

Population growth in a limited environment

Geometric increase of population size cannot continue forever. A population will eventually approach the limits of its environment: the food supply will dwindle, space will decrease, disease will become more prevalent in crowded conditions. In a limited environment, a model of population growth widely used by ecologists is the S-shaped growth curve given by

$$N_t = N_0 k / (N_0 + (k - N_0) q^t),$$

where:

N_t is the population's size at time t ,

N_0 is the population's initial size at time $t = 0$,

k is the "carrying capacity", or maximum population size that can be sustained,

q is a rate constant between 0 and 1 that determines how fast the population approaches carrying capacity. If q is near 1, growth toward carrying capacity is **slow**, while if q is near 0, the approach to carrying capacity is **fast**.