

Dr McConeghy's Environmental Science

## Carrying Capacity

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Text Definition:

"The maximum number of individuals of a given species that can be supported..on a sustainable basis. "

An organism in balance with its carrying capacity can be maintained indefinitely. If the number of individuals in the population is less than the number allowed by the carrying capacity, then the population can survive forever. But if the population is greater than the carrying capacity, or if something happens to unbalance the system, then resources have to be used up, and the population will suffer. They will eventually destroy themselves. In Nature there are numerous examples where this has happened. For business people, this would be equivalent to saying that if expenses are greater than revenue, you would have to expend capital assets to cover your costs -- sometimes this can be tolerated for a short time, but everyone understands that it cannot go on for long!

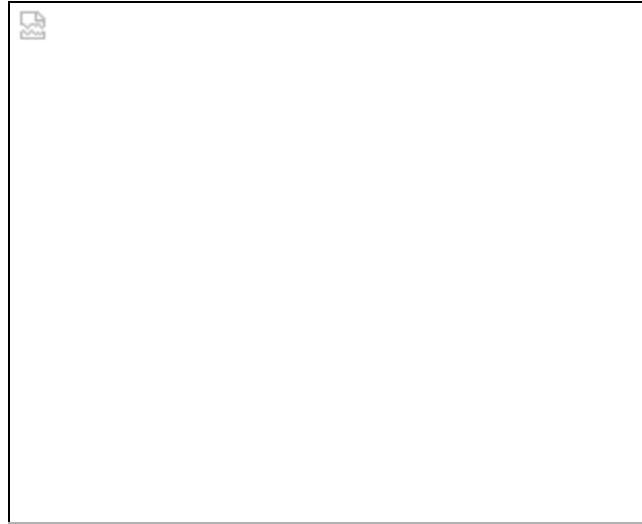
Just as a business can damage or improve the assets it owns, we can change the carrying capacity of the earth in various ways. Either positive, or negative.





Ireland and  
New Mexico

...



In class we talked about carrying capacity of cows on two ranches. That's all very well, but

*The real point is, what is the carrying capacity of Earth?*

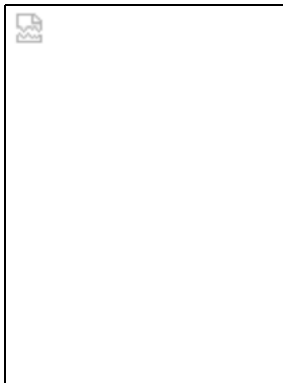
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*Can Earth hold an infinite number of people?*

If you agree that the capacity of the Earth is big, but finite, then we can ask the next question: "How many people can the Earth hold?" That is not an easy question to answer.

We know that the Earth has well over 6.4 billion people in the year 2005.

How many can the Earth hold?

*How many people can the Earth hold?*



We don't want to know how many people you can crowd on to the Earth. What we want to know is, how many people can you fit on the Earth without damaging the Earth! If we crowd too much, then the Earth will be damaged, and the ability of the Earth to support us will be decreased. Life will get worse. After a while humans might decrease in number, or even die out completely! On the other hand, if we find the right number, the number that is not too crowded, then we will be able to support that many people on Earth for a very long time -- the human community will be able to survive comfortably for 1000s of years.

The number of individuals who can survive indefinitely without damaging the environment, is called the "Carrying Capacity." We would like to know, "What is the Carrying Capacity of Earth?"

Is 6 billion a good number, or is it too many people? Or, is it too small, too pessimistic -- could we have 10 billion or 20 billion?

*Can we calculate the Earth's Carrying Capacity?*

After looking at the amount of supplies on the Earth -- how much water, food, etc. -- some scientists have calculated that the Earth can hold 40 billion people. Some other scientists looked at the

same numbers and calculated that the Earth could hold only 2 billion people.

It seems like they ought to be able to agree better than that! And anyway, how can they say that we can only hold 2 billion, when we already have 6 billion. What kind of sense does that make?

They are thinking about carrying capacity.

Humans need air, water, food, and sometimes shelter. Just about everything else is optional.

To meet basic human needs, a person could survive for a year on

- about 400 kilograms (liters) of water that is not very dirty or salty
- about 300 kilograms of food, mostly grain such as rice, or bread
- a shelter that maintains a temperature above freezing in winter

But, for Humans who have the choice to live a modern life style in the 21st century, the "optional" includes a lot of material goods, and especially, a lot of energy in the form of electricity and petroleum products.

To live a typical 2005 lifestyle in Rhode Island, USA, every year we provide for an average person:

#### *What Do We Need?*

- 100,000 kilograms(liters) of very clean water,
- 1000 kilograms of food, including a lot of meat and exotic food such as oranges, etc. that cannot be produced here in RI.
- 500 - 1000 kilograms of gasoline for transportation, imported.
- the equivalent of another 1000 - 2000 kilograms of gasoline in the form of electricity, imported or made from imported fuel
- tons of other industrial supplies such as sulfuric acid, steel, cement, commercial packaging, copper wire, industrial cleaning agents, plastics and other resins, cement, petroleum based dyes, glues and fabrics, etc., etc. Nearly all of this must be imported from outside RI.
- disposal systems that handle tons of solid waste, and clean and recycle a vast amount of dirty, unsanitary water for each person in the state.

#### *2 billion or 40 billion?*

When scientists say that the carrying capacity of the Earth is 2 billion, they are not forgetting that we have 6 billion already. What they are saying is, that if you add up all the supplies in the world, and divide them up according to the amount that a typical American uses, then there is only enough for 2 billion people. If we

have 6 billion people, the amount of fuel, water, electricity, etc. is just not enough to go around. Some people are going to be left out. We know that this is the case because, as we said in class, only about 1.2 billion people live in MDCs while the other 4.8 billion people have to make do with less.

When some scientists say that the carrying capacity of Earth is 40 billion, then they are saying that IF the rich people would give up all their luxuries such as cars, electricity, education, clean water, meat etc. then that would allow us to provide minimum amounts of supplies to a much larger number of people. In fact, they say, we could provide minimum supplies to 40 billion people IF no one lived a luxury modern life style like the average Americans of 2001.

We can change the carrying capacity of Earth in two obvious ways:

First, **if we damage the Earth**, by polluting the rivers, eroding the topsoil, chopping down the forests, etc. then the ability of the Earth to support us will be destroyed -- Earth's carrying capacity will be lessened. For instance, if we lose our farms because of erosion, then we will be able to grow less food. Fewer people will be supported.

Second, **if we conserve the Earth**, clean up pollution, and apply our skills and knowledge to finding less damaging ways of living, then the carrying capacity could be increased. For instance, suppose we prevent pollution of our water, and clean up water that is already polluted. Then our farmers will be able to grow more food. More people can be supported.

*Can we change the Carrying Capacity of Earth?*

If the population grows, then there will be less for everyone. Those of us in the USA who enjoy the benefits of a rich life style might have to be satisfied with less. Is there any way to avoid this? In fact, we would like to maintain our wonderful lifestyle, and also allow other people to live better as well. In order to do that, we have try to increase carrying capacity.

Technology can increase carrying capacity in many ways, if we use it wisely. For instance:

- if we have a limited amount of gasoline, we can build cars that will get better gas mileage. If each car uses less gas, then we can have more cars and use only the same total amount of gas.
- Or, if we increase the number of telephones by using old-fashioned standard phones we will need many, many miles of wire to connect all those phones. The copper for the wire will have to be dug out of the ground in mines that use a huge amount of fuel and cause tons of pollution to be

*Will we have to give up our modern life style?*

created. On the other hand, if we use wireless cell phones, we don't need wires, and we can save all that fuel and pollution. Of course, we have to check to make sure that wireless phones don't cause any harm...

- Or, if we use new kinds of plants that have been genetically engineered for growth in dry climates, resistance to disease, or increased nutrition, then we can grow the plants in new farms, without the use of pesticides, and get a better crop. (On the other hand, we will have to be careful that these new plants don't cause harm to the environment themselves!)

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