How many can the habitat support?

Carrying capacity, K, is the largest population of a particular species that an environment can sustain over time under its current resource and habitat conditions.

1. N IS THE COUNT; K IS THE SUSTAINABLE LIMIT



Illustrative logistic approach to a constant K. Growth slows as resources become limiting. A wild population need not follow this smooth curve.

2. RESOURCES SET THE CONTEXT

Food, water, suitable space and shelter can restrict how many individuals persist. As a population becomes crowded, competition may reduce reproduction or survival. The relevant limit depends on the species: nesting cavities can constrain one bird while food limits another.

Near K, a population can have little net change even though individuals are born and die. In a closed population, births roughly balance deaths. K is not the highest count ever observed and is not a fixed number shared by every species in a habitat.

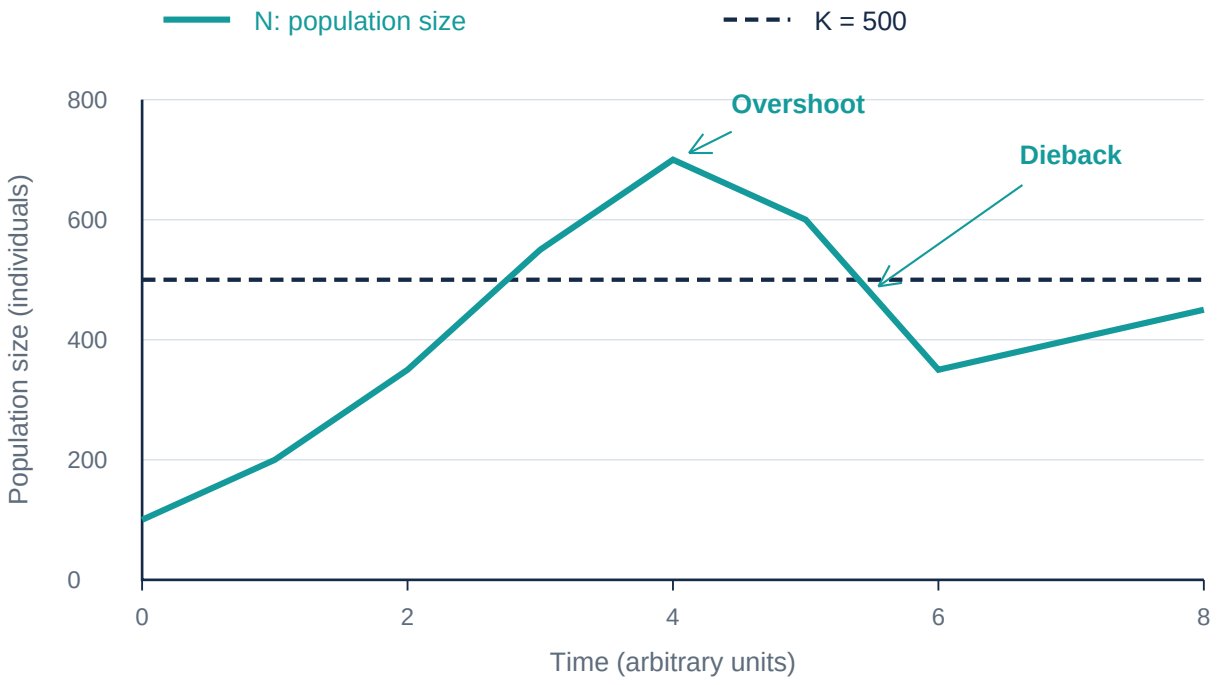
Carrying capacity and logistic growth: OpenStax, Biology 2e 45.3.
Competition and population regulation: OpenStax, Biology 2e 45.4.

Scope: College Board AP Environmental Science CED, Topic 3.4, p. 68.

Overshoot can lead to dieback

Overshoot occurs when population size exceeds carrying capacity: N > K. A population can exceed a sustainable limit temporarily, but the excess demand can deplete resources.

1. IDENTIFY THE OVERSHOOT AND THE DECLINE



Invented example with K held at 500. The peak of 700 is not K. The later fall is a dieback; a decline alone does not prove that overshoot caused it.

2. TRACE THE RESOURCE FEEDBACK

Demand exceeds renewal → Resources become depleted → Survival or reproduction falls

Food shortages can cause starvation, increase vulnerability to disease and intensify conflict over scarce resources. Dieback may be severe. Delayed responses allow overshoot, while damage to vegetation or habitat can also reduce future carrying capacity.

Overshoot, resource depletion and dieback: College Board, ERT-3.D-E.
Growth and environmental limits: OpenStax, Concepts of Biology 19.2.

Scope: College Board AP Environmental Science CED, Topic 3.4, p. 68.

The limit can change before the count

Drought, habitat loss or resource recovery can change carrying capacity. A population may become too large for the new conditions even without an increase in its numbers.

1. FOLLOW AN ILLUSTRATIVE DROUGHT

Condition	Before drought	Just after drought
Carrying capacity, K	500	300
Population size, N	450	450
Comparison	N < K	N > K

Assume reduced plant growth lowers food supply immediately; animal numbers have not yet responded. The population is now above the new K.

2. CALCULATE EXCESS RELATIVE TO THE NEW K

Excess = 450 - 300 = 150 individuals

$$\frac{150}{300} \times 100 = 50\% \text{ above carrying capacity}$$

3. DISTINGUISH POPULATION CHANGE FROM CAPACITY CHANGE

A storm might kill individuals without permanently changing resource supply: N falls, but K need not. If the storm destroys habitat or drought reduces food production, K may fall too. Resource recovery can raise K again, but the population response can lag behind.

To explain a graph, identify N and K, locate any period with N > K, and name the resource evidence. A single population count cannot establish carrying capacity or the cause of a decline.

Resource supply and changing K: OpenStax, Biology 2e 45.3.
Disturbance and population responses: OpenStax, Biology 2e 45.4.

Scope: College Board AP Environmental Science CED, Topic 3.4, p. 68.