Consumption and Secondary Production

Reading: pp. 411-416 (5th)

A. Food chains and food webs
   Grazing
   Detrital (decomposer)

B. Energy budget - flow of energy through an ecosystem

C. Trophic levels and ecological pyramids

D. Efficiency of energy transfer
   Consumption, Assimilation, Growth, Secondary production

E. How can we determine food web relationships?

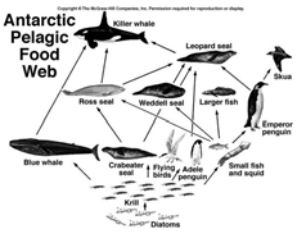
Why are big, fierce animals so scarce?

Where does the energy come from that fuels ecosystems?

What is the fate of that energy?

How does it affect the distribution and abundance of organisms of different types?

A. Food chains are simplifications of food webs



Simplified food web

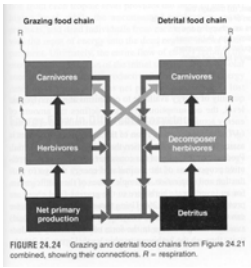
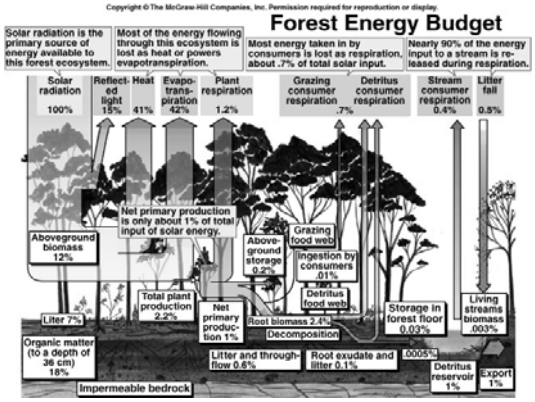


FIGURE 24.24 Grazing and detrital food chains from Figure 24.21 combined, showing their connections. R = respiration.

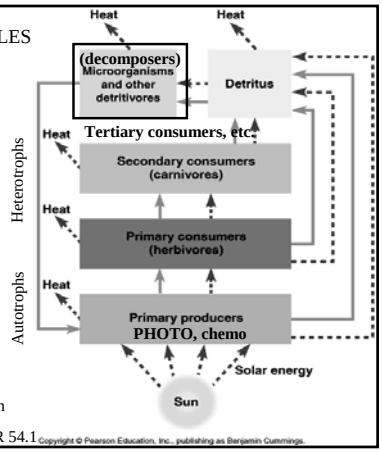
B. Energy Budget: Source and fate of energy



ECOSYSTEM PRINCIPLES
1- Energy flow
2- Chemical cycling

ENERGY- Cannot be recycled, flows through ecosystems, from an external source, enters as light exits as heat.

MATTER- Cycles within ecosystems.



Energy flow and chemical cycling described by grouping species in a community into trophic levels according to main source of nutrition and energy

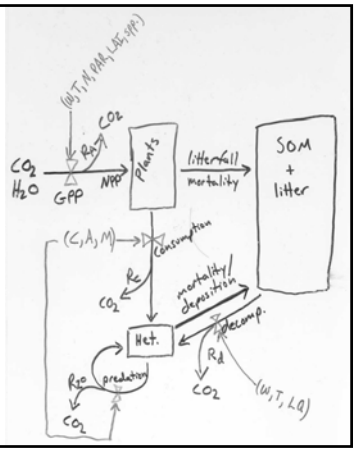
C&R 54.1

B. Energy Budget: Source and fate of energy

Points:
1. GPP > NPP > NEP

2. Energy flow is one-way
   - once used, it is dissipated as heat

C-cycle: the somewhat more detailed version



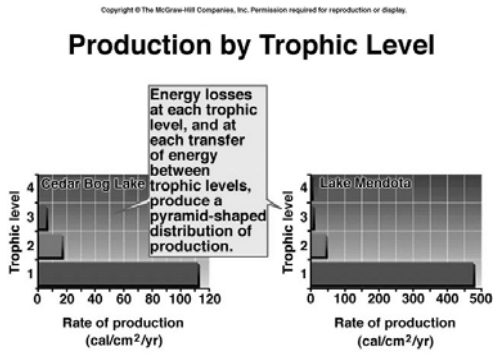
C. Trophic pyramids

Classic food chain

1. Trophic levels: Primary producers, herbivores, carnivores (predators), omnivores, detritivores

2. Rule of thumb: 10% energy transfer between trophic levels

Consequences for diversity



Inverted trophic pyramids

Biomass at each trophic level

carnivores

herbivores

1º producers

Can this ever happen with pyramids based on energy flow (productivity)?

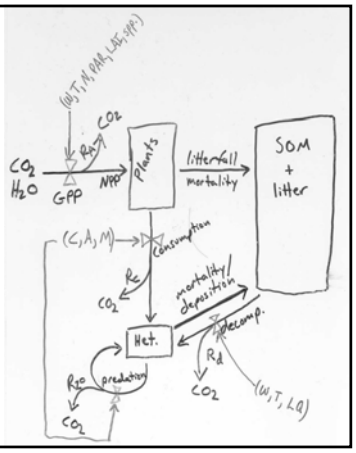
D. Efficiencies of energy transfer

Why is biomass of animals so small?

Where does all the energy go?

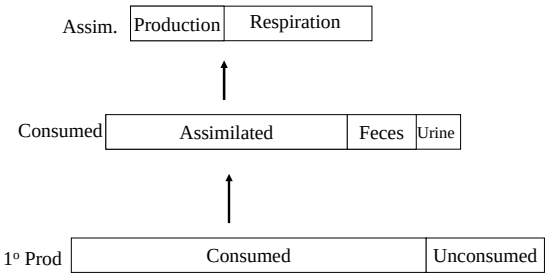
Why is transfer efficiency so low?

C-cycle: the somewhat more detailed version

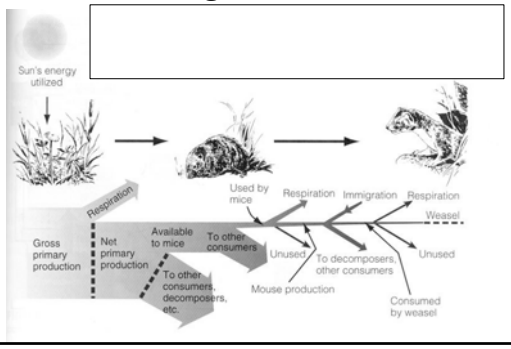


Availability of energy for growth

So, P = C - R - F - U

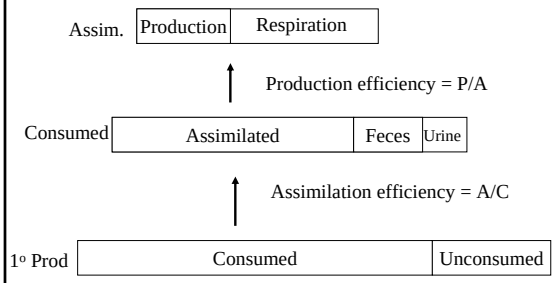


Trophic energy losses: a Michigan old-field



Availability of energy for growth: Depends on efficiency of transfer

Growth efficiency = P/C = P/A * A/C



Assimilation, production, and growth efficiencies for homeotherms and poikilotherms

Efficiency	All homeoth	All poikilo	Grazing arthropods	Sap-feeding herbivores	Lepidop-tera
Assim. A/C	77.5±6.4	41.9±2.3	37.7±3.5	48.9±4.5	46.2+4
Prod. P/A	2.46±0.5	44.6±2.1	45.0±1.9	29.2±4.8	50.0+3.9
Growth P/C	2.0 ±0.5	17.7±1.0	16.6±1.2	13.5±1.8	22.8+1.4

Smith (1998) Table 11.3, p. 181

Basal metabolic rate – endos & ectos

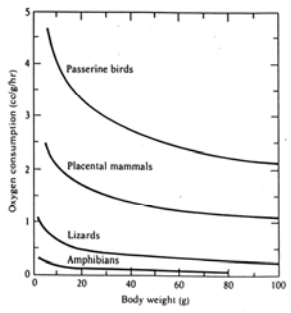
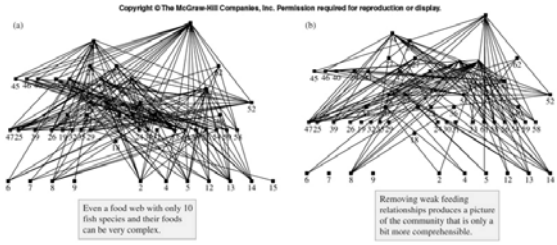


FIGURE 3–3 Metabolic rate versus body size for endotherms and non-endotherms. Body temperature for lizards is 37°C and for amphibians is 25°C. *(After Hill 1976.)*

Ehrlich & Roughgarden 1985

E. How can we determine food web relationships?

- Observation
- Gut/feces content
- You are what you eat, isotopically speaking.



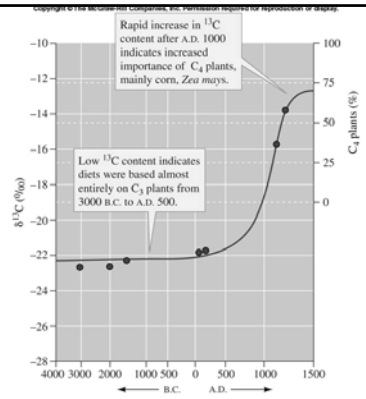


Fig. 18.20 – Human consumption of corn

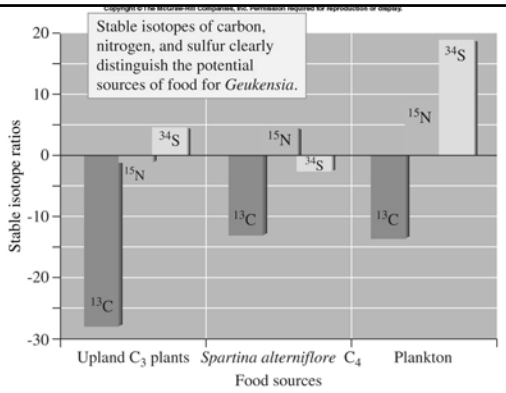


Fig. 18.18

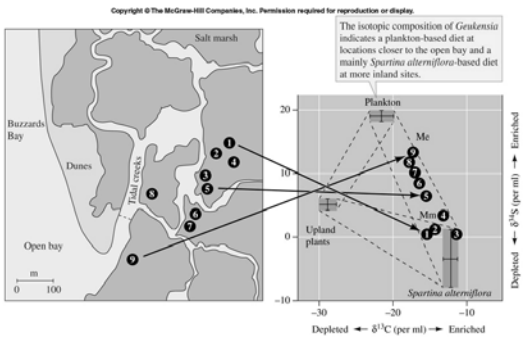


Fig. 18.19 – food sources of the ribbed mussel.