

Population, Resources, Environment

Stevan Harrell

ANTH 461

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What do we Need to Know about Population?

- How has the world's population grown through history?
- What determines population growth?
- What drives population growth?
- How do population growth and density vary in different kinds of societies?
- How does population growth affect the environment?
- What does the future look like?

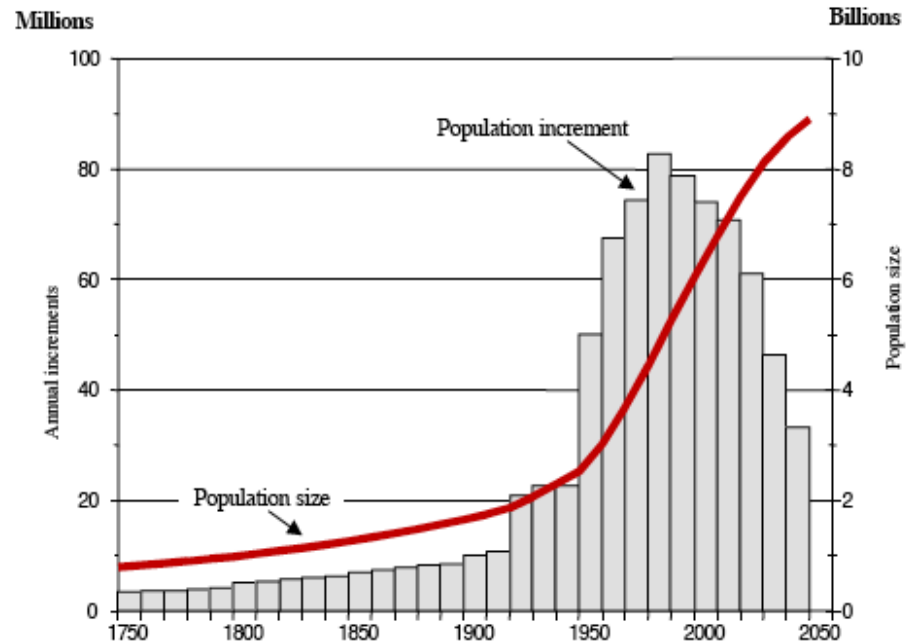
How has the world's population grown through history?

TABLE 1. WORLD POPULATION, YEAR 0 TO NEAR STABILIZATION

Year	Population (in billions)
0	0.30
1000	0.31
1250	0.40
1500	0.50
1750	0.79
1800	0.98
1850	1.26
1900	1.65
1910	1.75
1920	1.86
1930	2.07
1940	2.30
1950	2.52
1960	3.02
1970	3.70
1980	4.44
1990	5.27
1999	5.98
2000	6.06
2010	6.79
2020	7.50
2030	8.11
2040	8.58
2050	8.91
2100	9.46
2150	9.75
Near stabilization (after 2200)	Just above 10 billion

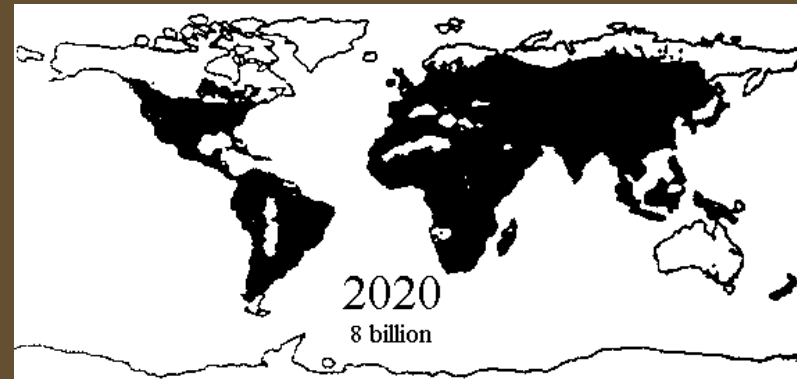
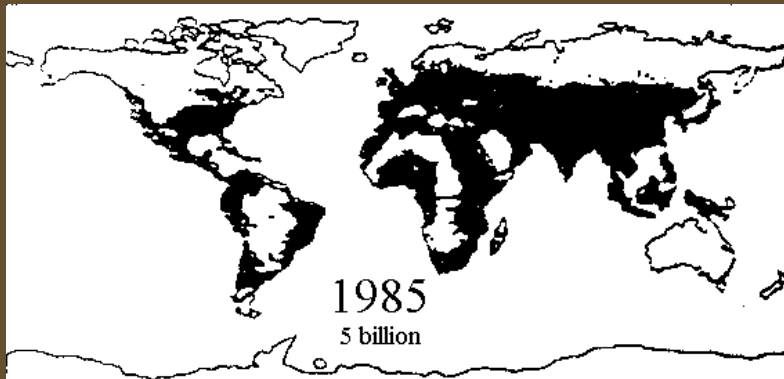
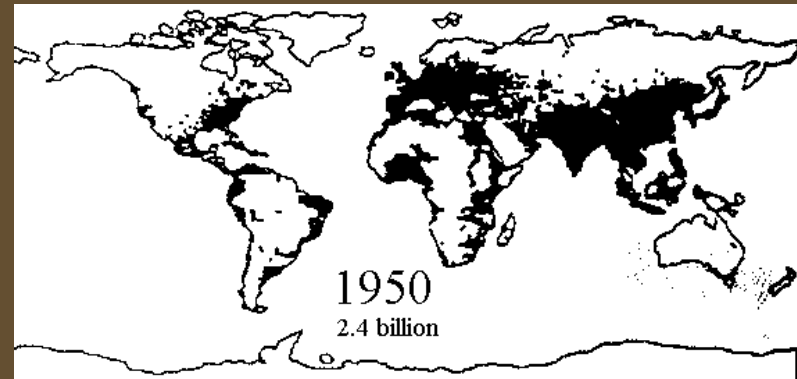
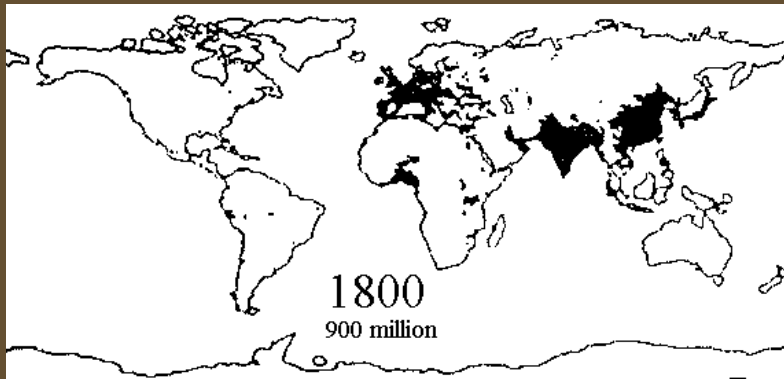
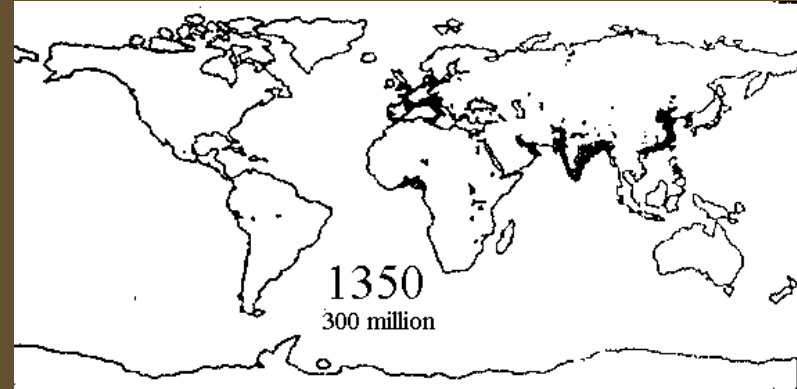
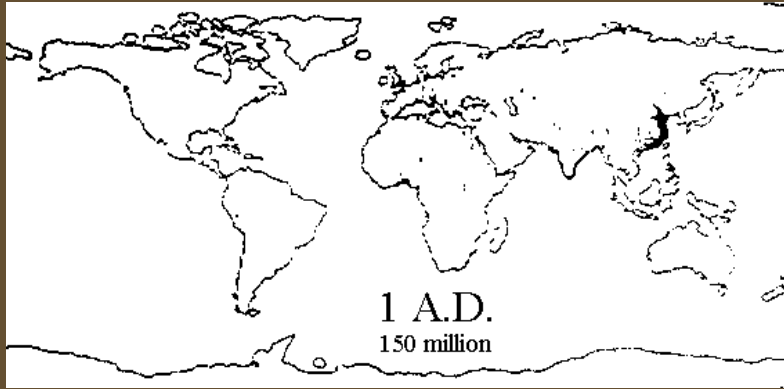
Source: United Nations Population Division.

Figure 1. Long-term world population growth, 1750 to 2050



Source: United Nations Population Division.

How has the world's population growth through history?



What determines population growth?

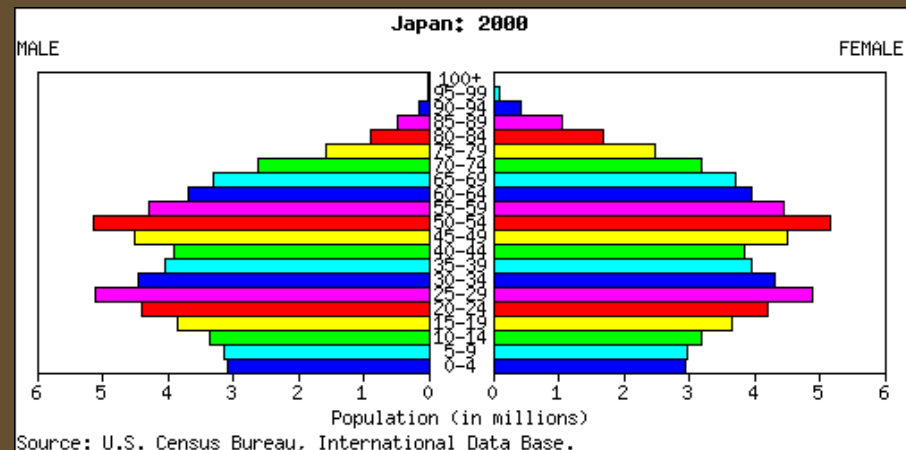
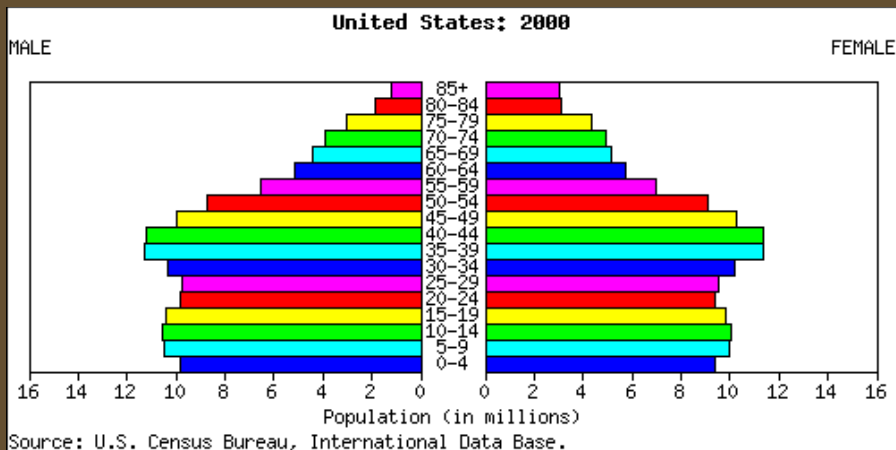
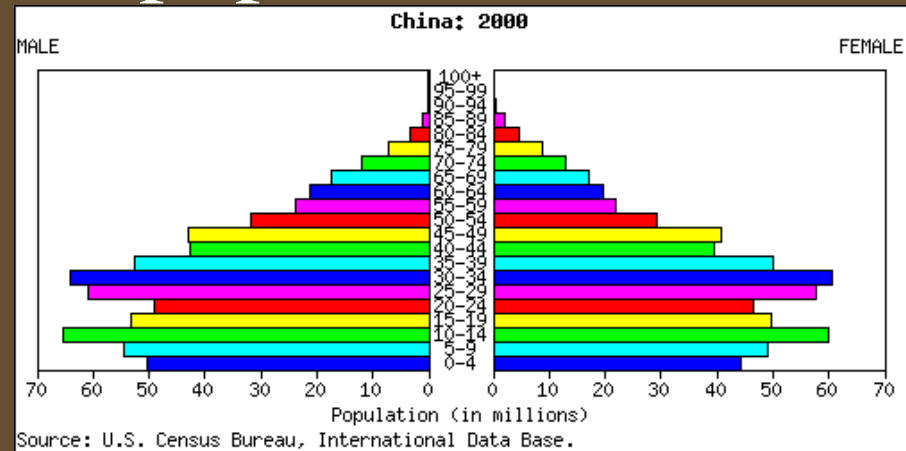
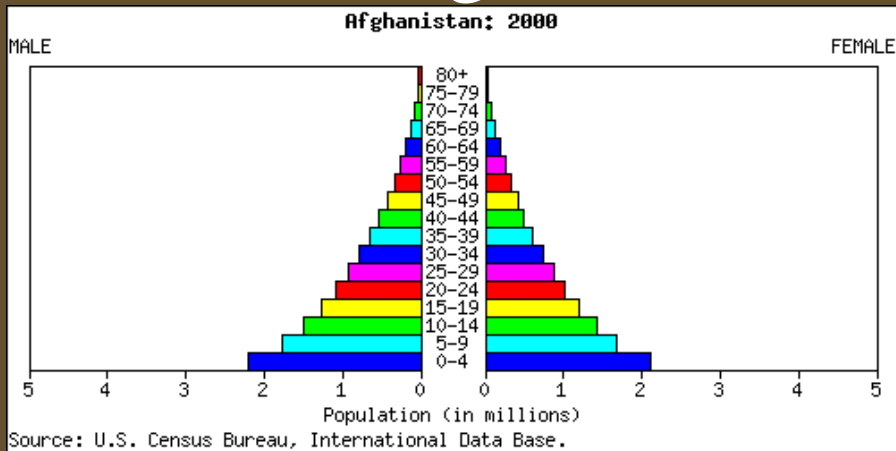
- Fertility: a measure of births per population per year
 - Crude birth rate: number of births per total population per year
 - Age specific fertility rate: number of births per woman of a specified age (e.g. 20-24) per year
 - Total fertility rate: the average number of children born per woman: sum of ASFR for all ages

What determines population growth?

- Mortality: A measure of deaths per population per year
 - Crude death rate: the number of deaths per total population per year
 - Age specific mortality rate: the number of deaths per population of a particular age (e.g. 1-4 or 70-74) per year
 - Life expectancy: the **average** number of years one can expect to live at a particular age

What determines population growth?

Age structure of a population



What drives population growth?

Measures

- Rising fertility
 - Earlier maturation
 - Shorter birth interval
 - Declining mortality at reproductive age
- Declining mortality
 - Control of infectious diseases, particularly in infancy
 - Assured food supply
 - Medical care??

What Drives Population Growth: Theories

- **Mortality driven:**

- Invention of new technologies allows lowered mortality and excess of births over deaths
- People will reproduce until they come up against “positive checks” (Malthus)

- **Fertility driven:**

- Population growth forces people to create new technologies to accommodate the extra people
- People are capable of limiting their fertility

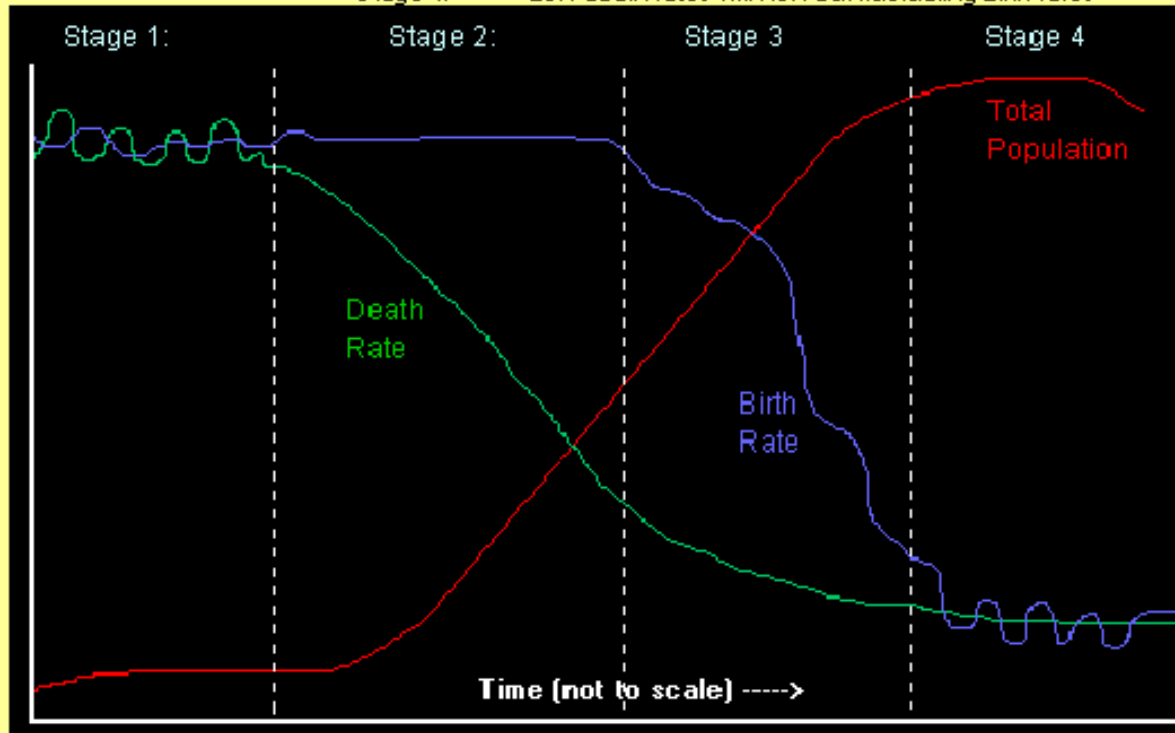
What Drives Population Growth: Demographic Transition

The Demographic Transition

The demographic transition is a model of population history based on the experience of western Europe. The demographic transition model describes changes in human fertility and mortality related to shifts in economic development, brought about by industrialization and urbanization.

It comprises four stages:

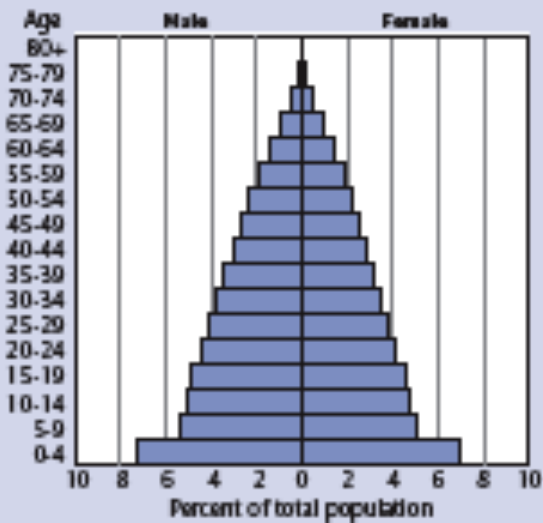
Stage 1:	High birth rate and high but fluctuating death rate
Stage 2:	Declining death rates and continuing high birth rates
Stage 3:	Declining birth and death rates
Stage 4:	Low death rates with low but fluctuating birth rates



The demographic transition was *both* fertility and mortality driven

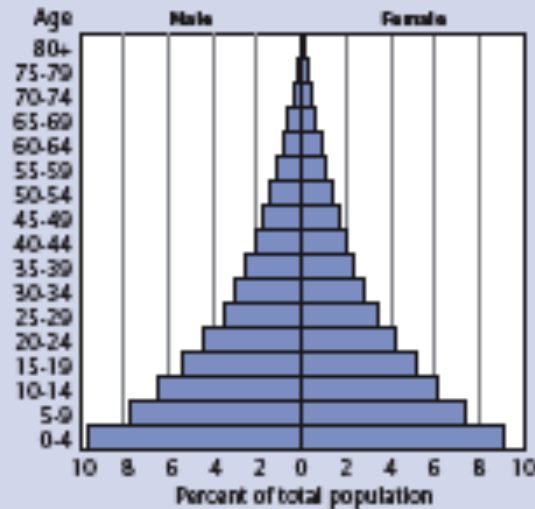
What Drives Population Growth: Demographic Transition

Population at Stage 1 of the Demographic Transition



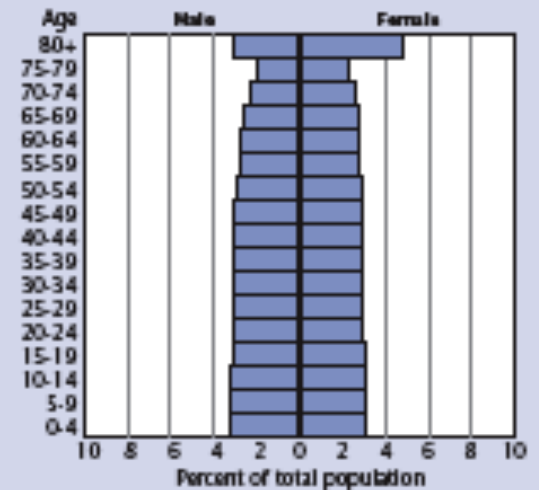
High fertility
High mortality

Population in Stage 2 of the Demographic Transition



High fertility
Low mortality

Population at the End of Stage 3 of the Demographic Transition



Low fertility
Low mortality

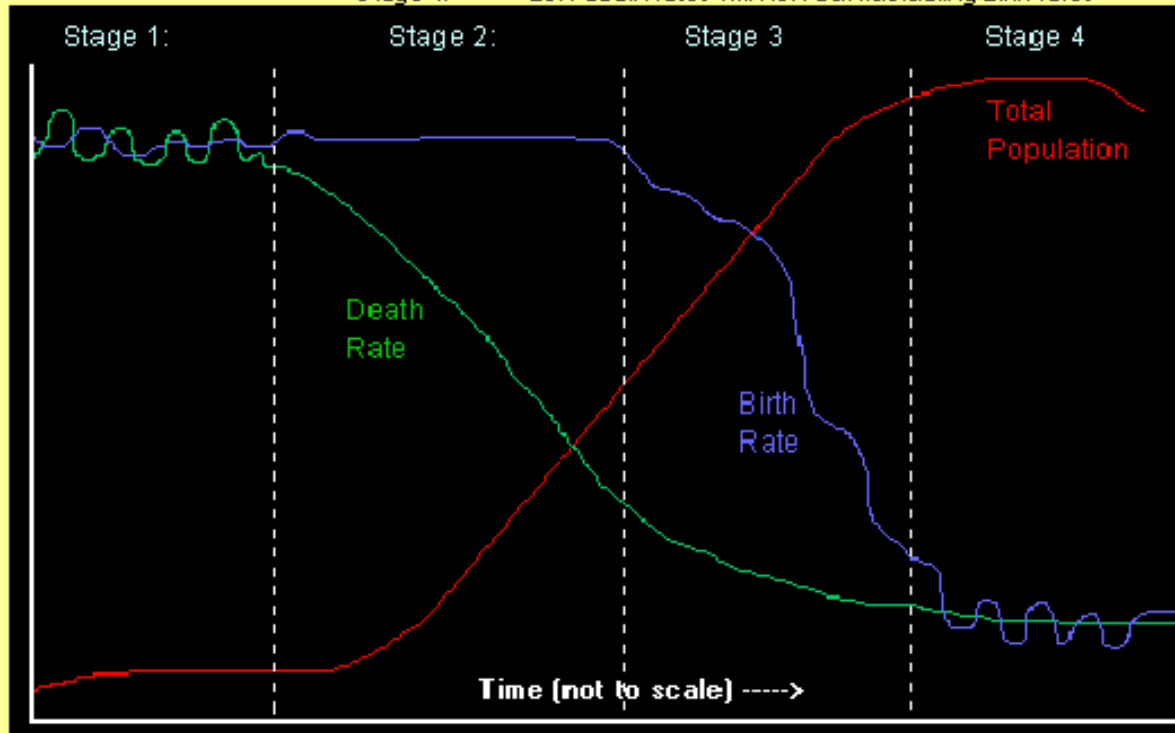
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Mortality is now already low, and not likely to change much. Therefore, future population growth will be *almost entirely* fertility driven

How do population growth and density vary in different kinds of societies?

Density of population

Nomadic hunter-gatherers (foragers)	<1/mi ²
Shifting cultivators	20-30/mi ²
Agrarian civilizations	1000/mi ²
Industrial societies	2000/mi ²

Maximum growth rate

Nomadic hunter-gatherers (foragers)	<.02%/yr
Shifting cultivators	
Agrarian civilizations	.5%/yr
Industrial societies	>2%/yr

How do population growth and density vary in different kinds of societies?

Effects of increasing population density

- Larger group size
- Increased pressure on local resources
- Increased infectious disease morbidity
- Possibilities for increased division of labor

How do population growth and density vary in different kinds of societies?

Effects of faster population growth

- Younger age structure
- More complex families
- Higher rates of migration
- Higher rates of conflict?

How does population growth affect the environment?

Some adverse affects, **all else being equal**

- Decreased habitat for other species
- Resource depletion
 - Changes in land cover
 - Deforestation and loss of carbon sinks
 - Extinction of prey species
- Pollution
 - Nitrogen from fertilizers and wastes
 - Sulfur from combustion
 - Other air pollution — photochemical smog etc.

How does population growth affect the environment?

But: all else is never equal

$I = PAT:$

Impact = population x affluence x technology

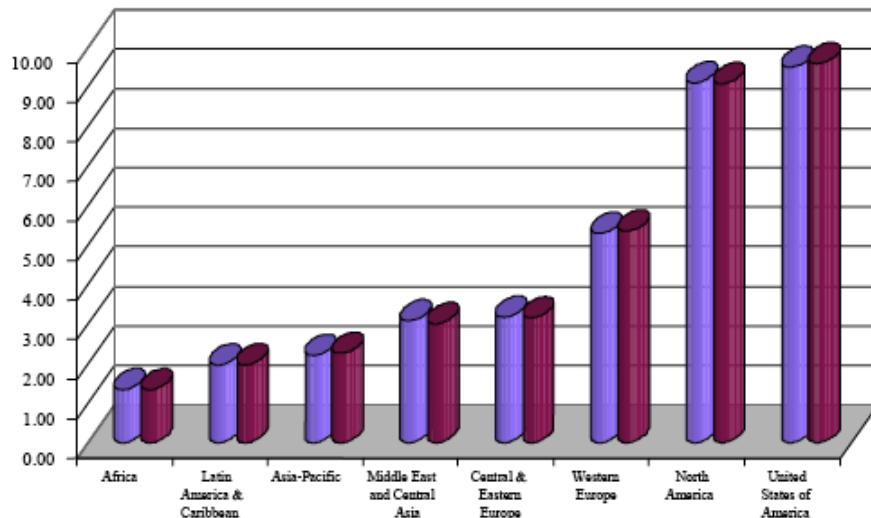
P changes slowly, so what do we need to do in the meantime? Control A or control T?

How does population growth affect the environment?

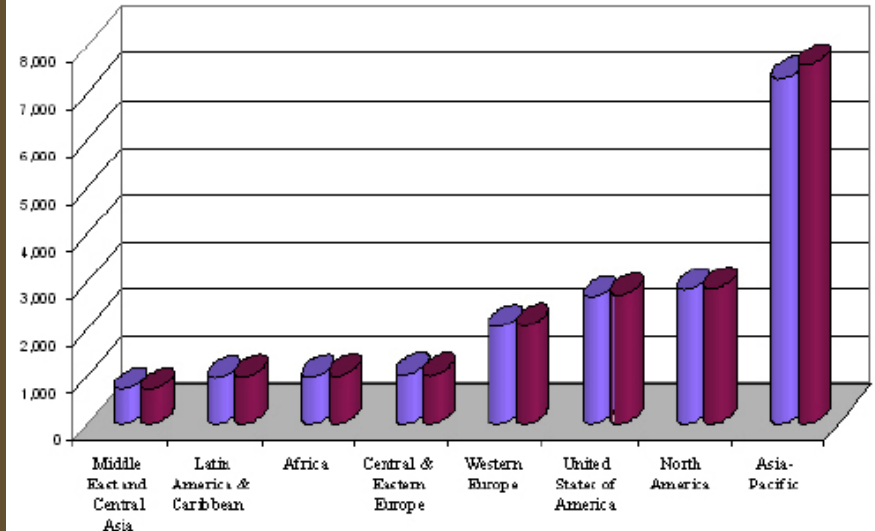
But: all else is never equal

Ecological footprint: The amount of land it takes to support one person (in hectares)

PER CAPITA FOOTPRINTS BY REGION 1999-2000

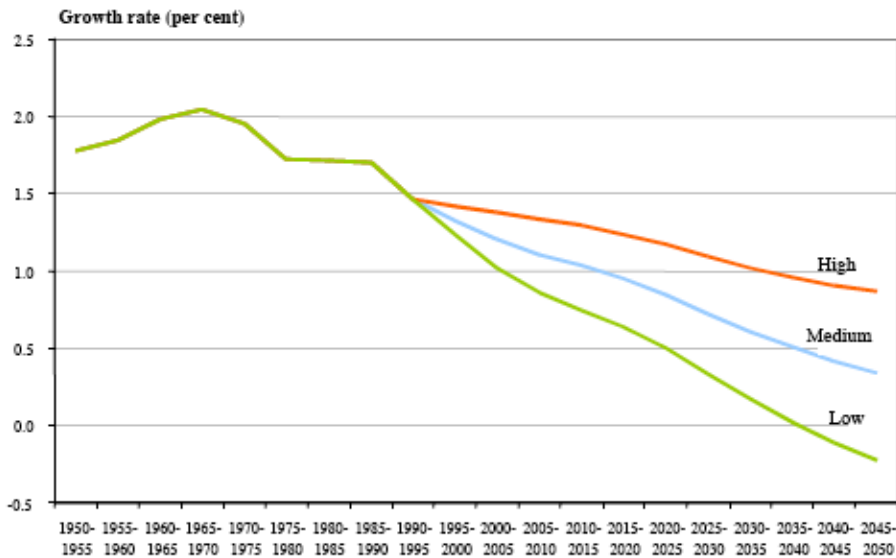


TOTAL FOOTPRINT BY REGION 1999-2000



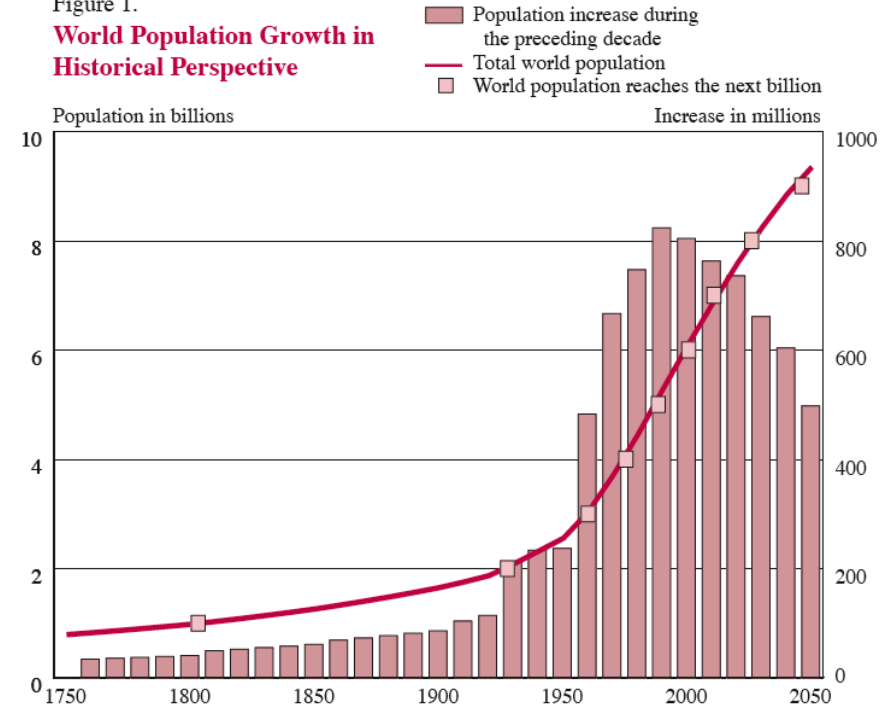
What does the future look like?

Figure 2. World population growth rates: past estimates and medium-, high- and low-fertility variants, 1950-2050



Source: United Nations Population Division.

Figure 1. World Population Growth in Historical Perspective



What does the future look like?

Some representative Total Fertility Rates

Country	TFR 1985	TFR 2000	TFR 2005-2010
World	4.2	2.8	2.52
Rwanda	7.8	5.7	5.4
Malawi	7.4	5.3	6.0
Bangladesh	5.5	3.1	2.4
India	4.3	3.1	2.7
Mexico	3.9	2.8	2.4
USA	1.8	2.1	2.07
Japan	1.7	1.5	1.3
Italy	1.5	1.3	1.4
Hong Kong	1.72	0.81	0.99

What does the future look like?

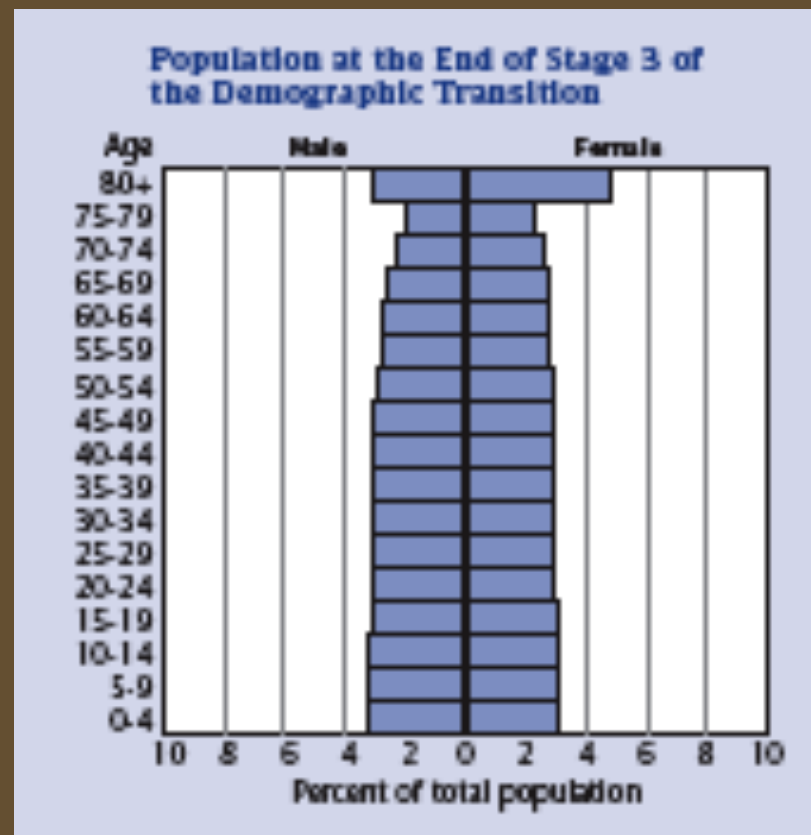
I = PAT:

The effects of population growth on the environment will be magnified by increases in the affluence of world populations

Population is going to level off in your lifetime. Environmentalists breathe cautious sighs of almost relief. Why do you think economists worry about this?

What does the future look like?

An aging population



What does the future look like?

A long-term fantasy

If the world population levels off at 10 billion mid-century

And global TFR declines to 1.9 and stays there, population in 3000 will be **2.14B**, around the 1950 level

And global TFR declines to 1.7 and stays there, population in 3000 will be **76M**, probably about the 2000 B.C.E. level

And global TFR declines to 1.3 and stays there, population in 3000 will be **24K**

So when we talk about sustainability, what is the right time-frame?