Virtual Academy of Sustainability

Lecture 3: Ecosystems and Human Wellbeing

Episode 1: Ecosystem Services

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Universität Bremen
ZMML Zentrum für Multimedia in der Lehre
DBU Deutsche Bundesstiftung Umwelt

Overview of the Lecture

Episode 1: Ecosystem Services

Episode 2: Ecological Integrity

Episode 3: Interview

Learning Outcomes

- You will learn the concept of ecosystem services.
- You are able to understand, why we depend on them for our survival.
- You will know ecosystem services valuation.

Structure of Episode 1

1. Defining Ecosystems
2. Ecosystem Services
3. Conclusion

Defining Ecosystems

- The term "ecosystem" was coined in 1930 by British botanist Arthur Roy Clapham to denote the combined physical and biological components of an environment.

- Grouping of plants, animals (including humans) and micro-organisms occupying an explicit unit of space and interacting with each other and their environment.

Defining Ecosystems

Ecosystems embody the concept that living organisms continually interact with each other and with the environment to produce complex systems with emergent properties, such that:

- "the whole is greater than the sum of its parts," and
- "everything is connected to everything else"

Defining Ecosystems

Two aspects of every ecosystem:

- Biotic component
  (living community or biota)

Source: www.wikipedia.de by W.J.Pilsak

- Abiotic component
  (nonliving or physical environment)

Defining Ecosystems

- Abiotic component includes the physical and chemical factors of an ecosystem as sunlight, rain, atmospheric gases (N_2, O_2, CO_2 are the most important), wind, water, soil, etc.

- Abiotic component represents the geological, geographical, hydrological and climatological features of a particular ecosystem.

Source: www.wikipedia.de by Eckhard Jakob

Defining Ecosystems

Biotic Component

All ecosystems have a similar biotic structure consisting of producers, consumers, detritus feeders and decomposers.

Producers (autotrophs)

Most producers are green plants, which use light energy to convert CO_2 and water to organic compounds such as glucose and release O_2 as a by-product (photosynthesis).

- Producers are mostly identified by a green pigment, chlorophyll molecule.
- Ranging in diversity from microscopic photosynthetic bacteria to gigantic trees.

Defining Ecosystems

Consumers (heterotrophs)

- Herbivores (primary consumers): animals as large as elephants or as small as mites, that feed directly on producers
- Carnivores (secondary consumers): animals that feed on primary consumers
- Omnivores: animals that feed on both

Detritus feeders and decomposers

- Detritus: dead plant and animal material and excrement
- Detritivores: organisms feeding on detritus (earthworms, millipedes, termites, ants, etc.) – they are part of the soil food chain (waste recycling system)

Defining Ecosystems

- Ecosystems vary dramatically from place to place, ranging from Artic ice to tropical rainforests, from sandy deserts to coral reefs, and from high mountains to the ocean depths

Source: www.wikipedia.de by JJ Harrison

- Other examples of ecosystems are forests, grasslands, wetlands, marshes, ponds, cities, each with their respective individuals (species) in a particular environment.

Defining Ecosystem Services

- Humankind benefits from a multitude of resources and processes that are supplied by ecosystems.

- Collectively, these benefits are known as **ecosystem services** and include products like clean drinking water and processes such as the decomposition of wastes.

- While scientists have discussed ecosystem services for decades, these services were popularized and their definitions formalized by the United Nations 2005 Millennium Ecosystem Assessment (MA), a four-year study involving more than 1,300 scientists worldwide.

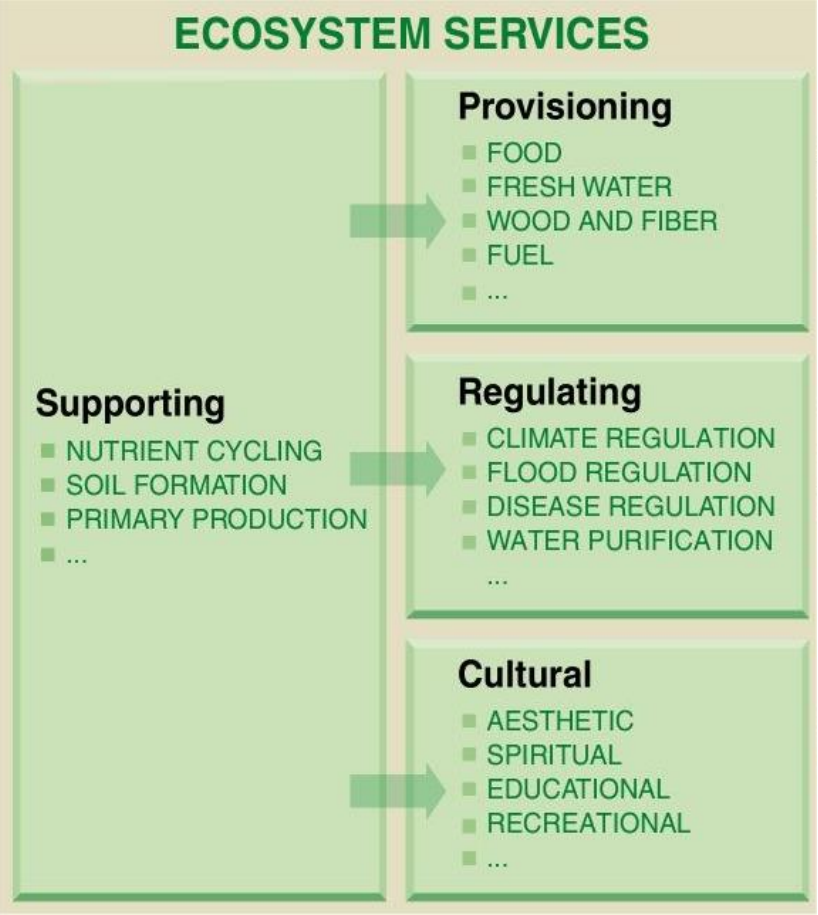
Defining Ecosystem Services

Supporting services – services needed for the production of all other ecosystem services.

Provisioning services – products obtained from Ecosystems.

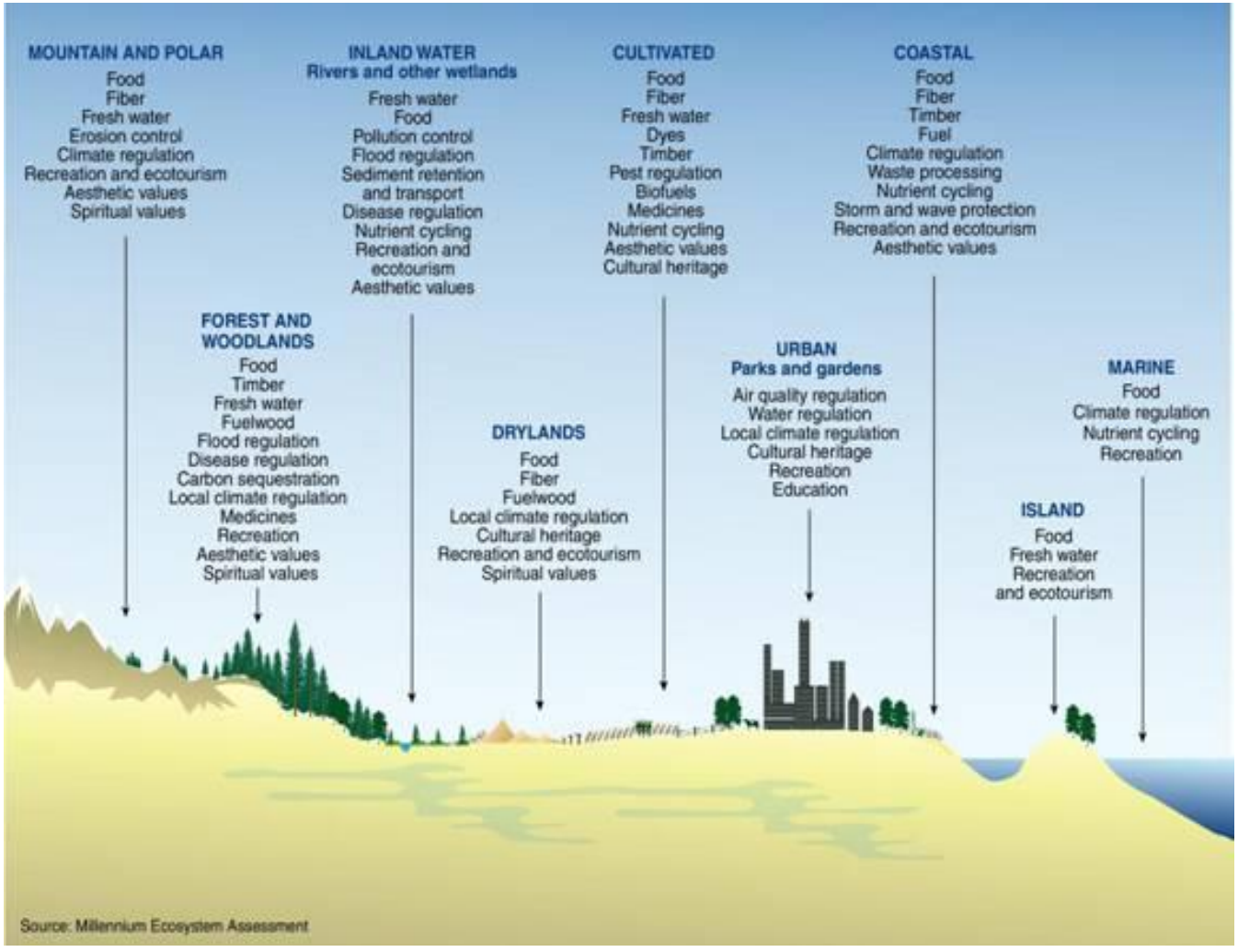
Regulating services – benefits obtained from regulation of Ecosystems.

Cultural services - non-material benefits from ecosystems.



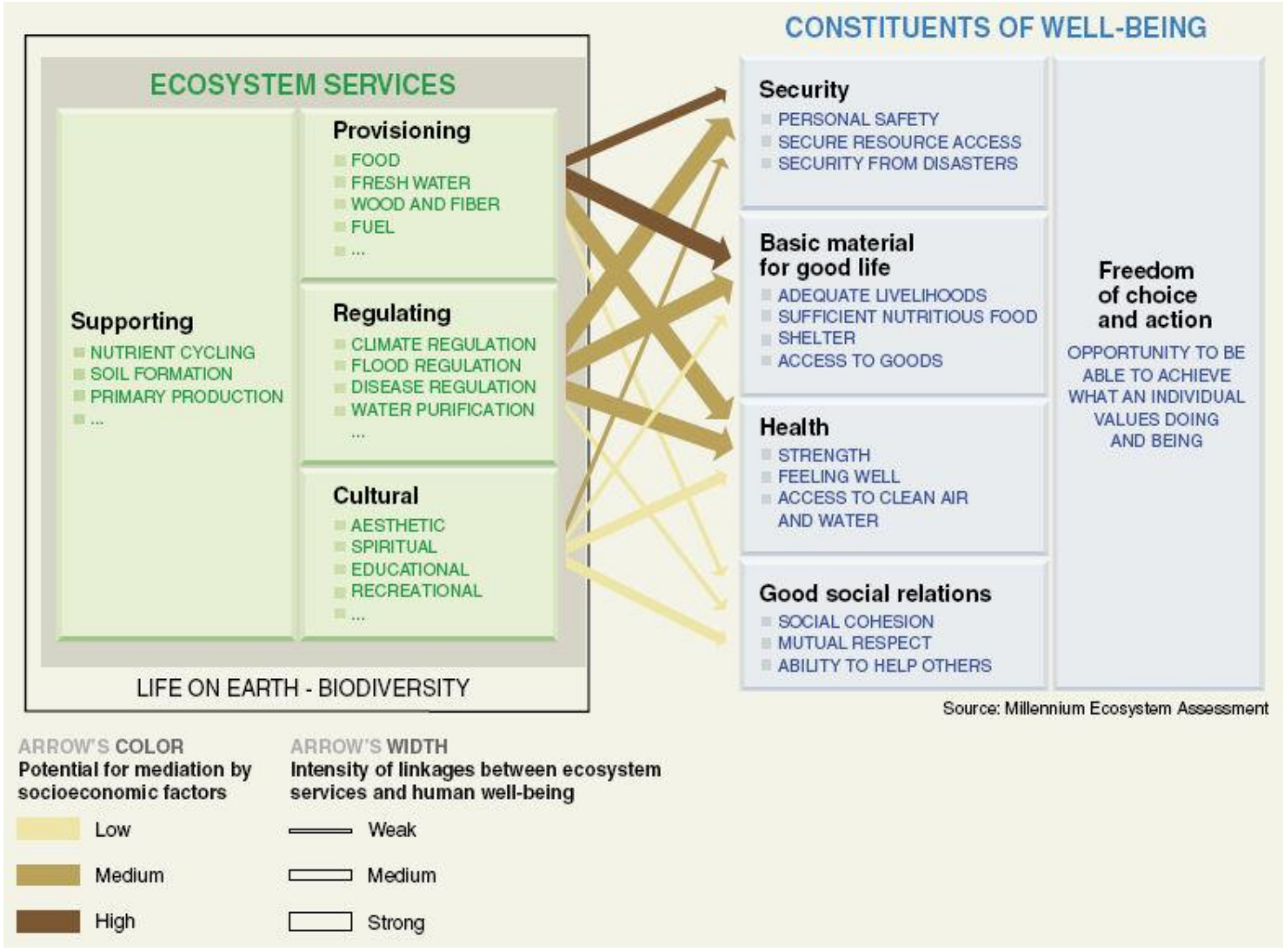
Source: Millennium Ecosystem Assessment Synthesis Report, http://www.maweb.org//en/Products.Synthesis.aspx

Defining Ecosystem Services



Source: Millennium Ecosystem Assessment Synthesis Report, http://www.maweb.org//en/Products.Synthesis.aspx

Ecosystem Services and Wellbeing



Source: Millennium Ecosystem Assessment Synthesis Report, http://www.maweb.org//en/Products.Synthesis.aspx

Ecosystem Services Valuation

- Many of ecosystem services are performed seemingly for "free", yet are worth many trillions of dollars.
- While it is often impossible to place an accurate monetary amount on ecosystem services, we can calculate some of their financial values.
- Economists measure the value of ecosystem services by estimating the amount people are willing to pay to preserve or enhance the services.

Ecosystem Services Valuation

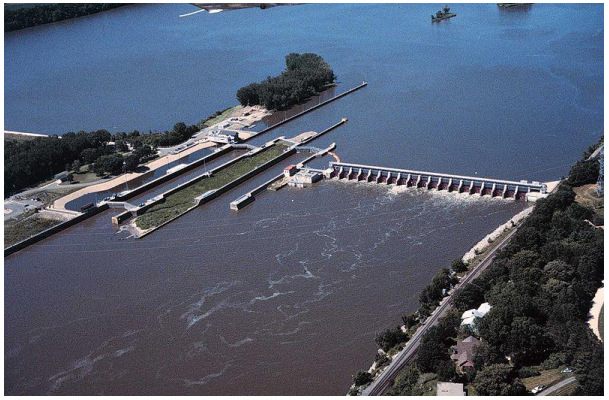
- Eighty percent of the world's population relies upon natural medicinal products.
- Of the top 150 prescription drugs used in the U.S., 118 originate from natural sources:

74%	from plants
18%	from fungi
5%	from bacteria
3%	from one vertebrate (snake species)

- Nine of the top 10 drugs originate from natural plant products.

Ecosystem Services Valuation

- Much of the Mississippi River Valley's natural flood protection services were destroyed when adjacent wetlands were drained and channels altered.
  - As a result, the 1993 floods resulted in property damages estimated at 20 billion dollars partially from the inability of the Valley to lessen the impacts of the high volumes of water.



Ecosystem Services Valuation

- One third of human food comes from plants pollinated by wild pollinators.
- The value of pollination services from wild pollinators in the U.S. alone is estimated at 4-6 billion dollars per year.

Source: http://www.flickr.com/photos/candiedwomanire/9730308/ by Dawn Endico

Ecosystem Services Valuation

Over 100,000 different animal species –bats, bees, flies, moths, beetles, birds, and butterflies – provide free pollination services.

Source: www.wikipedia.de by soebe

Source: www.wikipedia.de by soebe

Ecosystem Services Valuation

Crop Category (ranked by share of honey bee pollinator value)	Dependence on Insect Pollination	Proportion of Pollinators That Are Honey Bees	Value Attributed to Honey Bees[a] ($ millions)	Major Producing States[b]
Alfalfa, hay & seed	100%	60%	4,654.2	CA, SD, ID, WI
Apples	100%	90%	1,352.3	WA, NY, MI, PA
Almonds	100%	100%	959.2	CA
Citrus	20% - 80%	10% - 90%	834.1	CA, FL, AZ, TX
Cotton (lint & seed)	20%	80%	857.7	TX, AR, GA, MS
Soybeans	10%	50%	824.5	IA, IL, MN, IN
Onions	100%	90%	661.7	TX, GA, CA, AZ
Broccoli	100%	90%	435.4	CA
Carrots	100%	90%	420.7	CA, TX
Sunflower	100%	90%	409.9	ND, SD
Cantaloupe/honeydew	80%	90%	350.9	CA, WI, MN, WA
Other fruits & nuts[c]	10% - 90%	10% - 90%	1,633.4	—
Other vegetables/melons[d]	70% - 100%	10% - 90%	1,099.2	—
Other field crops[e]	10% - 100%	20% - 90%	70.4	—
Total	—	—	**14,564**	—

Source: Compiled by CRS using values reported in R. A. Morse, and N.W. Calderone, *The Value of Honey Bees as Pollinators of U.S. Crops in 2000*, March 2000, Cornell University, at [http://www.masterbeekeeper.org/pdf/pollination.pdf].

Conclusion

- Many of the goods and services provided by ecosystems are traditionally viewed as free benefits to society, or "public goods".
- For example: wildlife habitat and diversity, carbon storage, scenic landscapes, etc.
- Lacking a formal market, these natural assets are traditionally absent from society's balance sheet.
- Their critical contributions are often overlooked in public, corporate, and individual decision-making.

Exercises for Self-Study

1. Why the importance of ecosystems services is often overlooked in public, corporate, and individual decision-making?

2. How does an increasing demand for food, fiber, water and energy will affect ecosystem services in the 21st Century?

3. Explain how the conversion of forests to croplands impact ecosystem services.