Biological Communities: The Biome Concept

Educational Goals

Be familiar with:

- How ecological communities are classified at the global scale
- The significance of convergence
- Reasons for basing the biome classification on dominant plant forms and climate
- Walter’s climate classification
- Whittaker’s biome classification
Form and function match the environment

Convergence:

E.g. desert plants

Classification – A Global Perspective

- Biome =
Classification – Global Perspective

• Why plants?

• Why climate?

One Plant Form, Two Biomes

• Temperate salt marshes and grasslands
  – Both dominated by the same plant form
  – 2 very different environments
Not all biome classifications are the same…. 

Adaptations and Environment -- Not the Whole Story

• Species distribution not **solely** function of relationships to physical environment:

Climate is the major determinant of plant distribution

Climate defines the boundaries of terrestrial biomes

• Heinrich Walter – schemes based upon

• Relates to moisture and temperature stress on the dominant plants
### Walter’s Climate Classification

<table>
<thead>
<tr>
<th>Climate zone</th>
<th>Vegetation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I</strong> Equatorial: Always moist and lacking</td>
<td>Evergreen tropical rain forest</td>
</tr>
<tr>
<td>temperature seasonality</td>
<td></td>
</tr>
<tr>
<td><strong>II</strong> Tropical: Summer rainy season and</td>
<td>Seasonal forest, scrub, or savanna</td>
</tr>
<tr>
<td>“winter” dry season</td>
<td></td>
</tr>
<tr>
<td><strong>III</strong> Subtropical (hot deserts): Highly</td>
<td>Desert vegetation with considerable</td>
</tr>
<tr>
<td>seasonal, arid climate</td>
<td>exposed surface</td>
</tr>
<tr>
<td><strong>IV</strong> Mediterranean: Winter rainy season and</td>
<td>Scrubophyllous (drought-adapted),</td>
</tr>
<tr>
<td>summer drought</td>
<td>frost-sensitive shrublands and woodlands</td>
</tr>
<tr>
<td><strong>V</strong> Warm temperate: Occasional frost, often</td>
<td>Temperate evergreen forest, somewhat frost-sens-</td>
</tr>
<tr>
<td>with summer rainfall maximum</td>
<td>tive</td>
</tr>
<tr>
<td><strong>VI</strong> Nenoral: Moderate climate with winter</td>
<td>Frost-resistant, deciduous, temperate forest</td>
</tr>
<tr>
<td>freezing</td>
<td></td>
</tr>
<tr>
<td><strong>VII</strong> Continental (cold deserts): Arid, with</td>
<td>Grasslands and temperate deserts</td>
</tr>
<tr>
<td>warm or hot summers and cold winters</td>
<td></td>
</tr>
<tr>
<td><strong>VIII</strong> Boreal: Cold temperate with cool</td>
<td>Evergreen, frost-hardy needle-leaved forest</td>
</tr>
<tr>
<td>summers and long winters</td>
<td>(taiga)</td>
</tr>
<tr>
<td><strong>IX</strong> Polar: Very short, cool summers and long, very cold winters</td>
<td>Low, evergreen vegetation, without trees, growing over permanently frozen soils</td>
</tr>
</tbody>
</table>

### Biomes correspond closely to major climate zones

<table>
<thead>
<tr>
<th>Biome name</th>
<th>Climate zone</th>
<th>Vegetation</th>
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</thead>
<tbody>
<tr>
<td><strong>Tropical rain forest</strong></td>
<td>I Equatorial: Always moist and lacking temperature seasonality</td>
<td>Evergreen tropical rain forest</td>
</tr>
<tr>
<td><strong>Tropical savanna</strong></td>
<td>II Tropical: Summer rainy season and “winter” dry season</td>
<td>Seasonal forest, scrub, or savanna</td>
</tr>
<tr>
<td><strong>Subtropical desert</strong></td>
<td>III Subtropical (hot deserts): Highly seasonal, arid climate</td>
<td>Desert vegetation with considerable exposed surface</td>
</tr>
<tr>
<td><strong>Woodland/shrubland</strong></td>
<td>IV Mediterranean: Winter rainy season and summer drought</td>
<td>Scrubophyllous (drought-adapted), frost-sensitive shrublands and woodlands</td>
</tr>
<tr>
<td><strong>Temperate rain forest</strong></td>
<td>V Warm temperate: Occasional frost, often with summer rainfall maximum</td>
<td>Temperate evergreen forest, somewhat frost-sensitive</td>
</tr>
<tr>
<td><strong>Temperate seasonal forest</strong></td>
<td>VI Nenoral: Moderate climate with winter freezing</td>
<td>Frost-resistant, deciduous, temperate forest</td>
</tr>
<tr>
<td><strong>Temperate grassland/desert</strong></td>
<td>VII Continental (cold deserts): Arid, with warm or hot summers and cold winters</td>
<td>Grasslands and temperate deserts</td>
</tr>
<tr>
<td><strong>Boreal forest</strong></td>
<td>VIII Boreal: Cold temperate with cool summers and long winters</td>
<td>Evergreen, frost-hardy needle-leaved forest (taiga)</td>
</tr>
<tr>
<td><strong>Tundra</strong></td>
<td>IX Polar: Very short, cool summers and long, very cold winters</td>
<td>Low, evergreen vegetation, without trees, growing over permanently frozen soils</td>
</tr>
</tbody>
</table>
Walter’s Climate Diagrams
Whittaker's Biome Classification

Lisbon, Portugal
Climate: Mediterranean (IV)
Biome: Woodland/shrubland
Elevation: 41 meters

Annual precipitation: 462 mm
Average temp: 14.7 °C

Month

Cape Town, South Africa
Climate: Mediterranean (IV)
Biome: Woodland/shrubland
Elevation: 17 meters

Annual precipitation: 506 mm
Average temp: 17 °C

Month

Valparaiso, Chile
Climate: Mediterranean (IV)
Biome: Woodland/shrubland
Elevation: 77 meters

Annual precipitation: 708 mm
Average temp: 16.6 °C

Month
Classification Scheme’s

- Climate
- Vegetation

Other Considerations

- Fire shapes vegetation toward drier end of spectrum
Biome Concept Doesn’t Exist for Aquatic Systems

• What distinguishes a biome?

• Have their own classification system:

Aquatic Ecosystems – each has unique physical factors and biota
Apply Climate/Biome Classification

- Equatorial and tropical biomes
- Temperate biomes
- Boreal and polar biomes

Equatorial and Tropical Climate Zones
Andagoya, Colombia
Climate: Equatorial (I)
Elevation: 65 meters

- Annual precipitation: 6,905 mm (off scale)
- Average temperature: 27.2 °C

Brasilia, Brazil
Climate: Tropical (II)
Elevation: 910 meters

- Annual precipitation: 1,560 mm
- Average temperature: 21.8 °C
Temperate Climate Zones

Biomes differentiated by:

-
Omaha, Nebraska

Climate: Temperate (VI)
Elevation: 337 meters

Climate: Subtropical (hot deserts) (III)
Elevation: 31 meters
Boreal and Polar Climate Zones

- Boreal forest (taiga) 5°C and -5°C.
- Tundra below -5°C.

Boreal Forest Biome

Stockholm, Sweden

Climate: Boreal (VIII)
Elevation: 156 meters

- Annual precipitation: 575 mm
- Average temperature: 3.6 °C

Temperature °C ——— Precipitation (mm)

Increasing precipitation

Decreasing temperature
Significance

• Biome approach integrates **plant form** and **climate**
• Whittaker’s biome and Walter’s climate classification are **compatible**
• Climate zones/biomes distinguished by: