

The Carbon Cycle and Primary Productivity

Chap. 18: 399-411, Chap. 19: 423-4

I. Introduction

- A. Questions about elevated CO₂
- B. Ecosystem ecology definitions
Components, Pools and fluxes

II. C-cycle Pools and Fluxes

- A. Terms
- B. Schematics

III. Controls on Primary Production

- A. Climate
- B. Resources
- C. Time
- D. Organisms

I. Introduction

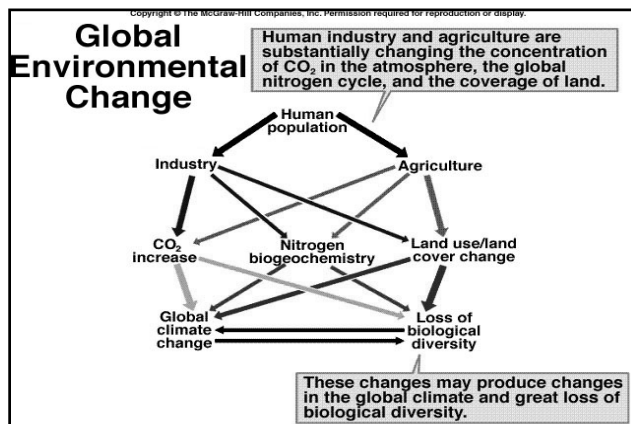
A. Questions

What causes uptake by natural systems?

How much capacity to continue absorbing CO₂?

What might limit their uptake capacity?

What can we do to enhance ecosystem uptake and thereby slow the atmospheric increase?

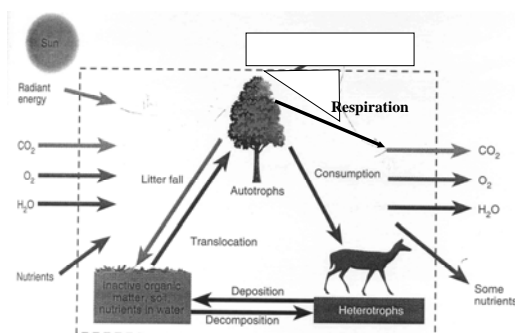


I. Introduction

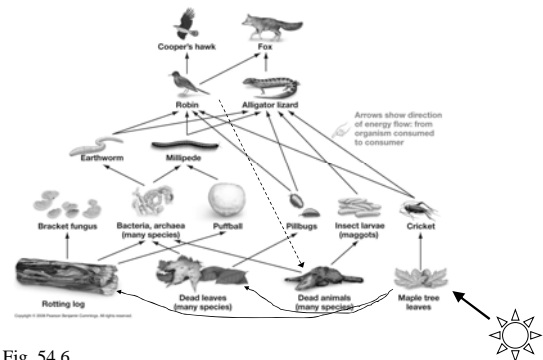
B. Ecosystem ecology terms

1. Components: autotrophs, heterotrophs, dead organic matter
2. Pools and fluxes
3. Ecosystem principles

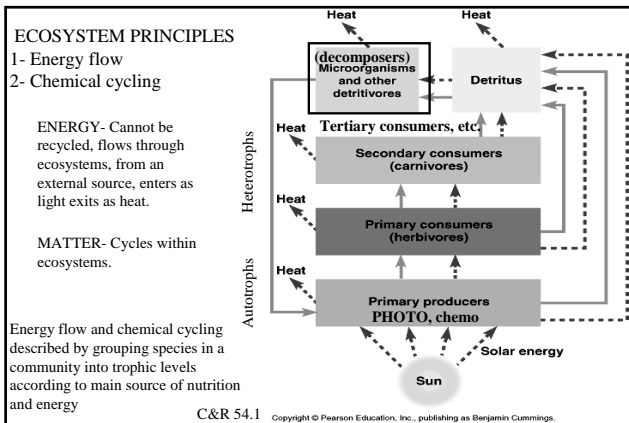
Ecosystems - components



Food webs



Freeman, Fig. 54.6



Main messages

C flow is linked to energy flow
Energy flows through systems
Matter, elements cycle
Organisms can be grouped in trophic levels

II. C-cycle pools and fluxes

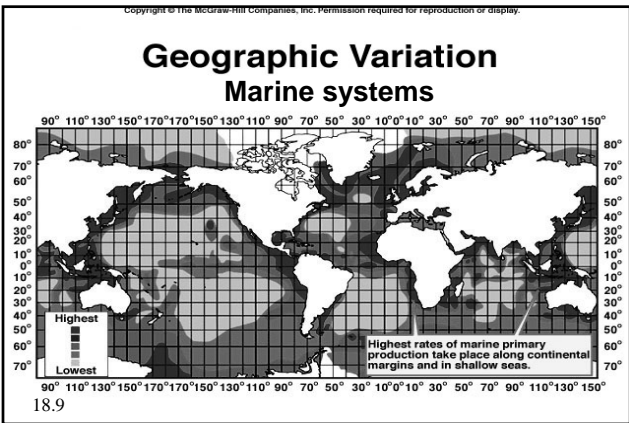
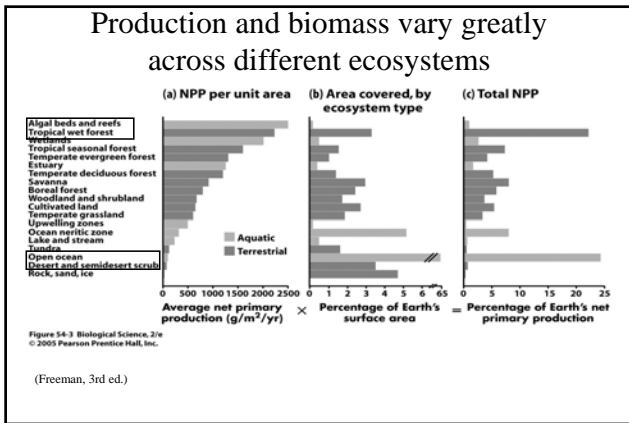
A. Terms

1. Simple C cycle schematic
2. Biomass vs. productivity
3. GPP vs. NPP vs. NEP
4. Secondary production

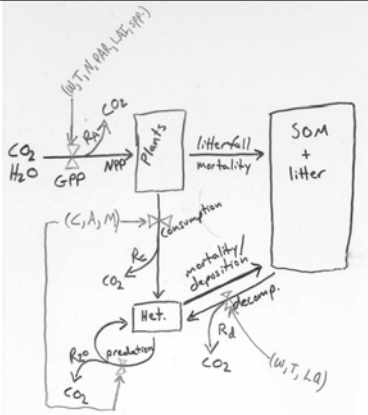
B. More detailed C-cycle schematic

1. C cycle: Simple Version

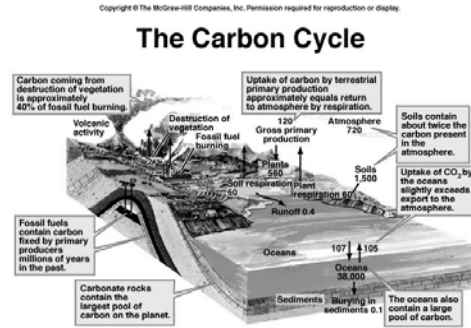
1. Terms
2. Biomass vs. productivity
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B. C-cycle schematic: the more detailed version



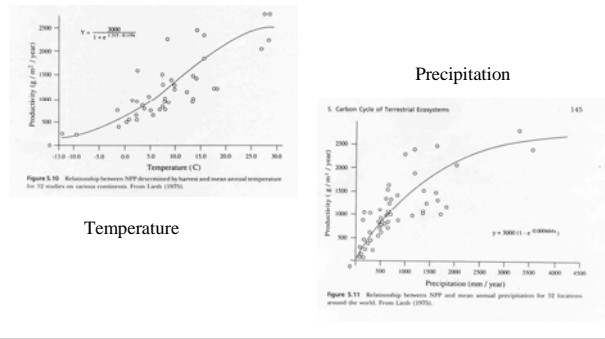
What influences sink strength?



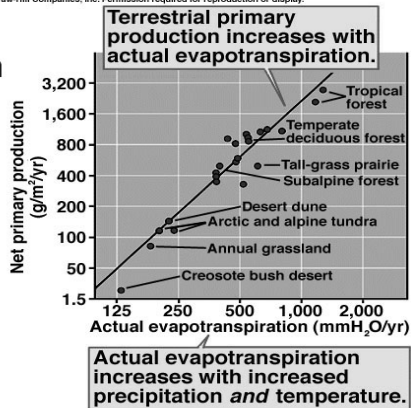
III. Controls on primary production

- A. Climate
- B. Resources
- C. Time
- D. Organisms

A. Climate controls

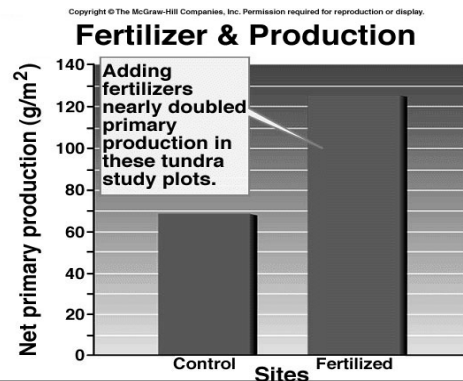


AET vs. Production

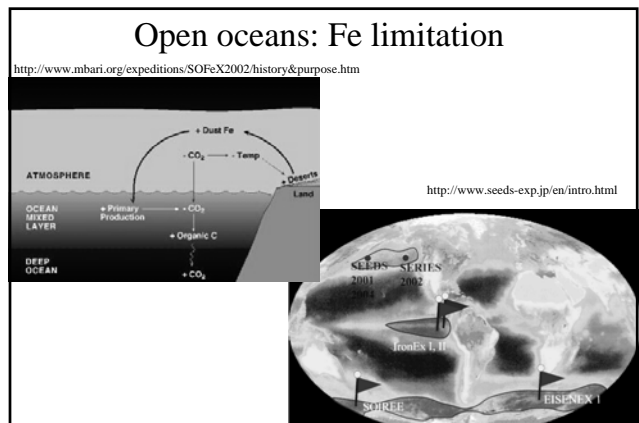
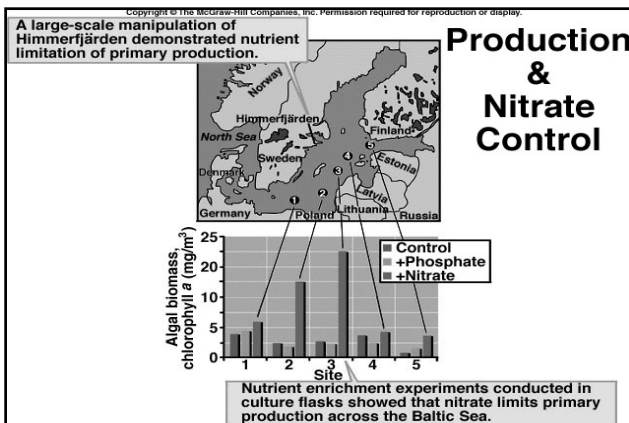
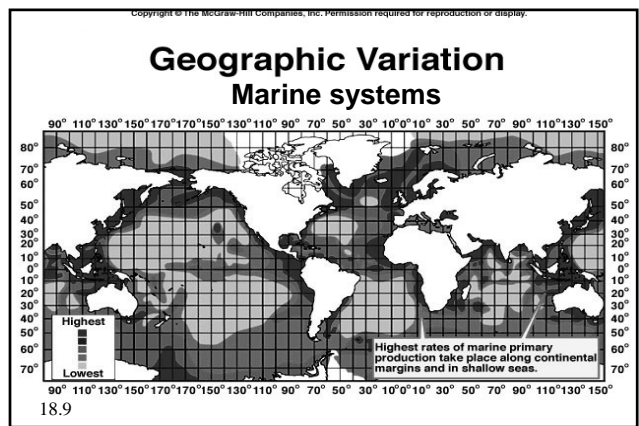
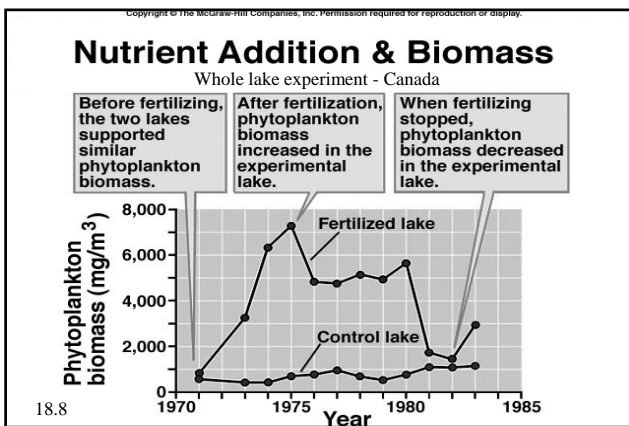
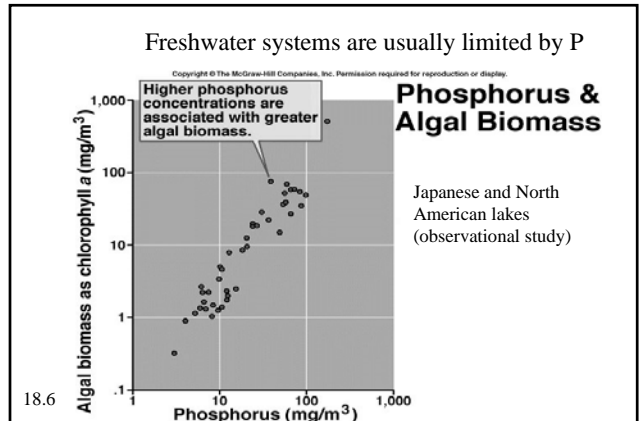
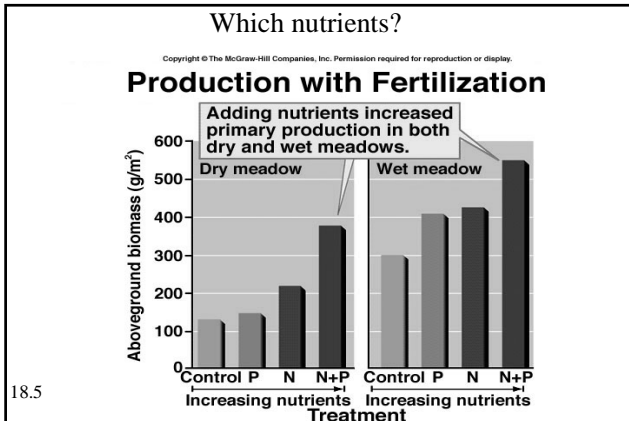


18.3

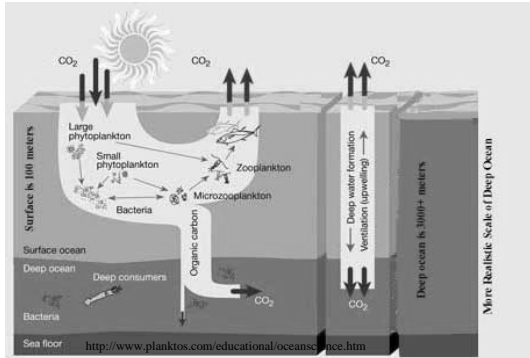
B. Resources: nutrients



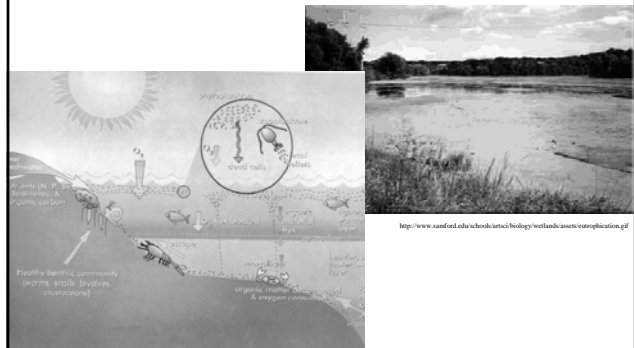
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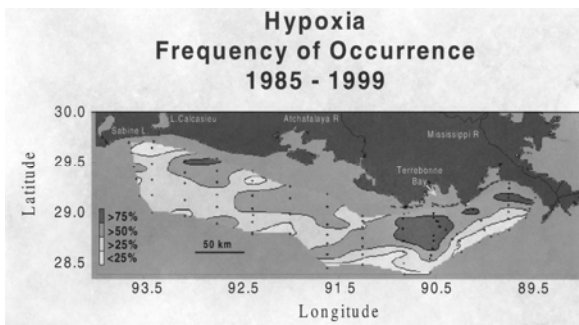
The Biological CO₂ pump



Eutrophication: Is more production always good?



Eutrophication in the Gulf of Mexico



Resources

What about CO₂?

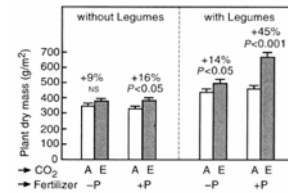


FIG. 14. Biomass responses to CO₂ enrichment are a function of nutrient availability. In natural systems, N input through legumes may increase, but only under the condition that phosphate supply permits. The factorial test with calcareous grassland on natural substrate illustrates that CO₂, legume presence, or P addition, alone or as paired treatments, have little or no effect, but all three combined induce a massive response. A and E indicate data for communities grown at ambient (360 μL/L) and elevated (600 μL/L) CO₂, respectively; - P and + P indicate nonfertilized and fertilized (1 g P per square meter per year) communities, respectively. (Redrawn from Stöcklin and Körner [1999: Fig. 1].)

C. Time – GPP, NPP, NEP peak in mid-succession

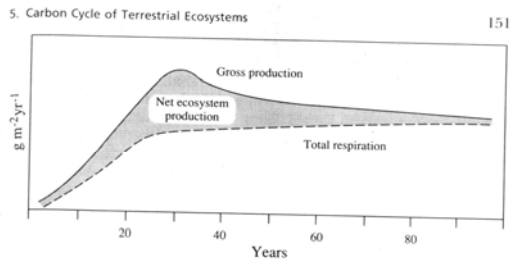
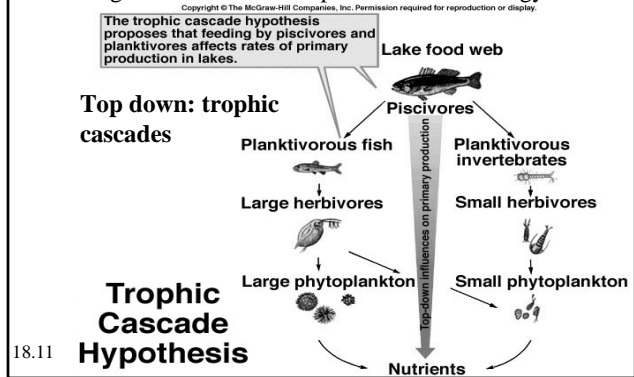


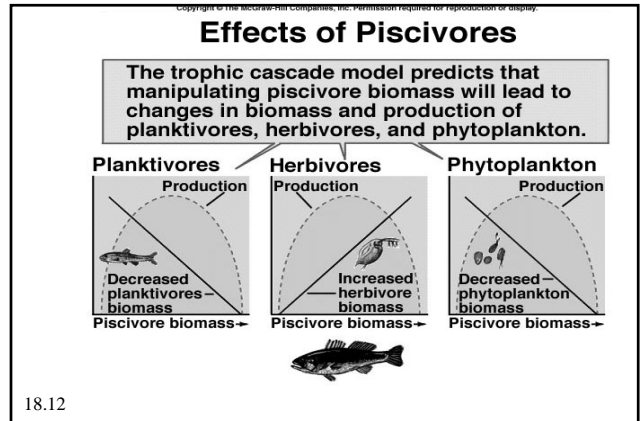
Figure 5.14 Generalized trends in primary production and respiration during ecosystem development. Modified from Odum (1969).

Schlesinger 2001

D. Organisms – effects on production and energy flow



Ecobeaker demonstration



End