

**Wolf Sheep model in ODD**  
The Wolf Sheep Simple 5 model explores the population dynamics in a minimal ecosystem comprising of wolves, sheep, and grass. The model allows different outcomes to emerge as we alter the number of wolves, sheep, patches of grass, the energetic requirements of the animals and the growth/ reproduction rate of the 3 ecosystem elements.

Overview: General Description

What is the research question?

What effects the stability of predator-prey ecosystems?  
Such a system is called unstable if it tends to result in the extinction for one or more species involved.  
A system is stable if it tends to maintain itself over time despite fluctuations in population sizes.

How would you categorize the role of the model?

Theoretical exposition: Establishing then characterizing (or assessing) hypotheses about the general behaviour of a set of mechanisms (using a simulation).

For whom is the model designed?

Audience interested in the introduction of population dynamics. For this purpose the ecosystem is minimalistic and includes 2 type of consumers (herbivores and carnivores) and 1 type of producer.

Description of purpose:

The model explores the population dynamics in a simplified ecosystem of wolf sheep and grass.

Credits and References

This model is an adapted version of:  
\* Wilensky, U. (2007). NetLogo Wolf Sheep Simple 5 model. <http://ccl.northwestern.edu/netlogo/models/WoIfSheepSimple5>. Center for Connected Learning and Computer-Based Modeling, Northwestern Institute on Complex Systems, Northwestern University, Evanston, IL.

How to cite

For the tool 000248M, please cite the following publication:  
Xanthopoulos, Thomas Gaitiras; Prinz, Andreas; Shultz, P. LeRon (2019). Generating Executable Code from High-Level Social or Socio-Ecological Model Descriptions. Lecture Notes in Computer Science (LNCS). ISSN: 0302-9743. 11753 LNCS 150 - 162. doi:10.1007/978-3-030-30698-0\_9.

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Overview: Entities, state variables, and scales

Entities

The entities in this model are: wolf, sheep  
The entity wolf has colour brown and shape wolf of size 2 and it describes wolves  
Entity wolf has the attributes  
Press enter to add attribute to wolf  
-----  
The entity sheep has colour white and shape sheep of size 1 and it describes sheep  
Entity sheep has the attributes  
Press enter to add attribute to sheep  
Press enter to add another entity

Common Attributes of all Entities

The common entity attributes are:  
The attribute energy is numerical. The attribute describes agents own energy  
Press enter to add another attribute

Networks

The networks in this model are: <press enter to create relationship>

Environment entities

The environment entities in this model are: grass  
Environment grass has colour green scaled by grass-amount .  
Press enter to add another environment entity

Environment Attributes

The environment attributes in this model are:  
The attribute grass-amount is numerical. The attribute describes patches have grass  
Press enter to add another attribute

Model Attributes

The model attributes are:  
The attribute energy-gain-from-sheep is numerical. The attribute describes energy that wolf gets from eating sheep  
The attribute energy-gain-from-grass is numerical. The attribute describes energy that sheep gets from eating grass  
The attribute grass-regrowth-rate is numerical. The attribute describes rate at which grass is regrowing  
The attribute movement-cost is numerical. The attribute describes cost of moving for wolves and sheep  
Press enter to add another attribute

Synthetic Attributes

Press enter to add synthetic attribute

Overview: Process overview and scheduling

Scheduling

1. Perform the action wiggle .
2. Perform the action move .
3. Perform the action check-if-dead .
4. Perform the action reproduce .
5. Perform the interaction eat-grass .
6. Perform the interaction eat-sheep with first partner and select 1 elements from sheep at same spot .
7. Perform the action regrow-grass .

Action wiggle describes the agent changes its heading - turn right then left, so the average is straight ahead  
It can be used of entity any entity , performing the following actions  
Turn randomly between +90 and +90 degrees.  
<options for wiggle >

Action move describes the agent moves which costs it energy  
It can be used of entity any entity , performing the following actions  
Move for a distance of 1 pixels.  
Attribute energy decreases by the amount of movement-cost  
<options for move >

Interaction eat-grass describes sheep eat grass  
The interaction involves a sheep (first partner) and a any environment (second partner), together performing the following activities.  
when grass-amount >= energy-gain-from-grass , then the following activities take place.  
The attribute energy of first partner is incremented by energy-gain-from-grass  
Attribute grass-amount decreases by the amount of energy-gain-from-grass  
<options for eat-grass >

Interaction eat-sheep describes wolves eat sheep  
The interaction involves a wolf (first partner) and a sheep (second partner), together performing the following activities.  
Kill entity second partner  
The attribute energy of first partner is incremented by energy-gain-from-sheep  
<options for eat-sheep >

Action check-if-dead describes when energy dips below zero, die  
It can be used of entity any entity , performing the following actions  
when energy < 0, then the following activities take place.  
Kill entity first partner  
<options for check-if-dead >

Action reproduce describes if this entity has enough energy to reproduce, then transfer energy to the offspring  
It can be used of entity any entity , performing the following actions  
when energy > 200, then the following activities take place.  
Attribute energy decreases by the amount of 100  
create 1 clones of the current entity  
The attribute energy is set to 100  
<options for reproduce >

Action regrow-grass describes regrow the grass  
It can be used of entity any environment , performing the following actions  
The attribute grass-amount is incremented by grass-regrowth-rate  
when grass-amount > 10.0, then the following activities take place.  
The attribute grass-amount is set to 10.0  
<options for regrow-grass >  
<click for options>

press enter to create a function

Design Concepts

Rationales

<press here to unfold rationales>  
<no designConcepts>

Interaction

interaction eat-grass  
interaction eat-sheep  
<no designConcepts>

Stochasticity

attribute grass-amount is initialized with a random value between 0 and 10  
<no designConcepts>

Details: Manual Experiments AKA Initialization

Initialize entities

The initial amount of wolf is 10 with the option to select a value between 0 and 100 with granularity 1  
Entities wolf are on initialisation distributed Random  
Initialization of wolf attributes:  
no attributes here  
The initial amount of sheep is 500 with the option to select a value between 0 and 1000 with granularity 1  
Entities sheep are on initialisation distributed Random  
Initialization of sheep attributes:  
no attributes here

Initialize common attributes

```
The initial value of attribute energy is 180

Initialize environment entities
Environment grass is located initially everywhere

Initialize environment attributes
The initial value of attribute grass-amount is a random value between 0 and 18

Initialize model attributes
The initial value of attribute energy-gain-from-grass is 1.7 with the option to select a value between 0 and 2
with granularity 0.1
The initial value of attribute grass-regrowth-rate is 0.3 with the option to select a value between 0 and 2
with granularity 0.1
The initial value of attribute movement-cost is 0.4 with the option to select a value between 0 and 2 with granularity
0.1
The initial value of attribute energy-gain-from-sheep is 3.5 with the option to select a value between 0 and 18
with granularity 0.1

Appearance
The size of the world for the simulation is 17
In the simulation the pixel size is 15
The world should wrap horizontally true and vertically true
The simulation uses the background colour press enter to select color

Simulation end
Any of the following conditions end the simulation:
No entity is wolf.
```

Details: Input

press enter and describe the model input. press enter to get new line>

Details: Submodels

press enter and describe the submodels. press enter to get new line>

Experiments

Press enter to show experiments