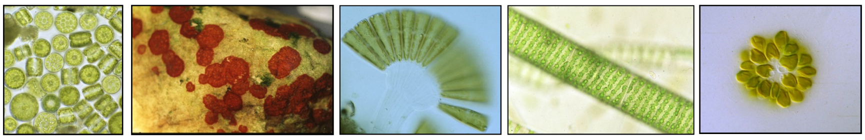
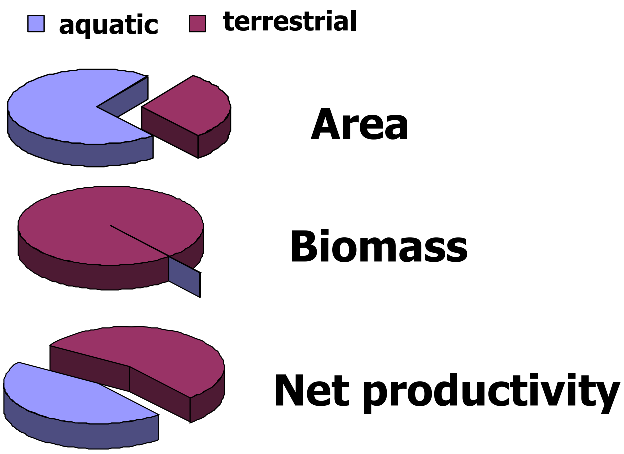


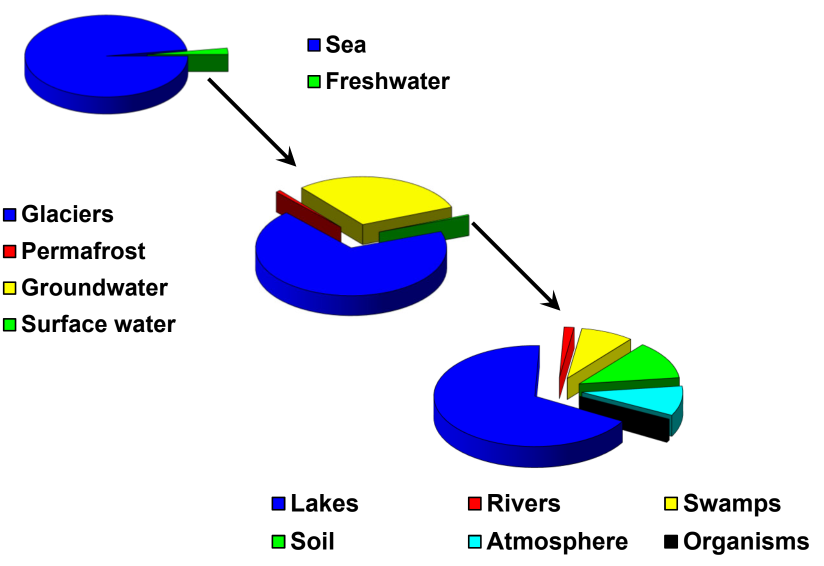
Pelagial

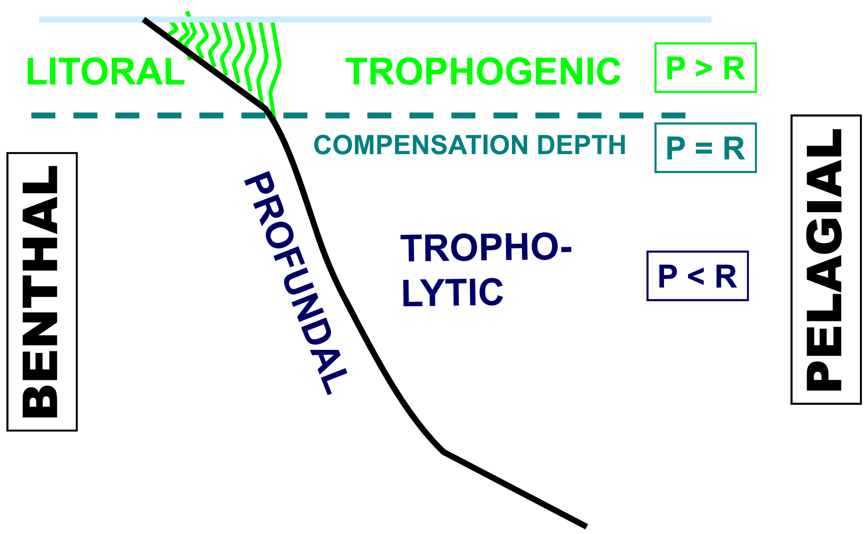
Freshwater Biodiversity
ao. Univ. Prof. Dr. Michael Schagerl

Ecosystems and element cycles from a global perspective



Water global





Aquatic biocoenoses

Nekton (gr. nekton „das Schwimmende"): larger organisms able to control their position in the pelagial by swimming; able to actively swim against water currents (eg. fish).

Plankton (altgr. „das Umherirrende"): organisms of the pelagial drifting passively with water movement; the direction is identical to water currents (mostly small organisms, but also jellyfish).

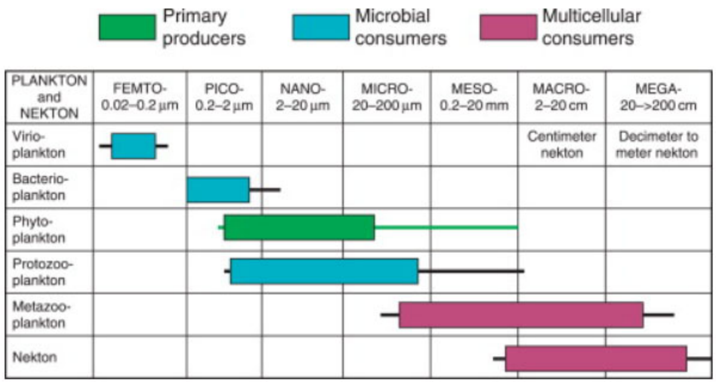
Pleuston (aus gr. pleuston „das Segelnde"): large organisms living on the water surface (eg. water fowl, water hyacinths).

Neuston (aus gr. neuston „das Schwimmende"); small organisms living at the water surface (= Epineuston; eg. water striders genus Gerris) or just below the water surface (= Hyponeuston; eg. microalgae, meniscus waterflea = Kahnfahrer).

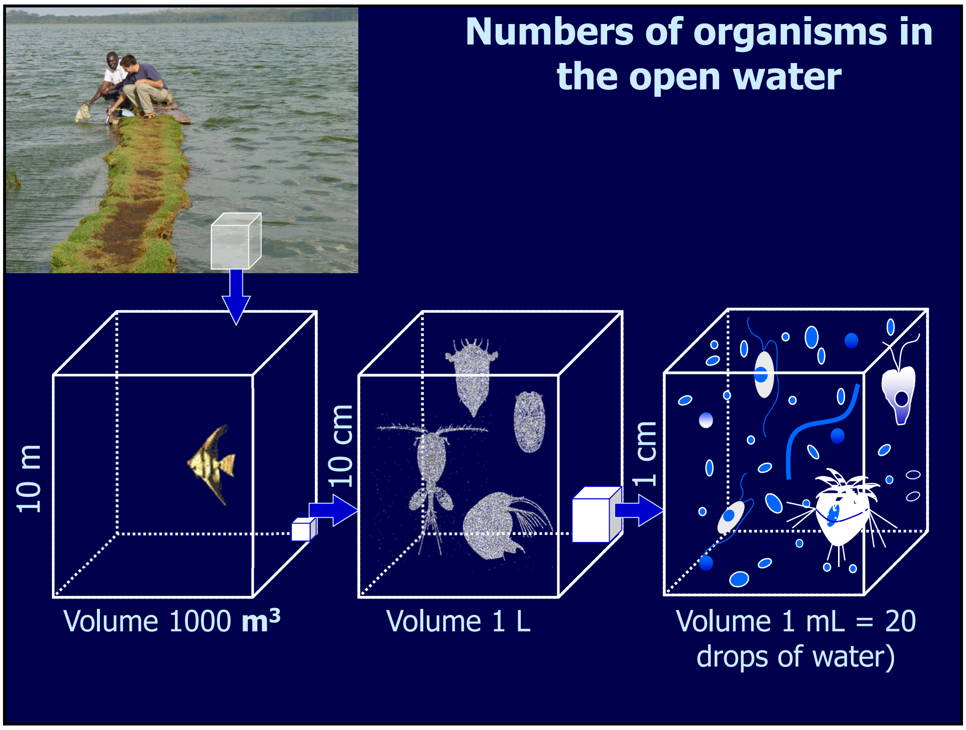
Benthos (gr. „die Tiefe"): organisms associated with any solid-liquid interface in water; associated with substrata.

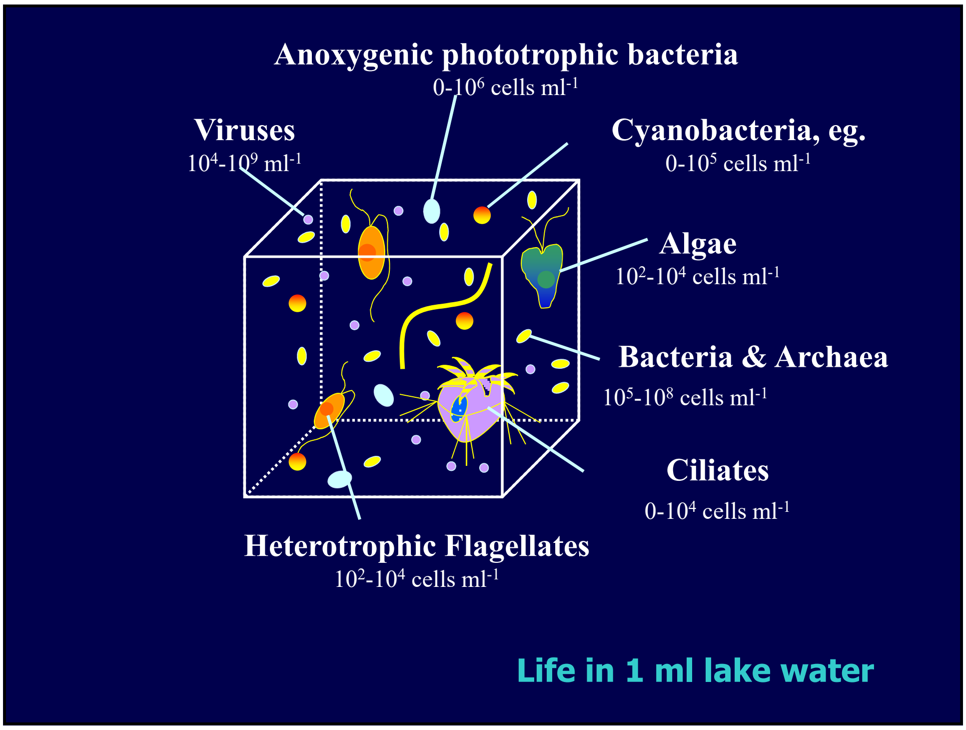
Plankton Size Classes

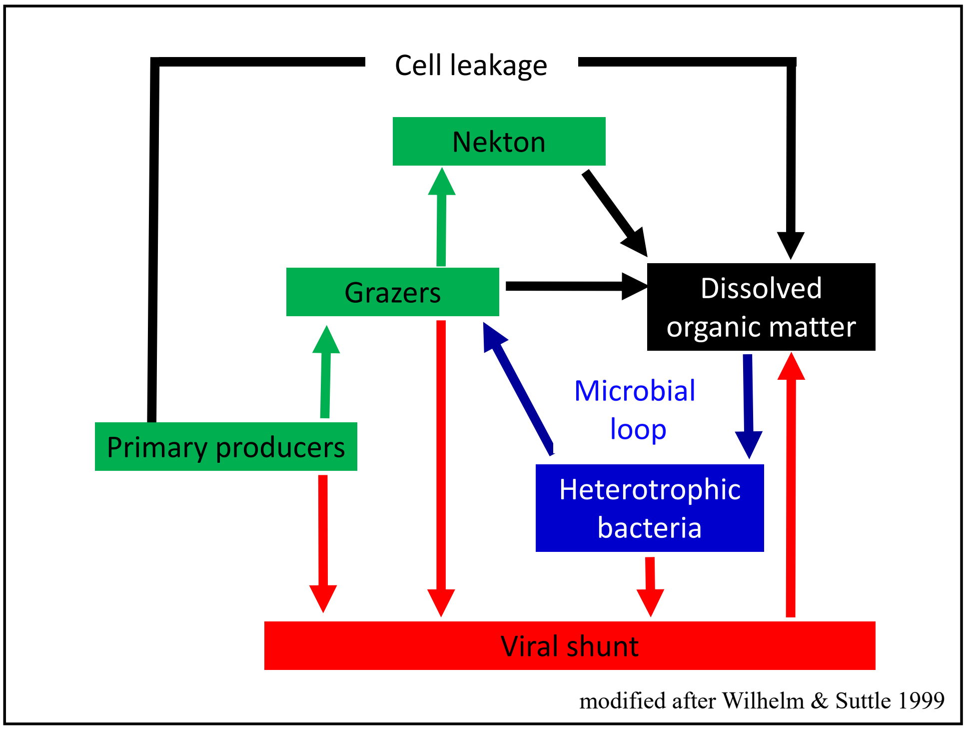
name	from size	to size	Organism groups
femtoplankton		0,2 µm	viruses, phages
picoplankton	0,2 µm	2 µm	bacteria, small phytoplankton, protozoa
nanoplankton	2 µm	20 µm	phytoplankton, protozoa, biggest bacteria
microplankton	20 µm	200 µm	big phytoplankton and protozoa, small metazoa (e.g. rotifers)
mesoplankton	200 µm	2 mm	biggest protozoa, phytoplankton colonies, many metazoa (e.g. cladocera, copepods)
macroplankton	2 mm	2 cm	very big phytoplankton colonies, big marine planktonic crustacea (e.g. Euphausiidae), insects (e.g. Diptera as *Chaoborus* larvae, bugs as *Anisops* sp.)
megaplankton	2 cm		biggest marine zooplankton, e.g. jellyfish



modified after Sieburth et al. (1978). Limnol. Oceanogr. 23: 1256-1263

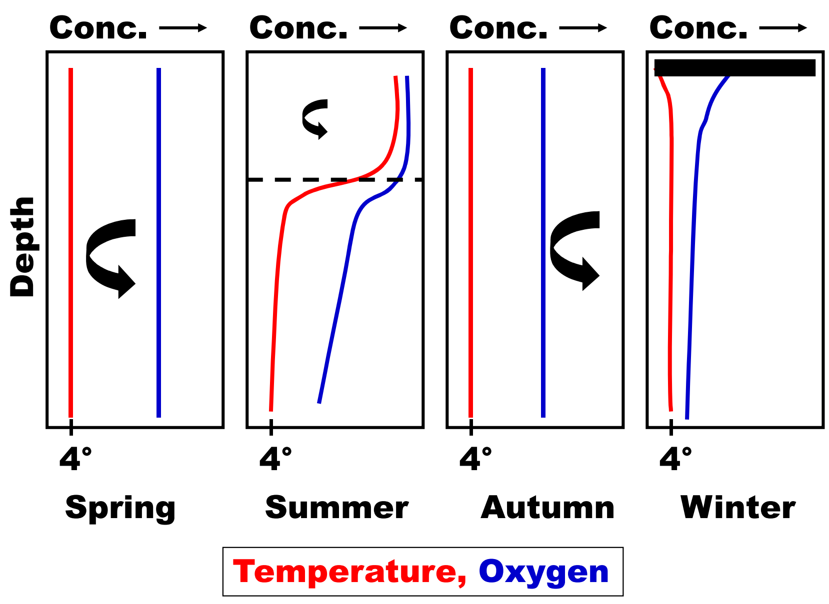



Anoxygenic phototrophic bacteria
0-10^6 cells ml^{-1}
Viruses
10^4-10^9 ml^{-1}
Cyanobacteria, eg.
0-10^5 cells ml^{-1}
Algae
10^2-10^4 cells ml^{-1}
Bacteria & Archaea
10^5-10^8 cells ml^{-1}
Ciliates
0-10^4 cells ml^{-1}
Heterotrophic Flagellates
10^2-10^4 cells ml^{-1}
Life in 1 ml lake water


Cell leakage
Nekton
Grazers
Dissolved organic matter
Microbial loop
Primary producers
Heterotrophic bacteria
Viral shunt
modified after Wilhelm & Suttle 1999

Standing water bodies

- long retention time from months to years
- temperature stratification
- turbulences – spiral-like movement of particles in the epilimnion
- nutrient limitation



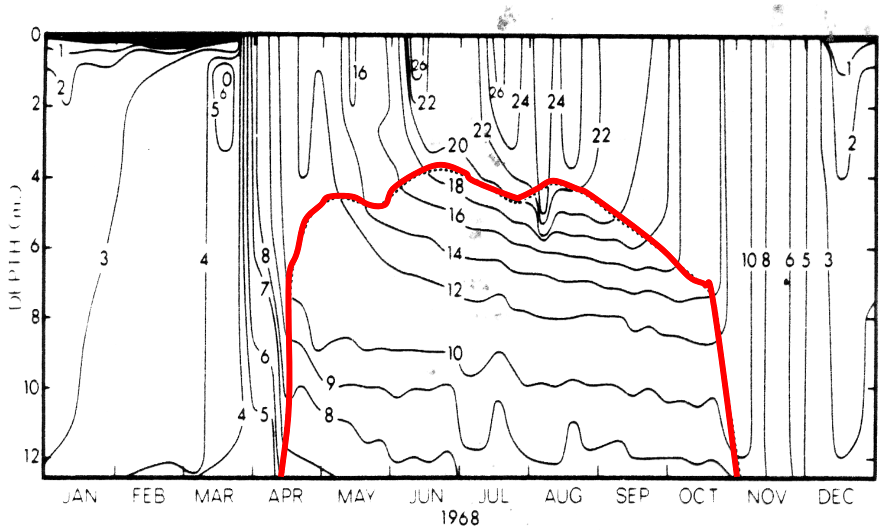


Figure 6-4 Depth-time diagram of isotherms (°C) in Lawrence Lake, Michigan, 1968. Dashed line indicates the upper metalimnetic-lower epilimnetic boundary. Ice-cover drawn to scale. (Modified from Wetzel, et al., 1972.)

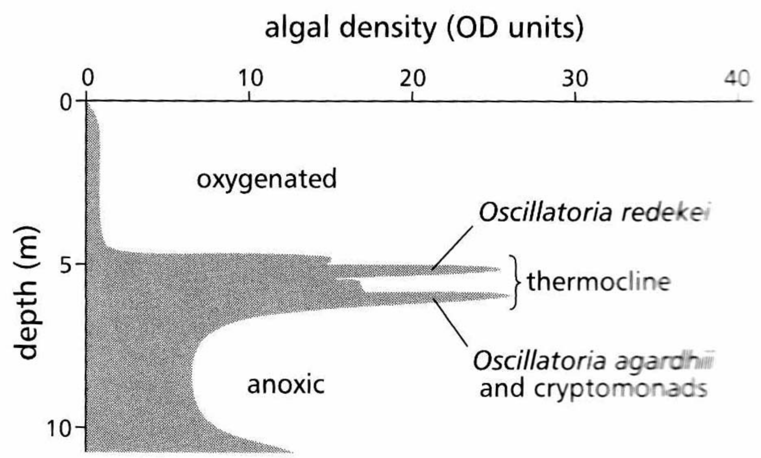


Figure 22–7 Vertical distribution of cryptomonads and *Oscillatoria* spp. in a stratified kettle lake. (Goldman, C. R., and A. J. Horne. 1983. *Limnology*. McGraw-Hill. Reproduced with permission of the McGraw-Hill Companies, based on Baker and Brook, 1971)

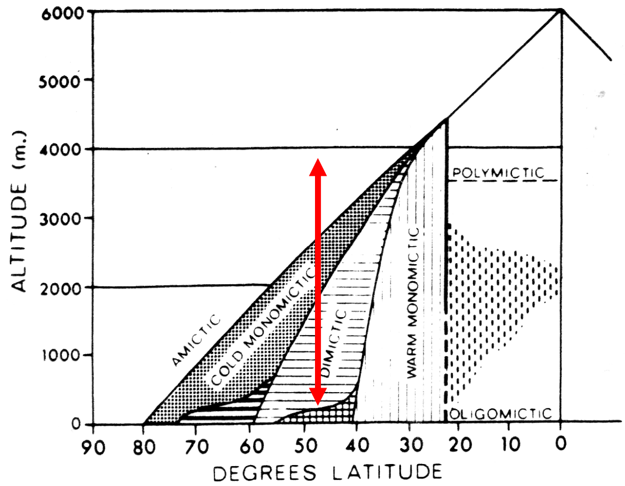


Figure 6-7 Schematic arrangement of thermal lake types with latitude and altitude. *Black dots*: cold monomictic; *black and white horizontal bars*: transitional regions; *horizontal lines*: dimictic; *crossed lines*: transitional regions; *vertical lines*: warm monomictic. The two equatorial types occupy the unshaded areas labelled oligomictic and polymictic, separated by a region of mixed types, mainly variants of the warm monomictic type *(broken vertical lines)*. (Modified from Hutchinson and Löffler, 1956.)

Austria 47° latitude

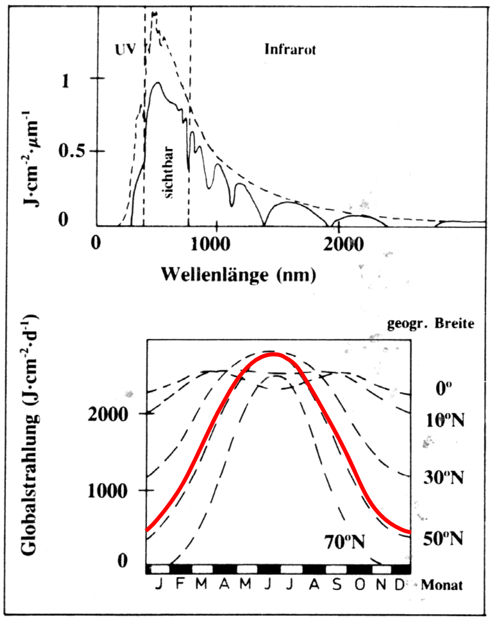
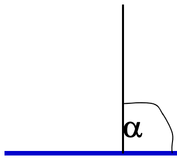


Abb. 4.2. Spektralverteilung der Energie der Sonnenstrahlung (– – –: auf die Atmosphäre eintreffende Srahlung; ________: Strahlung am Erdboden) und Jahresgang der täglichen Globalstrahlung an wolkenlosen Tagen in Abhängigkeit von der geographischen Breite

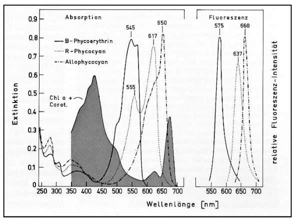
LIGHT AND WATER

Reflection



60° 6%
70° 13%
80° 35%

Absorption



Scattering

Energy flux density W m^{-2} (maximum 350 W m^{-2} PAR)

Photon flux density mol photons m^{-2} s^{-1} (maximum 2000 µmol m^{-2} s^{-1} PAR)

1 µmol photons m^{-2} s^{-1} = 0.20 – 0.25 W m^{-2}

$$\varepsilon = \frac{1}{z}\ln\frac{I_0}{I_z}$$

ε...vertical coefficient of attenuation

z...depth

I_0...light intensity surface

I_z...light intensity depth z

$$I_z = I_0 e^{-\varepsilon z}$$

z_{eu}...euphotic zone (1% of surface light intensity)

$$z_{eu} = \frac{1}{\varepsilon}\ln\frac{100}{1} = \frac{1}{\varepsilon}4.6$$

Reflection, Absorption und Scattering cause

Shortening of day length in water compared to terrestrial systems

Worse light supply compared to terrestrial systems

Shift of the spectral properties with water depth

Adaptations

UV-absorbing substances in cell walls and mucilage, cellular protection mechanisms (carotenoids), negative phototaxis against excess light

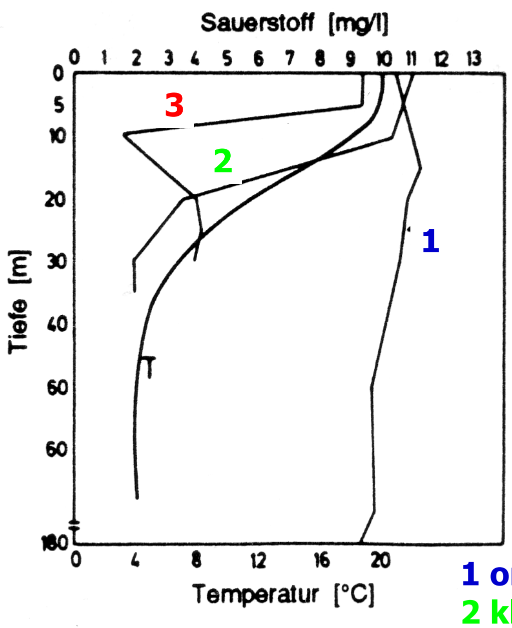
Reduced sinking, positive phototaxis, increase in cellular pigment levels at suboptimal light conditions

Phar

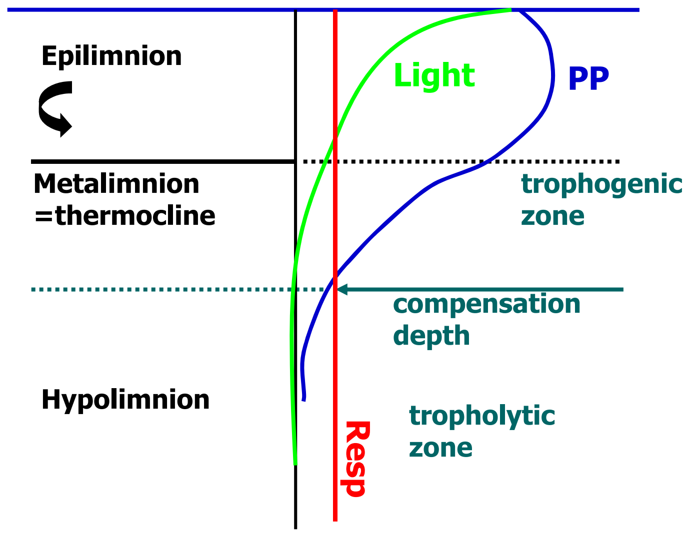
$$6CO_2 + 6H_2O \longleftrightarrow 6CH_2O + 6O_2$$

Carbon dioxide – assimilation, puffer capacity

Oxygen – respiration, decomposition processes, water chemistry



1 orthograde – oligotroph
2 klinograde – eutroph
3 negative heterograde



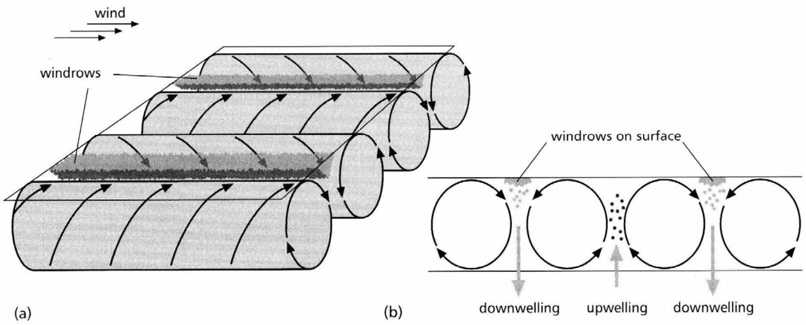


Figure 22–9 The formation of Langmuir cells in a lake is marked by windrows on the surface (a). Water in each cell follows a spiral path through the water in the direction of the wind. Adjacent cells, seen in cross section in (b), rotate in opposite directions, creating regions of downwelling (where the windrows occur) and upwelling. Foam and buoyant algae (gray circles) accumulate in the downwelling regions where currents converge. Negatively buoyant algae (black circles) accumulate in the upwelling zones beneath the surface.

Trophy = Intensity of primary production

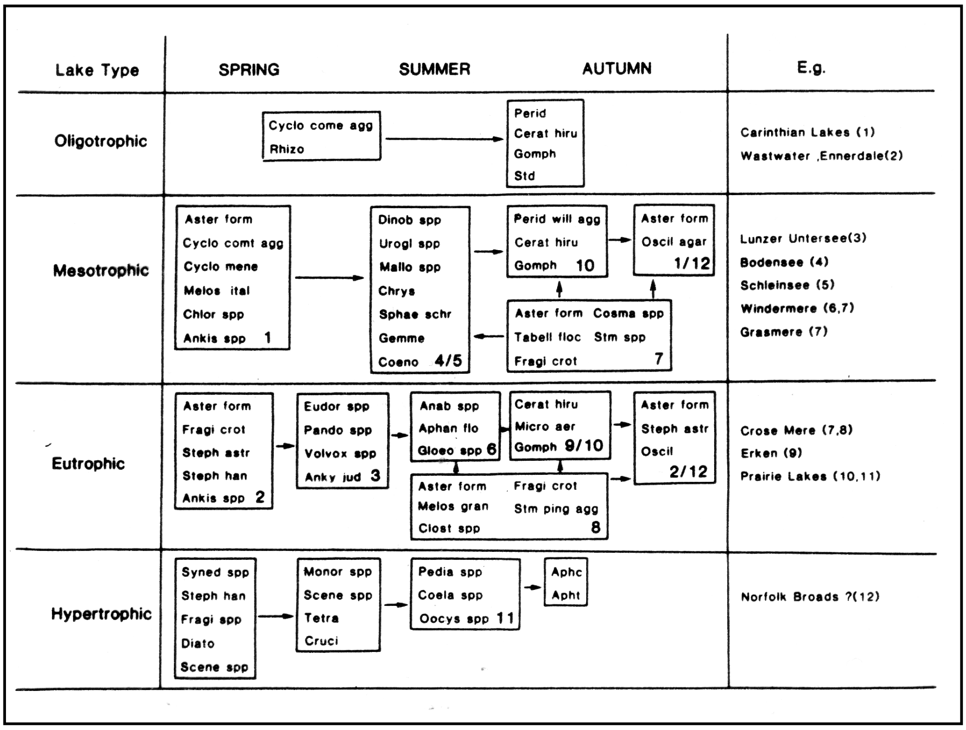
Oligotrophic = very low production

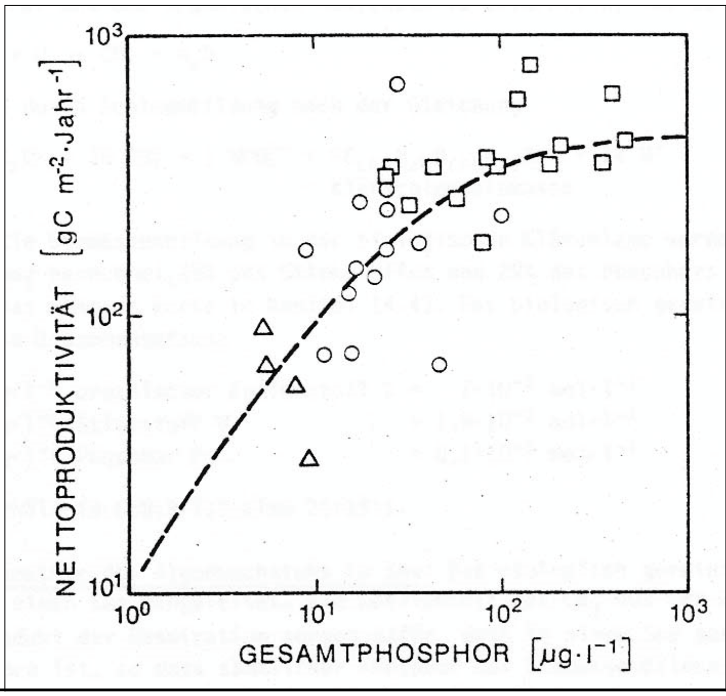
Mesotrophic = low production

Eutrophic = high production

Hypertrophic = massive production

Merkmal	Trophiegrad oligotroph	eutroph
Produktivität	niedrig	hoch
Anzahl von Tier- und Pflanzenarten	hoch	hoch (Reduktion in hypertrophen Seen)
Biomasse	niedrig	hoch
Algenblüten	selten	häufig
Anteil Cyanobakterien	gering	hoch
euphotische Zone	bis zum Hypolimnion	an der Oberfläche
Makrophyten im Litoral	selten bis häufig	oft häufig, hoher Anteil filamentöser Algen
charakteristische Algen Taxa	Chlorophyceen *Staurastrum* Diatomeen *Tabellaria* *Cyclotella* Chrysophyceen *Dinobryon*	Cyanobakterien *Anabaena* *Aphanizomenon* *Microcystis* *Oscillatoria* Diatomeen *Melosira* *Fragilaria* *Stephanodiscus* *Asterionella*
charakteristische Zooplankton Taxa	*Bosmina obtusirostris* *B. coregoni*	*B. longirostris* *Daphnia culcullata*
O_2 im Hypolimniom	das ganze Jahr hoch	während der Stagnationsphase niedrig
Mittlere Tiefe	oft tief	oft flach
Größe des Hypolimnions	oft groß	klein oder groß


Lake Type
SPRING
SUMMER
AUTUMN
E.g.
Oligotrophic
Cyclo come agg
Rhizo
Perid
Cerat hiru
Gomph
Std
Carinthian Lakes (1)
Wastwater ,Ennerdale(2)
Mesotrophic
Aster form
Cyclo comt agg
Cyclo mene
Melos ital
Chlor spp
Ankis spp 1
Dinob spp
Urogl spp
Mallo spp
Chrys
Sphae schr
Gemme
Coeno 4/5
Perid will agg
Cerat hiru
Gomph 10
Aster form
Oscil agar
1/12
Aster form Cosma spp
Tabell floc Stm spp
Fragi crot 7
Lunzer Untersee(3)
Bodensee (4)
Schleinsee (5)
Windermere (6,7)
Grasmere (7)
Eutrophic
Aster form
Fragi crot
Steph astr
Steph han
Ankis spp 2
Eudor spp
Pando spp
Volvox spp
Anky jud 3
Anab spp
Aphan flo
Gloeo spp 6
Cerat hiru
Micro aer
Gomph 9/10
Aster form
Steph astr
Oscil
2/12
Aster form
Melos gran
Clost spp
Fragi crot
Stm ping agg
8
Crose Mere (7,8)
Erken (9)
Prairie Lakes (10,11)
Hypertrophic
Syned spp
Steph han
Fragi spp
Diato
Scene spp
Monor spp
Scene spp
Tetra
Cruci
Pedia spp
Coela spp
Oocys spp 11
Aphc
Apht
Norfolk Broads ?(12)


NETTOPRODUKTIVITÄT [gC m-2.Jahr-1]
GESAMTPHOSPHOR [µg·l-1]
10^1
10^2
10^3
10^0

Trophic level	PP in C $gm^{-2}a^{-1}$	Ntot μgl^{-1}	Ptot μgl^{-1}	Chl-a μgl^{-1}	Secchi m
oligotrophic	< 70	< 400	< 15	< 3	4.0
mesotrophic	70-150	400-600	15-25	3-7	2.5-4.0
eutrophic	150-500	600-1500	25-100	7-40	1.0-2.5
hypertrophic	> 500	> 1500	> 100	> 40	<1.0