



Population increase

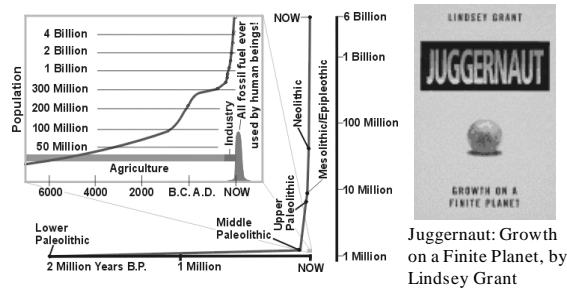
- Reproduction is one of the few basic things all species must do to survive, therefore, most are good at it.
- Populations, left unchecked, can increase exponentially.
- Predation, competition, limited resources, disease, or other forms of mortality usually keep natural populations from growing exponentially
- Competitively-superior populations freed from normal mortality grow exponentially until they reach (or exceed) the carrying capacity of their environment, at which point their numbers stabilize or decline, in the process driving less-competitive species to extinction. (Competitive exclusion hypothesis)
- Any species come to mind?

Human population through time

- Talking about human population growth makes some people uneasy because of various personal, cultural, environmental, and social aspects.
- It concerns sometimes sensitive topics such as sex, family planning, religion, relief aid, and environmental concerns.
- Today, we'll talk a little about ecological aspects of human population growth
- We'll cover large-scale issues of human population growth, i.e., talk about billions of people as though they are numbers, but we need to realize the sense of pride, joy, and accomplishment that new babies bring families and that each of the "billions" that we'll talk about is an important individual just like you and me.
- Because we're taking a global perspective, immigration and emigration will be ignored

Human Population

- Today's population is about 6,579,762,451 and growing at >2 per second



An exercise in logic

- Sustained positive exponential growth eventually leads to an infinite number of individuals.
- Infinite numbers require infinite resources.
- Earth is finite.
- Therefore, Earth cannot support sustained positive exponential growth.
- There are two ways to reduce global population growth
 - decrease birth rates
 - increase death rates
- Which approach do you think we should take?

Earth's human carrying capacity

- depends LARGELY on the life-style member's of the population want to have. Will the population consist of the wasteful American lifestyle or the rice and water subsistence lifestyle?
- First estimate made by Antoni van Leeuwenhoek in 1679 as 13.4 billion. Since then, estimates have gotten more variable, ranging from <1 billion to >1 trillion.
- Very difficult to predict Earth's carrying capacity because it depends on multiple, often interacting, moving factors. It seems simple enough to divide the total amount of the most limiting resource (Law of the minimum) by the individual requirement for that resource.
- However, each birth represents a new set of hands as well as a new mouth to feed, carrying capacity can change as populations change
- Most reputable scientists put the earth's human carrying capacity at 10 ± 3 billion
- Other important consideration...how much of earth's surface should be allocated to non-human species?

Are we living sustainably? How do you know when you are not?

- Once growth surpasses sustainable yield (interest), the resource base (principle) begins to dwindle.
- Mankind behaves towards the environment much the same way as young people behave towards their finances (they expect salary to increase in the future), not the way retired people treat their finances (fixed income). I would argue that we should behave like the retired when it comes to environmental matters, given the potential for additional resources is slim (exceptions might include fusion, desalination, or biologically-engineered photosynthetic people, colonizing other planets, and other far-out technologies).
- Exceeded sustainable yield of freshwater: some rivers don't reach the sea, countries have to import grain b/c there's not enough water, aquifers are declining. Where does Denver's water come from? Water no longer flows downhill...

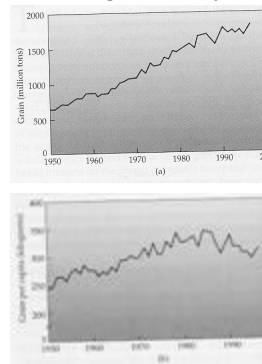
or have we passed the carrying capacity?

- Exceeding sustainable yield of fisheries...
- Crop productivity is pretty much maxed, but cropland/topsoil is declining...erosion > soil formation.
- What will happen as the human population continues to grow as the resource base declines?
- CO₂ emissions outstripping nature's ability to absorb it...
- Rangelands over-grazed...
- 1,000/9,000 birds in trouble
- 1,100/4,400 mammals in trouble, including half of 232 primates
- 33% of fish in trouble, including 37% in NA, 42% in Europe, 67% in S Africa, 68% of semi-arid MX

Thomas Malthus

- Populations grow exponentially, but resources just arithmetically
- this prediction has been wrong for the last 2 centuries but fails to point out that it is becoming correct over the last couple decades, and that the current population size has been accomplished in non-sustainable manners
- "Positive checks" such as disease and famines check populations.
- "Preventative checks" include all factors that reduce human births
- "Moral restraint", including late marriage and celibacy until one can afford kids

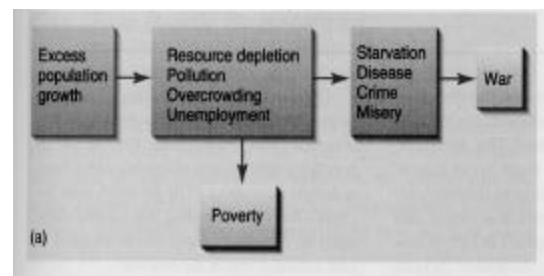
Hunger likely to increase in future



Thomas Malthus

- Malthus believed people were too immoral or lazy to voluntarily regulate births.
- He therefore opposed welfare and aid to the needy, believing it just encourages them to have more babies they can't feed.
- Neo-Malthusians believe the way to solve the world's problems is by making birth control our highest priority

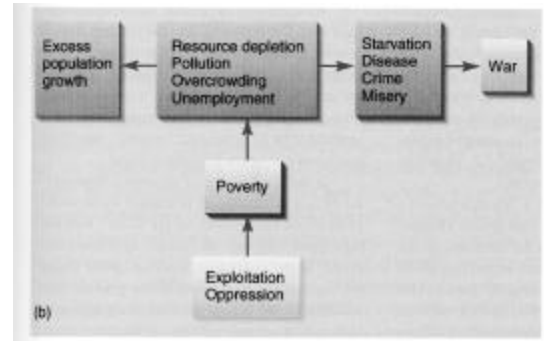
Malthus model



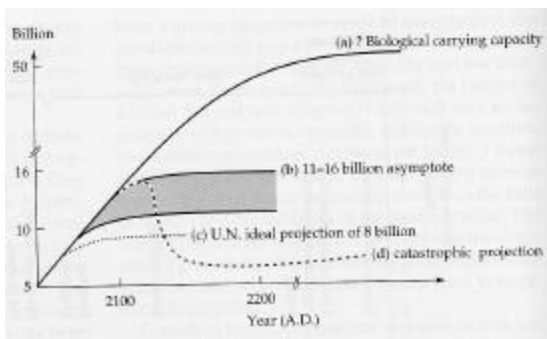
Karl Marx view of human population

- Believed population growth was the result of exploitation and oppression, and the only way to reduce growth was through social justice.
- Neo-Marxians believe the way to solve the world's problems by alleviating oppression and poverty through social justice and technological advances

Marx model



What does the future hold? UN predictions



Summary

- During last 3 centuries, declining death rates are more responsible for increased population size than are birth rates
- Fertility rate - # babies/woman - has dropped from 6.1 to 3.3 in last 20 years
- ZPG (zero population growth) or replacement level of fertility. 2.1 kids (at current death rates!!!)
- On the surface, it seems somewhat ironic that countries having the most babies are the ones least able to feed them

Who's your neighbor. Out of 1000 people....

- Ethnicity: 385 E. Asian, 209 S. Asian, 129 African, 91 Europeans, 78 Latin America, 52 USSR, 51 USA, 5 Oceania
- 500 speak 1 of 6 major world languages, the rest speak 1 of 6000 other languages
- Every year, 26 are born and 9 die. 3 of deaths are in kids < 5yo, 1 heart disease, 1 cancer, 2 from acute lung disease, 2 from violence, accidents, and misc diseases
- Average income is \$3,800. >500 earn \$580, while 100 earn \$22,000
- Richest 200 control and consume 80% of resources

Who's your neighbor. Out of 1000 people....

- Half of the 620 adults are illiterate.
- 500 females do 2/3 of manual labor, receive 1/10th the wages, and own < 1% property
- 400 are ill at any one time
- 200 don't have clean water
- 150 are chronically hungry
- 452 live in a village
- 548 live in countryside
- 900 have access to television
- <10 have a computer