EARTH SC 2EI3 -
Introduction to Environmental Issues

Environment and Resources

Unit 1

Change and Challenges

Key Concepts

- Change in natural systems: timescales involved, types of changes, examples

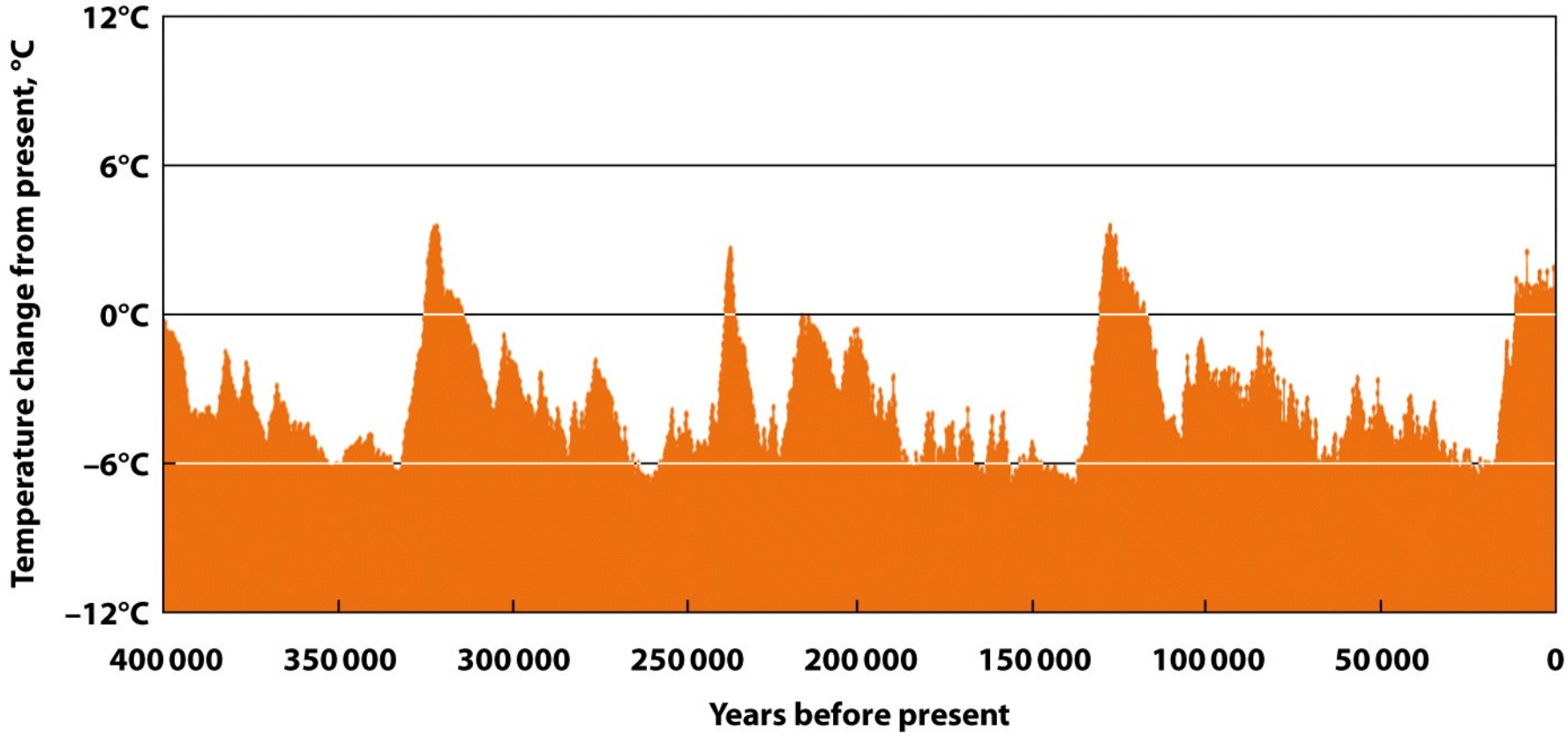
- Types and examples of societal changes

- Major challenges that society faces as a result of environmental change

Change in Natural Systems

Brueghel, Pieter the Elder, *Hunters in the Snow*, January, 1565/Kunsthistorisches Museum, Vienna, Austria/The Bridgeman Art Library

Change in Natural Systems



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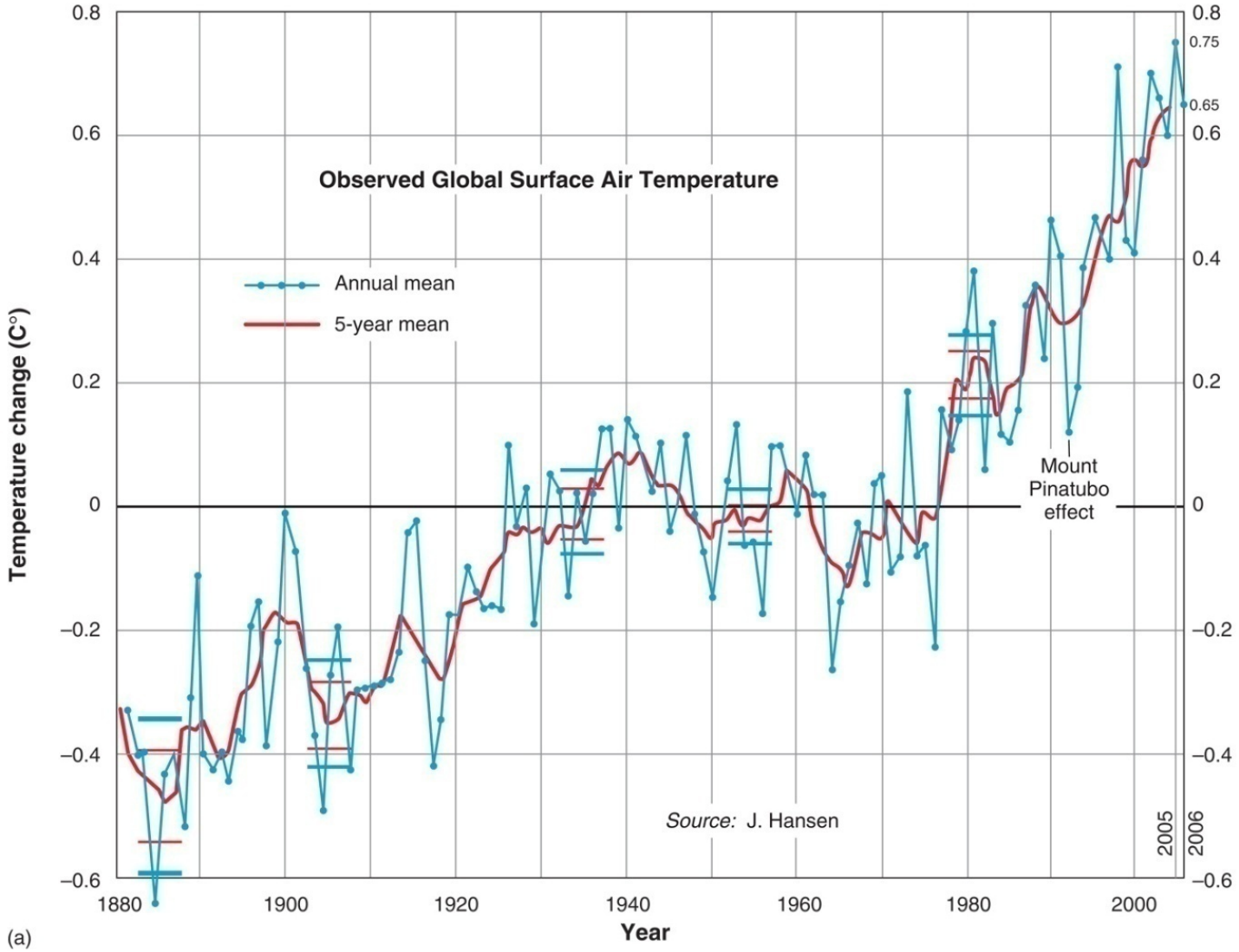
Change in Natural Systems



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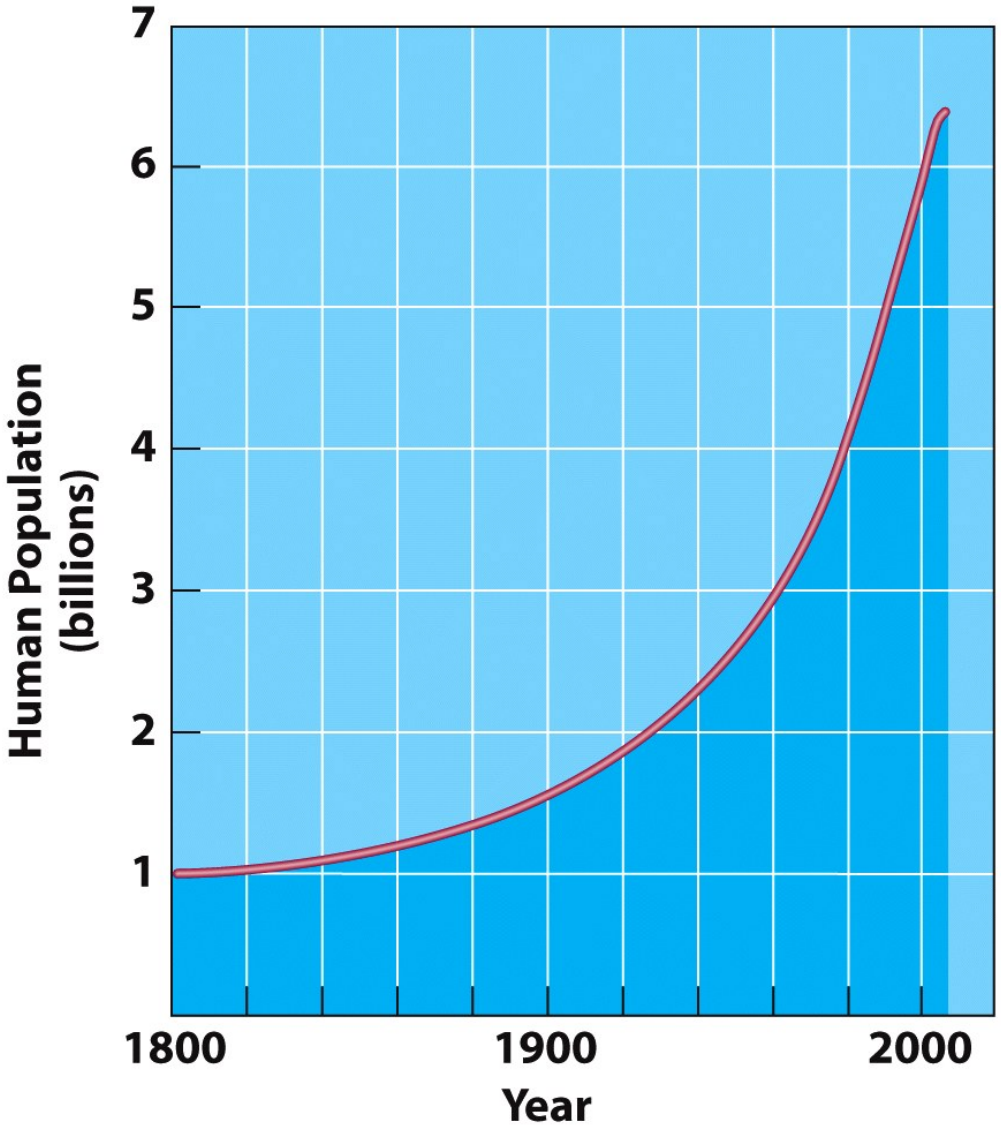
Change in Natural Systems

Change in Societies

Change in Societies



Change in Societies

Jodi Cobb/NG Image Collection

Change in Societies

Change and Challenge

Change and Challenge

Water Control Structure, Mississippi River, United States

Study Notes

- Humans have constantly experienced changes, for example the Little Ice Age, a period that started in Medieval Times and ended in the 19th century, during which people in Europe experienced a return of cold conditions

- Variation is constant in natural systems, for example the oscillations between cold, glacial periods, and warm interglacial periods, over the past several hundreds of thousands of years

- Changes in natural systems seemingly are now more abrupt or are happening faster

Study Notes

• Earth's climate is changing, and so is our environment

•Eg global warming, this trend of globally increasing average surface temperature since the midde of the 19th century

• There is strong evidence that human activities are a key driving force behind environmental change

•These changes are due in part to how humans are interacting with natural systems, in their activities

•Eg atmospheric pollution, deforestation

Study Notes

- Human societies are also changing

- Eg urban environments are growing

- Human population growth and increased consumption lead to both economic growth and environmental change

- While some of the changes are due to the rapid population increase in past 2 centuries, it does not explain all of them

- Growing demand worldwide for a certain standard living

- Eg more and more people around the world own a car

Study Notes

- These changes are occurring more rapidly and with greater magnitude than previously

- These changes threaten the well-being of our society and the ecosystems that sustain it

- There have been also changes in attitudes

- Eg how we relate to environment

- Human values, expectations, perceptions, and attitudes influence these changes

Study Notes

- Changes in natural and human systems force us to think about present and future conditions

- How do we meet basic human needs and protect integrity of biophysical systems?

- For example, will our soils be able to provide food for everyone?

- Society must respond, and quickly

- The question also is how to answer to these challenges now and in the future

Study Notes

- And which approach is more realistic, in our attempt to answer:

- By controlling natural systems?

- Or by managing our interactions with them?

Environment and Resources

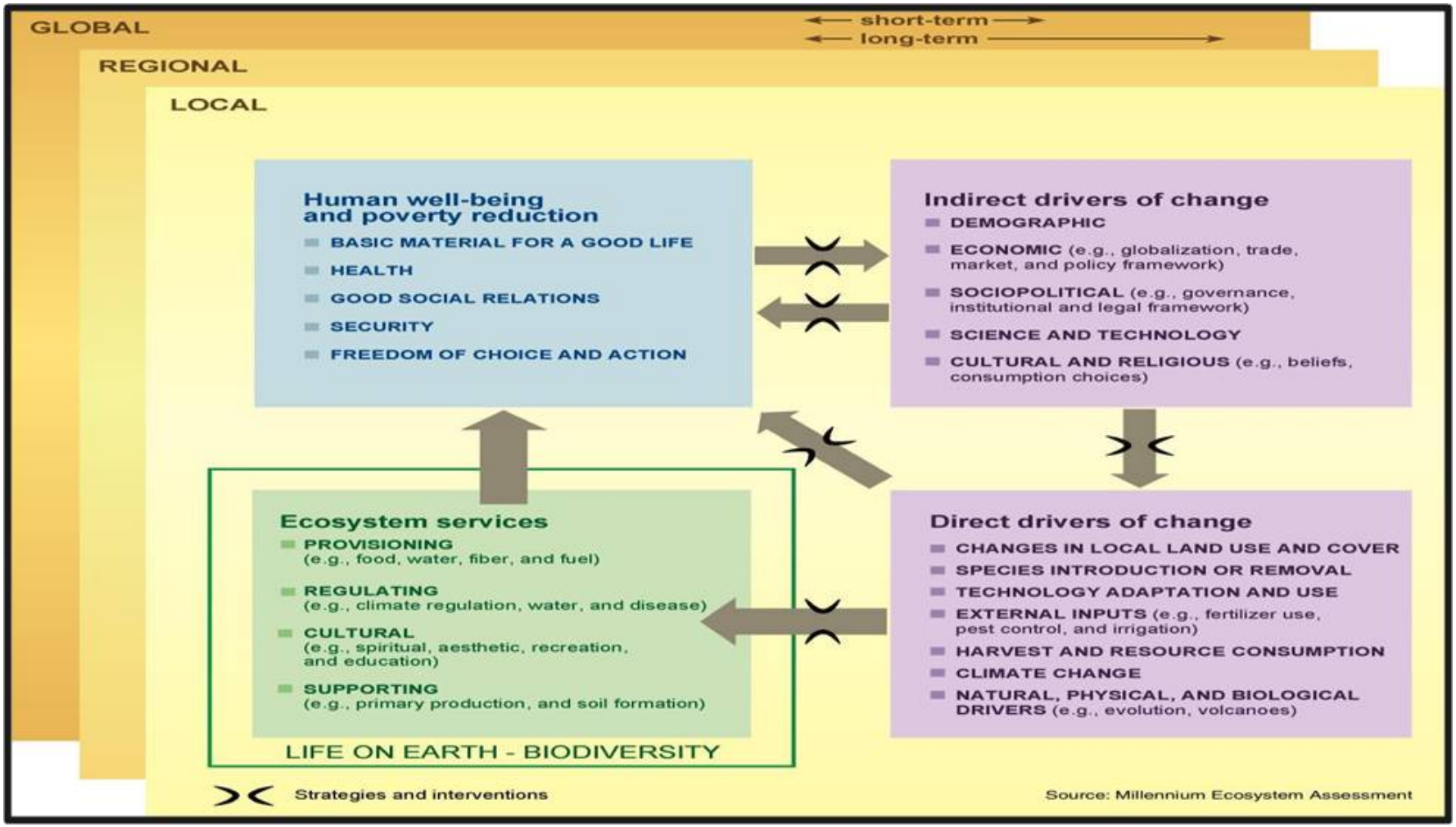
Unit 2

The Global Picture

Key Concepts

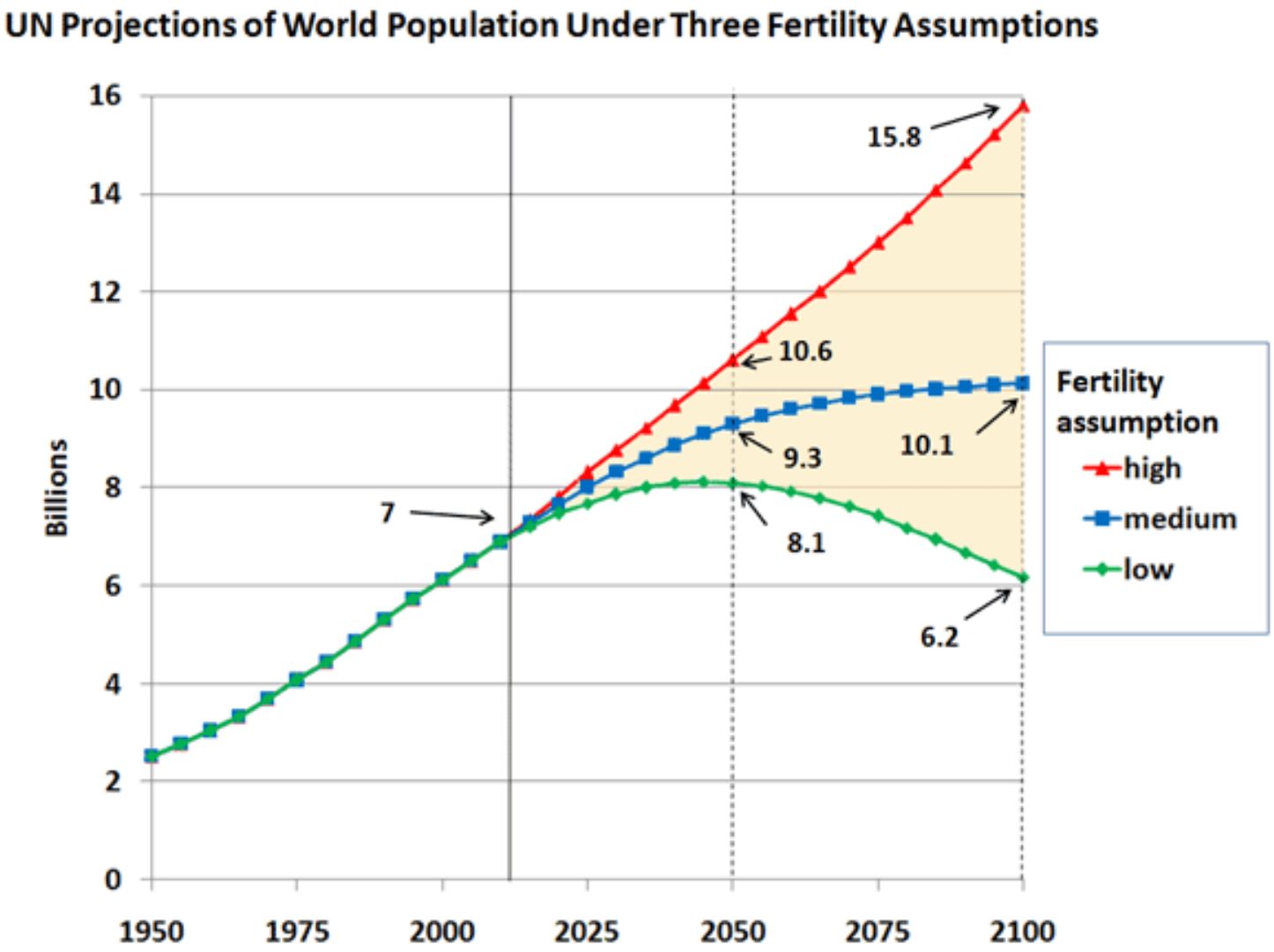
- The Millennium Ecosystem Assessment, its findings, and the development goals
- The impact of population of growth
- The relation between economic growth and the demographic transition

The Millennium Ecosystem Assessment (MEA)

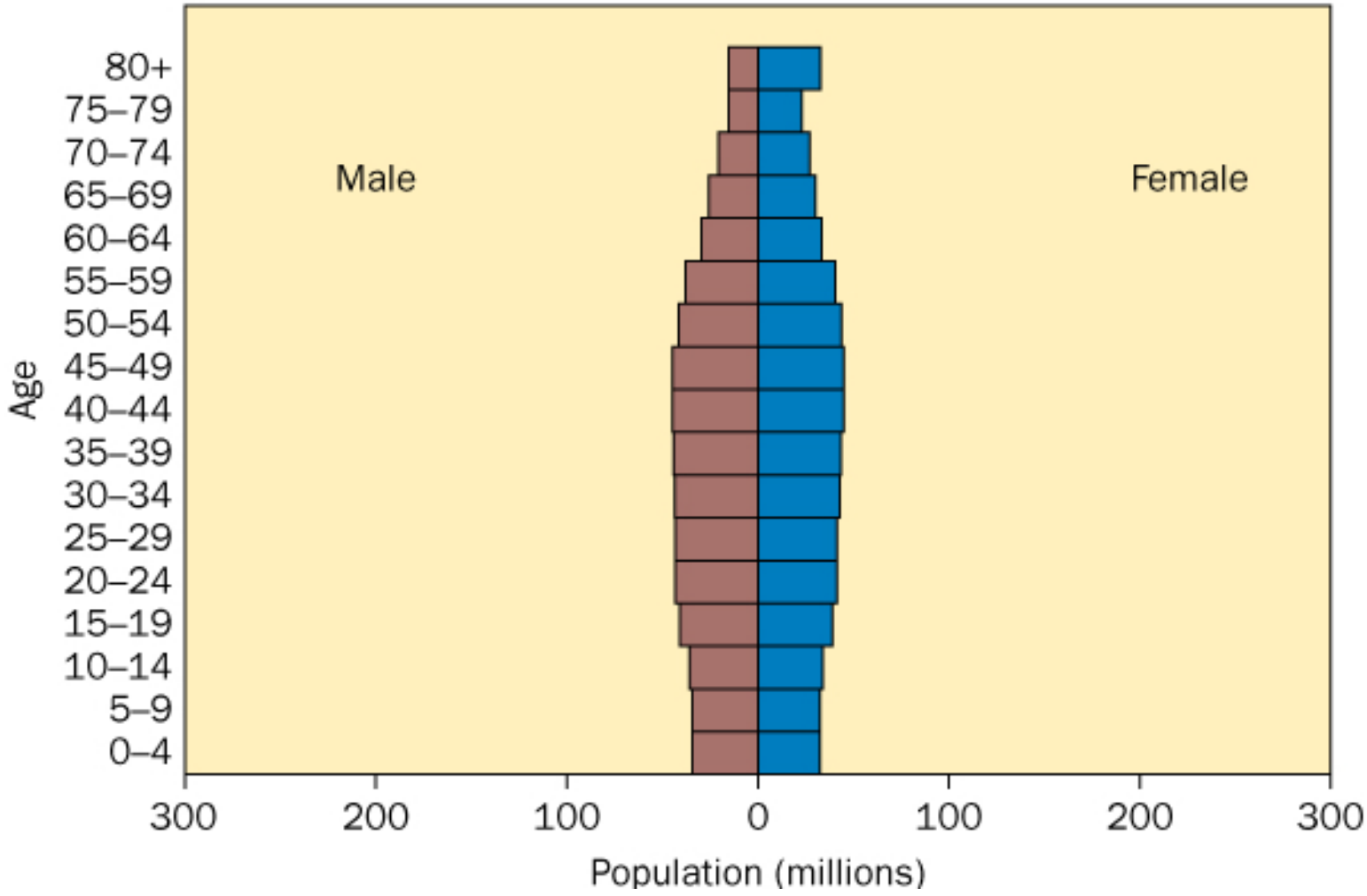


The Millennium Ecosystem Assessment (MEA)

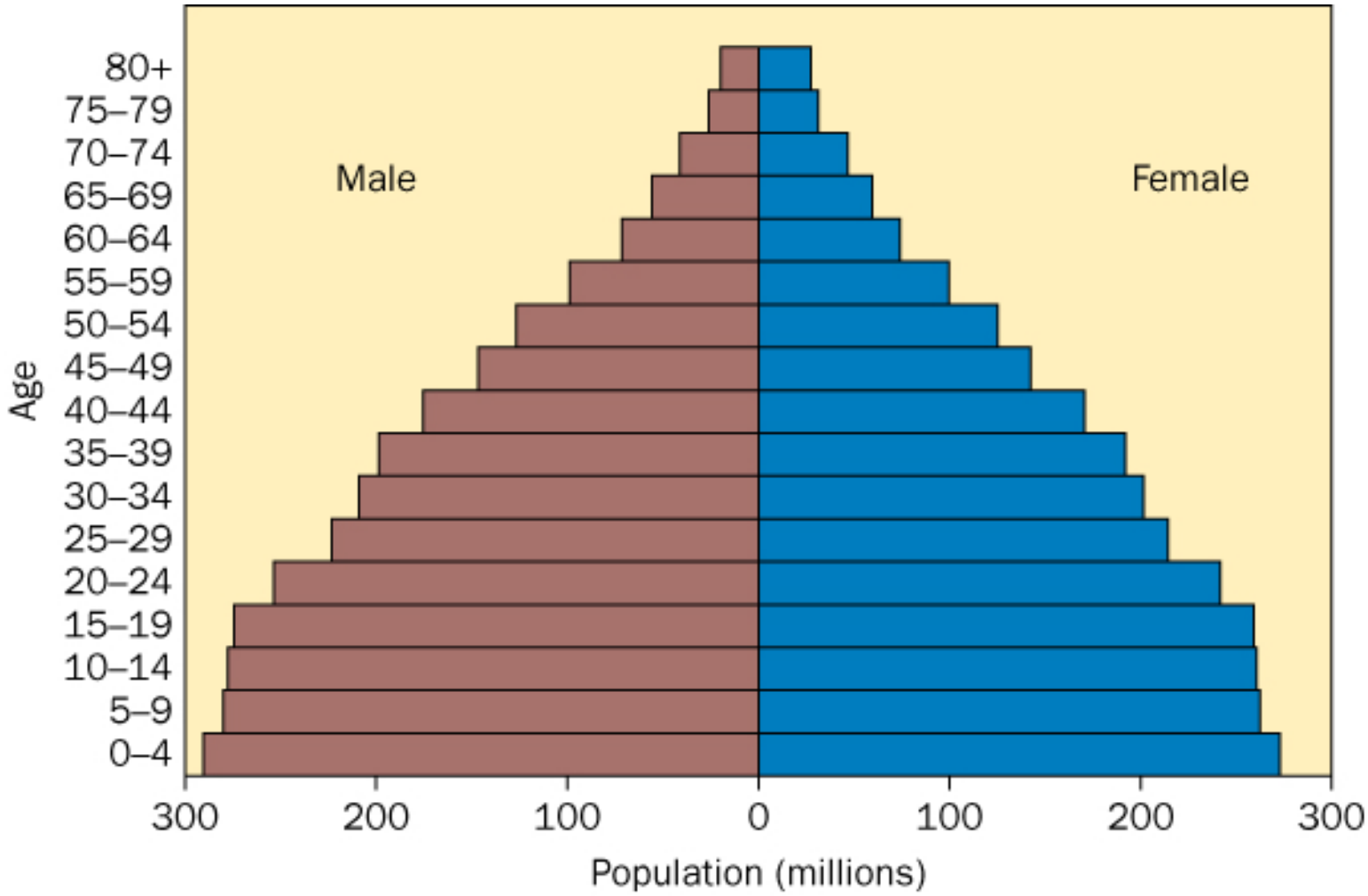
The Impact of Population



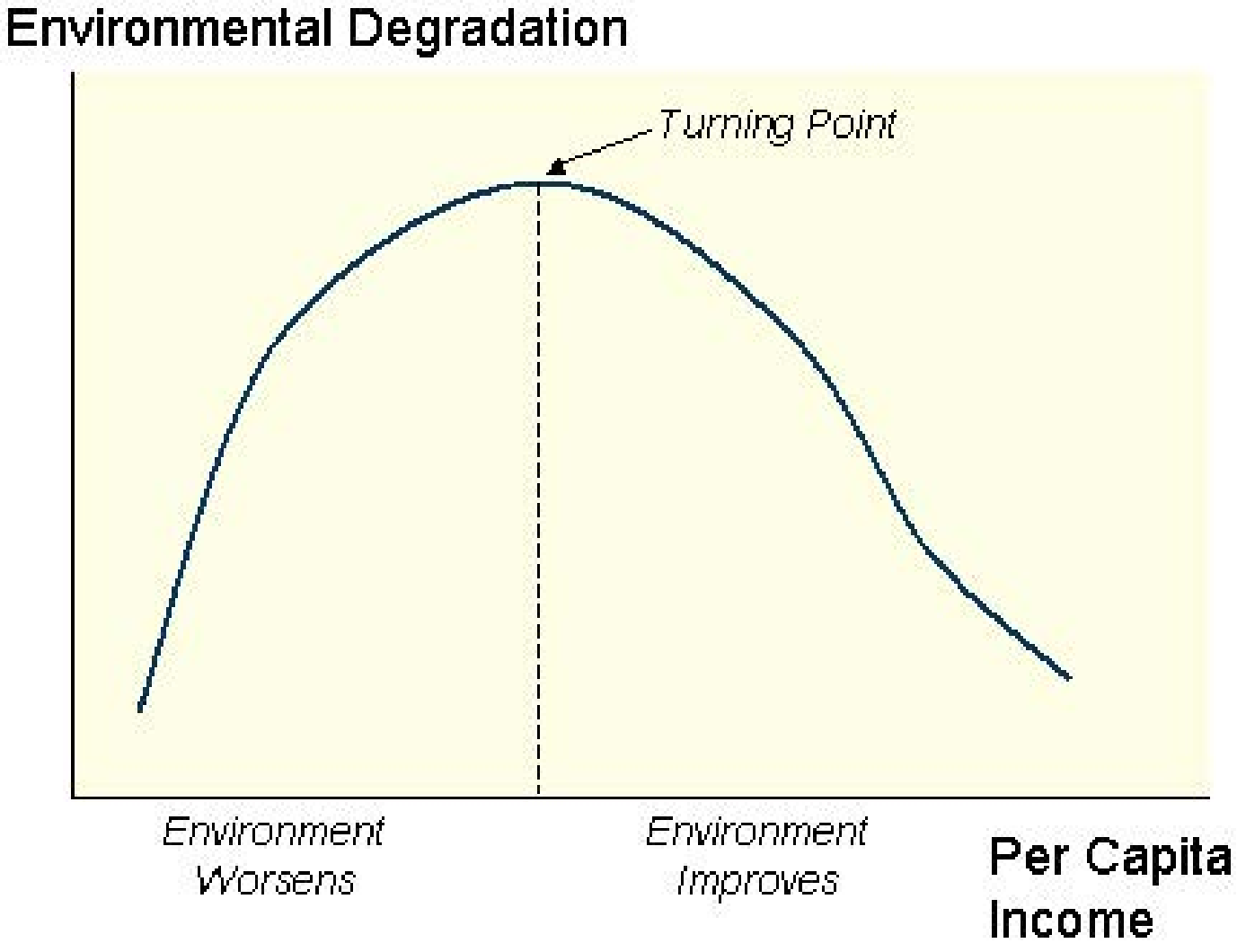
Age cohorts within Populations



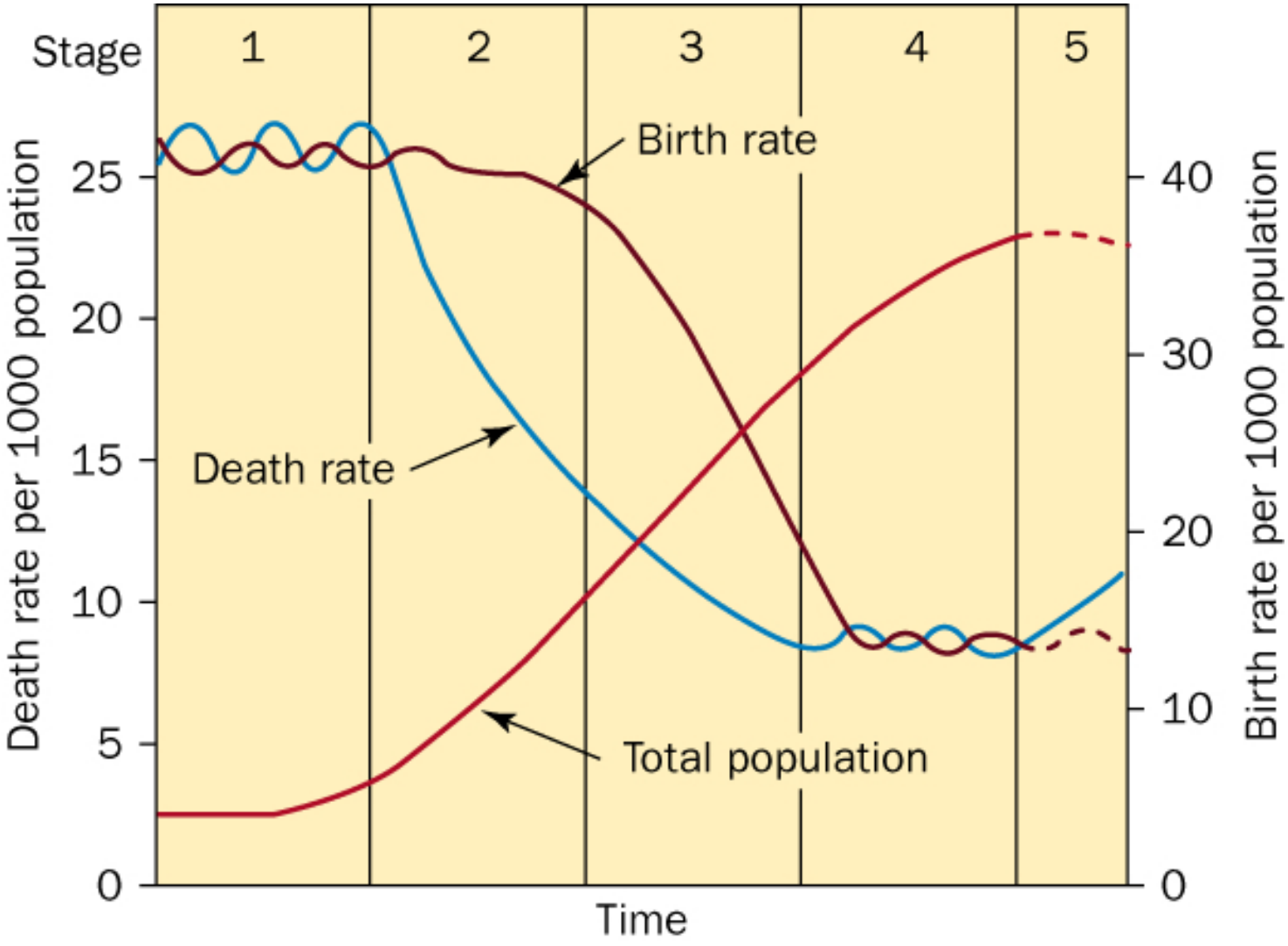
Age cohorts within Populations



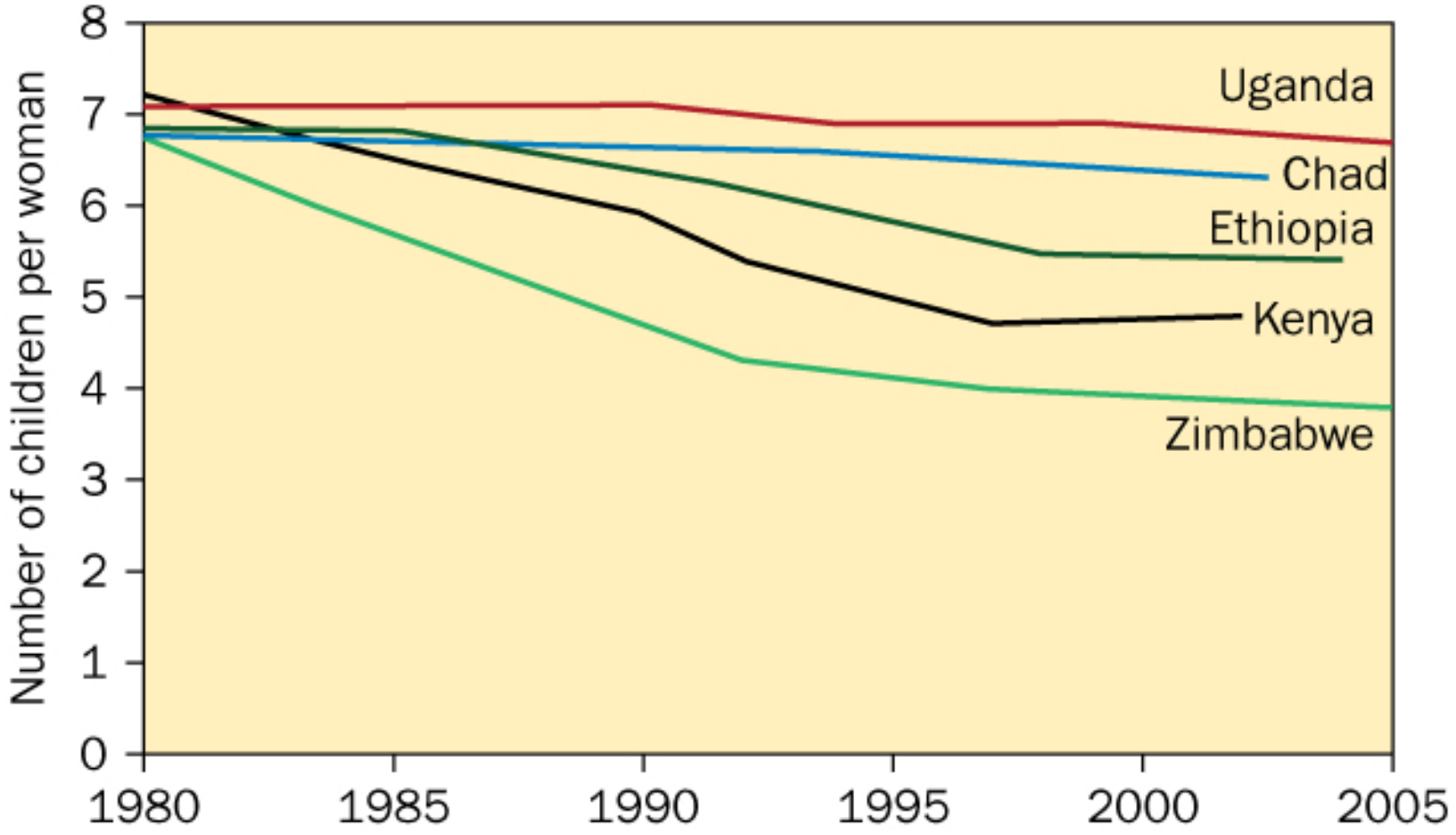
Economic growth



Population and Economic Development



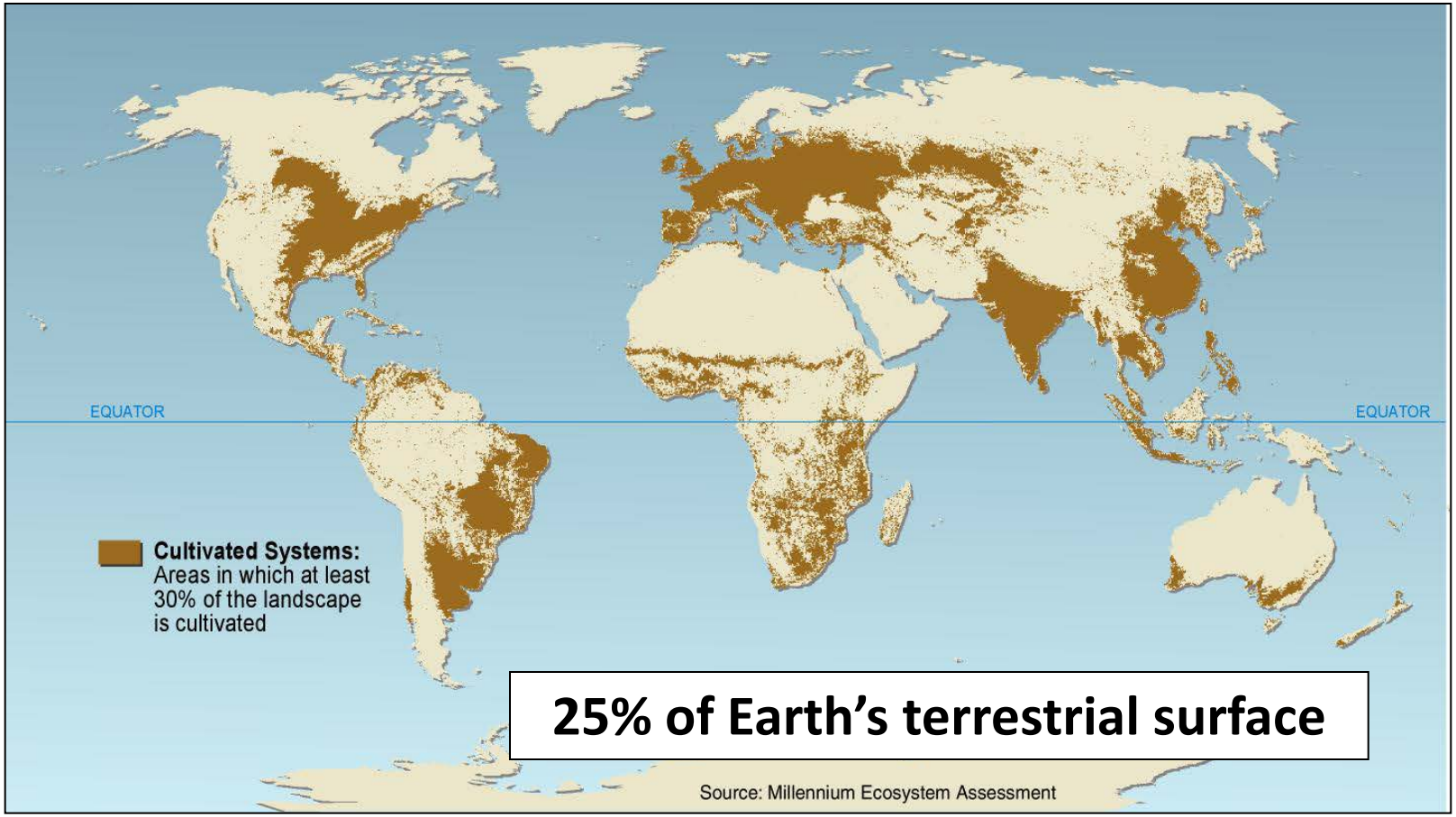
Population and Economic Development



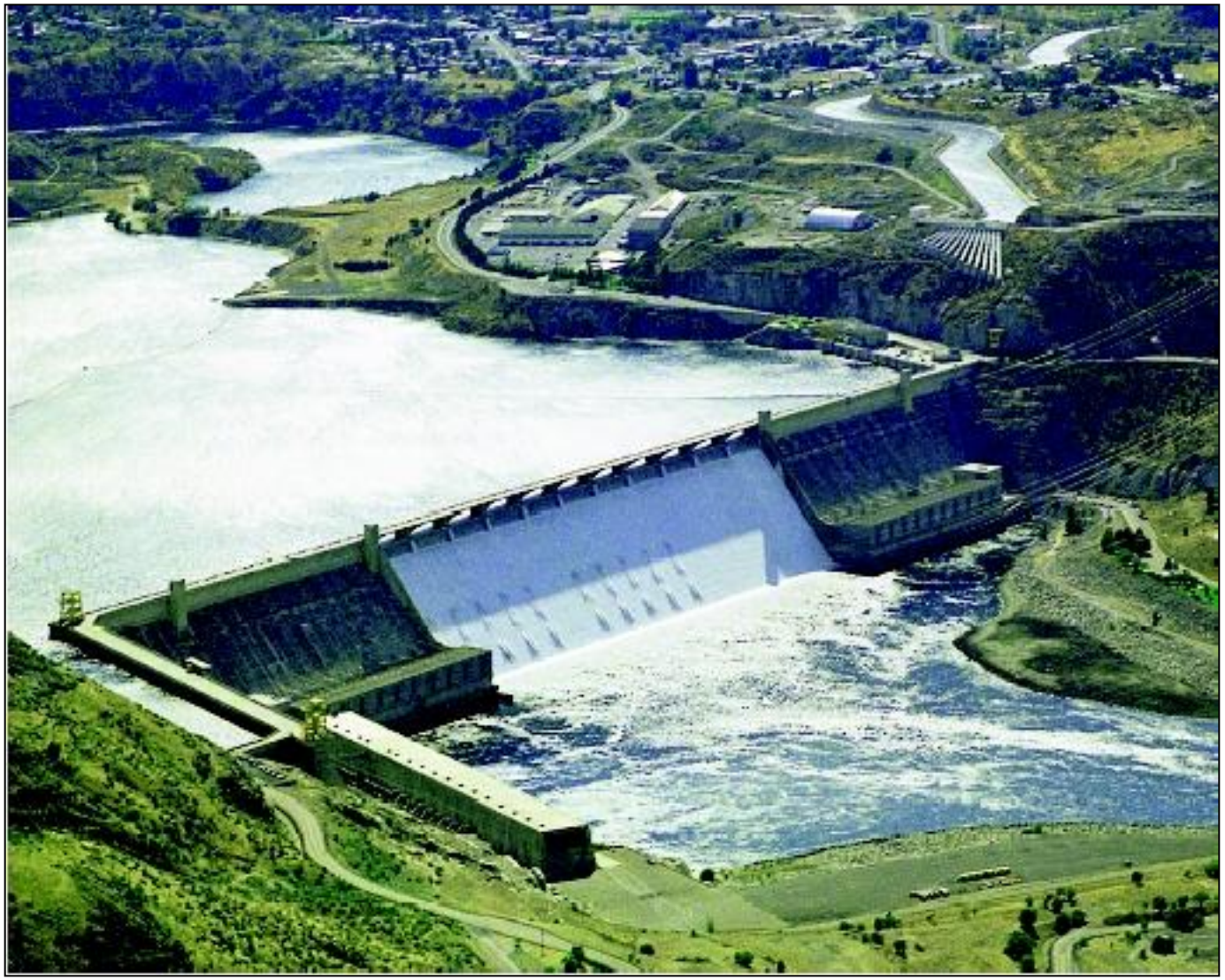
The Millennium Development Goals

Findings of the MEA

More land was converted to cropland in the 30 years after 1950 between 1700 and 1850



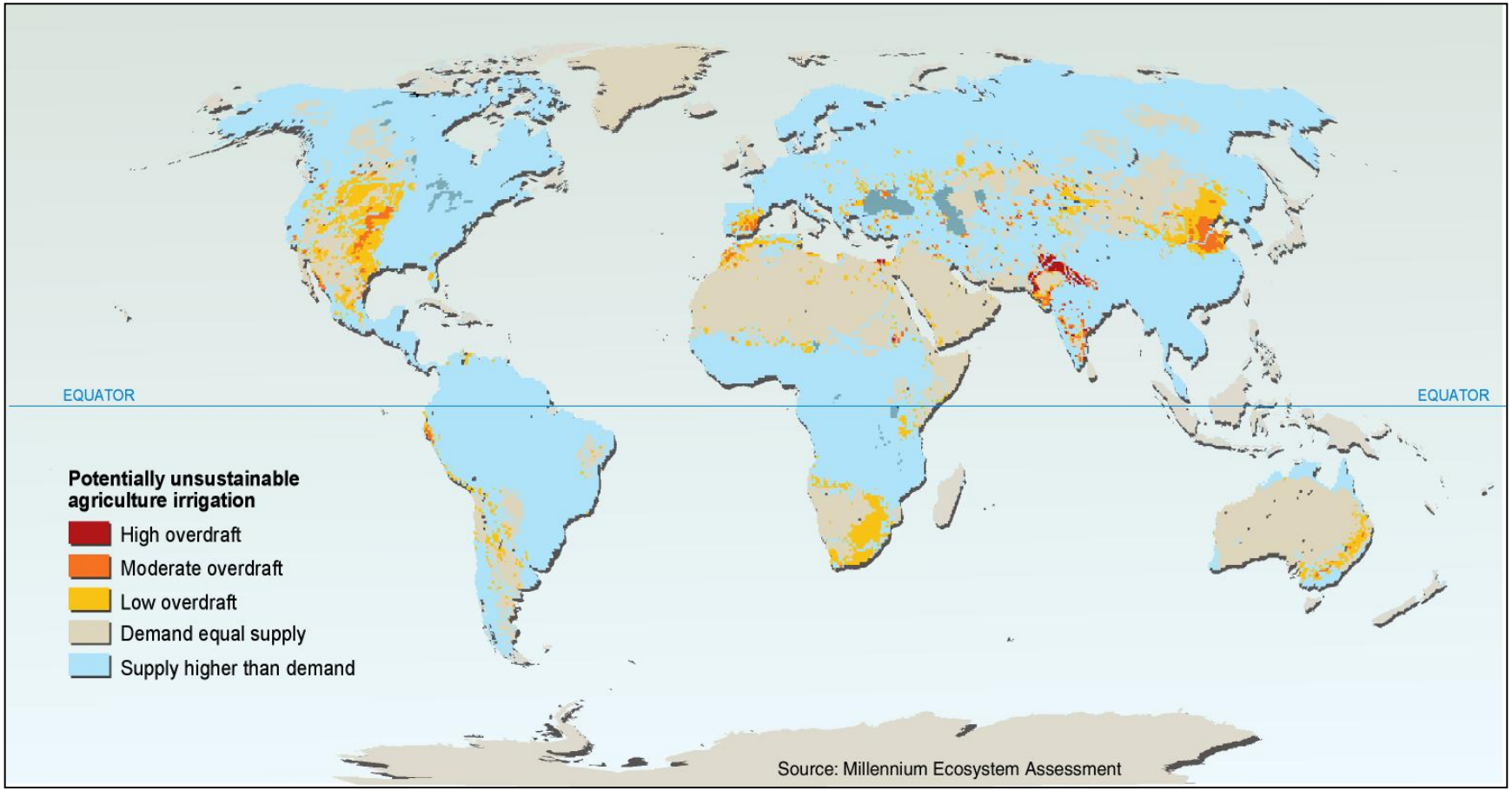
Findings of the MEA



Findings of the MEA

Findings of the MEA

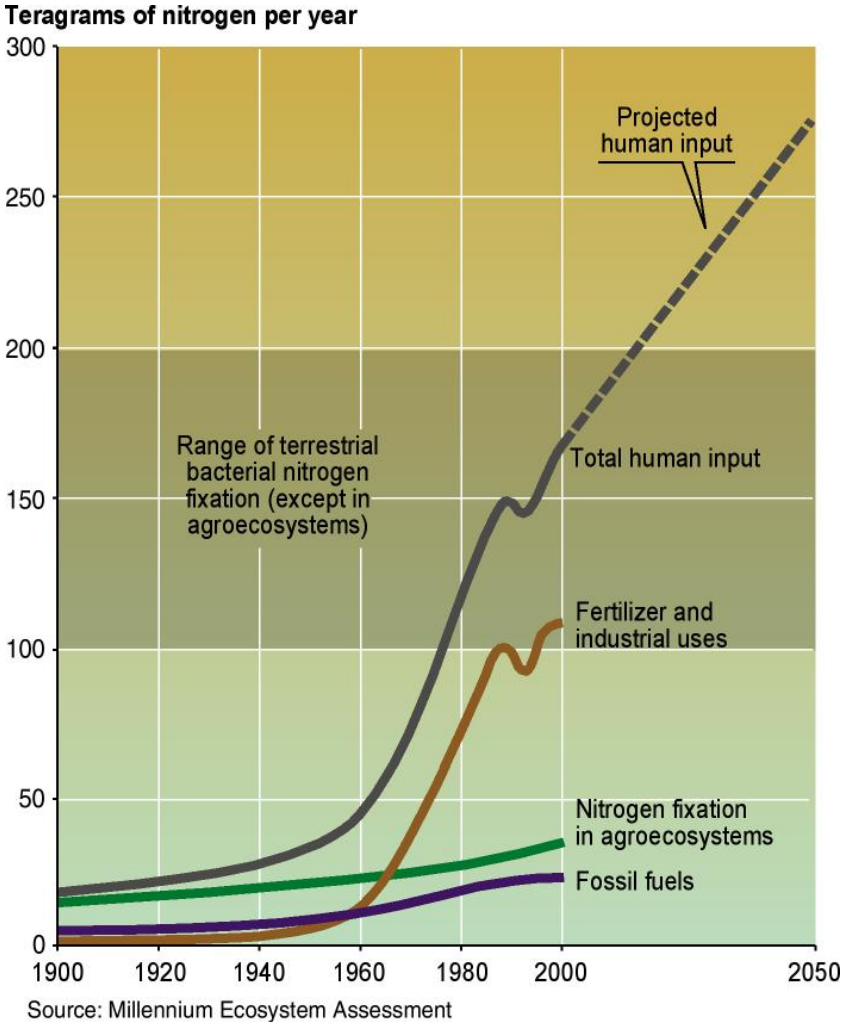
5 to 25% of global freshwater use exceeds long-term accessible supplies



Findings of the MEA

Findings of the MEA

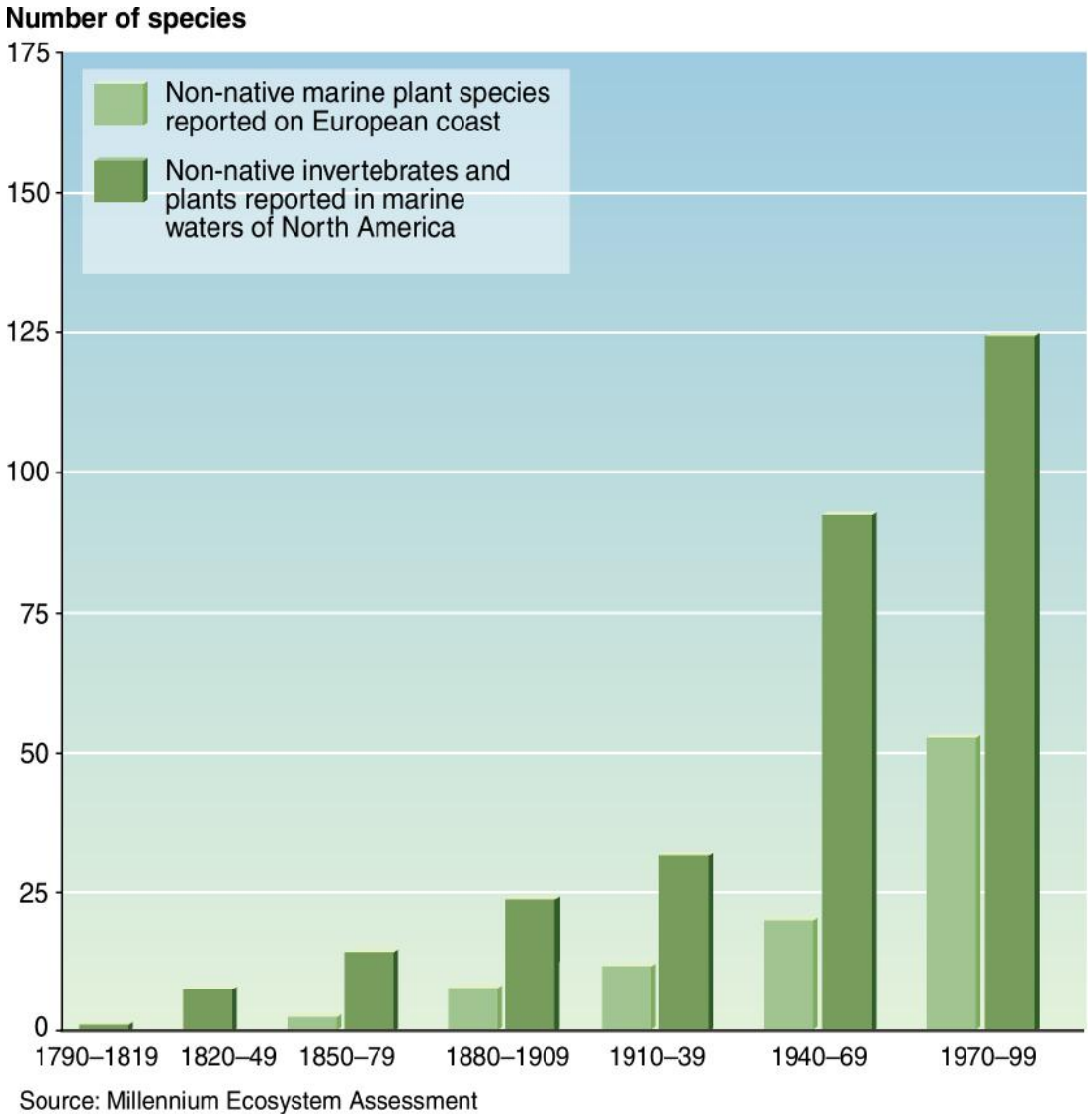
Human-produced Reactive Nitrogen



Source: Millennium Ecosystem Assessment

Findings of the MEA

Historic Progression of non-native plant and invertebrate species reported in Europe and North America, 1790-1999



Study Notes

- The Millennium Ecosystem Assessment was called for by the UN Secretary-General Kofi Annan in 2000

- It was carried out between 2001 and 2005 to assess the consequences of ecosystem change for human well-being and to establish the scientific basis for actions needed to enhance the conservation and sustainable use of ecosystems and their contributions to human well-being

- Involved the work of more than 1,300 experts from 95 countries

Study Notes

- Findings provide a scientific appraisal of the condition and trends in the world's ecosystems; and options to restore, conserve or enhance the sustainable use of ecosystems

- The experts concluded that many of the changes are non-linear and once they start, the processes of degradation will increase rapidly

- A key variable that affects our impact on the planetary life support system is the number of people being supported; over 7 billion as of late 2011

Study Notes

- Global energy consumption has risen sharply as the population has increased, as well as pollution

- 4.3 people are born every second worldwide, 80 million per year

- Under replacement-level fertility levels, the UN predicts over 10 billion people by 2100

- Reproductive choices have large implications: they have the potential to lead to a drastic increase in world population

Study Notes

- These choices are reflected by the relative distribution of age cohorts within population

- Barrel typical of low birth rates but high life expectancy is shown here: this is the profile commonly observed in developed countries

- Pyramid typical of high birth rates but low life expectancy is shown here: this is the profile commonly observed in less developed countries

- Population age structure is also important

Study Notes

• Generation between 10 and 19 years old is largest in human history

• Economic growth is a driving force behind the demographic transition

• Overpopulation leads to poverty and the inability to prevent environmental degradation

• The Goal of development planning is therefore to help less developed countries to reach this turning point

• Aid agencies aim to foster economic development

Study Notes

- With greater income, environmental services should become more affordable

- Usually process of economic development generates a demographic transition

- There is a relationship between economic growth and population that occurs in four main phases as a population passes through this transition:

    1. High equilibrium marked by high birth and death rates

    2. High expanding marked by a high birth rate, and a low death rate

Study Notes

3.Low expanding marked by a falling birth rate, and a low death rate)

4.Low equilibrium marked by low, equal birth and death rates. This is the equilibrium commonly observed in developed countries

- Eventually, the Demographic transition stabilizes populations

- Birth rates, death rates and life expectancy determine the population age-structure shape

Study Notes

- Different countries may have similar population sizes, but differing age structures; this can have a huge impact on future population growth

- Fertility rate is the number of children a woman has over her lifetime, and varies greatly amongst countries, determining whether populations grow, shrink or remain stable

- There is some indication that decrease in fertility accompanying economic development is reaching plateau in less developed countries

Study Notes

- The Millennium Development Goals were adopted by the United Nations, in 2000

- This is an attempt to adopt at global scale goals for reaching a sustainable society by 2015

- And to improve human well-being by:
  - reducing poverty and hunger, child, and maternal mortality
  - ensuring education for all
  - controlling and managing diseases
  - tackling gender disparity
  - ensuring environmental sustainability
  - pursuing global partnerships

Study Notes

• Here are some highlights of the findings made by the Millennium Ecosystem Assessment

• One of them is a Change in the structure and function of ecosystems, e.g.: more land was converted to cropland in the 30 years after 1950 than between 1700 and 1850

• Cultivated Systems in 2000 cover 25% of Earth's terrestrial surface

• They are Defined as areas where at least 30% of the landscape is in croplands, shifting cultivation, confined livestock production, or freshwater aquaculture

Study Notes

- The amount of water in reservoirs has quadrupled since 1960

- In terms of intercepted Continental Runoff, it means that there is 3-6 times as much water in reservoirs as in natural rivers

- Water withdrawn from rivers and lakes has doubled since 1960

- 70% of water use worldwide is for agriculture.

Study Notes

- It is estimated, with low to medium certainty, that for 5 to possibly 25% of global freshwater, the use exceeds long-term accessible supplies

- 15 - 35% of water withdrawn for irrigation exceed supply rates and are therefore unsustainable

Nitrogen

- Since 1960, the Flows of biologically available N in terrestrial ecosystems have doubled

- Over 50% of all the synthetic nitrogen fertilizer ever used has been used since 1985

Phosphorus

- The Flows of P have tripled during the same period

Study Notes

- The amount of biologically available N may grow a further 65% by 2050

- This graph shows the changes that have occurred since the start of the 20th century and the projections for 2050

- In parallel, 60% of the increase in the atmospheric concentration of CO2 that has occurred since 1750, has taken place since 1959

- The distribution of species on Earth is becoming more homogenous

- in other words, the set of species in any one region of the world are becoming more similar to other regions.

Study Notes

- in other words, the set of species in any one region of the world are becoming more similar to other regions.

- This is largely as a result of the massive movement of species associated with increased travel and shipping.
-
- Eg: Growth in Number of Marine Species Introductions in North America and Europe

- In addition, the population size or range (or both) of the majority of species across a range of taxonomic groups is declining

Environment and Resources

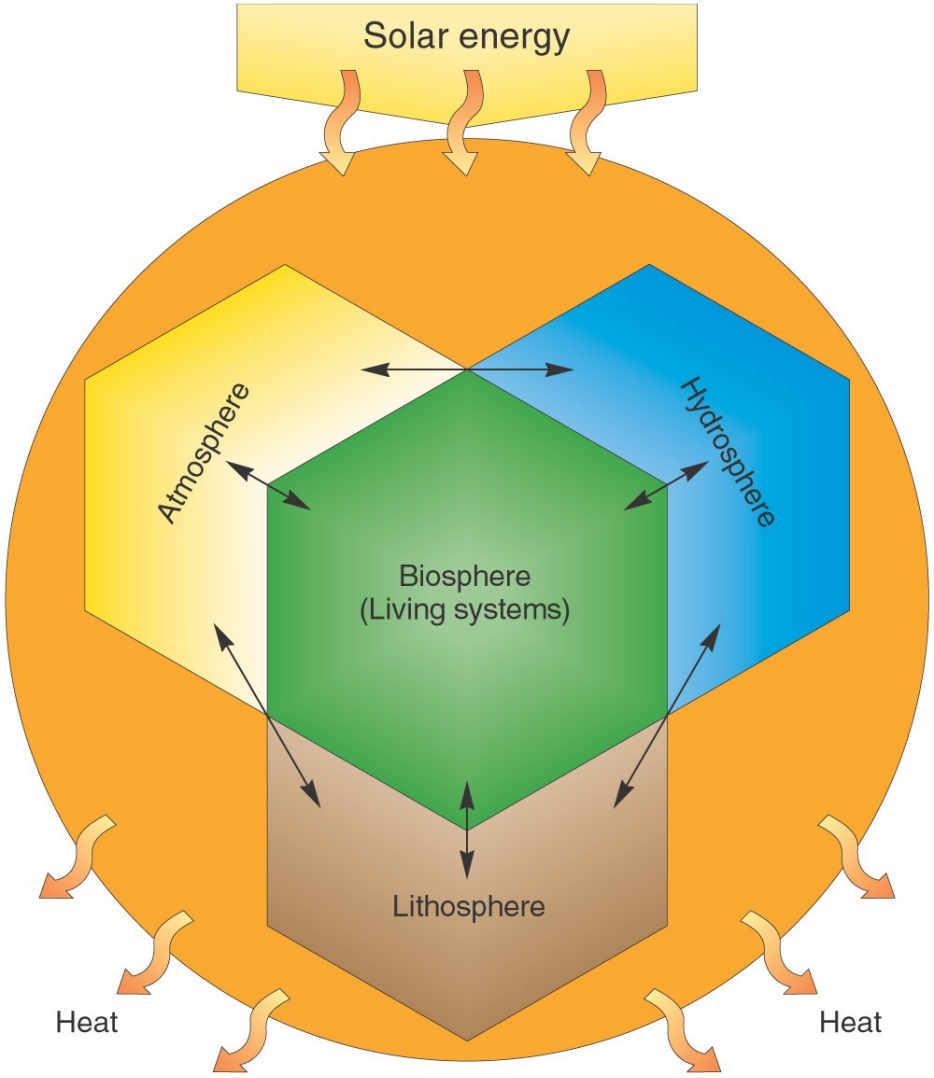
Unit 3

Views on Resources

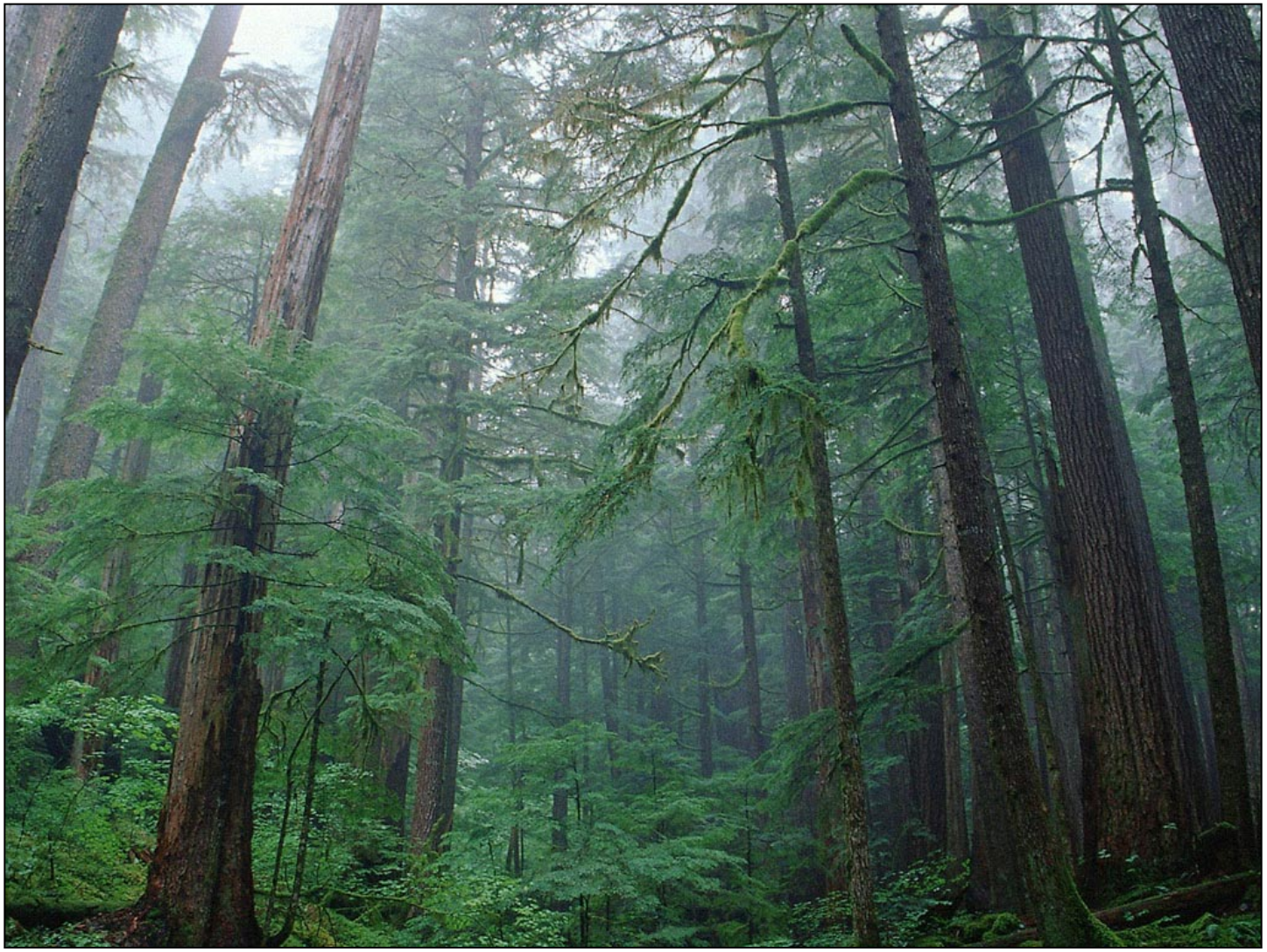
Key Concepts

- What is the environment
- What is a resource, and examples
- The different perspectives on what constitutes a resource

What is the Environment?



What is a Resource?



What is a Resource?

What is a Resource?

What is a Resource?

Anthropocentric view

Resources are valued only with respect to human utility

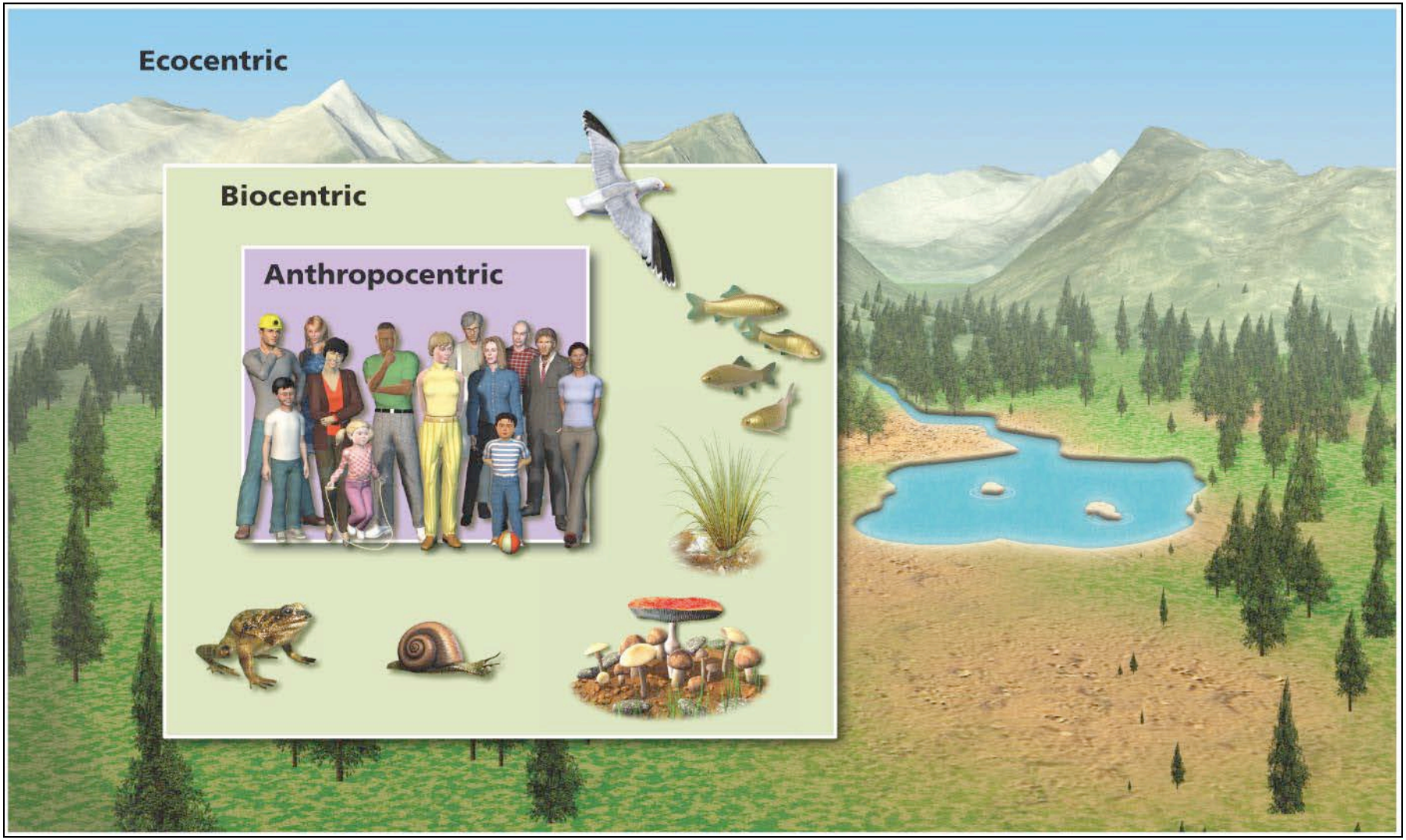
Anthropocentric view

Biocentric (Ecocentric) view

Resources exist independently from human desires

Biocentric (Ecocentric) view

Biocentric (Ecocentric) view



Study Notes

- The environment includes the atmosphere, hydrosphere, cryosphere, lithosphere, and biosphere in which humans, other living species, and non-living components exist

- Resources are specific components of the environment, such as forests, oceans, rivers and lakes, minerals and petroleum, and wildlife

- There are different perspectives on what constitutes a resource

- According to the anthropocentric view, value is defined relative to human interests, wants, and needs

Study Notes

- Elements in the environment, such as minerals, or animals, do not become resources until they have value for humans

- For example, coal and copper were not considered resources until humans understood how they could be used, and had the technology to access and utilize them

- A contrasting view is the biocentric, or ecocentric, view.

- According to this perspective, resources exist independently from human desires

Study Notes

- They have ecological and existence value in their own right

- In this view, they do not necessarily have an immediate value to humans

- Instead their value reside in that they contribute to Earth as a global ecosystem

- For example, grizzly bears have intrinsic value regardless of their immediate value to people

Study Notes

- The difference between the biocentric and ecocentric views is that non-living components are part of an ecocentric perspective, not just living beings

- The physical integrity of ecosystems is also important according to this view

- Eg water quality, air quality, etc.

Environment and Resources

Unit 4

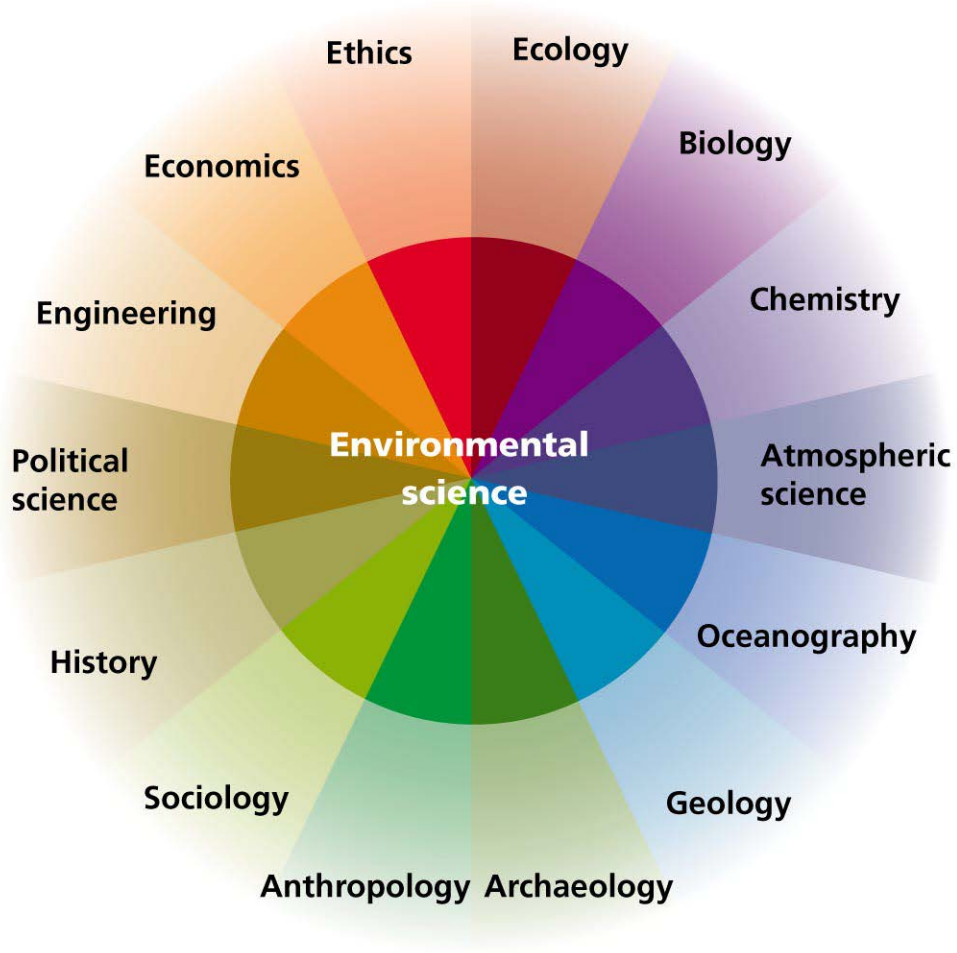
Approaches to Understanding the Environment

Key Concepts

- The different approaches to understanding the environment, and our relation to it

- The aspects to be considered for science-based management of the environment

How do we understand the Environment?



Disciplinary Approach

Organized around concepts of a given discipline

Multi-disciplinary Approach

Synthesis occurs after individual studies have been completed

Cross-disciplinary Approach

Researchers actively use knowledge from another discipline

Interdisciplinary Approach

Specialists from separate areas actively working together from the beginning

Transdisciplinary Approach

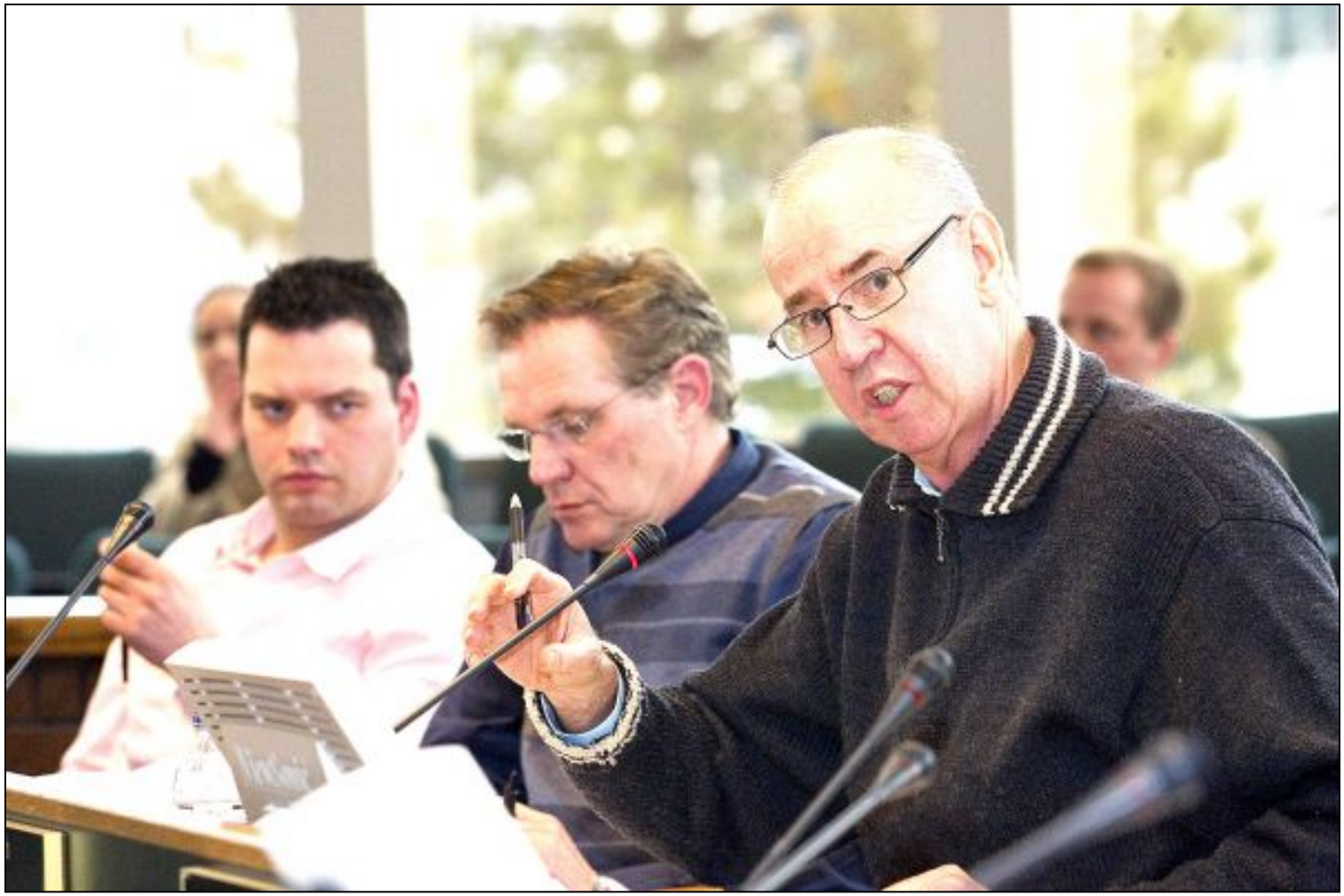
The subject is not the domain of a particular discipline

Science-based Environmental Management

Science-based Environmental Management

Science-based Environmental Management

Science-based Environmental Management



Science-based Environmental Management

Study Notes

- The world is not compartmentalized

- However we have yet to have an holistic view of the environment.

- It is still delineated by knowledge constrained within different disciplines

- This is reflected by different approaches to our understanding of the environment

Study Notes

- Disciplinary Approach is organized around the concepts, theories, assumptions, and methods associated with one academic discipline; may limit understanding of complex systems

- This approach breaks down environmental problems in different parts, that may be easier to grasp

- For instance, we can consider a problem from the perspective of the field of biology, from the perspective of environmental chemistry

- This represents however a reductionist view of the environment

Study Notes

- In a Multidisciplinary approach, specialists examine an issue from each of their disciplinary perspectives, and their findings and insights are synthesized, increasing understanding

- A drawback is that combining results after the research has been conducted may result in a lack of connecting research

- In cross-disciplinary research, a disciplinary specialist borrows concepts, theories, and methods from other disciplines to enhance their perspective.

Study Notes

- For example, a soil specialist using concepts and methods from plant science

- It can increase understanding of a problem, or can also lead to misunderstanding

- The researcher may also overlook material with which he or she is unfamiliar

- In Interdisciplinary research, various specialists work together from the beginning of a project, leading to synthesis and integration of understanding;

Study Notes

- This approach is time-consuming, requiring trust, patience and openness

- Interdisciplinary research incorporate the benefits of all disciplines right from the start – therefore connective research needs can be identified

- A drawback is that it takes extra money and time or communication

- Transdisciplinary research extends the interdisciplinary perspective by seeking a holistic understanding that transcends disciplinary boundaries, not viewing them in the context of any one discipline and weighing each area equally;

Study Notes

- This can enhance understanding or lead to confusion and may lead to information overload.

- An example is sustainable development, which brings together concepts and methods from the environmental science, engineering, and economics

- It includes equally important research from environmental, social and other areas of research

- When managing resources and environmental problems, from a science perspective, all the relevant information and interpretation must be considered

Study Notes

- The information is revealed to all parties involved, and the choice of course of action to be taken is left to decision-maker(s)

- E.g. governments

- Science-based Environmental Management should follow some guidelines:

- First, focus the science on key issues, and communicate it in a policy-relevant form

- Decision-makers interested in solving immediate problems, not necessarily in advancing scientific knowledge

Study Notes

- Use science to figure out if we are asking the right questions in the first place

- Use scientific information to clarify issues, identify potential management options, and estimate the consequences of actions

- Communicate issues in a policy-relevant form, i.e. how can we address problems with what we know

- Identify potential management options, and estimate the consequences of decisions

Study Notes

- Clearly and simply communicate key scientific findings to all participants

- Scientists report their findings in academic, peer-reviewed journals – however, when it comes to the environment it is important that the public-at-large knows new information as well – this requires educating the public in a manner that the public will understand

- Evaluate whether or not the final decision is consistent with scientific information.

- Policy-makers are held accountable for making decisions based on scientific knowledge – not just based on economics

Study Notes

- Policy-makers are held accountable for making decisions based on scientific knowledge – not just based on economics

- Finally Avoid advocacy of any particular situation

- Scientists need to be, and should appear as, unbiased –

- What credibility would the results of a scientist reporting no effects of a new pesticide be if it was known that his or her research was supported by the company manufacturing this product?

Environment and Resources

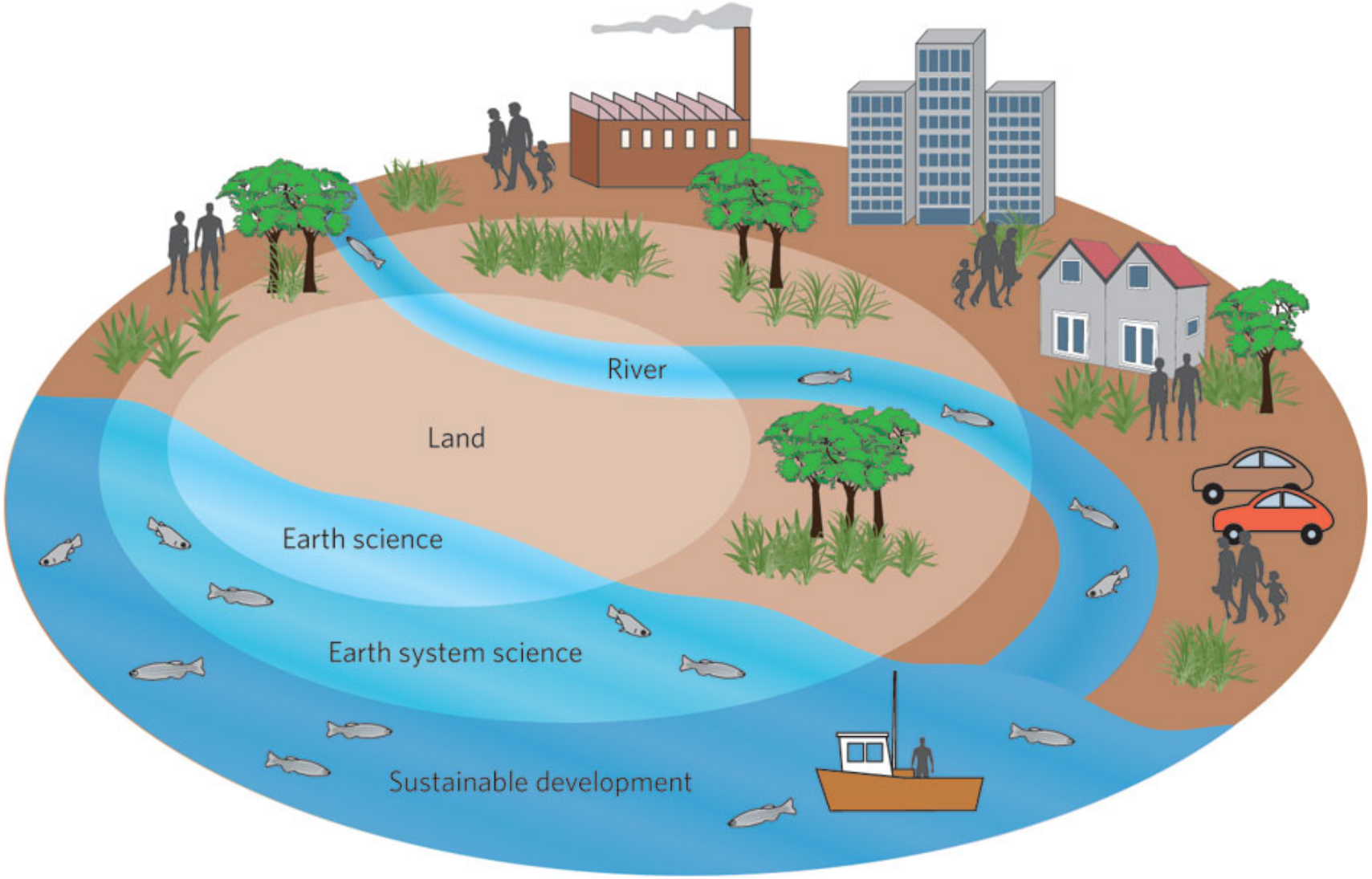
Unit 5

Sustainable Development & Indicators

Key Concepts

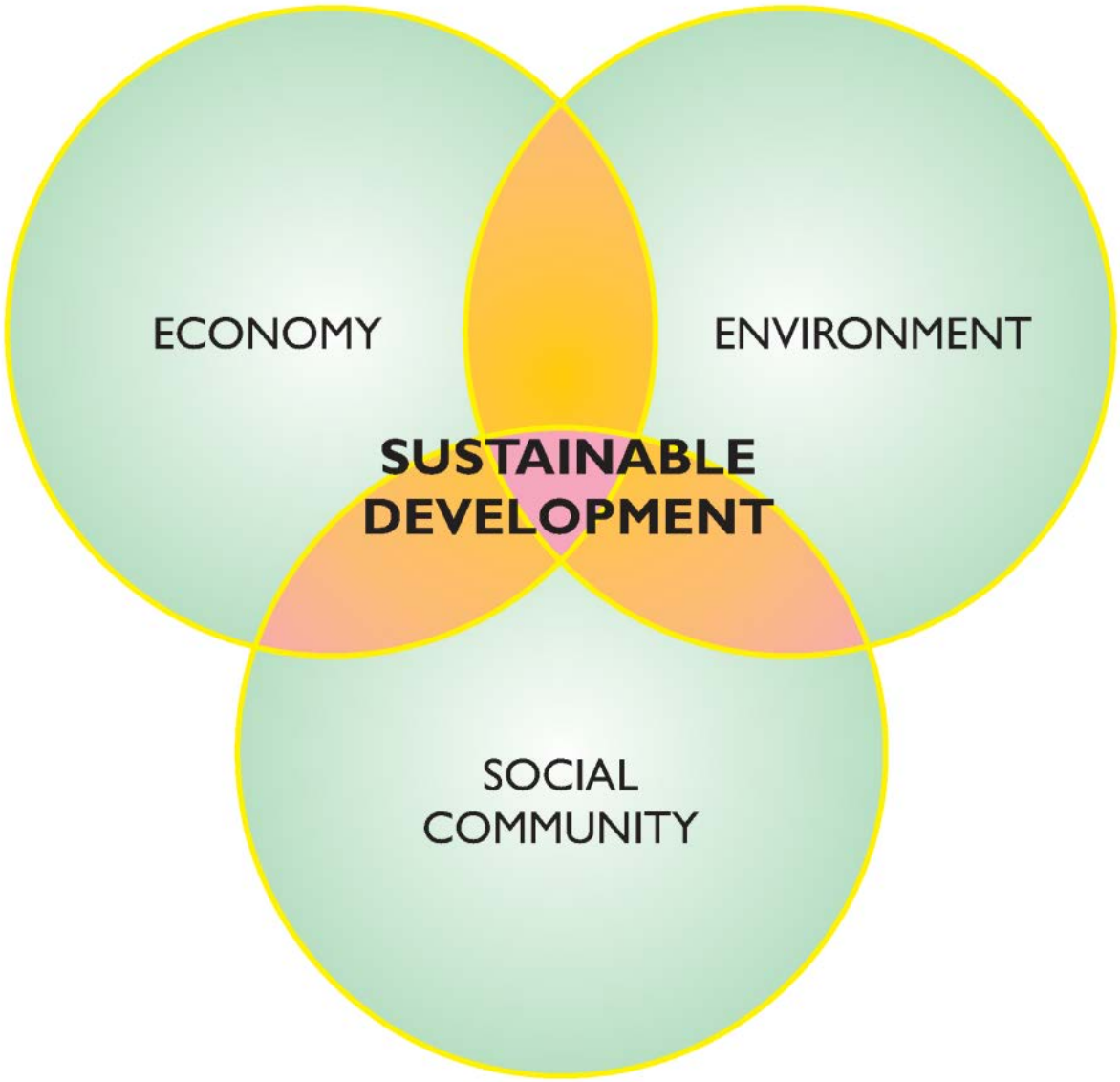
- Sustainable development and livelihoods
- Resilience
- Environmental indicators and their use
- Ecological footprint and the Living Planet Index
- Rate of resource consumption

Sustainable Development



Sustainable Development

Sustainable Development

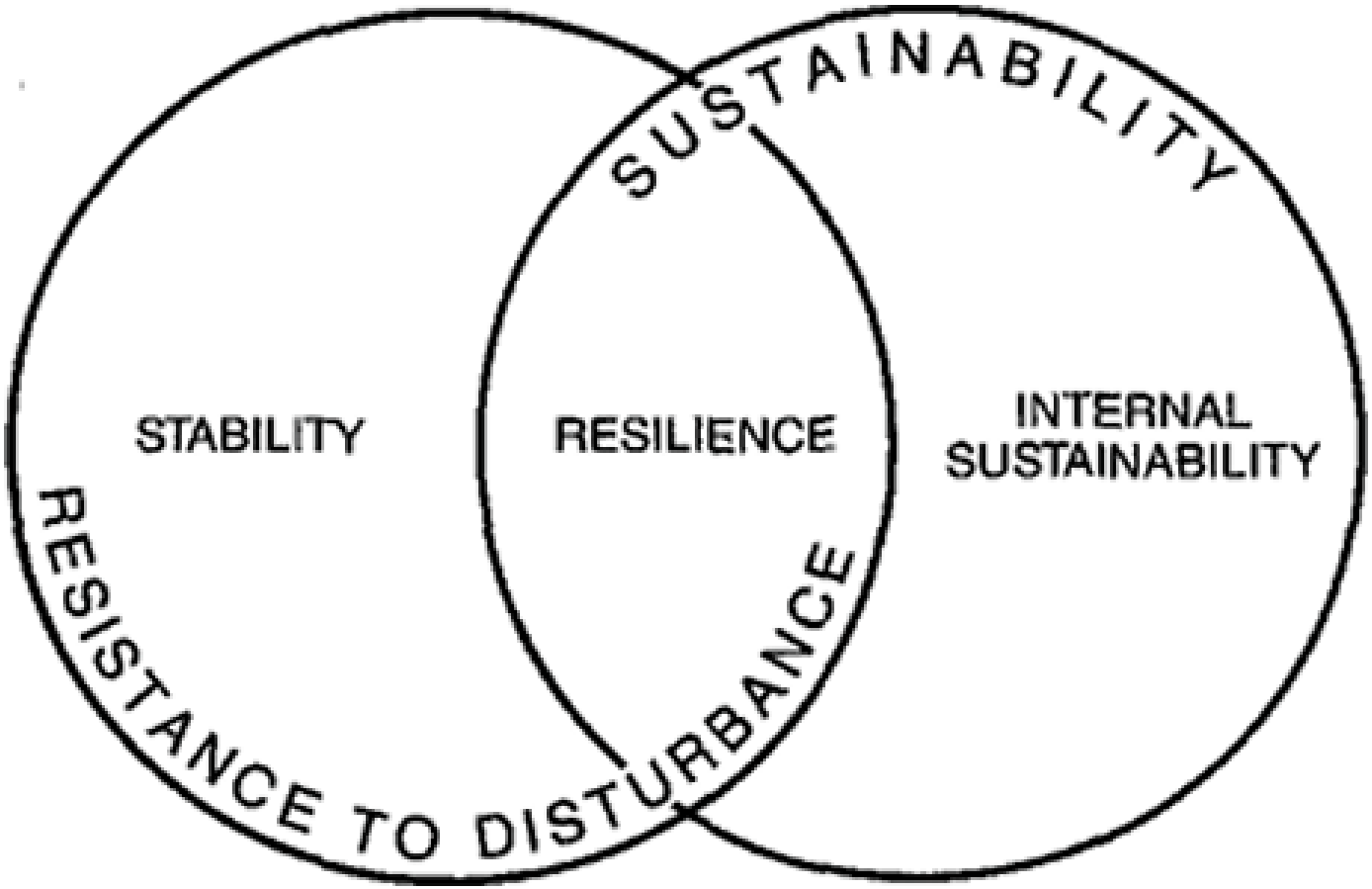


Sustainable Livelihoods

A human-centered approach to broad environmental management

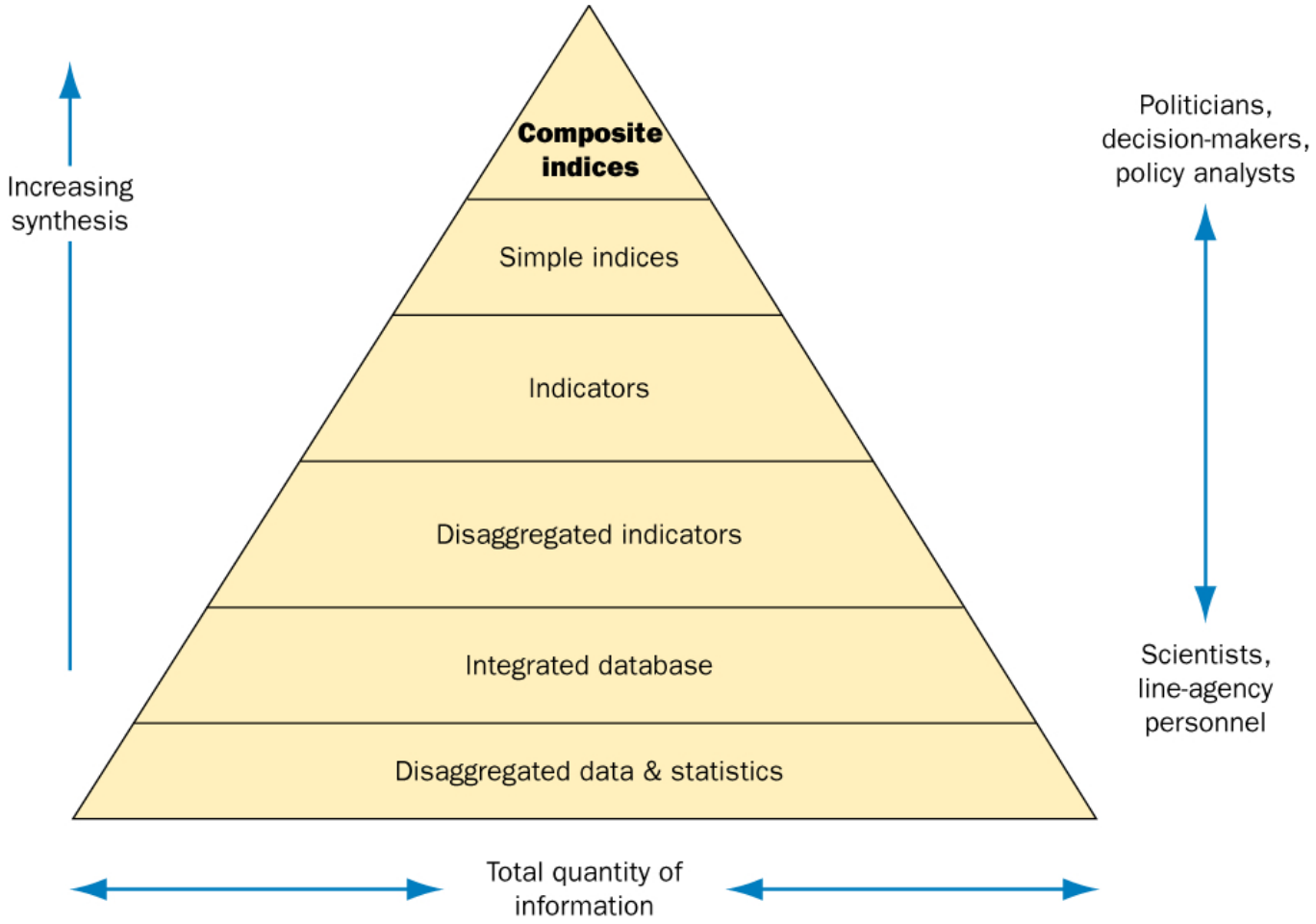
Resilience

The ability of a system to absorb disturbance

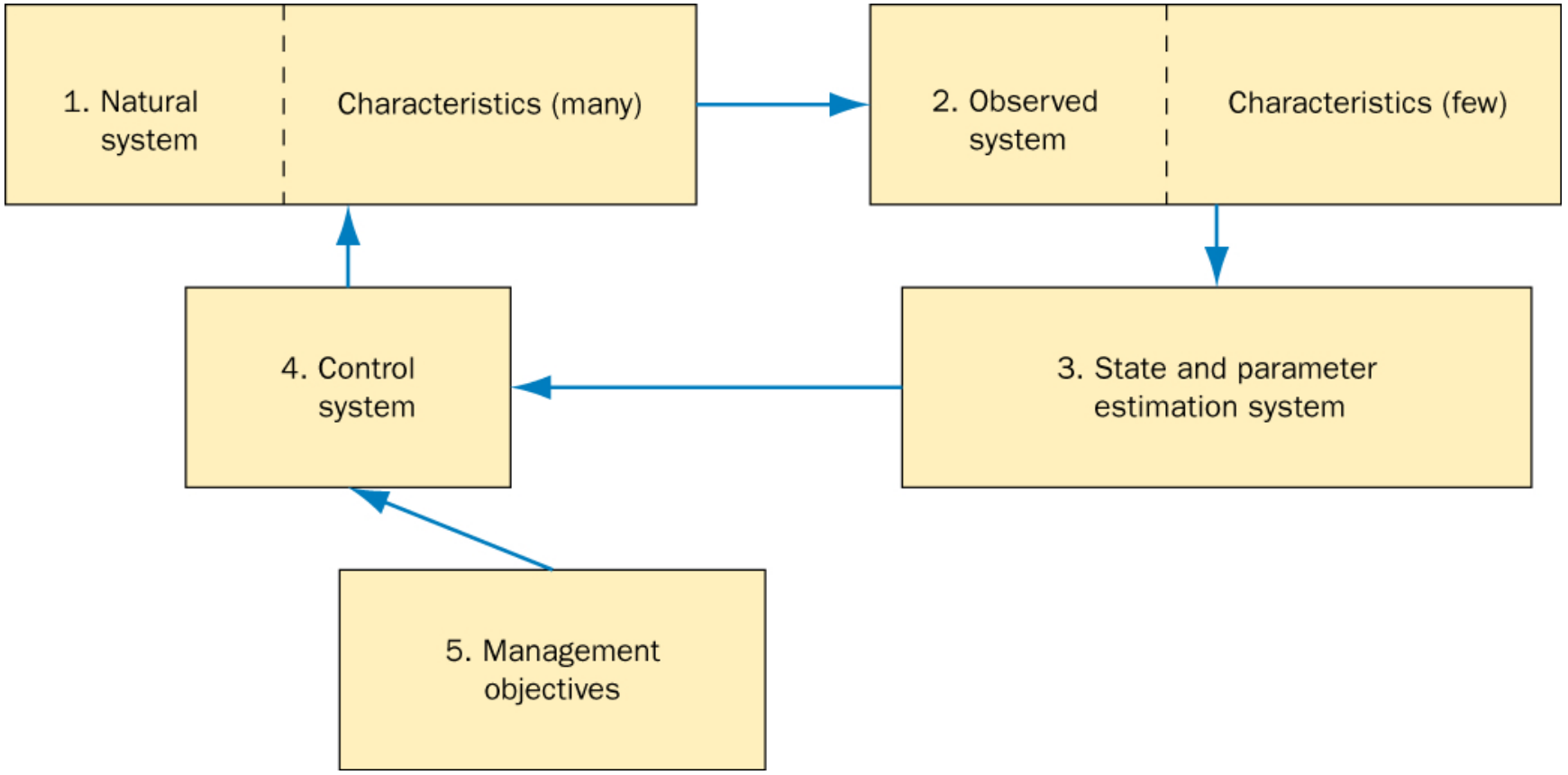


Environmental Indicators

Specific facets of a particular system that provide information about its current state

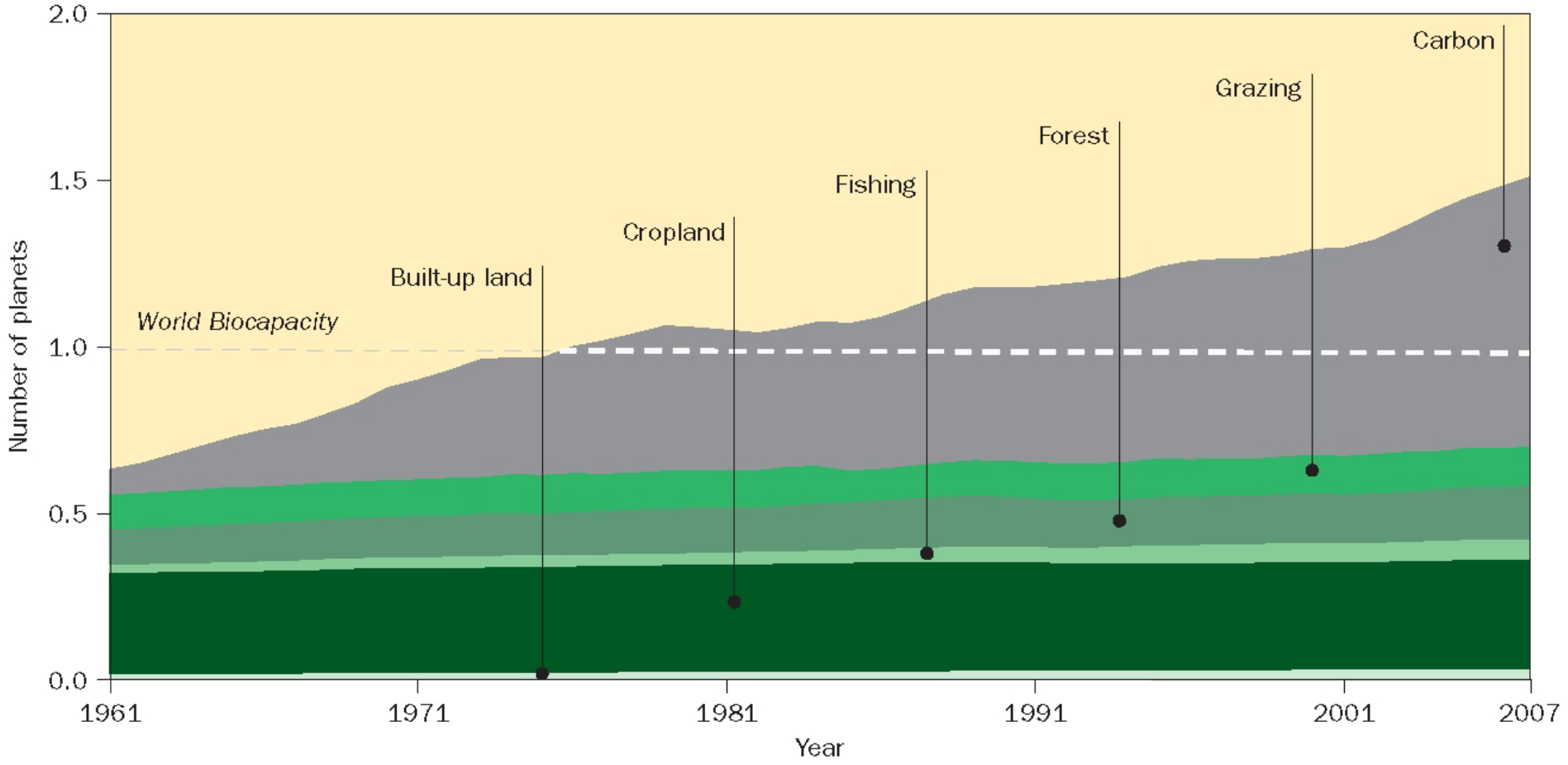


Interactions between Biophysical and Social Systems



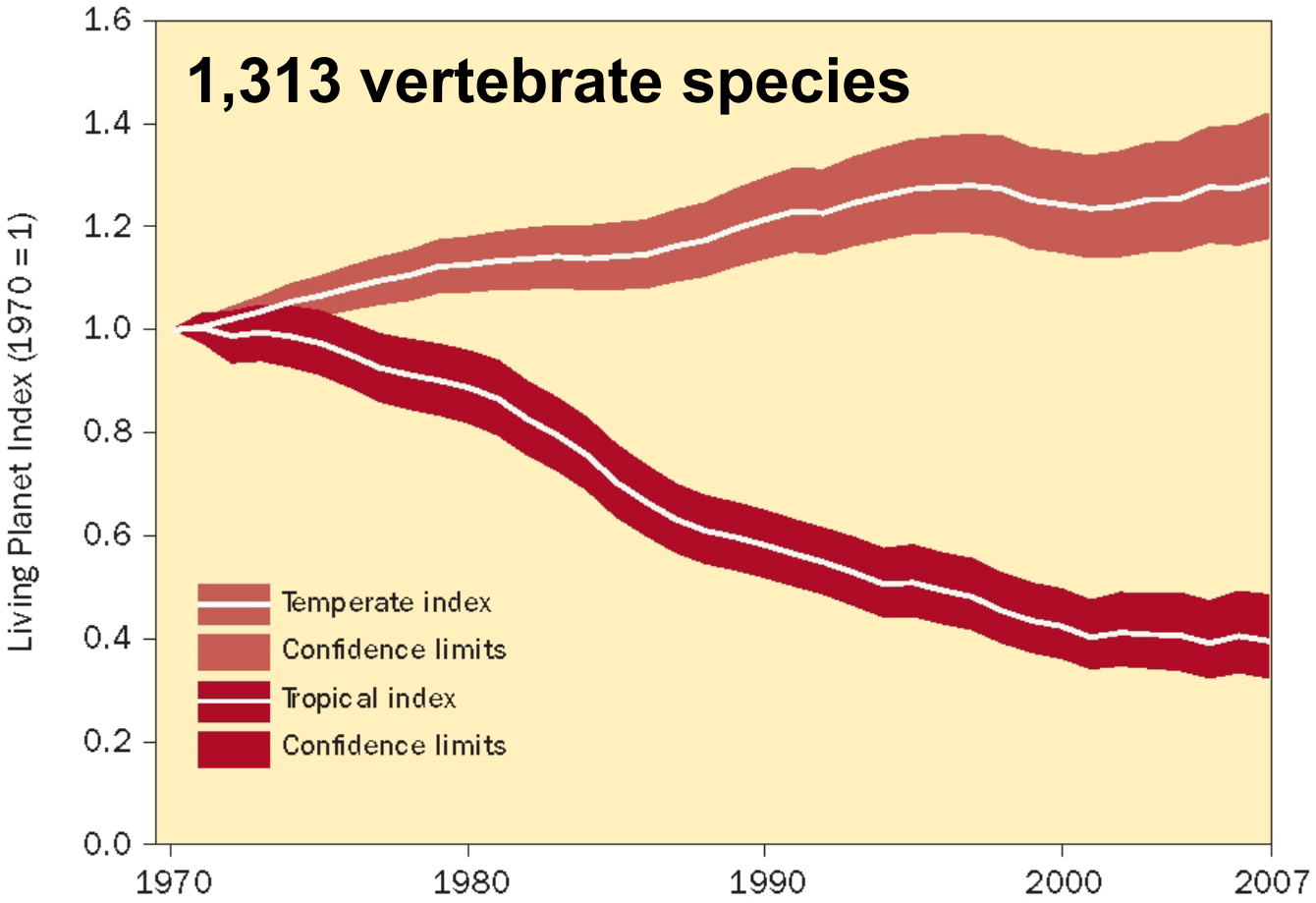
Ecological Footprint by Component

Growing gap between the Global Ecological Footprint and the world's Biocapacity

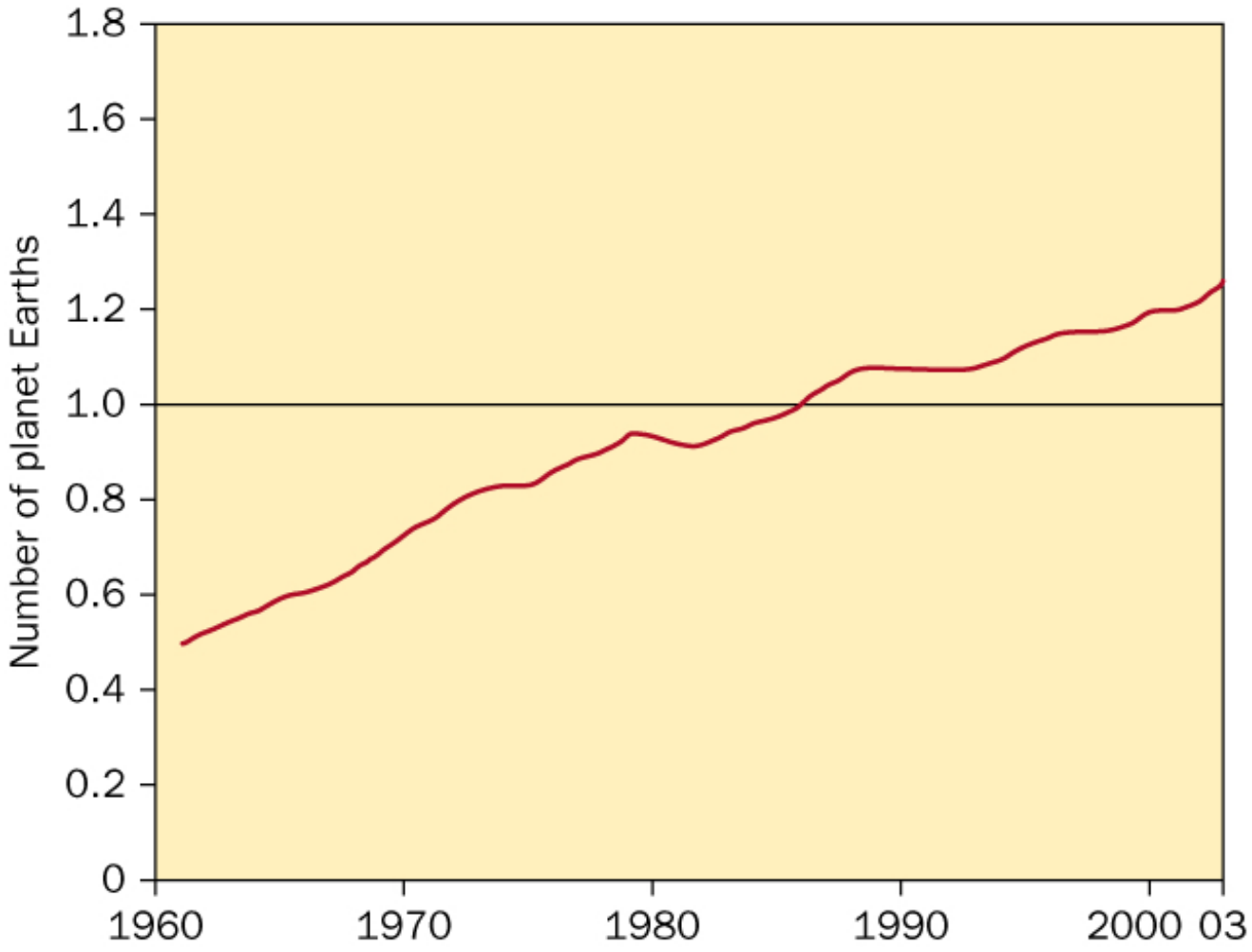


Living Planet Index

35% reduction since 1970



Sustainable use of Resources



Study Notes

- Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs

- It has 3 strategic aspects

- It presents a vision regarding the nature of future societies, for example a notion of human stewardship of nature

- It emphasizes a system of governance and management characterized by openness, transparency, decentralization, and accessibility

Study Notes

- It seeks to ensure that economic, environmental, and social aspects are considered together, and that trade-offs are visible and transparent to those affected

- Some believe that it provides a compelling vision for the twenty-first century that acknowledges longer-term development implications and the need to balance social, economic and environmental considerations

- Others believe that the term is so vague that it can be used in different ways to suit varying and often conflicting interests, such as justifying economic growth so that future generations have same standard of living

Study Notes

- Sustainable livelihoods emphasize the conditions necessary to ensure that basic human needs are satisfied

- It is a human-centered approach to broad environmental management

- It is directed towards ways for local people to meet their basic needs as well as other needs related to security and dignity through meaningful work

- At the same time, it aims to minimize environmental degradation, rehabilitate damaged environments, and address concerns about social justice

Study Notes

- Resilience is the ability of a system to absorb disturbances and still retain its basic function and structure

- Resource management that enhances resilience of social-ecological systems is more sustainable than the traditional approach, which focuses on optimizing output of goods and services from a natural resource system

- One of the goals of science is to provide understanding of complex problems, and one way of doing this is to use of indicators.

Study Notes

- They are Specific facets of a particular system that provide information about its current state

- E.g. population of a key species within an ecosystem

- An indicator does not help to understand by itself why a system is in that state

- It helps decision-makers in choosing which management policy to adopt

- They represent greater and greater levels of synthesis of different data

Study Notes

• Different indicators that are thematically linked are called indices

• They are aggregates of similar indicators

• Composite indices represent the highest levels of aggregation and are useful for decision-makers, but while they tell us what is happening, they do not explain why

• We still must be able to decompose them easily to understand why the change is occurring

• Models are needed to decide the best approach for both the preservation of natural systems and human needs

Study Notes

- And to best appreciate the impacts of actions

- Only a fraction of the characteristics of natural system are in fact observed

- Based on an observation, an attempt is made to decide what is the status of system

- Eg is a soil suitable for agriculture

- Depending on the objectives, this is followed by an attempt to control of system

- Eg adding fertilizers, irrigating the land

Study Notes

• Then we can observe the results and make changes to the management approach

• Ecological footprints measure the human use of the environment in hectares per person

• They enable us to compare the overall impacts of various countries

• This graph shows a growing discrapancy since 1961 between the global footprint and the world's biocapacity

• Biocapacity is the amount of biologically productive area available to meet humanity's needs

Study Notes

- The Living Planet Index, created by the World Wildlife Fund, is a widely used index

- It tracks 1,313 vertebrate species

- It is assumed that trends for vertebrates are indicative of trends overall

- In this graph, the temperate index gives to people living in these areas impression that situation is better than it actually is

- The index overall shows a 35 per cent reduction in the overall health of the planet since 1970.

Study Notes

- Cumulatively, indices indicate that, at the current rate of resource consumption, there is not resources on Earth to sustain this rate of consumption

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