ energy units stored (as fat). When it is born, it has 75% of its maximum value.
- If a warg drops below 25% of its maximum energy, its first priority is always to seek food.
- A warg with more than 75% of its maximum energy does not try to eat, but wanders about or rests (unless it is mating season).
- During mating season, a warg will try to mate unless its energy is below the 25% threshold.

At Setup

- Some food should already be available.
- The world should start with 15 wolves, with sexes and sizes distributed as described above.
- Initially, all wolves should be between 2 and 5 years old—fully grown and sexually mature.

User Interface

- In addition to a setup and go button, there should be sliders as described above.
- Use monitors to output a few interesting values to help analyze what is going on, including the current year and the current day of the year.
- Show (in the command center console) the deaths of all wargs and the reasons for death. Also show when wargs have successfully mated and given births.

Hints and Suggestions:

- It will be useful to keep track of which female wargs have mated.
- Use appropriate global variables and global constants.
- Think in advance how you want to store the age of warg (days verses years), and be consistent so you don't get confused.
- You need to know, at any given time, a warg's actually current size, and its genetic potential size.

Bonus (For Up To 10 Extra Credit Points)

- A new warg should have its size potential determined genetically by its parents with a small random variation. (**Hint**: In addition to the hatch procedure, keep track for each female of the genetic size of its mate.)
- Wargs seeking mates prefer the largest nearby mate. So size is a genetic advantage to mating. However increased size also increases energy needs as outlined above.
- Monitor the average size of wargs, plus the number of genetically small wargs (genetic size under 2.4) and the number of large wargs (genetic size over 2.6).
- *Can you find food conditions or other parameters to the simulation that favor smaller wargs over the long term? Larger wargs? How about conditions that tend toward very average-sized wargs?*