River Ecology

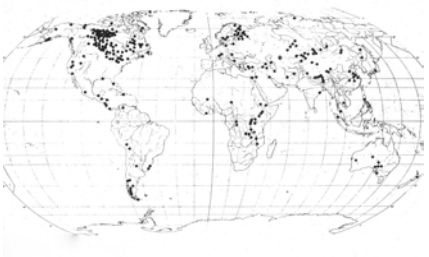
Lotic Ecosystems

Limnology, The Science Of Lakes

Limnology, The Science Of Lakes

Courtesy *NASA*

Distribution Of Large Lakes



Lake Louise, Alberta, Canada

New Zealand Lake

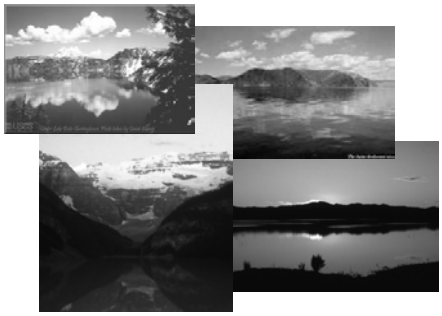
Pedder Lake, Australia
(Tasmania)

Quake Lake, Montana

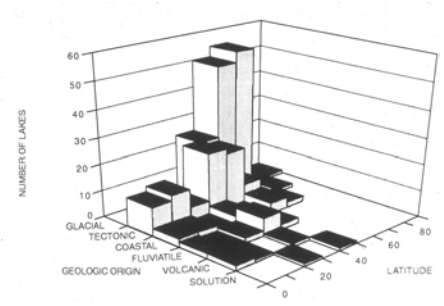
New York City Drinks Lake Water

So Does Northern New Jersey

Lentic Ecosystems



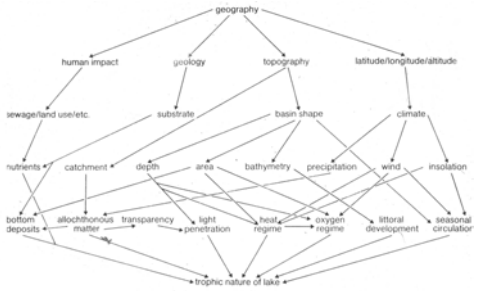
Classification Of Large Lakes



Frequency of occurrence of large lakes by area

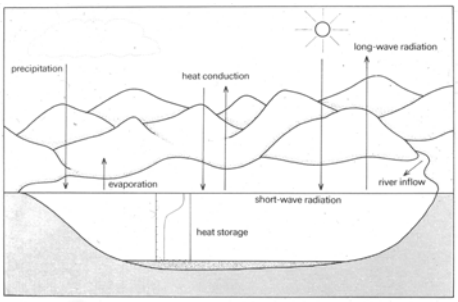
Range in area (km²)	Total number	Total area (km²)	Mean area (km²)
500– 1,000	113	76,330	675
1,000– 2,000	63	84,643	1,343
2,000– 3,000	21	50,192	2,390
3,000– 4,000	9	30,907	3,434
4,000– 5,000	13	58,543	4,503
5,000– 10,000	15	102,768	6,851
10,000– 50,000	5	291,478	22,421
50,000–100,000	1	331,910	66,382
<100,000	1	374,000	374,000
Total	253	1,400,771	

Factors Affecting The Trophic Status Of lakes

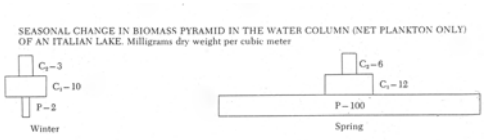


Interrelationships of the main factors affecting the trophic status of a lake

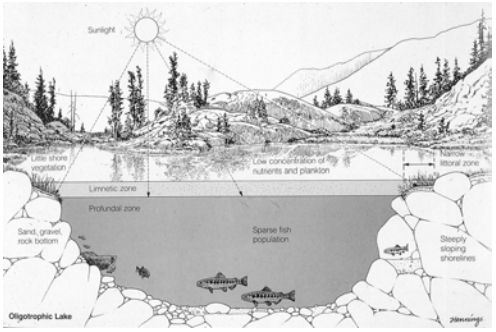
Energy Considerations



Food Pyramids

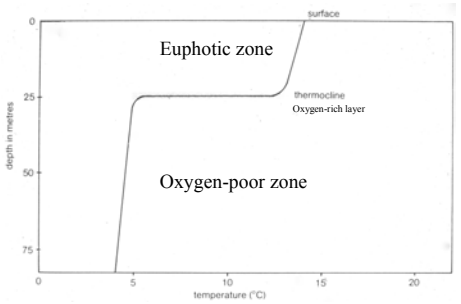


Oligotrophic lakes

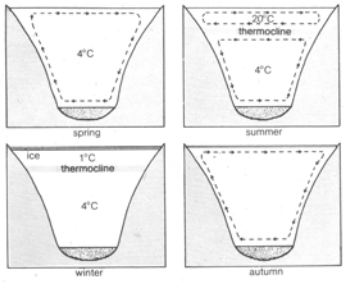


From: Miller, *Living In The Environment*

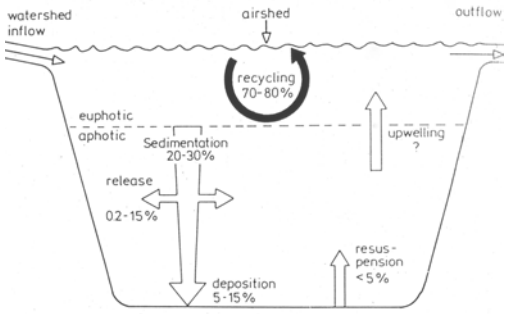
Temperature Profile, Summer



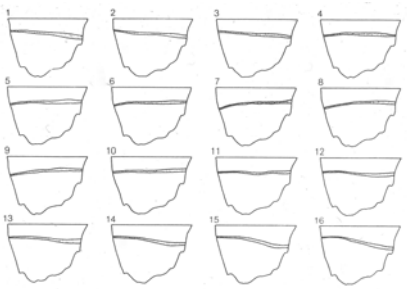
Temperature Profiles Throughout The Seasons In An Oligotrophic Lake



Circulation Patterns



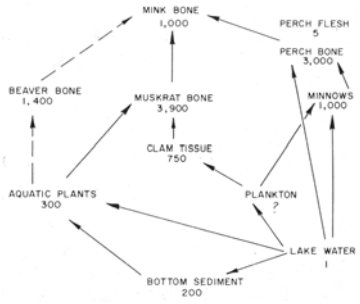
Thermal Profiles Of An Oligotrophic Lake Over A 12 Hour Period



Energy Flow In An Oligothrophic Lake

Energy flow in Loch Leven, Scotland.

Accumulation Of Strontium ^{90} In A Lake



Langmuir Circulation

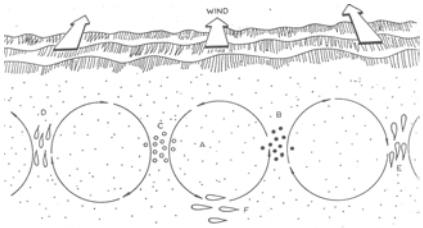
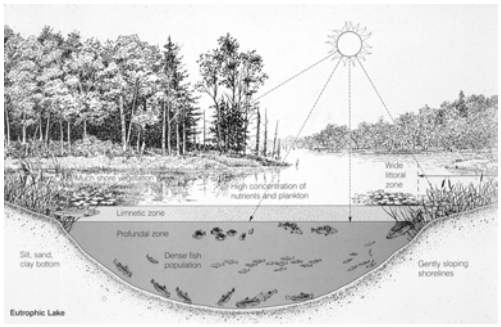


Figure 3.18 Langmuir circulation and plankton distribution: A, randomly distributed neutrally buoyant particles; B, sinking particles aggregated in upwelling zone; C, floating particles concentrated in downwelling zone; D, E, and F, zooplankton aggregation positions determined by the velocity field in the cell. Redrawn from Stavn (1971) by Ledbetter (1979).

Eutrophic Lakes



From:Miller, *Living In The Environment*

All Lake Undergo Eutrophication And Eventually Fill In With Detritus And Dry Up

Pitcher Plant Bog

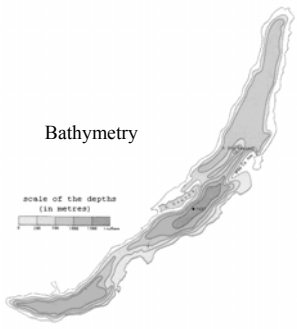
Unusual Lakes

Lake Baikal From Space

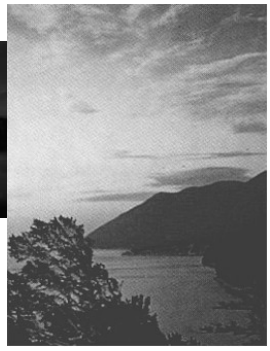
Courtesy *NASA*

Lake Baikal From Space

Lake Baikal, Siberia



Lake Baikal, Siberia

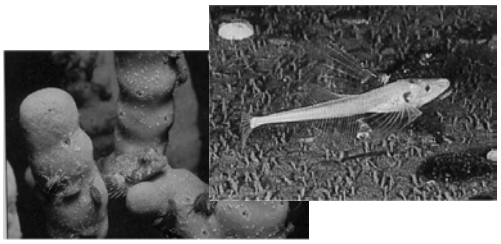


Living Lakes

http://www.livinglakes.org/baikal/

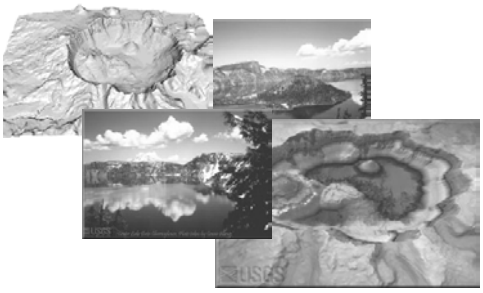
Lake Baikal, Siberia

Lake Baikal, Siberia



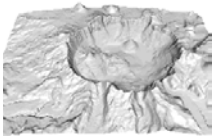
Baikal has more endemics than any other lake in the world. Its great age--more than 25 million years--also sets it apart from any other freshwater lake as a living laboratory of evolution. During its life, 30 species of sculpins (above) have evolved. In comparison, 10,000-year-old Lake Superior has but four species.

Crater Lake, Oregon



http://craterlake.wr.usgs.gov/bathymetry.html

Crater Lake, Oregon

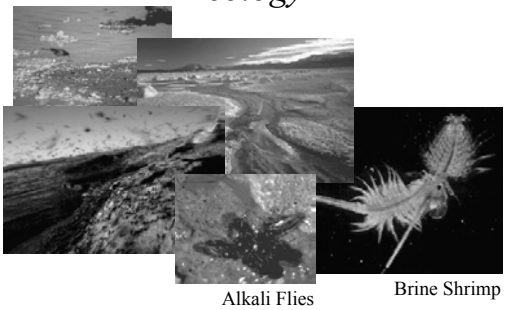


Biological studies include the discovery of bacterial colonies associated with hydrothermal fluids. These yellow-orange mats consist of thousands of *Gallionella* and *Leptothrix* bacteria. Golden-colored bacteria were found surrounding Llao's Bath. A thick band of moss, *Drepanocladus aduncus*, encircles the lake at depths from 26-140 m (85-460 ft). It hangs like icicles on vertical cliffs and forms thick, lush fields on the gentler slopes around Wizard Island. A fascinating discovery is the animals living in the deepest basin of Crater Lake (589 m, or 1,932 ft). These animals which withstand such high water pressure include flatworms, nematodes, earthworms, copepods, ostracods, and the midge fly *Heterotrissocladius*.

Mono Lake, California

Mono Lake, California: Ecology

Birds feeding on shrimp and flies



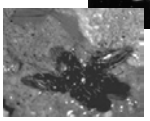
Alkali Flies

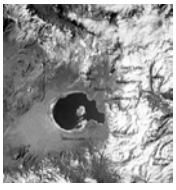
Brine Shrimp

Mono Lake, California: Ecology

Pluvial lake (no outlet)
Carbonates ($CaC0_3$), chlorides, sulfates
pH - 9.8
Salinity - 70-90g/L

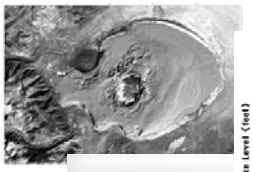
Desulfonatronum thiadismutans - alkali-loving bacterium
Spirochaeta americana - haloalkaliphilic anaerobe
Bacillus arsenicoselenatis - arsenate-loving benthic bacterium

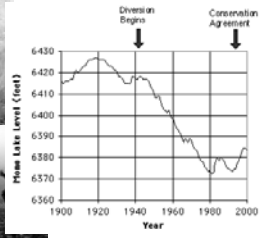




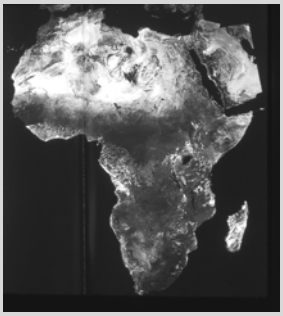
Halophilic green algae:
Nannochloris sp. dominates
Primary productivity: 340-540g C/m^2/yr

Mono Lake, California: Remediation

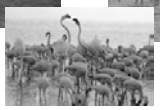


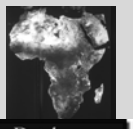


Tropical Lakes Of Africa



Tropical Lakes Of Africa: Lake Nakuru



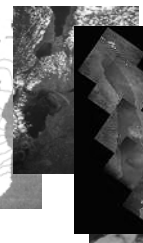


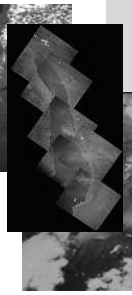
World Lakes Database

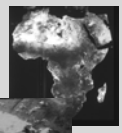
http://www.ilec.or.jp/database/afr/afr-07.html

Surface area [km2]	40
Volume [km3]	0.092
Maximum depth [m]	2.8
Mean depth [m]	2.3
Water level	Unregulated
Length of shoreline [km]	27
Catchment area [km2]	1,800** Including the lake area.

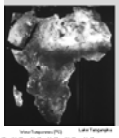
Tropical Lakes Of Africa: Lake Malawi







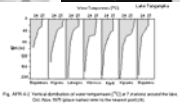
Tropical Lakes Of Africa: Lake Tanganyika



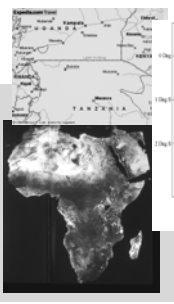
Surface area [km2]	32,000
Volume [km3]	17,800
Maximum depth [m]	1,471
Mean depth [m]	572
Water level	- Unregulated
Length of shoreline [km]	1,900
Catchment area [km2]	263,000

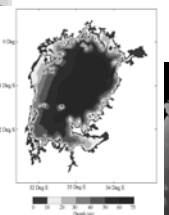
PRIMARY PRODUCTION RATE [mg C m-2 day-1](t, 4)

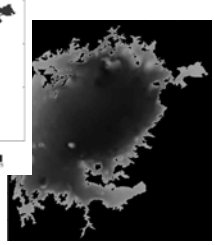
April-May	600
October-November	1,400
Annual	1,000



Lake Victoria, East Africa







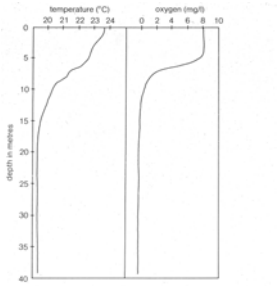
Tropical Lakes Of New York City

Cichlids Unlimited

Some Attributes Of Three African Lakes

Lake	*World Rank in Size*	*Area km² (miles²)*	*Depth m (feet)*	*Clarity m (feet)*	*Age in Years*	*Cichlid Species*
Tanganyika	7th	34,000 (13,100)	1,470 (4,823)	22 (72)	6 million	300
Malawi	9th	31,600 (12,200)	700 (2,310)	17 (56)	1–2 million	500
Victoria	3rd	68,600 (26,500)	95 (305)	1–8 (3–25)	12,400	400

Temperature And Oxygen Profiles Of A Tropical Lake

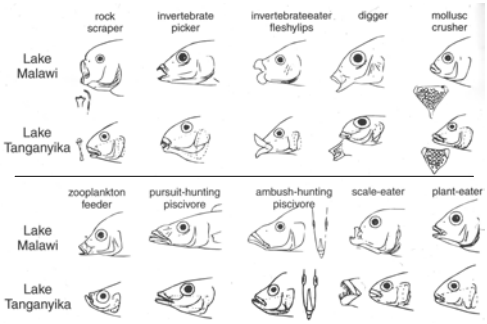


Vertical profiles for temperature and oxygen in a stratified lake—Lake Bunyonyi in Uganda (after Denny, 1972).

Lakes Malawi And Tanganyika: Speciation Of Cichlids

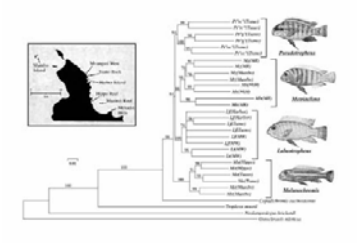
Speciation of Cichlids

*Speciation Of Cichlids**



*Parallel Trophic Evolution

Phylogenetics Of Lake Malawi Cichlids



http://tilapia.unh.edu/wwwPages/malawi/Phylogenetics.html

Lake Victoria Has Cichlids, Too

That Is Until Someone Stocked It With Nile Perch!

Nile Perch And Foe

New York City Drinks Lake Water

So Does Northern New Jersey

*Two Approaches To Watershed Management**

New York City

Northern New Jersey

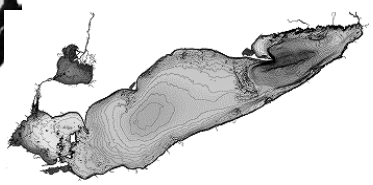
*Which water would you rather drink?

Beavers Alter The Landscape In favor Of Wetlands

Most Significant Cause Of Pollution World-wide: Agricultural Runoff

Zebra Mussels and Lake Erie

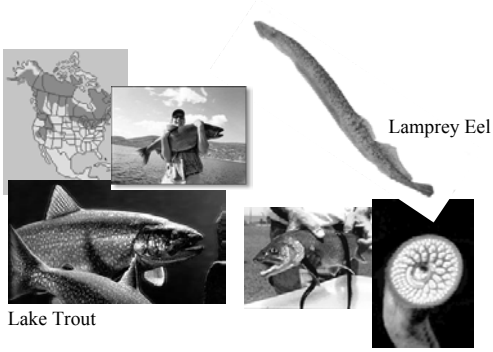
Lake Erie dead zone may be due to zebra mussels
September 2003
U.S. Water News Online
Researchers think zebra mussels may be causing a low-oxygen ``dead zone'' in the central basin of Lake Erie.



St. Lawrence Seaway

The seaway was officially opened on June 26th 1959 and cost 470 million US dollars

Host, Predators, And Parasites

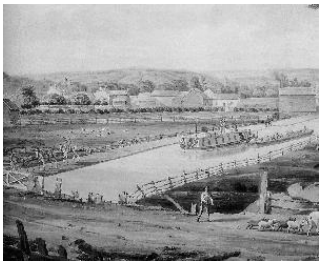


Lamprey Eel

Lake Trout

Lake Trout With Wounds Inflicted By Lamprey Eels

How The Lamprey Eel Got Into The Great Lakes



The Erie Canal, circa 1825

How The Lamprey Eel Gained Entrance Into The Great Lakes:

The Welland Canal

1829

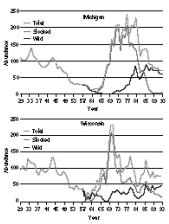
Today

Controlling Lamprey Populations

1. Lampricides - TMF (3-trifluoromethy-4-nitrophenol)
2. Adult lamprey trapping

The Lamprey Eel And Lake Trout:

Remediation (of sorts)



Lake Trout in the Great Lakes

by
Michael J. Hansen
National Biological Service
James W. Peck
Michigan Department of Natural Resources

Lake trout (*Salvelinus namaycush*) populations in the Great Lakes collapsed catastrophically during the 1940's and 1950's because of excessive predation by the sea lamprey (*Petromyzon marinus*) and exploitation by fisheries.

http://biology.usgs.gov/s+t/noframe/m2130.htm