

# Population, Resources, Environment

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# What do we Need to Know about Population?

- How has 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?

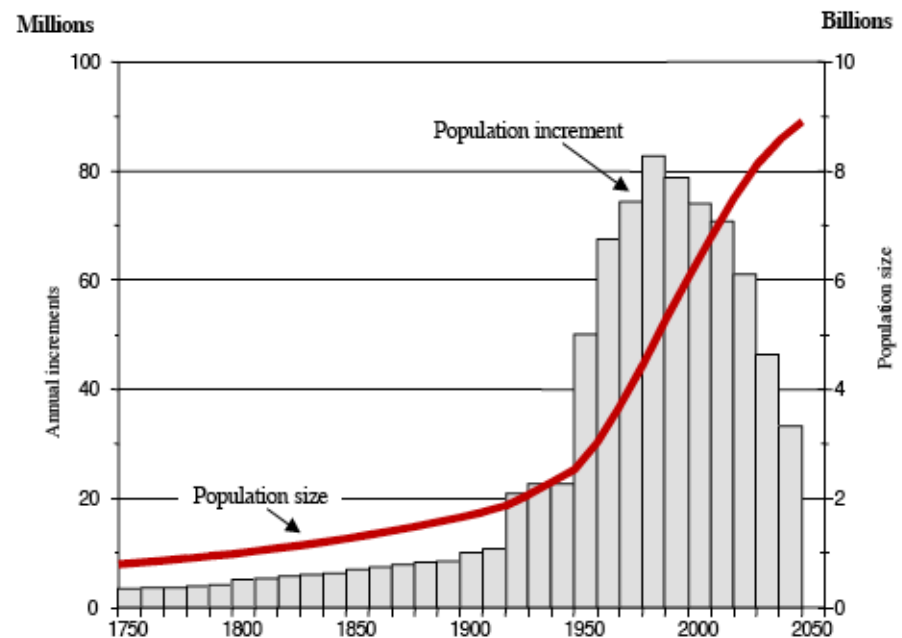
TABLE 1. WORLD POPULATION, YEAR 0 TO NEAR STABILIZATION

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.

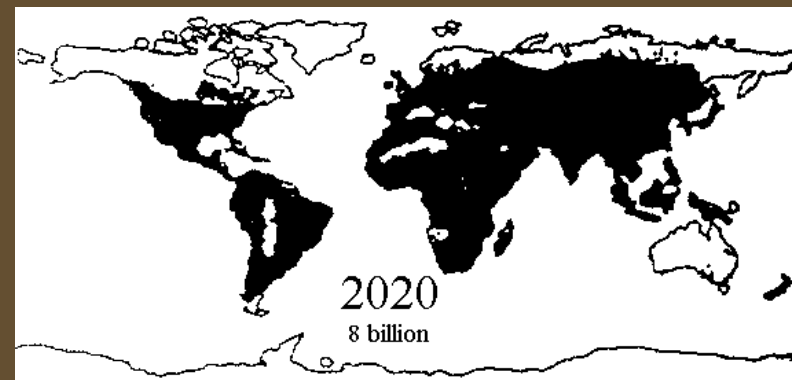
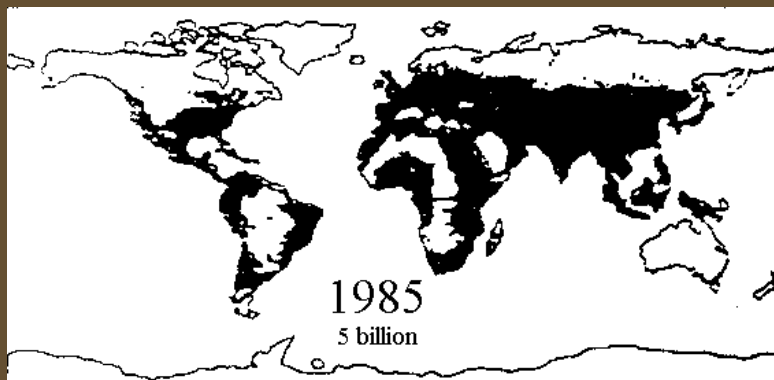
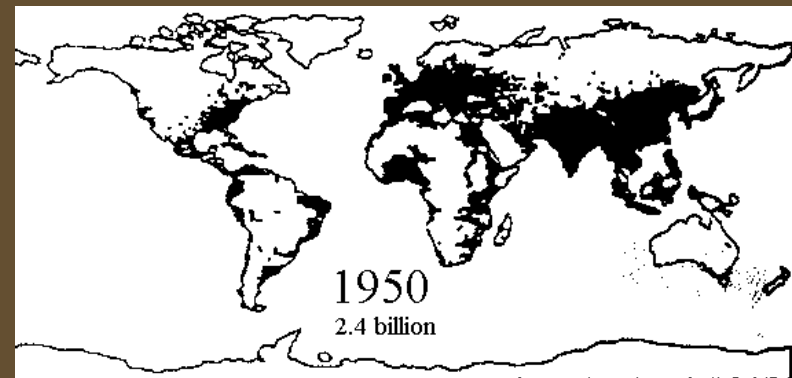
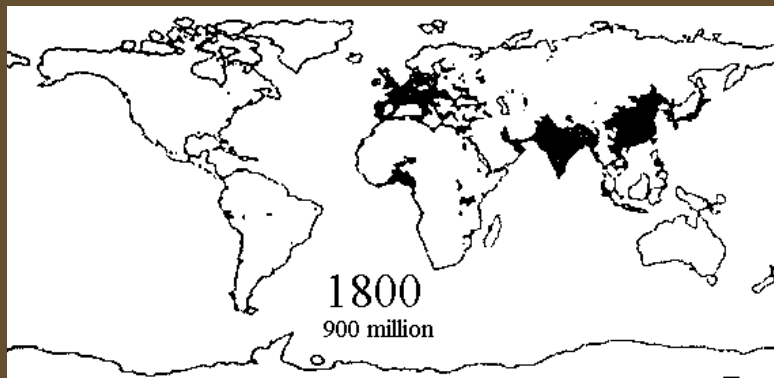
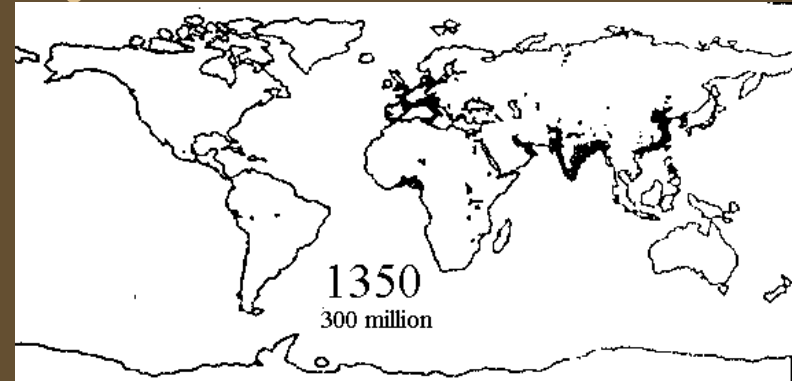
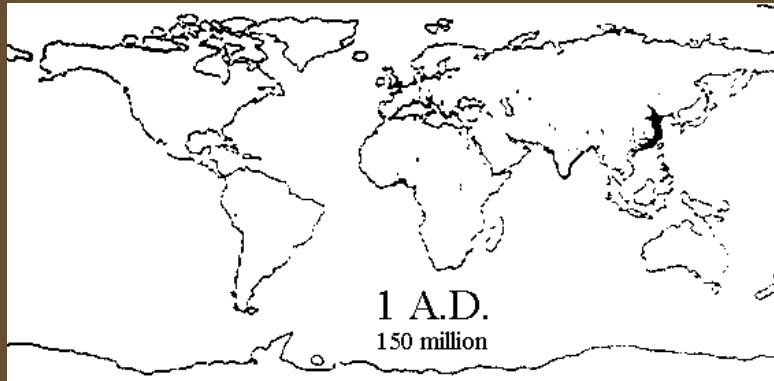
# How has the world's population grown through history?

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

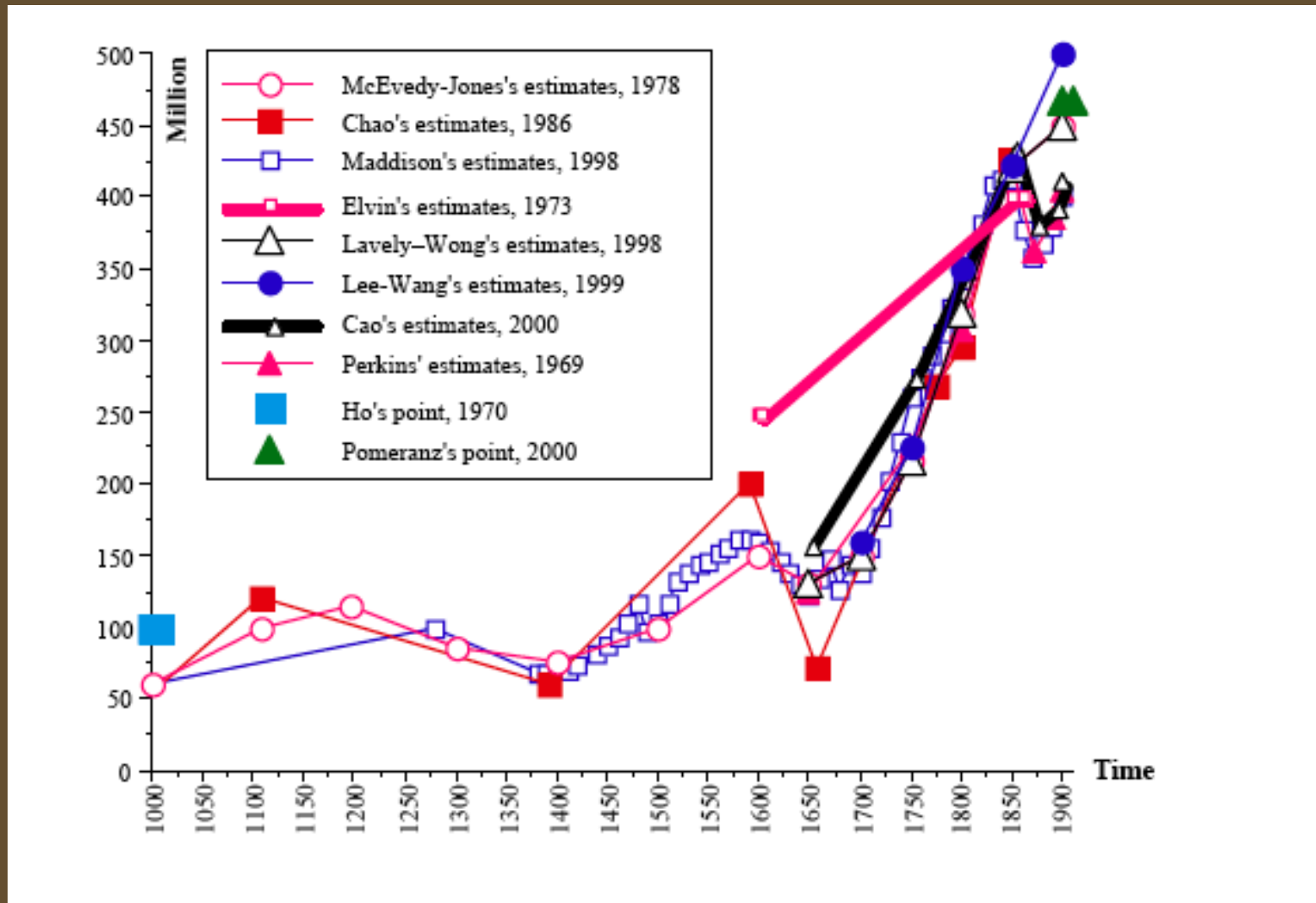


Source: United Nations Population Division.

# How has the world's population grown through history?



# How has China's population grown through history?

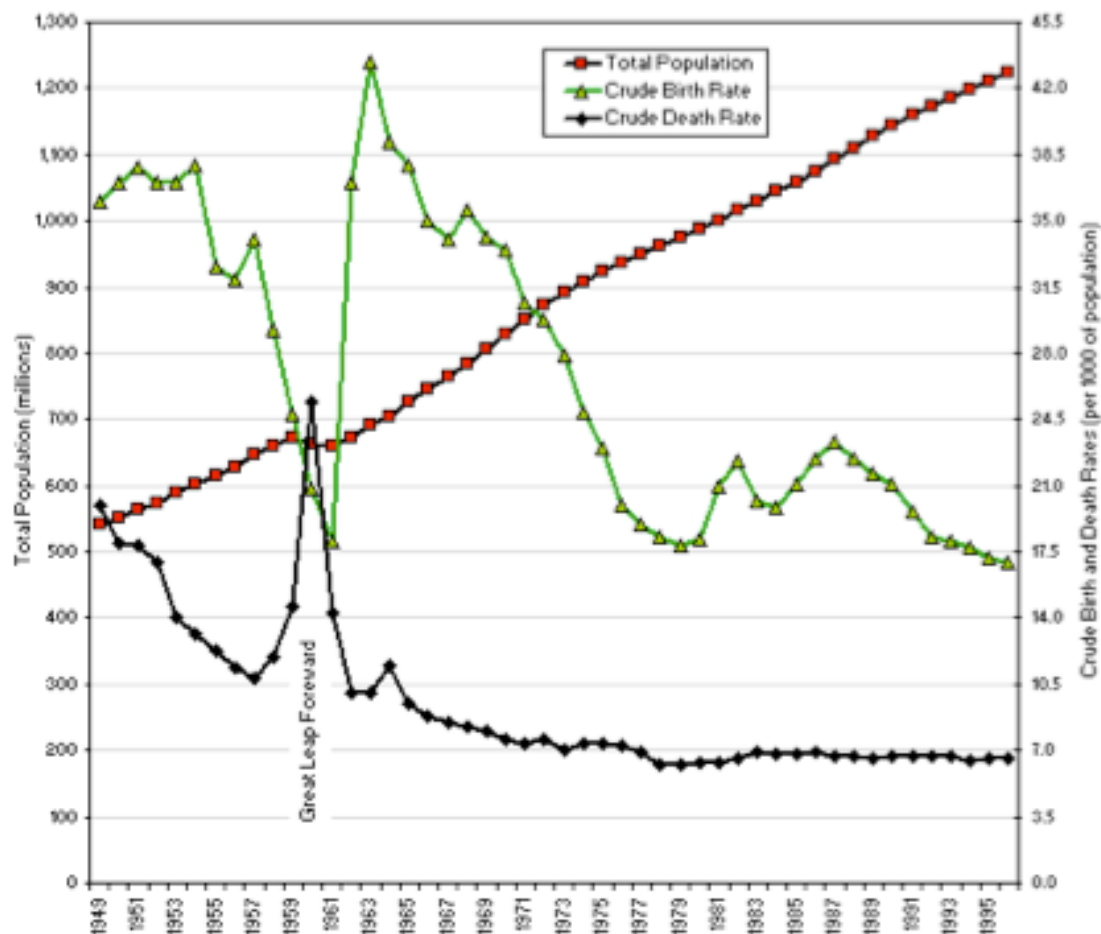


Kent G. Deng: Unveiling China's True Population Statistics for the Pre-modern Era with Official Census Data. *Population Review* 43,2 2004.

# Fertility, Mortality, and Population, 1949-1996

## Data - Population Growth

Population growth, crude birth and death rates, 1949 - 1996



# What determines population growth?

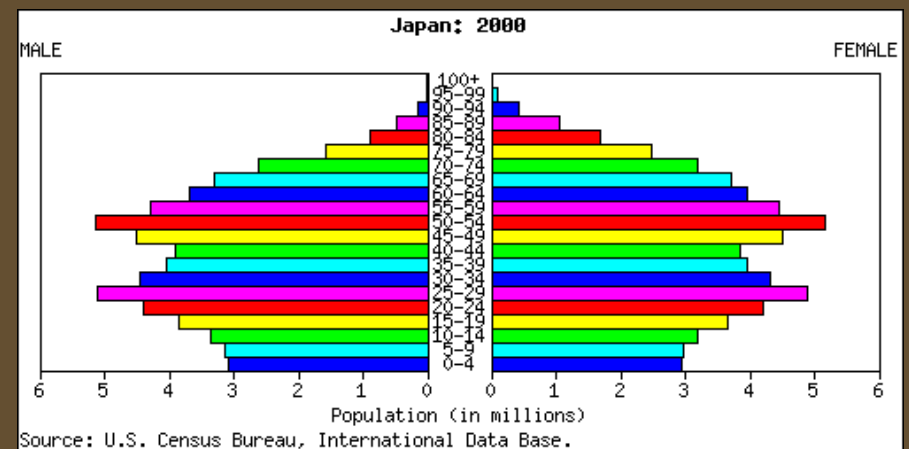
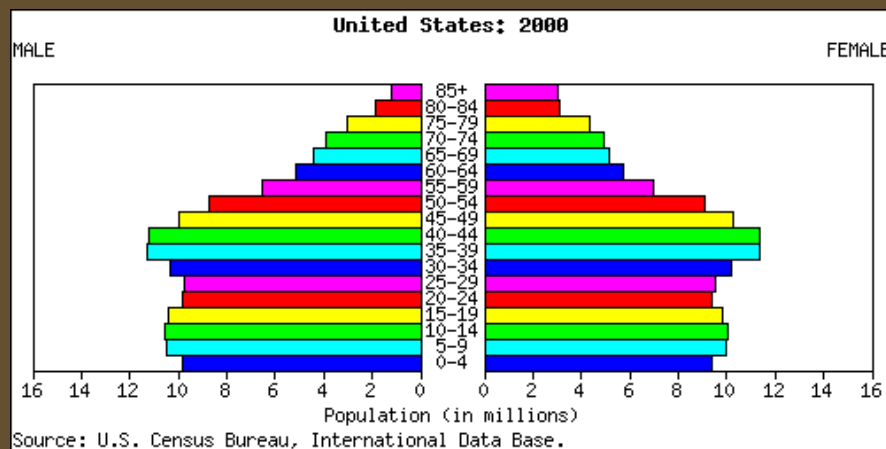
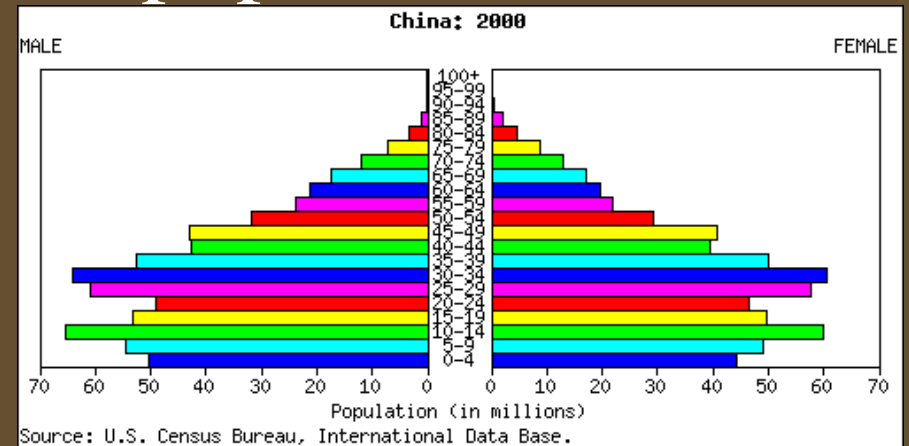
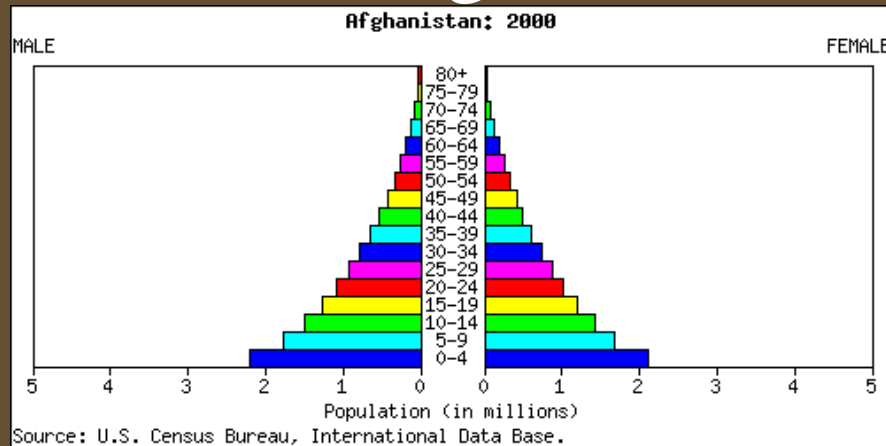
- Fertility: a measure of births per population per year
  - Crude birth rate: number of births per total population per year
  - Age specific fertility rate: number of births per woman of a specified age (e.g. 20-24) per year
  - Total fertility rate: the average number of children born per woman: sum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

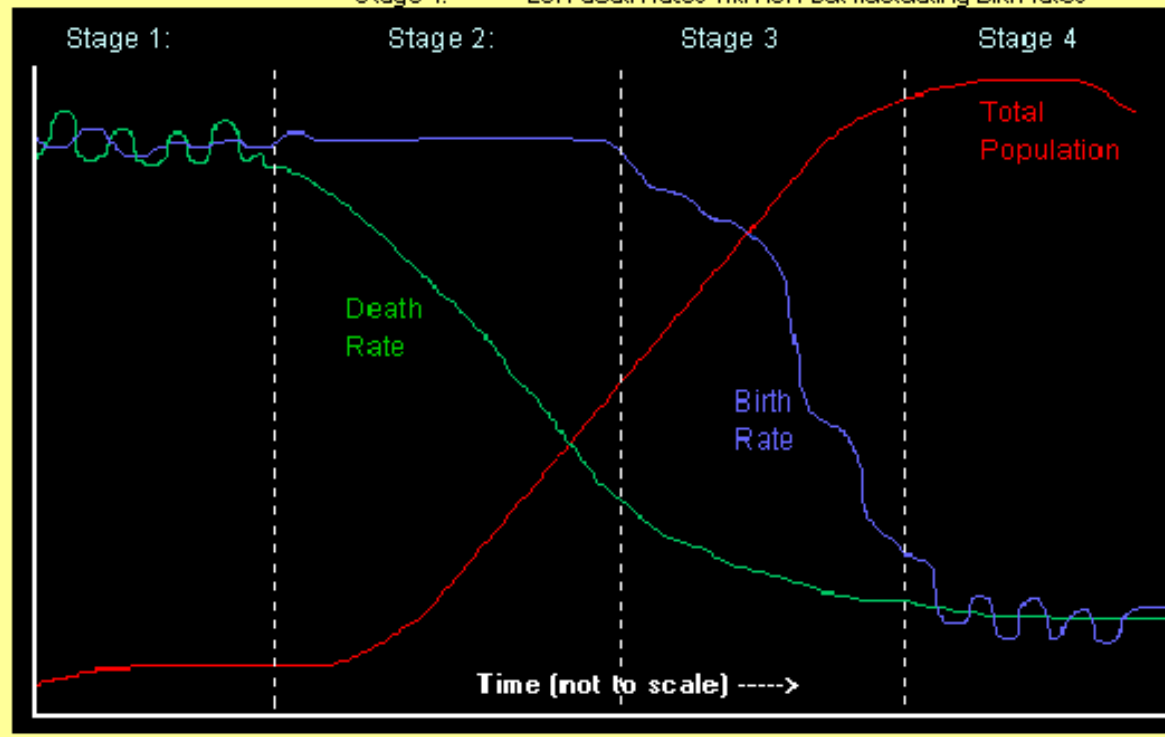
# What Drives Population Growth: Demographic Transition

## The Demographic Transition

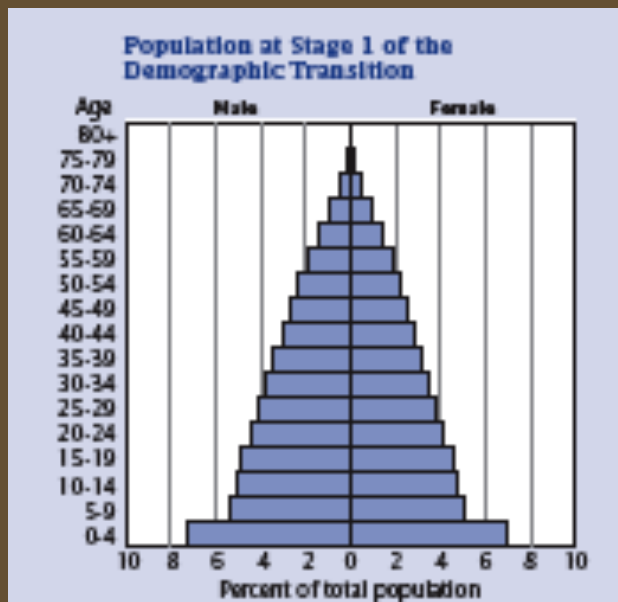
The demographic transition is a model of population history based on the experience of western Europe. The demographic transition model describes changes in human fertility and mortality related to shifts in economic development, brought about by industrialization and urbanization.

It comprises four stages:

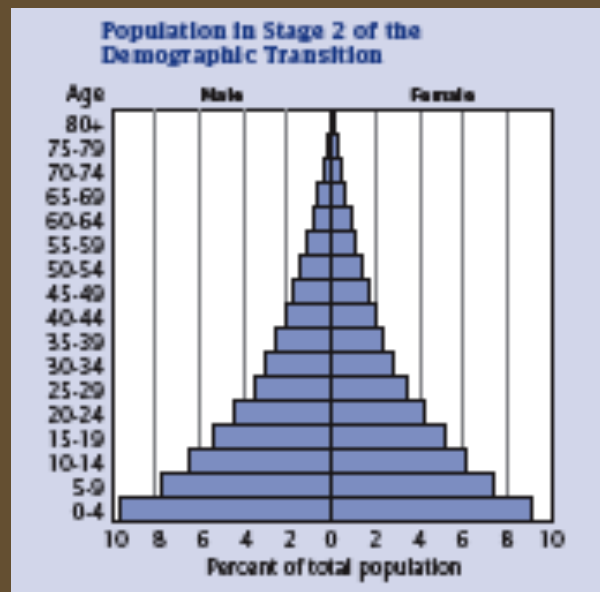
- Stage 1: High birth rate and high but fluctuating death rate
- Stage 2: Declining death rates and continuing high birth rates
- Stage 3: Declining birth and death rates
- Stage 4: Low death rates with low but fluctuating birth rates



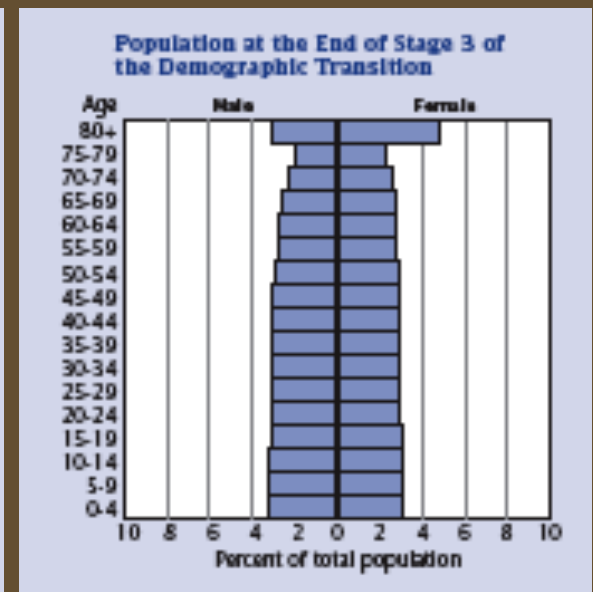
# What Drives Population Growth: Demographic Transition



High fertility  
High mortality



High fertility  
Low mortality



Low fertility  
Low mortality

# Effects of faster population growth

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

## And, conversely, slower population growth

- Older age structure
- Less complex families
- Lower rates of migration
- Lower 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

# How does population growth affect the environment?

But: all else is never equal

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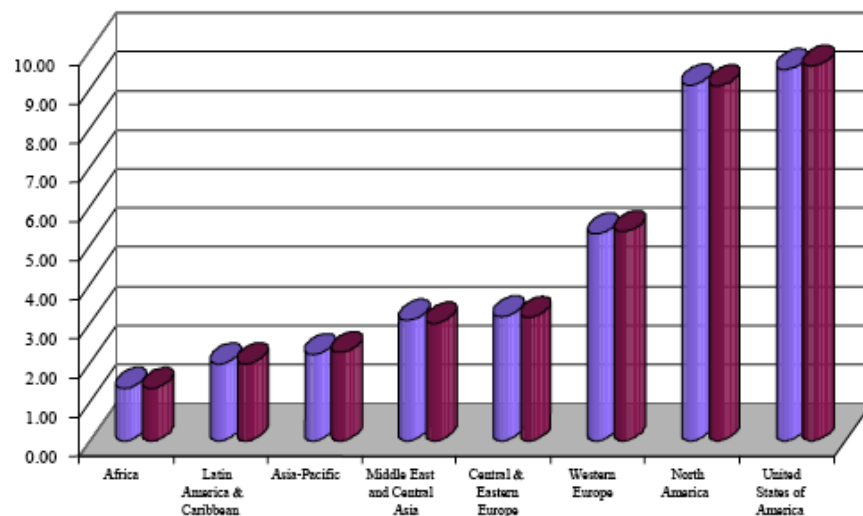
Impact = population x affluence x technology

# How does population growth affect the environment?

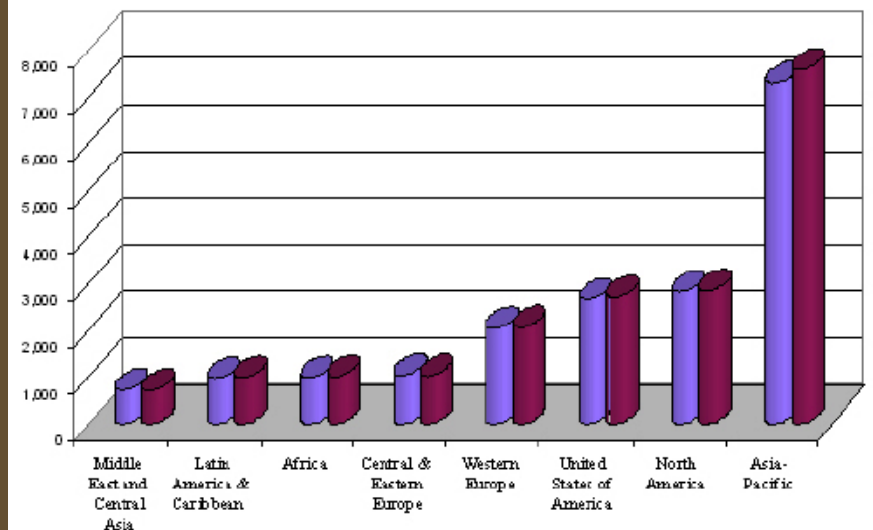
But: all else is never equal

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



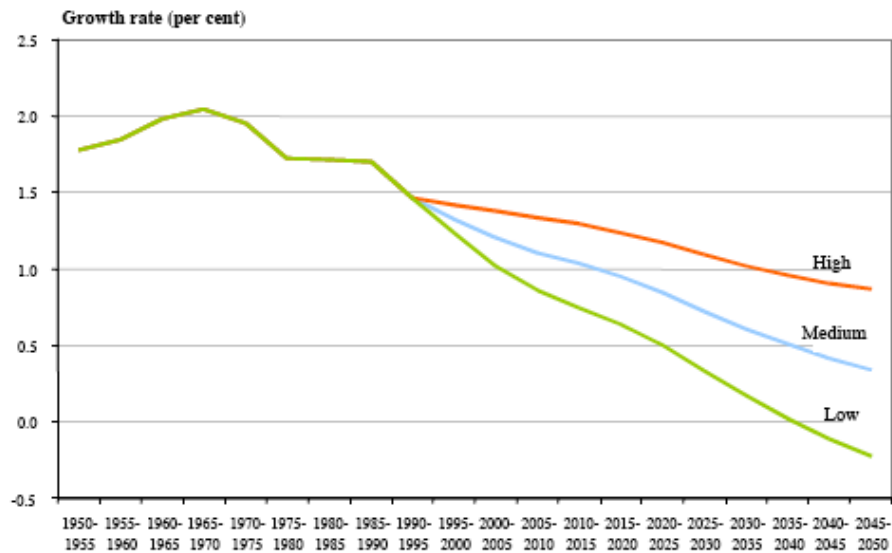
# What does the future look like?

## Some representative Total Fertility Rates

Country	TFR 1985	TFR 2000	TFR 2005-2010
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
China	1.5	1.7	1.64
Italy	1.5	1.3	1.4
World	4.2	2.8	

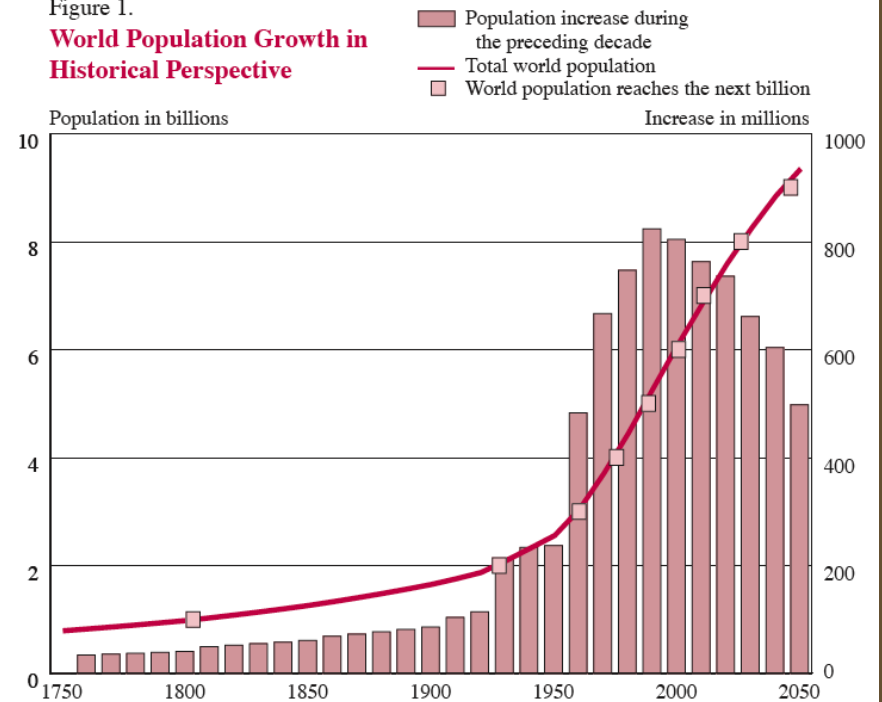
# What does the future look like?

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

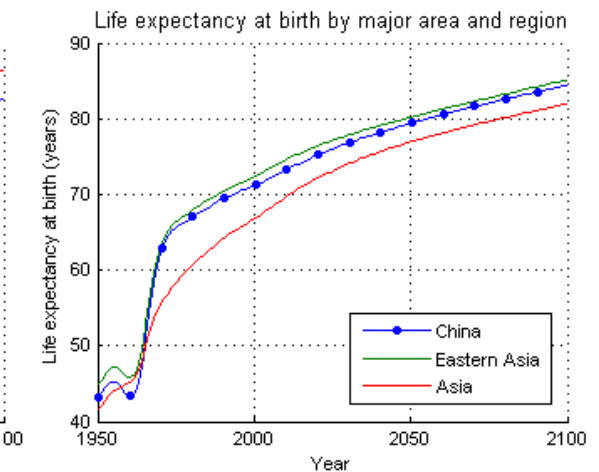
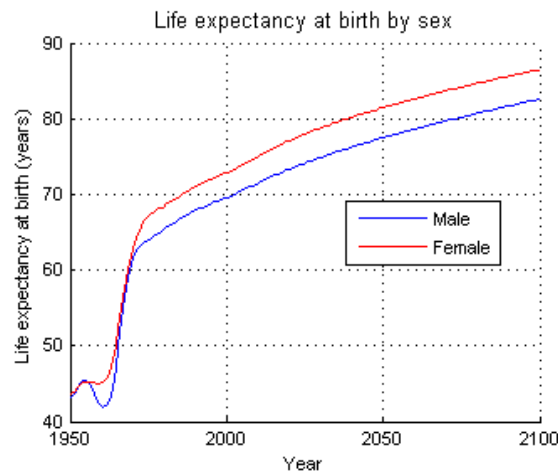
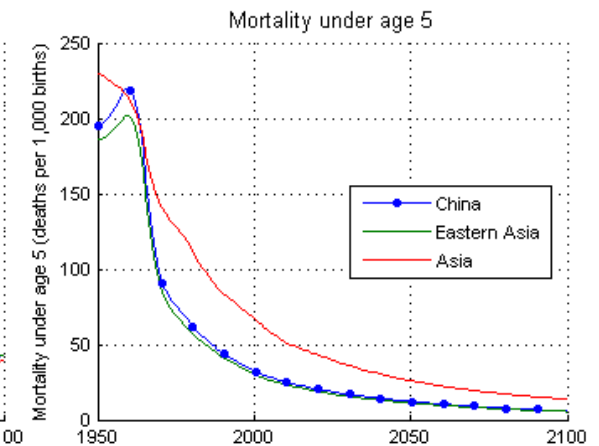
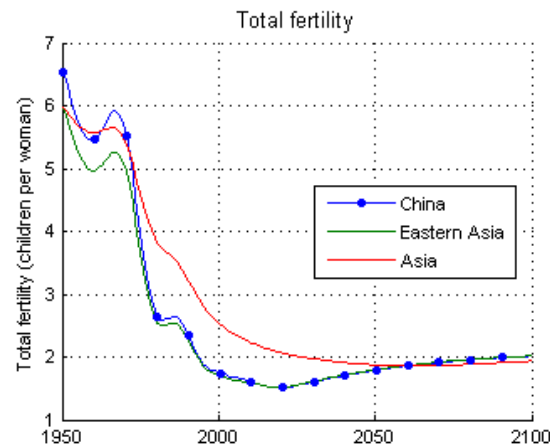
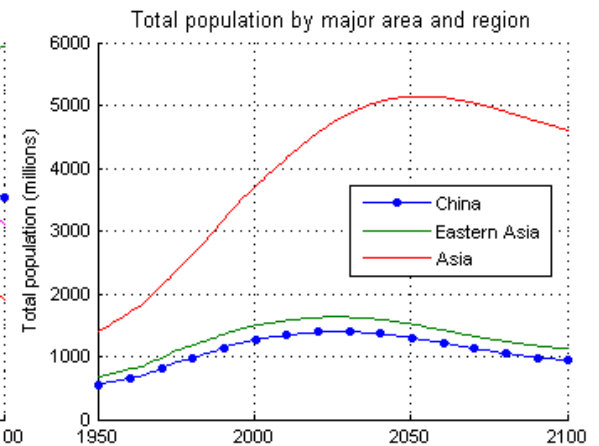
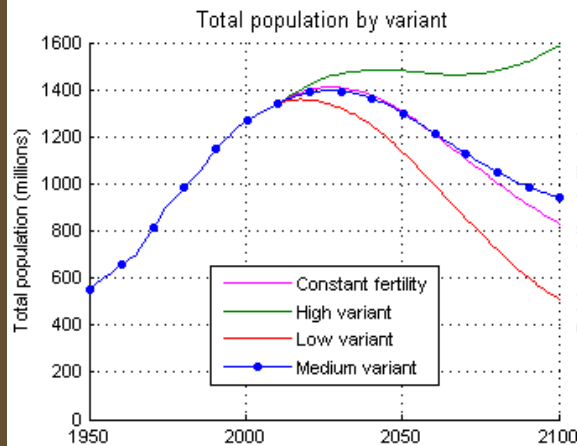


Source: United Nations Population Division.

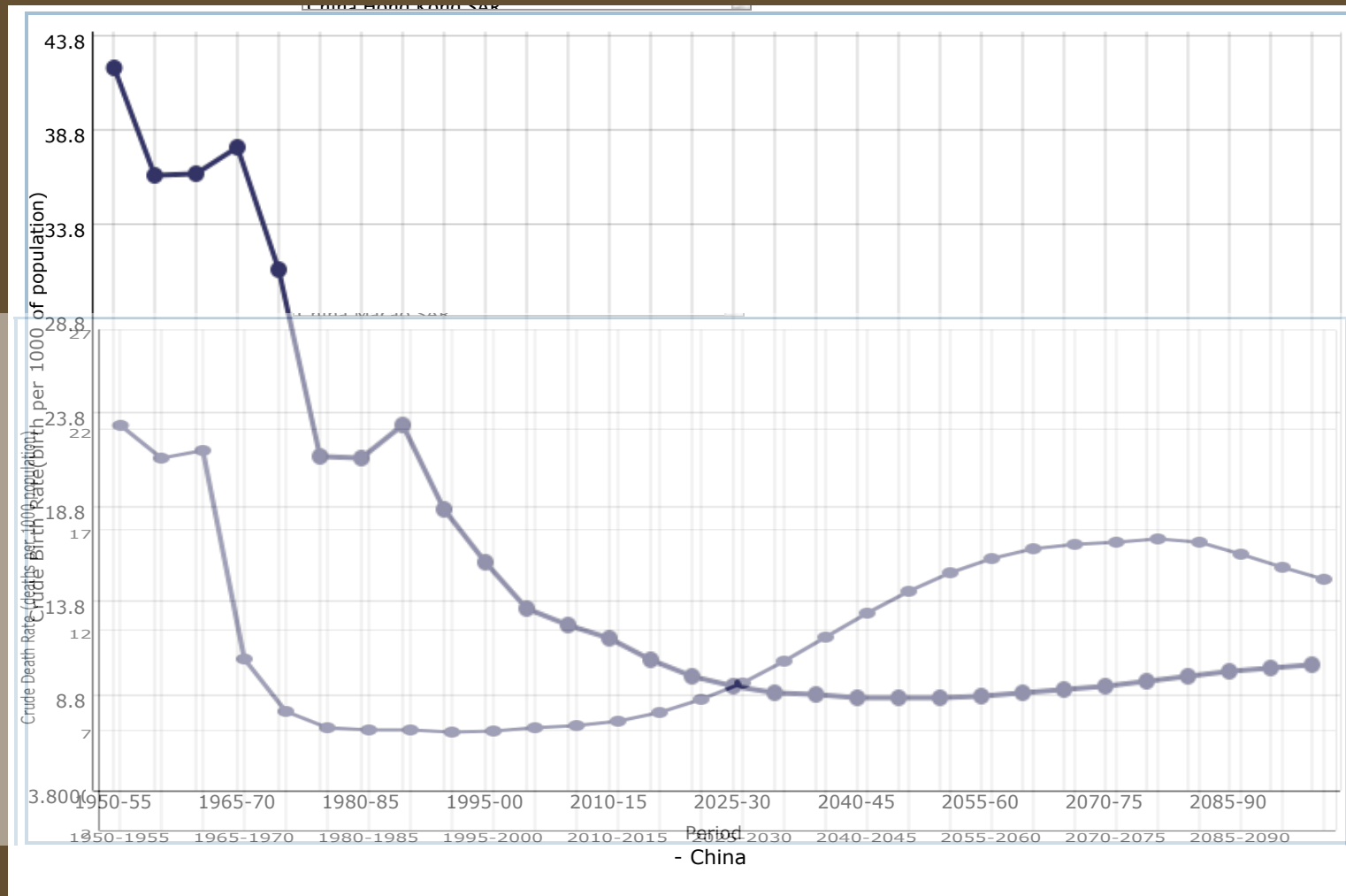
**Figure 1. World Population Growth in Historical Perspective**



# Future Projections: China



# Birth and Death Rates, 1950-2100



# What does the future look like?

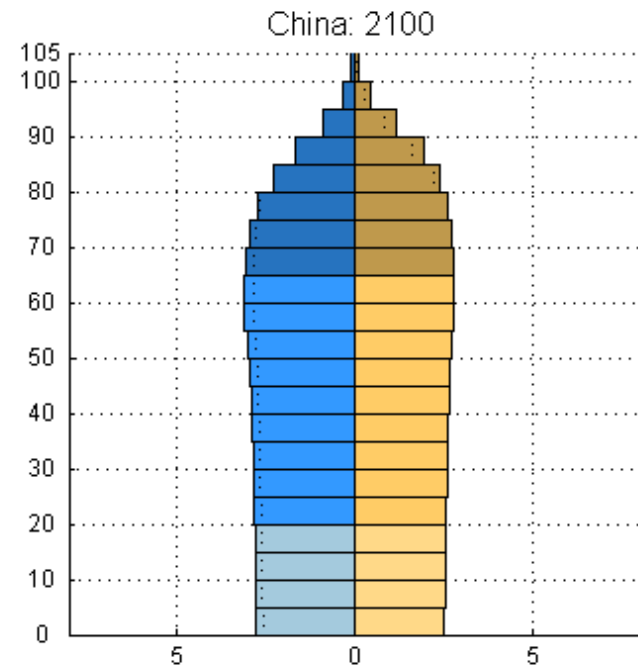
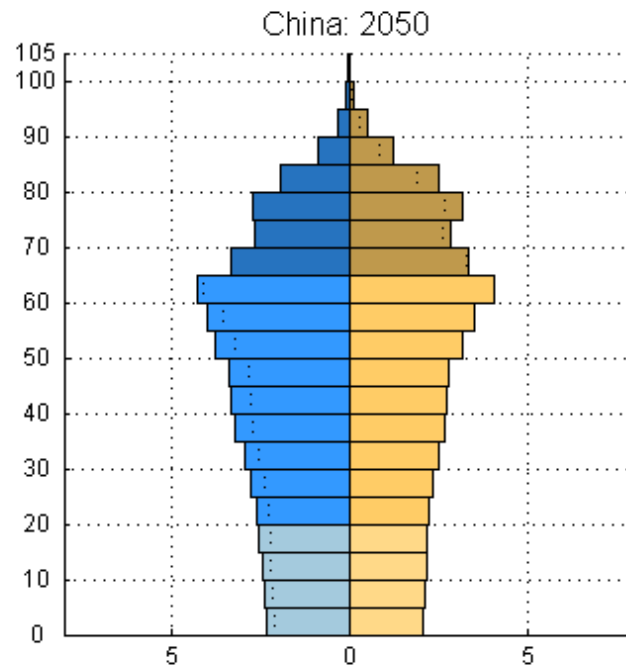
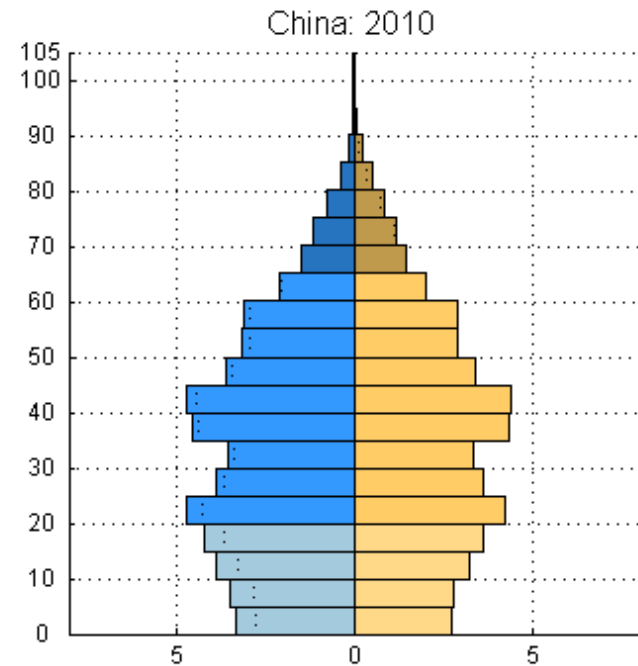
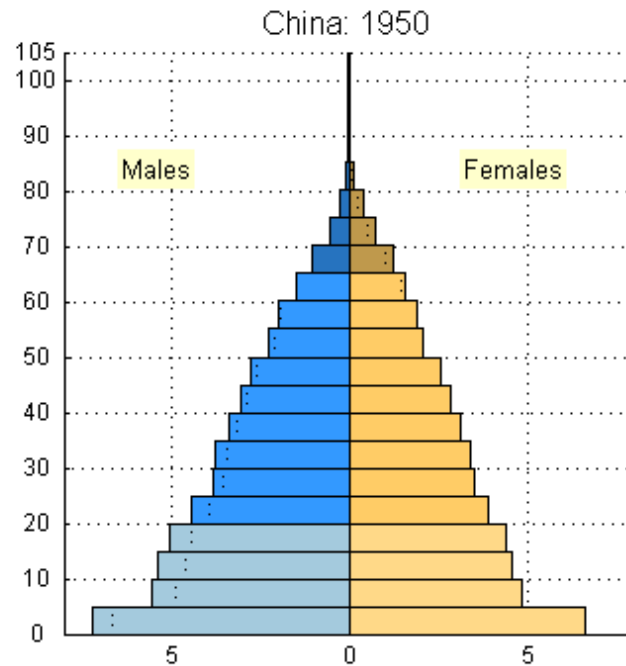
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The effects of population growth on the environment will be magnified by increases in the affluence of world populations

What  
does the  
future  
look like?

Aging  
Population

Unbalanced  
Sex-ratio



# What does the future look like?

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**, only a third enough to fill Husky Stadium