

# BioSim parameter- and function descriptions

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## Animals

Herbivores and Carnivores share the same parameters (excepting *DeltaPhiMax* which only applies to Carnivores, see section regarding the parameter for more information).

## Weight

### w\_birth & sigma\_birth

When calculating the birthweight of a new animal, the species' *w\_birth* and *sigma\_birth* are used.

$$\mu = \log \left( \frac{w_{\text{birth}}^2}{\sqrt{\sigma_{\text{birth}}^2 + w_{\text{birth}}^2}} \right)$$
$$\sigma = \sqrt{\log \left( 1 + \frac{\sigma_{\text{birth}}^2}{w_{\text{birth}}^2} \right)}$$

The newly calculated values are then used in a log-normal function in order to draw randomly distributed samples of the new animals birthweight.

### w\_birth & sigma\_birth & zeta & xi & gamma

In addition to calculating the birthweight, *w\_birth* and *sigma\_birth* are used along with *zeta* in order to calculate the weight threshold for an animal to give birth. If this condition is not met, the animal will not give birth.

$$\text{weight} \geq \text{zeta}(w_{\text{birth}} + \text{zeta}_{\text{birth}})$$

When an animal gives birth, it loses weight.

$$\text{weight} -= \text{xi} \times \text{baby weight}$$

An animal may only give birth if is able to lose this weight (its weight cannot be negative).

The probability of producing offspring is also dependent on its *gamma*. The animal may in addition only give birth with a probability of the sum of its fitness and *gamma*.

### beta

When an animal eats, it gains weight accordingly

$$\text{weight} += \text{beta} \times \text{food eaten.}$$

### eta

Each year the animal loses weight accordingly

$$\text{weight} -= \text{eta} \times \text{weight.}$$

## Fitness

### **phi\_age & a\_half & phi\_weight & w\_half**

The animals fitness is calculated as

$$\Phi = \begin{cases} 0 & w \leq 0 \\ q^+(a, a_{\frac{1}{2}}) \times q^-(w, w_{\frac{1}{2}}) & \text{elsewhere} \end{cases}$$

where  $q^{\pm}$  is calculated by

$$q^{\pm}(x, x_{\frac{1}{2}}, \phi) = \frac{1}{1 + e^{\pm\phi(x - x_{\frac{1}{2}})}},$$

substituting  $x$  with *phi\_age* and *a\_half* for  $q^+$  and with *phi\_weight* and *w\_half* for  $q^-$ .

## Movement

### **mu & F**

The movement of an animal depends on multiple factors. The first being a probability calculated as *mu* times the animals fitness. In addition, if this is satisfied, an animal may still be static. The additional probability is calculated by

$$\text{abundance} = \frac{\text{food available}}{(N + 1) \times F},$$

where  $N$  is the number of animals of the same species in the cell,  $F$  is the amount of fodder an animal tries to eat every year.

The propensity is then calculated for each of the possible cells the animal may move to by

$$\pi = \exp(\text{abundance})$$

and the probability of moving to the selected cell

$$\text{probability} = \frac{\pi_{i=\text{selected}}}{\sum_{i=1}^4 \pi_i}$$

If  $\pi$  is 0 for all the neighboring cells, the probability of movement is set at 50%.

### **stride**

The number of cells an animal moves per year.

### **Highland & Lowland & Desert & Water**

The terrain-types the animal may move to (*True* for the movable types and *False* otherwise).

## Death

### **omega**

An animal may die. The probability of death is calculated as

$$\text{probability} = \text{omega}(1 - \text{fitness}).$$

## DeltaPhiMax

When a carnivore tries to eat a herbivore, it compares the herbivores' fitness to its own. If this difference is below *DeltaPhiMax*, the probability of killing that herbivore is

$$\text{probability} = \frac{\text{difference}}{\text{DeltaPhiMax}}$$

## Island

There are also some parameters that refers to the island as a whole. These parameters describe the growth of fodder in the different landscape types. The following section describes what changing these parameters affect.

## Fodder

### Highland & Lowland & Desert & Water

Describes the amount of available fodder in the selected terrain-type. See section on eating (under 'Weight') for information about how the available fodder is used.

### alpha & v\_max

The regrowth of fodder in a cell is determined by the factors *alpha* and *v\_max* through the equation

$$\text{available\_fodder} = \min \left[ \text{current\_fodder} + v\_max \left( 1 - \frac{\text{alpha}(f\_max - \text{current\_fodder})}{f\_max} \right), f\_max \right]$$

where *f\_max* is the value set in the previous section.