

# Carrying capacity

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## Pre-reading.

1. How would you define carrying capacity? Order the definition.

can the size the that indefinitely population the species of sustain environment

2. What do animal species and humans need for survival?
3. Try to explain these terms:

population density

birth rate

death rate

fluctuation

equilibrium

domino-like effect

4. What is the relation between population density, birth rate, and death rate?

As population density ....., birth rate.....and death rate.....

5. What is the difference between the birth rate and the death rate?

6. Below carrying capacity, populations .....while above they.....

7. Do you know what CARCAP means?

Go through the text and check your answers.

The **carrying capacity** of a biological species in an environment is the population size of the species that the environment can sustain indefinitely, given the food, habitat, water and other necessities available in the environment. For the human population, more complex variables such as sanitation and medical care are sometimes considered as part of the necessary establishment.

As population density increases, birth rate often decreases and death rate typically increases. The difference between the birth rate and the death rate is the "natural increase". The carrying capacity could support a positive natural increase, or could require a negative natural increase. Thus, the carrying capacity is the number of individuals an environment can support without significant negative impacts to the given organism and its environment. Below carrying capacity, populations typically increase, while above, they typically decrease. A factor that keeps population size at equilibrium is known as a regulating factor. Population size decreases above carrying capacity due to a range of factors depending on the species concerned, but can include insufficient space, food supply, or sunlight. The carrying capacity of an environment may vary for different species and may change over time due to a variety of factors, including: food availability, water supply, environmental conditions and living space.

The term "CARCAP" comes from its use in the shipping industry to describe freight capacity, and a recent review finds the first use of the term in an 1845 report by the US Secretary of State to the Senate (Sayre, 2007).

## Carrying Values

Fill in the missing words.

drastic	selection	statistically	temporarily
fluctuation	gradual	unknown	consequences

It is possible for a species to exceed its carrying capacity 1..... Population variance occurs as part of the natural 2..... process but may occur more dramatically in some instances. Due to a variety of factors, one determinant of carrying capacity may lag behind another. For example, a waste product of a species may build up to toxic levels slower than the food supply is exhausted. The result is a 3..... in the population around the equilibrium point which is 4..... significant. These fluctuations are increases or decreases in the population until either the population returns to the original equilibrium point, or a new equilibrium is established. These fluctuations may be more devastating for an ecosystem than are 5..... population corrections, because, if they produce 6..... decreases or increases, those may affect other species in the ecosystem and they may begin to move with statistical significance around their own equilibrium points. The fear is of a domino-like effect, where the final 7..... are 8..... and may lead to collapses of species or even whole ecosystems.

## Humans

Scan the text and decide whether the statements are true or false. Correct the false ones.

1. Many scholars criticized the concept of carrying capacity because it did not reflect the complexity of the problem.
2. Many scholars criticized the concept of carrying capacity because it blamed wrong people or animals.
3. External forces cannot trigger environmental change.
4. Relationship of humans to the environment is the same as the relationship of other species to their environment.
5. The humans can both increase and decrease the productivity of land.
6. The concept of carrying capacity applies to both humans and animals.
7. The calculation is accurate when humans eat less than they need.
8. The carrying capacity is reached when X equals Y.
9. If one wants a house, it means he does not want to eat.

- 10. Commerce based on money changed local human carrying capacity.**
- 11. Purchases of goods do not influence distant areas.**
- 12. Ecological footprint compares human demand with planet Earth's ecological capacity to regenerate.**
- 13. Carrying capacity divides the blame for the impacts between the rich and poor.**
- 14. The poor are blamed for having too many children.**
- 15. This kind of discussion answers the questions related to overexploitation.**

In the words of one researcher: "Over the past three decades, many scholars have offered detailed critiques of carrying capacity—particularly its formal application—by pointing out that the term does not successfully capture the multi-layered processes of the human-environment link, and that it often has a blame-the-victim framework. These scholars most often cite the fluidity and non-equilibrium nature of this relationship, and the role of external forces in influencing environmental change, as key problems with the term."<sup>[3]</sup>

In other words, the relationship of humans to their environment may be more complex than is the relationship of other species to theirs. Humans can alter the type and degree of their impact on their environment by, for instance, increasing the productivity of land through more intensive farming techniques, leaving a defined local area, or scaling back their consumption; of course, humans may also irreversibly decrease the productivity of the environment or increase consumption.

Supporters of the concept argue that humans, like every species, have a finite carrying capacity. Animal population size, living standards, and resource depletion vary, but the concept of carrying capacity still applies.

Carrying capacity, at its most basic level, is about organisms and food supply, where "X" amount of humans need "Y" amount of food to survive. If the humans neither gain nor lose weight in the long run, the calculation is fairly accurate. If the quantity of food is invariably equal to the "Y" amount, carrying capacity has been reached. Humans, with the need to enhance their reproductive success, understand that food supply can vary and also that other factors in the environment can alter humans' need for food. A house, for example, might mean that one does not need to eat as much to stay warm as one otherwise would. Over time, monetary transactions have replaced barter and local production, and consequently modified local human carrying capacity. However, purchases also impact regions thousands of miles away. For example, carbon dioxide from an automobile travels to the upper atmosphere. This led Paul R. Ehrlich to develop the IPAT equation: Ehrlich and Holdren 1971

$$I = P * A * T$$

where:

- I* is the impact on the environment resulting from consumption
- P* is the population number
- A* is the consumption per capita (affluence)
- T* is the technology factor

This is another way of stating the carrying capacity equation for humans which substitutes impact for resource depletion, adding the technology term to cover different living standards. As can be seen from the equation, money affects carrying capacity - but it is too general a term for accurate carrying capacity calculation.

The concept of the "ecological footprint" was developed to examine differential consumption by humans. By calculating the average consumption of humans over a small area, projections can be made for that type of population's impact on the environment.

Carrying capacity 'averages' the blame for these impacts by blaming the rich for using too many resources, as well as blaming the poor for being too numerous. Carrying capacity calculates the 'average' use of food and resources, which of course is closer to the billions of poor in the world than to the hundreds of billionaires.

This type of discussion raises the question of whether or not it is possible to define a measure of sustainability which does not already contain implicit assumptions about solutions to the problems of resource over-exploitation and environmental degradation.

**Word study:**

**Try to find words of the opposite meaning.**

**Drastic x .....**

**Detailed x .....**

**External x .....**

**Complex x .....**

**Upper x .....**

**Close x .....**

**General x .....**

**Implicit x .....**

**Finite x .....**

**Intensive x .....**