
Mathematical Ecology (Single Species)

What is Ecology?

- Ecology is the study of

- Ecologist are interested in

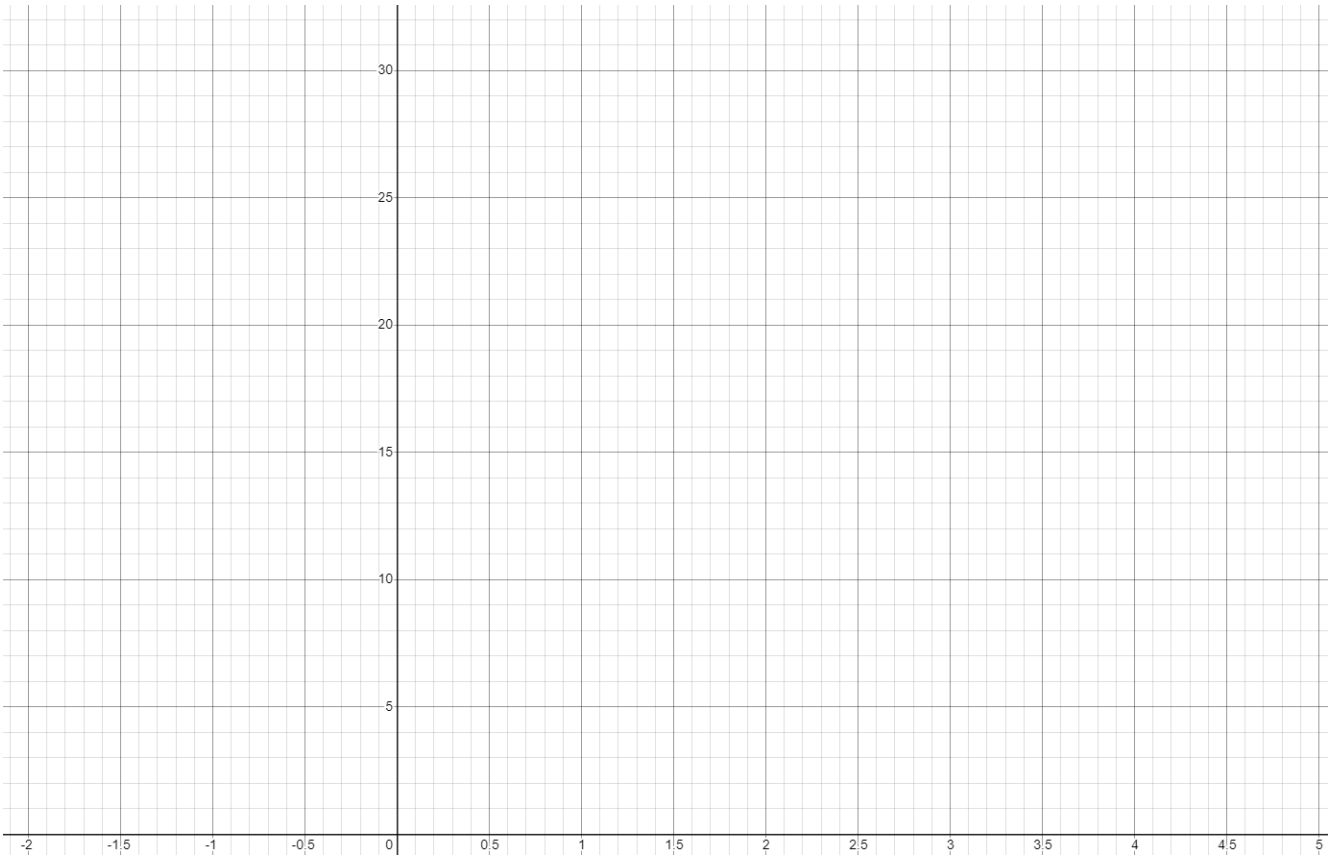
Therefore, Mathematical Ecologists use techniques from mathematics to

The simplest population model is

What is exponential growth?

- **Biology Definition**: A population grows exponentially if

Example:



In mathematics, we describe exponential growth in much of the same way.

We write

The equation for exponential growth with rate $r > 0$ is given by

The parameter r dictates the growth rate of the population.

The function $P(t)$ which changes according to the above equation is

$$P(t) =$$

Question: Suppose a population has 100 individuals at $t = 0$. If the change in population is given by $\frac{d}{dt}P(t) = \frac{1}{10}P(t)$, determine the population at time $t = 10$.

Exponential growth is not applicable to many ecological systems, for example, it cannot capture

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Goal:

Let $P(t)$ denote the population of sheep in a field, and let K denote

If there are no sheep, how does the sheep population change?
Mathematically:

If there are some sheep, but not too many, how should the sheep population change?
Mathematically:

If there too many sheep, how should the sheep population change?
Mathematically:

If the sheep population is exactly at its capacity, what should happen to the population?
Mathematically:

Putting all of this together, we seek a function $f(P(t))$, where $\frac{d}{dt}P(t) = f(P(t))$, and

- $f(0) =$
- $f(K) =$
- $f(P(t)) > 0$ if
- $f(P(t)) < 0$ if

Use the remaining space for calculations