

# 1 ☐ EVPP 110 Lecture

Instructor: Dr. Largen Fall 2002

## Physical Environment: Climates, Biomes

### 2 ☐ Ecosystems

#### ✓ Ecosystem

- a concept in which the physical and biological components of the environment are considered as a single, interactive system
- two main categories
  - **terrestrial**
  - **aquatic**

### 3 ☐ Ecosystems & Biomes

#### ✓ Ecosystem

- similar physical environments lead to
  - the evolution of organisms similar in form and function
  - similar ecosystems
- this is known as the rule of climatic similarity
  - leads to the concept of the **biome**
    - which is a kind of ecosystem

### 4 ☐ Ecosystems & Biomes

#### ✓ Biomes

- major communities of organisms that
  - have a characteristic appearance
  - are distributed over a wide land area
    - defined largely by regional variations in **climate**

### 5 ☐ Ecosystems & Biomes

#### ✓ Biomes

- the strong relationship between climate and life suggests that
  - if we know the climate of an area
    - we can predict what **biome** will be found there
      - » approximate biomass
      - » approximate productivity
      - » dominant types of organisms

### 6 ☐ Ecosystems and biomes

- ✓ distribution of biomes results from interaction of
  - physical features of the earth
  - two key physical factors
    - amount of solar heat

- global atmospheric circulation
- ✓ together these factors dictate local climate
  - two most important climatic factors are
    - precipitation
    - temperature

## 7 ☐ Climate shapes the character of ecosystems

- ✓ why are there variations in the earth's climate?
  - different parts of the earth receive different amounts of energy from the sun
    - variations in the amount of energy received from the sun
      - responsible for
        - » many of the major climatic differences on the earth
        - » and, indirectly, for much of the diversity in the earth's biomes

## 8 ☐ Climate shapes the character of ecosystems

- ✓ why the tropics are warmer?
  - since the earth is a sphere, some parts receive more energy from the sun than others on a per unit area basis
    - tropics are warmer than temperate regions
      - because they receive more sun energy per unit area
    - poles are colder than other areas
      - because they receive less sun energy per unit area

## 9 ☐ Climate shapes the character of ecosystems

- ✓ key natural and physical elements
  - **precipitation**
    - all organisms require water
    - on land, water is often scarce
    - important aspects
      - total amount per year
      - form in which it arrives
      - seasonal distribution
    - ecosystem productivity increase with increased precipitation

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## 11 ☐ Climate shapes the character of ecosystems

- ✓ key natural and physical elements
  - **precipitation**
    - generally low near 30° N & S latitude
      - where air is descending & warming
    - partly as a result of this, all the great deserts of world lie near 30° N or S latitude
    - other major deserts are formed in the interiors of large continents
      - where precipitation is limited because of the great distance from the sea, the ultimate source of most moisture

12 ☐ Climate shapes the character of ecosystems

✓ key natural and physical elements

– **precipitation**

- precipitation is generally higher near equator and 60° north and south latitude
  - where air is rising & cooling
    - » releasing moisture it contains as its ability to hold the moisture decreases as temperature decreases

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14 ☐ Climate shapes the character of ecosystems

✓ key natural and physical elements

– **precipitation**

- **rain shadow effect** can produce deserts
  - some mountains intercept moist winds from the sea
    - » air encounters mountains & then rises
    - » as air rises, its ability to hold moisture decreases
  - results in increased precipitation on the windward side of mountains (the side from which the wind is blowing)

15 ☐ Climate shapes the character of ecosystems

✓ key natural and physical elements

– **precipitation**

- **rain shadow effect** can produce deserts
  - air descends the other side of the mountains (the leeward side)
    - » is warmed & moisture-holding capacity increases
    - » which tends to inhibit precipitation
  - example, Sierra Nevada Mountains of CA
    - » eastern sides much drier than western sides & vegetation often very different

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18 ☐ Climate shapes the character of ecosystems

✓ key natural and physical elements

– **temperature**

- most organisms are adapted to live within a relatively narrow range of temperatures
  - won't survive if temperatures are significantly warmer or colder
    - » ex., growing season of plants is influenced by temperature
- ecosystem productivity increases with increased temperature

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20 ☐ Climate shapes the character of ecosystems

✓ key natural and physical elements

– **temperature** is affected by **latitude**

- **tropical latitudes**

- temperatures higher in tropics
  - » more sunlight falls per unit area
- highest mean global temperatures occur near equator
- there are no seasons in the tropics
  - » there is little variation in mean monthly temperature in tropical ecosystems

## 21 ☐ Climate shapes the character of ecosystems

- ✓ key natural and physical elements
  - **temperature** is affected by **latitude**
    - **temperate latitudes**
      - temperatures decrease as you move from the equator toward temperate latitudes
        - » less sunlight strikes earth per unit area
      - temperature variations increase because of increasingly marked seasons

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## 23 ☐ Climate shapes the character of ecosystems

- ✓ key natural and physical elements
  - **temperature** is affected by **elevation**
    - higher altitudes become progressively colder
      - at a given latitude, air temperature falls about 6°C/1000m increase in elevation
      - ecological consequences of temp varying w/elevation = temp varying w/ latitude

## 24 ☐ Climate shapes the character of ecosystems

- ✓ key natural and physical elements
  - **temperature** is affected by **elevation**
    - higher altitudes become progressively colder
      - in North America, a 1000m increase in elevation results in a temp drop ~ to that of an 800 km increase in latitude
      - this is reason “timberline” (the elevation above which trees do not grow) occurs at progressively lower elevations as one moves farther from the equator

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## 26 ☐ Figure: Vegetation, Latitude, Altitude

## 27 ☐ Figure: Temperature and latitude

## 28 ☐ Biomes

- ✓ **Biomes**
  - are terrestrial climax communities with wide geographic distribution
  - concept is useful for describing in broad terms
    - the general structure of the ecosystem
    - the types of niches present
  - of the same type from different areas will exhibit variations in the exact species present
  - affected by two nonbiological factors
    - temperature
    - precipitation

29  Biomes

✓ Biomes

- major biomes of the world
  - **desert**
  - **grassland**
  - **savanna**
  - **tropical rainforest**
  - **temperate deciduous forest**
  - **taiga or boreal forest**
  - **tundra**

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31  Biomes

✓ deserts

- dry places where rainfall is <25 cm/yr
  - so little that vegetation is sparse and survival depends on water conservation
  - world's great deserts are located in the interiors of continents
    - Sahara in Africa
    - Gobi in Asia
    - Great Sandy Desert in Australia

32  Biomes

✓ deserts

- organisms have evolved adaptations to help them survive
  - restricting activity to times of the year when water is present
  - avoiding high temperatures by living in deep, cool, & moist (sometimes) burrows
  - emerging only at night when temperatures are lower, especially if active year round
  - drinking large quantities of water when it is available (camels) & then survive long, dry periods

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34  Figure 6.10a: Climagraph for Cairo

35  Figure: Desert biome and climagraphs

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37  Biomes

✓ Grasslands

- also known as **temperate grasslands, prairies, steppes**
- widely distributed throughout temperate regions
  - ~ halfway between equator & poles
- rainfall is ~ 25cm -75cm per year
- tend to be windy with hot summers, cold to mild winters

- grasses make up 60%-90% of the vegetation

## 38 Biomes

### ✓ Grasslands

- once covered much of interior North America, were widespread in Eurasia & South America
  - often highly productive when converted to agricultural use
    - many of the agricultural lands of the US & Canada were originally occupied by grasslands (prairies)
      - » roots of perennial grasses characteristically penetrate far into soil
      - » grassland soils, therefore, tend to be deep and fertile

## 39 Biomes

### ✓ Grasslands

- temperate grasslands are often populated by herds of grazing mammals
  - in North America, huge herds of bison and pronghorns once inhabited the prairies
    - herds are almost all gone now
    - most of the prairies have been converted into the richest agricultural region on earth

## 40

## 41 Figure 6.11a: Climagraph for Tehran

## 42 Figure: Temperate grassland biome and climagraph

## 43 Biomes

### ✓ Savanna

- great grasslands located in dry climates that border the tropics
- transitional between tropical rainforest and desert (on global scale)
- rainfall is 50cm-150cm /yr & occurs seasonally
  - period of heavy rainfall followed by prolonged drought
- predominant plants are grasses
  - with widely spaced, drought resistant trees
- landscape is open

## 44 Biomes

### ✓ Savanna

- many of its animals and plants are active only during the rainy season
- fire is common and trees tend to be fire-resistant
- savannas are increasingly being converted to agricultural use
  - causing the inhabitants of savannas to struggle to survive

## 45

## 46 Figure 6.12a: Climagraph for Rangoon

## 47 Figure: Savanna biome and climagraph

## 48 Biomes

### ✓ Tropical rainforest

- rainfall is >200cm/yr
- temperatures are warm and relatively constant, no frost
- richest ecosystems on earth
  - contain ~ half of all species of terrestrial plants and animals
    - in 1sq mi of tropical forest in Rondonia, Brazil there are 1200 species of butterflies
      - » which is twice the number found in the U.S. and Canada combined

## 49 Biomes

### ✓ Tropical rainforest

- communities are diverse
  - each kind of organism is often represented in a given area by only a few individuals
- located near the equator
  - South America, Africa, southeast Asia
- are being destroyed
  - many of the species in rainforests have never been seen by humans
  - during our lifetime, a quarter of the world's species will disappear with the rainforests

## 50

## 51 Figure 6.13a: Climagraph for Singapore

## 52 Figure: Tropical rain forest biome and climagraphs

## 53 Biomes

### ✓ temperate deciduous forests

- rainfall is 75cm-100cm per year
- in areas with warm climates (warm summers and cool winters)
  - plants grow actively for ~1/2 year
- found in northeastern US, eastern Canada, Eurasia
- often populated by deer, beaver, bear, raccoon
- generally have a lower number of species but a higher number of individuals per species
- trees are the major producers

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## 55 Figure 6.14: Climagraph for Chicago

## 56 Figure: Temperate deciduous forest

## 57 Biomes

### ✓ Taiga

- rainfall is 25cm-100cm per year
  - climate is humid due to low evaporation resulting from generally low temperatures
- winters are long and cold
  - soil freezes in winter
- northern forests of coniferous trees such as hemlock, spruce, fir
  - needle-shaped leaves limit moisture loss
  - pyramid shapes accommodate snow
- is one of the largest ecosystems on earth

## 58 Biomes

### ✓ Taiga

- has very short growing season for farming so few people live there
- populated by many types of large mammals and carnivores such as moose, elf, deer, wolves, bear, lynx
- has been used for fur trapping and lumber production
- located in a ring that extends across vast areas of Asia and North America
- also known as **boreal forest, northern coniferous forest**

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## 60 Figure 6.15a: Climagraph for Moscow

## 61 Figure: Taiga biome and climagraphs

## 62 Biomes

### ✓ tundra

- located in the far north of the taiga and south of the polar ice
- rainfall is <25cm/yr
- soil layer is known as **permafrost**
  - it is permanently frozen
- extremely cold and windy
- open, grassland that is often boggy
- enormous ecosystem that covers 1/5<sup>th</sup> of the earth's land area

## 63 Biomes

### ✓ tundra

- no trees grow in the area
- herbs are perennials that grow rapidly during the brief summer
- populated by large grazing mammals such as musk-oxen, caribou, reindeer and carnivores such as wolves, foxes, lynx

## 64

## 65 Figure 6.16a: Climagraph for Fairbanks

## 66 Figure: Tundra biome and climagraphs

## 67 Figure: World Biomes

## 68 Figure 6.8: Influence of precipitation and temperature on vegetation

## 69 The End