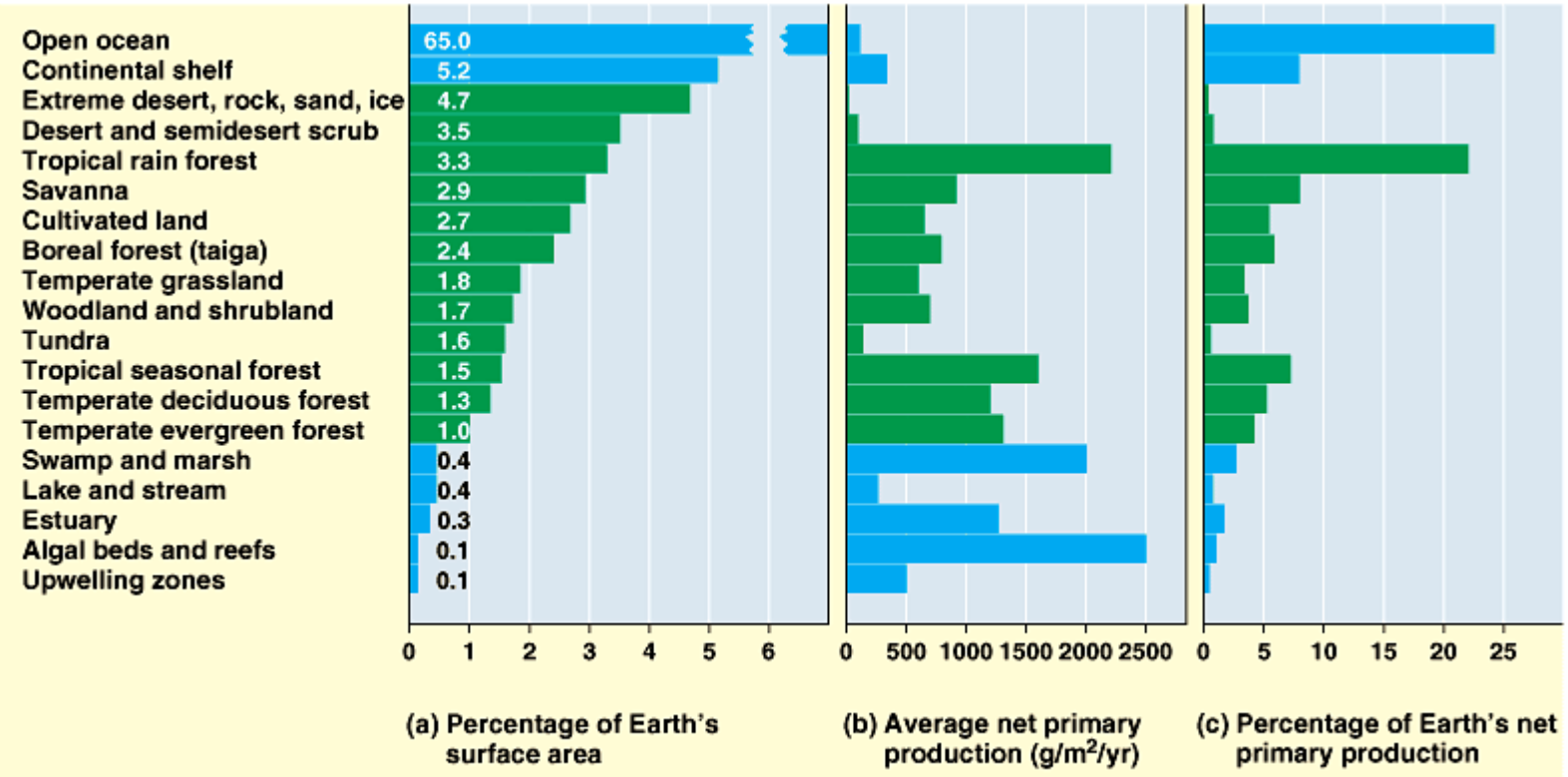
Ecosystems & Mineral Cycling

- What is an ecosystem?
- Types of Ecosystems
- Productivity
- Energy Flow: Trophic levels, Food webs/chains
- Nutrient cycling

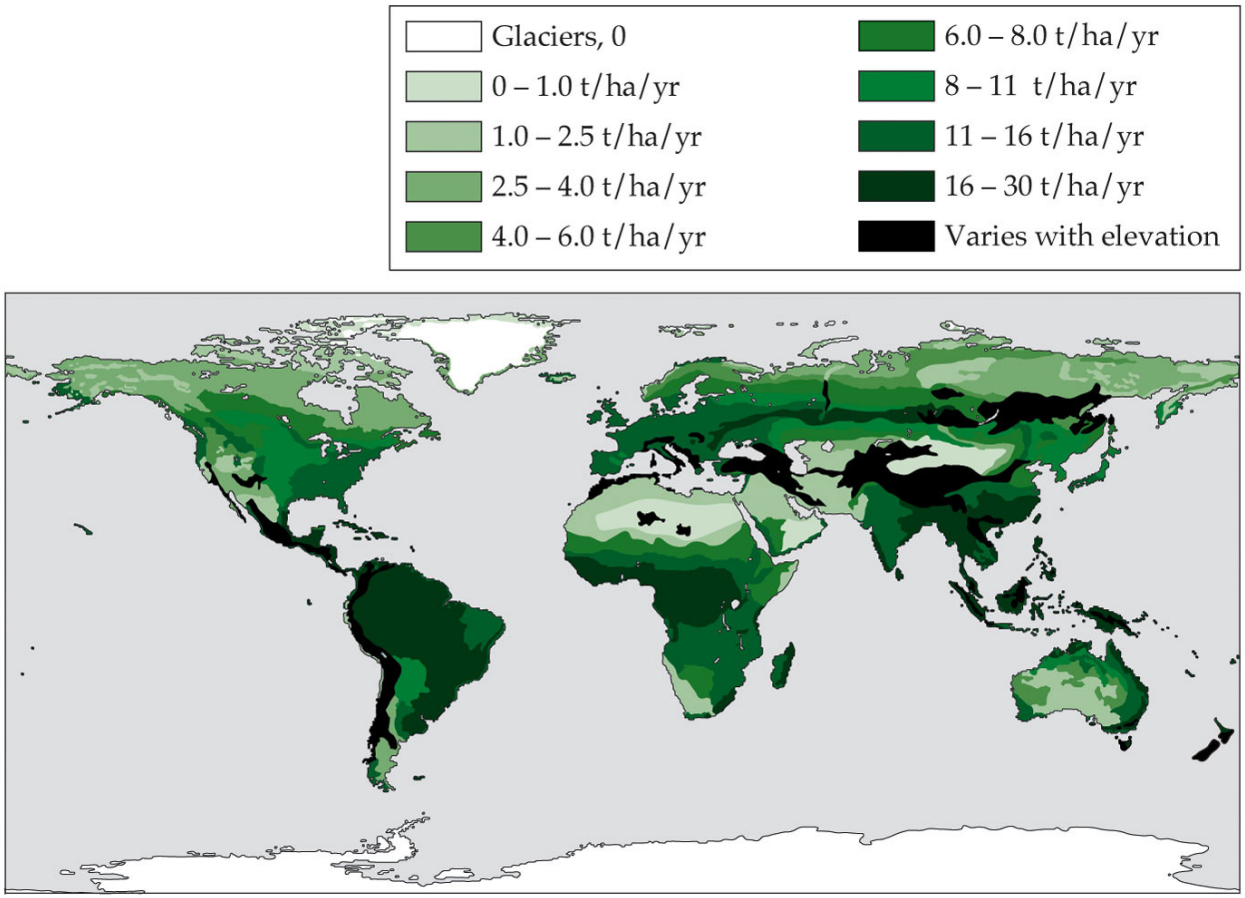
What is an ecosystem?

- Tansley (1935)
- Entire system of living organisms in the context of the physical factors on which they depend and which they are interconnected.
- Overlap, interlock and interconnect with one another.

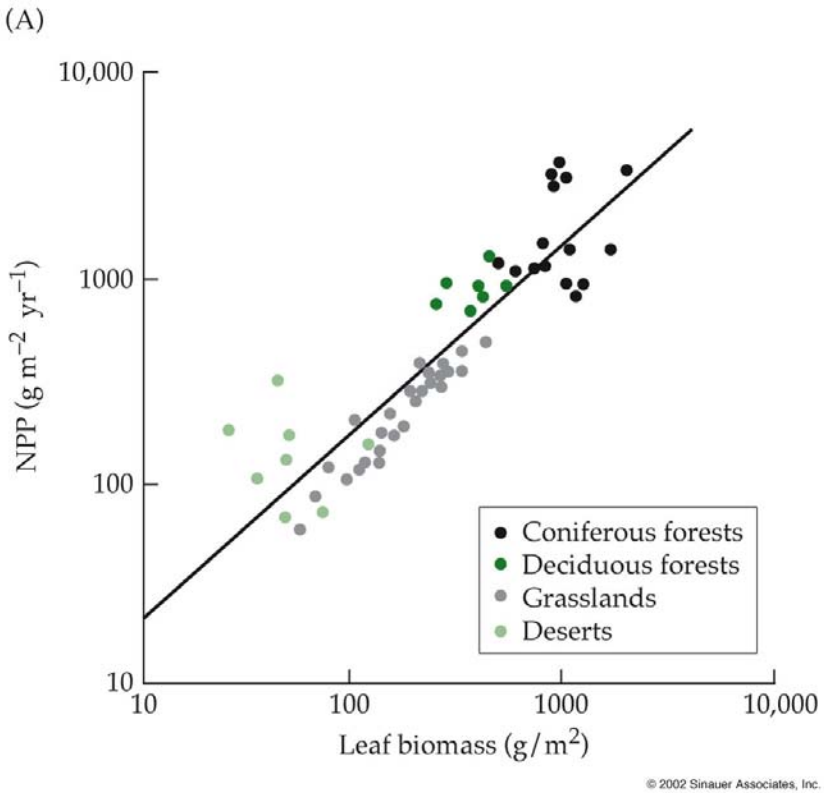
Types of Ecosystems



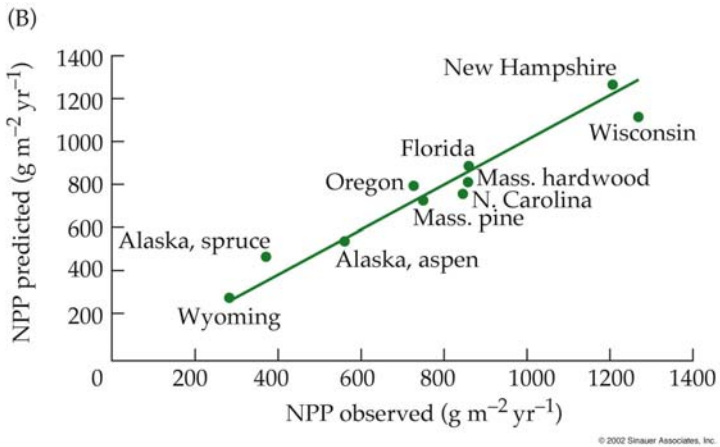
Productivity



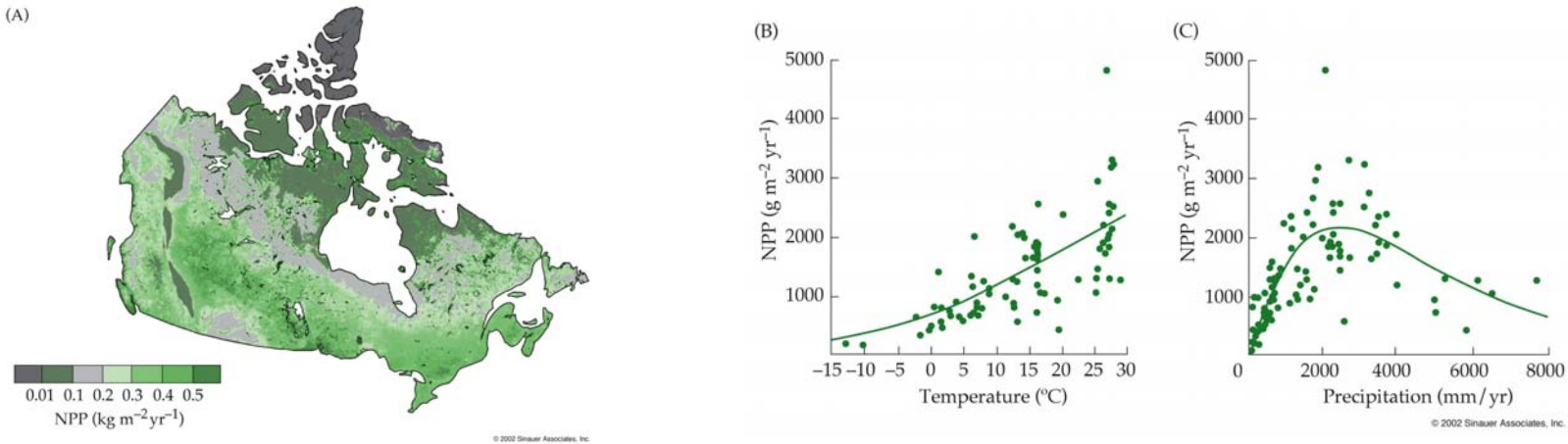
Net Productivity



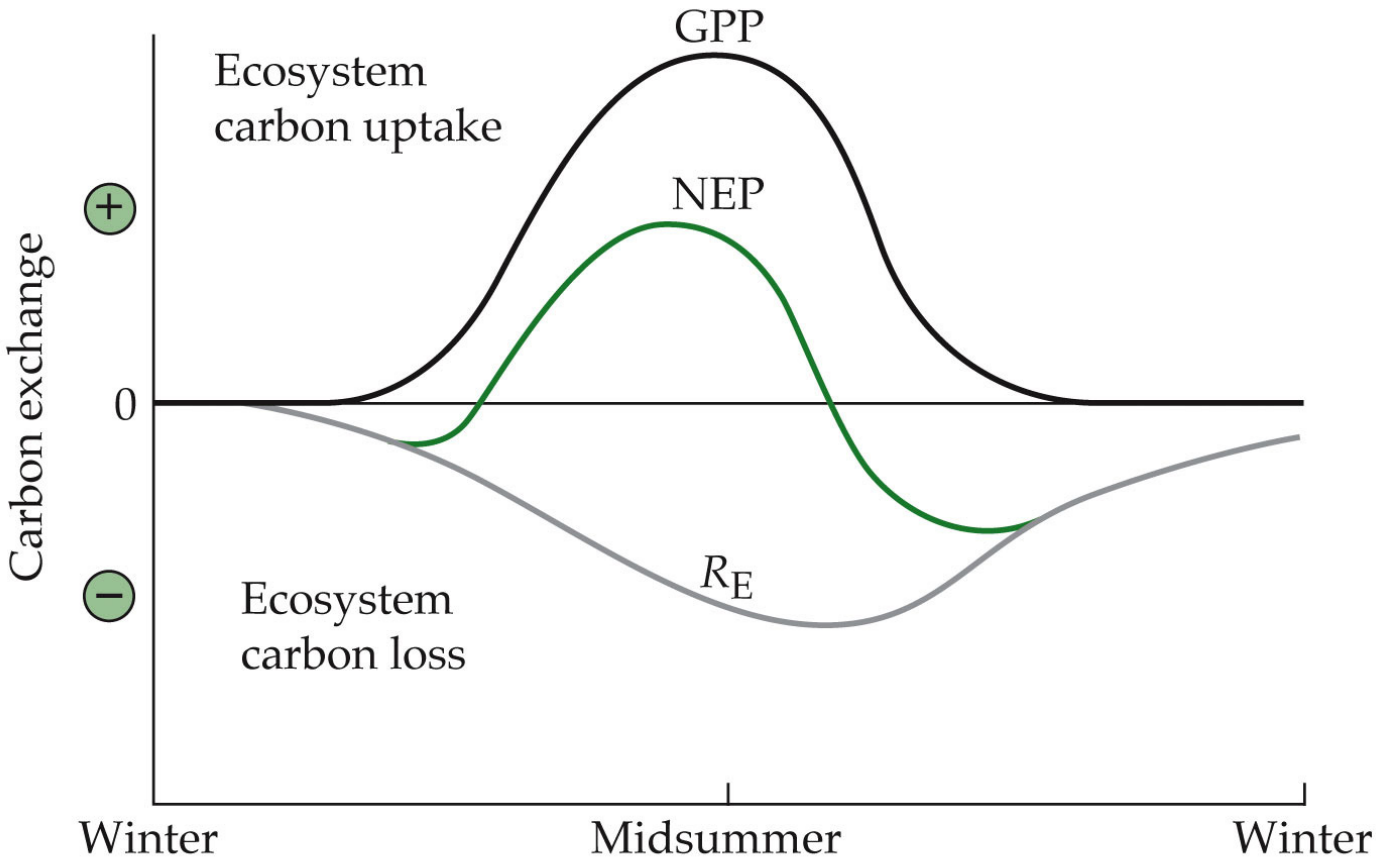
net primary productivity	= rate at which plants produce chemical energy through photosynthesis	− rate at which plants use chemical energy through aerobic cellular respiration



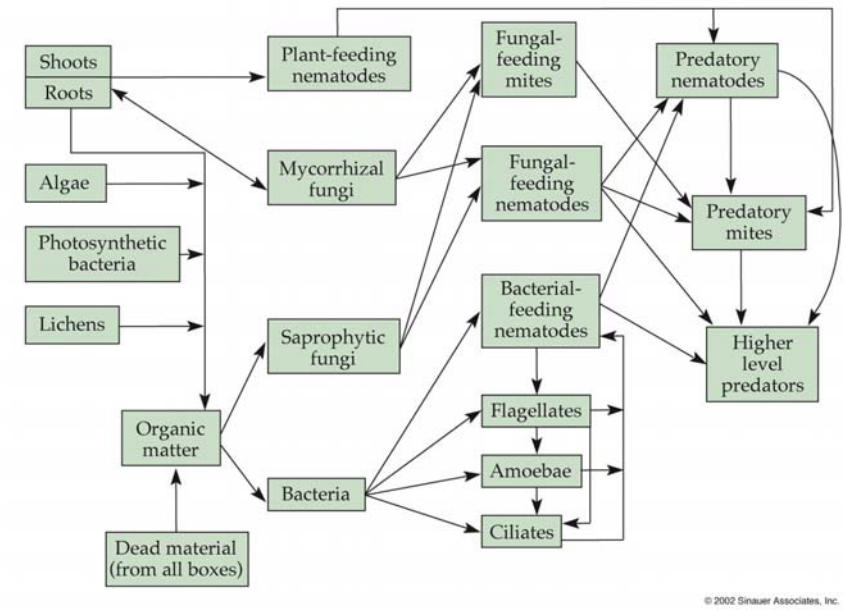
Measurements of Productivity

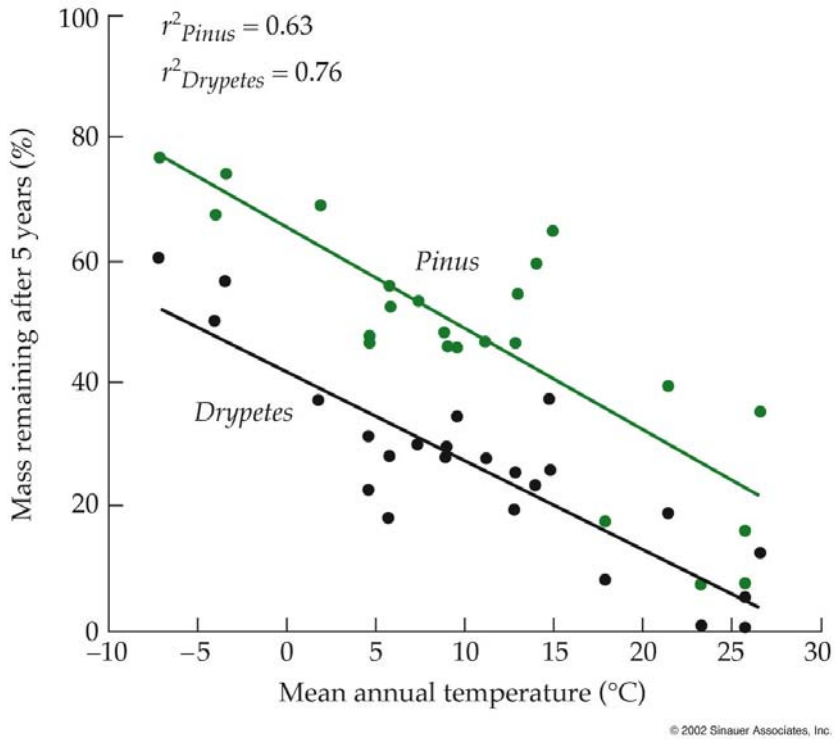


Ecosystem productivity



Soil food web





Nutrient cycling

Table 15.1 Nutrient cycling in a 22-year-old stand of the chaparral scrub *Ceanothus megacarpus* near Santa Barbara, California (Part 1)

	Biomass	N	P	K	Ca	Mg
Atmospheric input (g/m²/year)						
Deposition	—	0.15	—	0.06	0.19	0.10
Nitrogen fixation	—	0.11	—	—	—	—
Total input	—	0.26	—	0.06	0.19	0.10
Pools (g/m²)						
Foliage	553	8.20	0.38	2.07	4.50	0.98
Live wood	5929	32.60	2.43	13.93	28.99	3.20
Reproductive tissues	81	0.92	0.08	0.47	0.32	0.06
Total live	6563	41.72	2.89	16.47	33.81	4.24
Dead wood	1142	6.28	0.46	2.68	5.58	0.61
Surface litter	2027	20.5	0.6	4.7	26.1	6.7

Source: Schlesinger (1997), modified from Gray (1983) and Schlesinger et al. (1982).

Nutrient cycling cont.

Table 15.1 Nutrient cycling in a 22-year-old stand of the chaparral scrub *Ceanothus megacarpus* near Santa Barbara, California (Part 2)

	Biomass	N	P	K	Ca	Mg
Annual flux (g/m²/year)						
Requirement for production						
Foliage	553	9.35	0.48	2.81	4.89	1.04
New twigs	120	1.18	0.06	0.62	0.71	0.11
Wood increment	302	1.66	0.12	0.71	1.47	0.16
Reproductive tissues	81	0.92	0.08	1.47	0.32	0.07
Total in production	1056	13.11	0.74	4.61	7.39	1.38
Reabsorption before abscission	—	4.15	0.29	0	0	0
Return to soil						
Litterfall	727	6.65	0.32	2.10	8.01	1.41
Branch mortality	74	0.22	0.01	0.15	0.44	0.02
Throughflow	—	0.19	0	0.94	0.31	0.09
Stemflow	—	0.24	0	0.87	0.78	0.25
Total return	801	7.30	0.33	4.06	9.54	1.77
Uptake (=increment – return)	—	8.96	0.45	4.77	11.01	1.93
Streamwater loss (g/m²/year)	—	0.03	0.01	0.06	0.09	0.06

Source: Schlesinger (1997), modified from Gray (1983) and Schlesinger et al. (1982).

Table 15.1 Nutrient cycling in a 22-year-old stand of the chaparral scrub *Ceanothus megacarpus* near Santa Barbara, California (Part 3)

	Biomass	N	P	K	Ca	Mg
Comparisons of turnover and flux						
Foliage requirement/total requirement (%)	—	71.3	64.9	61.0	66.2	75.4
Litterfall/total return (%)	—	91.1	97.0	51.7	84.0	79.7
Uptake/total live pool (%)	—	21.4	15.6	29.0	32.6	45.5
Return/uptake (%)	—	81.4	73.3	85.1	86.6	91.7
Reabsorption/requirement (%)	—	31.7	39.0	0	0	0
Surface litter/litterfall (year)	2.8	3.1	1.9	1.2	3.3	4.8

Source: Schlesinger (1997), modified from Gray (1983) and Schlesinger et al. (1982).

Nutrient input

Table 15.2 Annual nutrient requirements supplied by various sources in the Hubbard Brook Experimental Forest, New Hampshire

	N	P	K	Ca	Mg
Requirement kg/ha/year	115.4	12.3	66.9	62.2	9.5
Percentage supplied by:					
Intersystem inputs					
Atmospheric	18	0	1	4	6
Rock weathering	0	1	11	34	37
Intrasystem transfers					
Reabsorptions	31	28	4	0	2
Detritus turnover (includes return in throughflow and stem flow)	69	67	87	85	87

Sources: Reabsorption data are from Ryan and Bormann (1982). Data for N, K, Ca, and Mg are from Likens and Bormann (1995) and for P from Yanai (1992).

Cycles

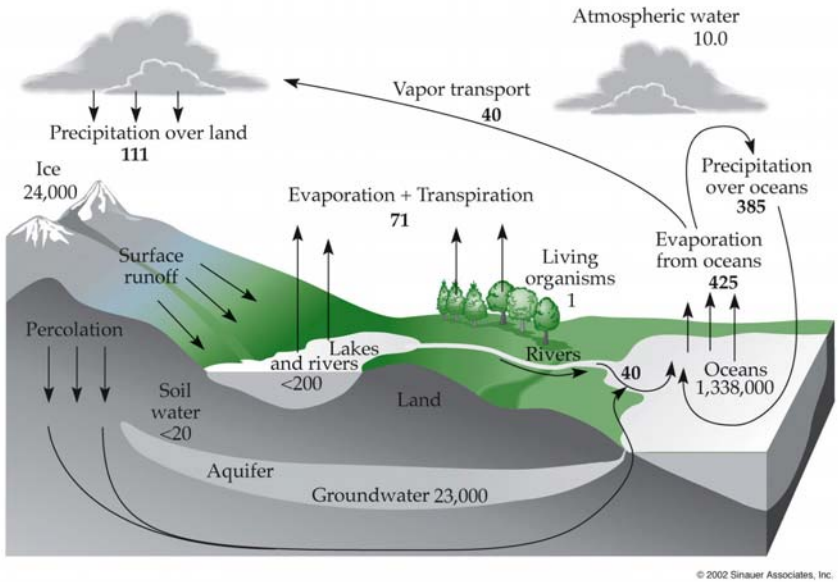
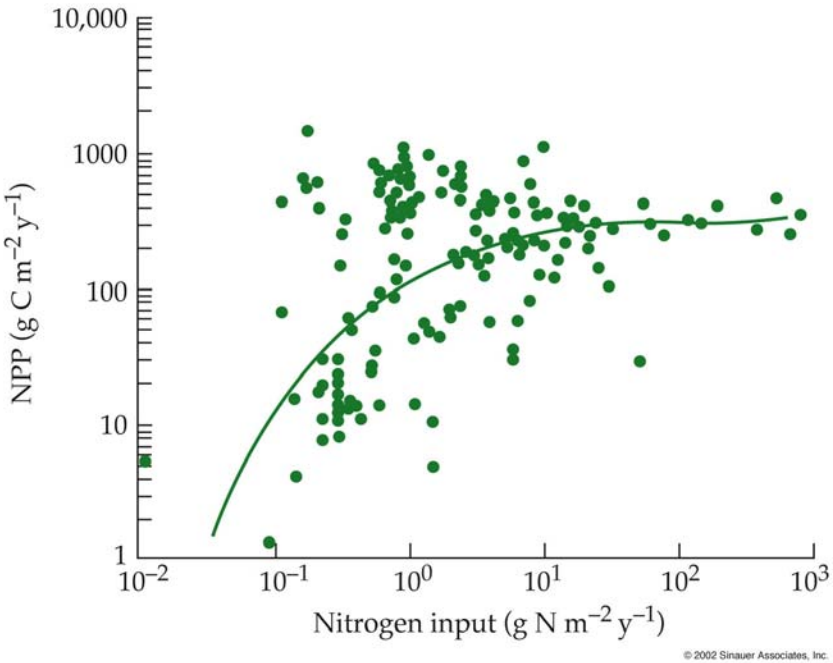


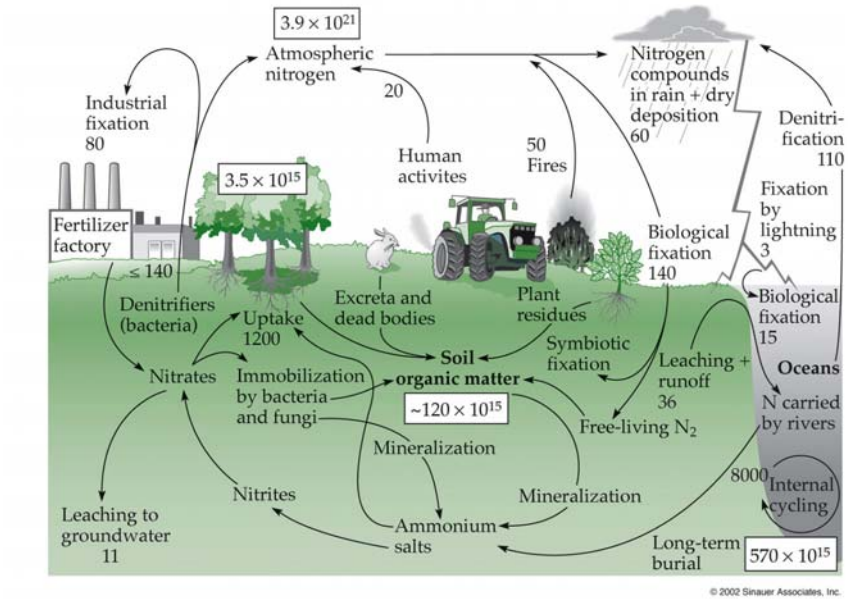
Table 15.3 Relative importance of pathways leading to the loss of water in a variety of terrestrial ecosystems

Biome	Evaporation (%)	Transpiration (%)	Runoff and groundwater recharge (%)
Tropical rainforest	25.6	48.5	25.9
Tropical rainforest	10	40	50
Tropical rainforest	11	56	32
Temperate forest	13	32	53
Temperate grassland	35	65	0
Temperate grassland	33	67	0
Temperate grassland	55	45	0
Temperate grassland	56	34	10
Desert	28	72	0
Desert	20	80	—
Desert	73	27	—
Desert	65	35	—

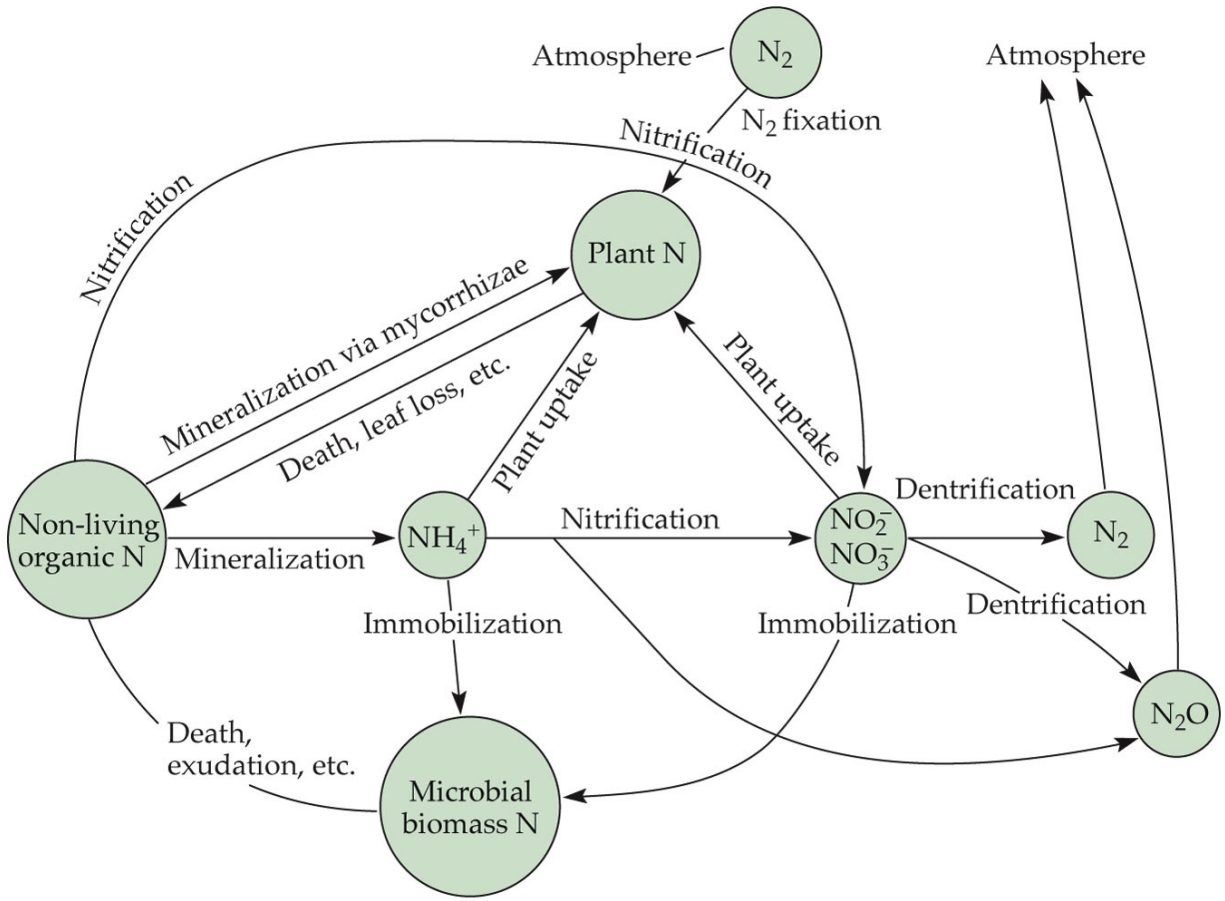
Source: Schlesinger (1997).

Nitrogen cycle





Soil cycle



Pitcher plant

Sarracenia purpurea

Summary

- Productivity: Gross Vs net, different ecosystems
- Energy Flow: Trophic levels, Food webs/chains
- Nutrient cycling: know examples