Decomposition
(Ch. 19: 424-429)

I. What is it?
II. Who does it?
III. What controls it?
IV. How does it fit into the big picture?

The Global Carbon Cycle - 1990s

<table>
<thead>
<tr>
<th>Units</th>
<th>Gt C</th>
<th>Gt C y⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmosphere</td>
<td>63</td>
<td>0.6</td>
</tr>
<tr>
<td>Fossil Deposits</td>
<td>8.3</td>
<td>2.0</td>
</tr>
<tr>
<td>Plants</td>
<td>91.7</td>
<td>9.0</td>
</tr>
<tr>
<td>Soil</td>
<td>60</td>
<td>8.0</td>
</tr>
<tr>
<td>Oceans</td>
<td>39,000</td>
<td>16,000</td>
</tr>
</tbody>
</table>

...are leading to a build up of CO₂ in the atmosphere...
...and land clearing in the tropics...

Fate of tundra and boreal soil C?

<table>
<thead>
<tr>
<th>Ecosystem type</th>
<th>Mean soil organic C (g C/m²)</th>
<th>Total mean soil organic C (g C/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tropical forest</td>
<td>30.8</td>
<td>11.5</td>
</tr>
<tr>
<td>Broadleaved forest</td>
<td>35.8</td>
<td>12.5</td>
</tr>
<tr>
<td>Coniferous forest</td>
<td>33.8</td>
<td>11.5</td>
</tr>
<tr>
<td>Tropical savanna</td>
<td>37.8</td>
<td>12.5</td>
</tr>
<tr>
<td>Temperate deciduous forest</td>
<td>30.8</td>
<td>11.5</td>
</tr>
<tr>
<td>Temperate coniferous forest</td>
<td>33.8</td>
<td>11.5</td>
</tr>
<tr>
<td>Tundra</td>
<td>40.8</td>
<td>12.5</td>
</tr>
<tr>
<td>Boreal forest</td>
<td>35.8</td>
<td>12.5</td>
</tr>
<tr>
<td>Tundra shrubland</td>
<td>33.8</td>
<td>11.5</td>
</tr>
<tr>
<td>Tundra grassland</td>
<td>37.8</td>
<td>12.5</td>
</tr>
</tbody>
</table>

I. What is it?
Respiration of dead organic matter: litter & SOM

II. Who does it?

- Primary decomposers: bacteria & fungi
  - Extracellular enzymes for degrading complex organic molecules
- Conditioners
  - Mechanical: increased surface area
  - Biological: gut passage
Primary decomposers: Bacteria and Fungi

- Get carbon and energy from organic sources
- Release enzymes
- Enzymatic breakdown of substrate
- Products diffuse back into hyphae or bacterial cells

CO₂

Products diffuse back and are used in respiration and to build biomass

III. What controls it?
A. Climate - precipitation

Worms: conditioners

Conditioners

Conditioners

Annual leaf mass loss in tropical forests is about three times that occurring in temperate forests.
III. What controls it?
A. Climate

Decomposition is more rapid where actual evapotranspiration is higher.

B. Organism controls – litter quality

IV. In the big picture
A. Nutrient regeneration – feedback to production

Brief Nitrogen Cycle
- Emphasize: inputs, recycling, outputs
- Inputs: lots in atmosphere, but little available.
  - N-fixation, importance in early succession
- Recycling - Mineralization: N regeneration in plant available form → plant uptake
- Losses:
  - denitrification (Fertilizer inputs → N₂O (greenhouse gas))
  - Leaching → eutrophication

IV. In the big picture
B. Source of CO₂ to atmosphere, component of NEP
- on average, in balance with production
  - except early successional ecosystems.

C. Balance of Prod and Decomp leads to large diffs in C pools among ecosystems
- Implications –
  - C feedback in tundra
  - C loss with ag in grasslands
  - Soil fertility in tropics
Soil Organic Matter Content
Source: W. W. Hargrove and R. J. Luxmoore

Loss of SOM with tillage

Low soil organic matter in tropical soils

http://www.seattlepi.com/local/348200_dirt22.html

Tropical forest in Panama
http://www.lancs.ac.uk/staff/bardgett/Research.html

END