Computational Physics Group Project: Ecosystem: predator and prey

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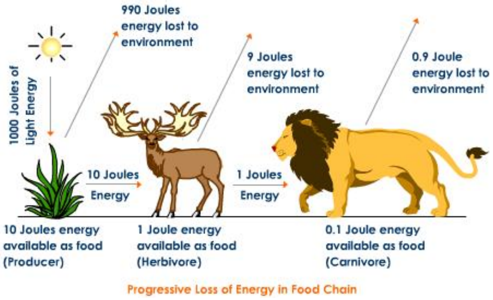
Population interaction of predator and prey in eco-system



1000 Joules of Light Energy
990 Joules energy lost to environment
9 Joules energy lost to environment
0.9 Joule energy lost to environment
10 Joules Energy
1 Joules Energy
10 Joules energy available as food (Producer)
1 Joule energy available as food (Herbivore)
0.1 Joule energy available as food (Carnivore)
Progressive Loss of Energy in Food Chain

Figure : default

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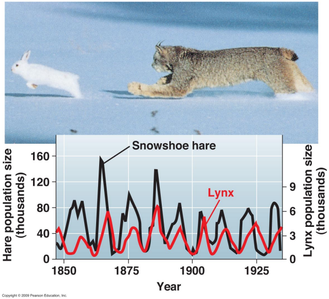

Figure : http://www.anselm.edu/homepage/jpitocch/genbi101/ecology1intropops.html

A simplified determinsitic mode: L-V equation

Simulation of a eco-system with predator and prey

A simulation keep the essential nature of the interaction between and within the species, and predict the evolution of population step by step.

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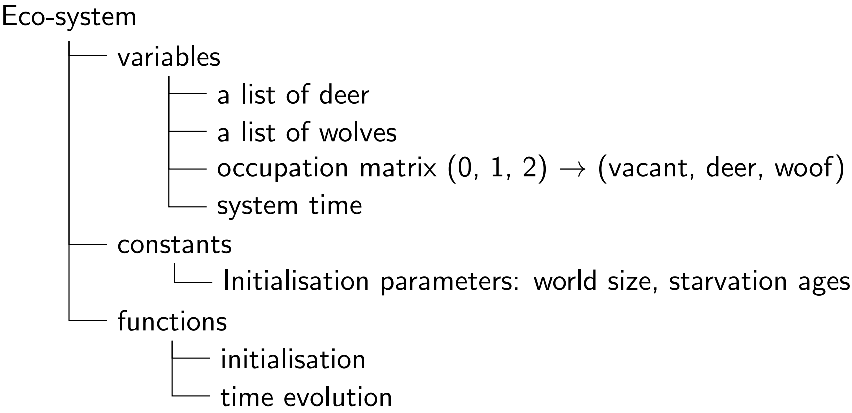
- Predator and prey will die out if maximum age is reached or starved for enough long time
- However, simulation is a random process and change the deterministic nature of LV equation (more realistic).

Structural setup

Animal Class → Deer/ Wolf

- variables
  - presentation position
  - previous position
  - reproducing age variable
  - starving age variable
- constants
  - starvation age
  - reproduction age
- functions
  - check status: live/dead
  - check maturity: procreate/not

Structural setup



- Eco-system
  - variables
    - a list of deer
    - a list of wolves
    - occupation matrix (0, 1, 2) → (vacant, deer, woof)
    - system time
  - constants
    - Initialisation parameters: world size, starvation ages
  - functions
    - initialisation
    - time evolution

Initialisation

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- Reproduction age of predators must be larger than their starvation age. (Or else wolf can sustain themselves ...)
- Starvation age of the deer is extremely large. (Always enough plants!)

time evolution (All things are done serially!)

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- Step5: go back to Step1 and increase system time by 1

parameter scanning

Parameter Search

5 parameters to test (5-D parameter space)

- **Initial population of deer**
- **Initial population of wolves**
- Reproduction age of deer
- Reproduction age of wolf
- Starvation "age" of wolf

Reduce to 4 dimensions (4-D)

- **Ratio of initial populations : Size of point**
- Reproduction age of deer : x-axis
- Reproduction age of wolf : y-axis
- Starvation "age" of wolf : z-axis

Results of Full Parameter Search

Results of Restricted Parameter Search

Fix initial population ratios

Ecosystem at Equilibrium

Parameters used: ....