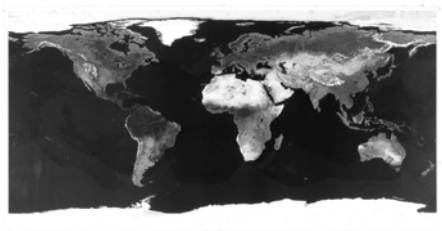
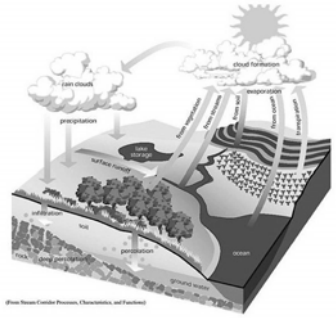
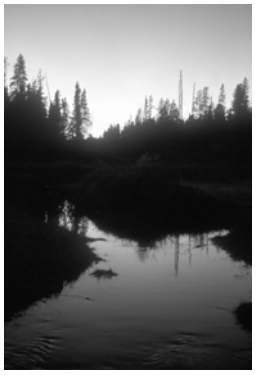
The Ecology Of Running Waters



The Hydrological Cycle



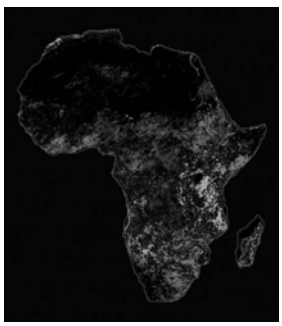
Some Nice Places



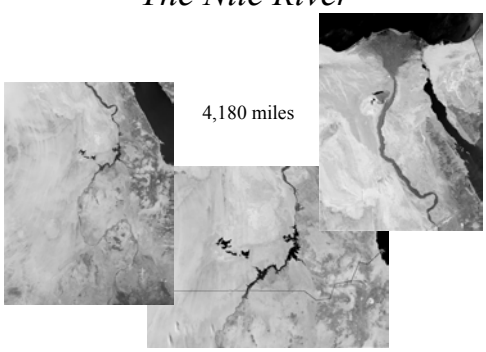
25 Longest Rivers In The World

Rank	River	Length	Location
1	Nile	6693km (4160mi)	North/East Africa
2	Amazon	6436km (4000mi)	South America
3	Chang Jiang (Yangtze)	6378km (3964mi)	China
4	Huang He	5463km (3395mi)	China
5	Ob-Irtysh	5410km (3362mi)	Russia
6	Amur	4415km (2744mi)	Northeast Asia
7	Lena	4399km (2734mi)	Russia
8	Congo	4373km (2718mi)	Central Africa
9	Mackenzie	4241km (2635mi)	Canada
10	Mekong	4183km (2600mi)	Southeast Asia
11	Niger	4167km (2590mi)	Africa
12	Yenisey	4092km (2543mi)	Russia
13	Parana	3998km (2485mi)	South America
14	Mississippi	3765km (2340mi)	USA
15	Missouri	3725km (2315mi)	USA
16	Murray-Darling	3717km (2310mi)	Australia
17	Volga	3685km (2290mi)	Russia
18	Purus	3379km (2100mi)	Brazil
19	Madeira	3239km (2013mi)	Brazil
20	Sao Francisco	3199km (1988mi)	Brazil
21	Yukon	3184km (1979mi)	Alaska/Canada
22	Rio Grande	3057km (1900mi)	USA/Mexico
23	Brahmaputra	2896km (1800mi)	India
24	Indus	2896km (1800mi)	India
25	Danube	2858km (1776mi)	Europe

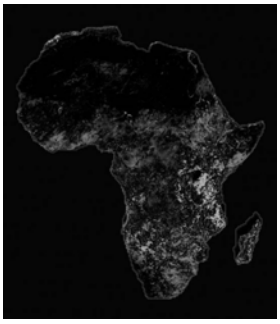
The Nile River



The Nile River



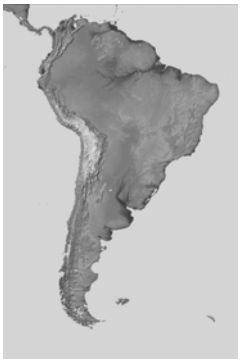
Okavango River



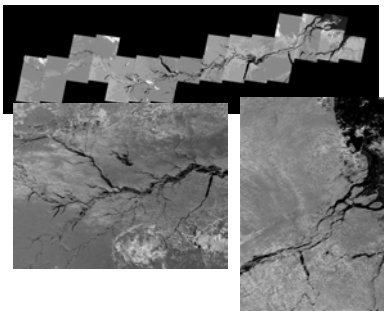
Okavango Delta, Botswana

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

The Amazon River

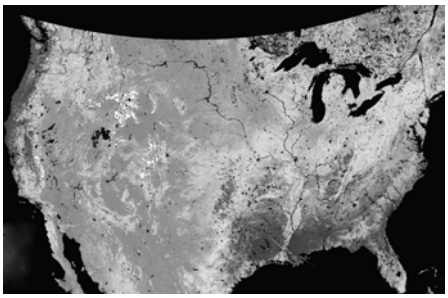


The Amazon River

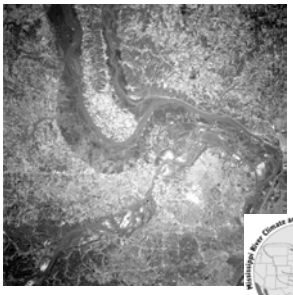


3,912 miles

Mississippi-Missouri River



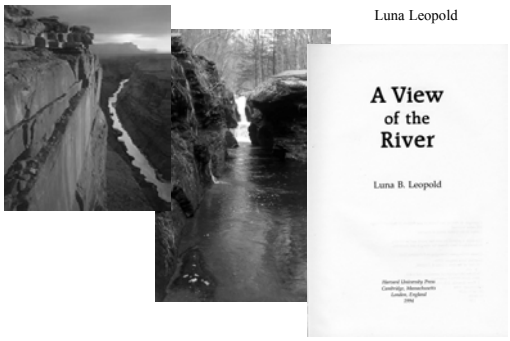
Mississippi-Missouri River



3,710 miles

"The river is the carpenter of its own edifice"

Luna Leopold



"The river where you set you foot just now is gone, those waters giving way to this, then this" ___ Heraclitus

River Meanders

Colorado River Photo: Thomas Wiewandt

Origins Of Rivers

Origins Of Rivers: Aquifers

Origins Of Rivers: Springs

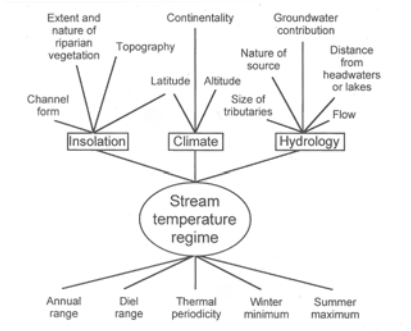
Source of Boiling Springs River, Pennsylvania

Origins Of Rivers: Underground rivers

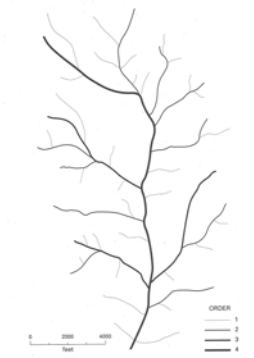
Source of Crows Nest River, Alberta

Physical Characteristics

Factors Affecting The Temperature Regime Of A Stream

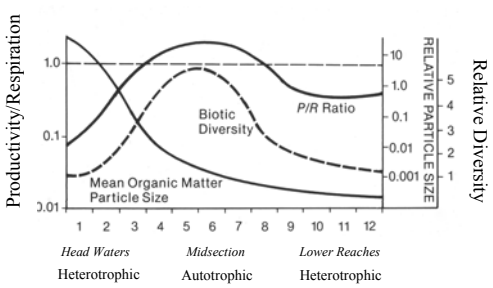


*Stream Order**

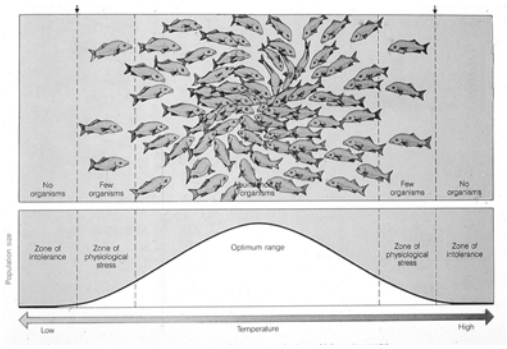


* Dendritic system

Stream Order: General Considerations

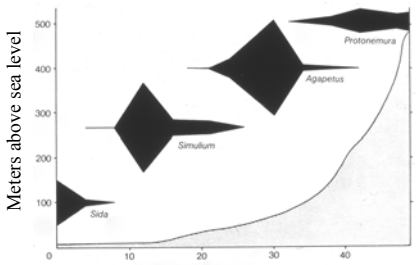


Tolerance Limits



from Miller, *Living In The Environment* Thompson, Pub.

Rivers Are Linear Gradients



Kilometers from river mouth

Chemical Characteristics

Components Of Fresh water

A. Dissolved Inorganic Compounds
1. Calcium
2. Magnesium
3. Sodium
4. Iron
5. Sulfate
6. Chloride

B. Particulate Inorganic Compounds
1. Silt
2. Suspended material

C. Dissolved Organic Compounds
1. Nitrogen
2. Phosphorous
3. Bicarbonate

D. Particulate Organic matter
1. Bacteria
2. Algae
3. Leaves

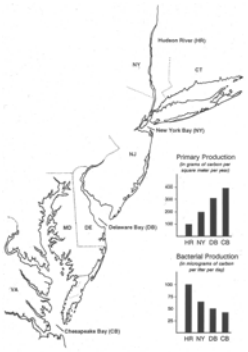
E. Dissolved Gasses
1. Oxygen
2. Nitrogen
3. Carbon dioxide
4. Methane
5. Hydrogen sulfide

Productivity

Autochthanous vrs Allochthanous

Sources Of Energy

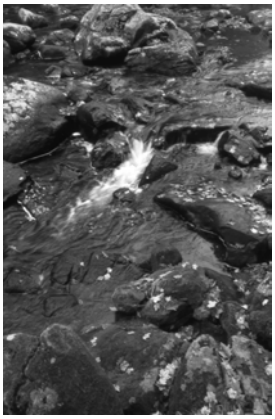
Primary Productivity



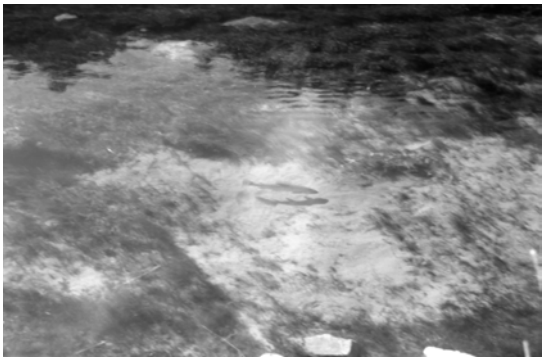
River Types

River Types: Freestone

River Types: Feeder Streams



River Types: Limestone

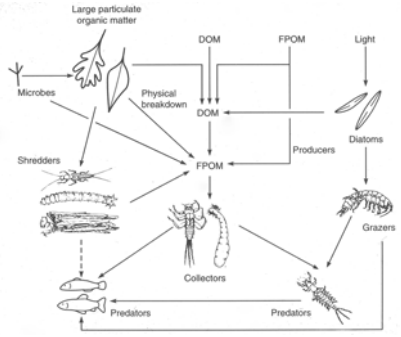


River Types: Tailwater Fisheries

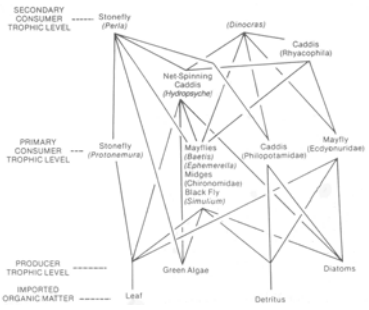
Autochthanous vrs Allochthanous:

Freestone vrs Limestone

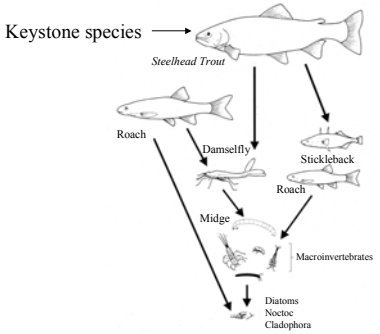
Food Webs



Trophic Levels

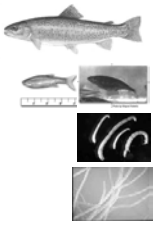


Trophic Levels



Effects of fish in river food webs. 1990. M.E. Power. Science 250:811-814.

Food Pyramid In A Western Trout Stream



Steelhead Trout (Keystone species)

↓

Roach And Stickleback Minnows

↓

Macroinvertebrates (Midge larvae, etc.)

↓

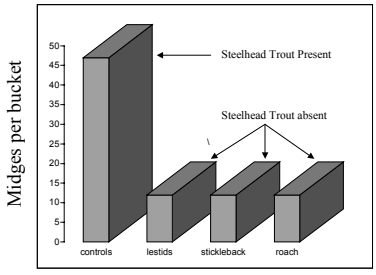
Algae (Nostoc, Cladophora, etc.)

What Happens To The Trophic Levels Of An Ecosystem When A Keystone Species Is Removed?

You Get More Algae!

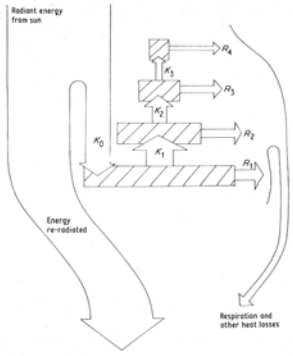
Why?

Trophic Levels And Keystone Species: Removal Of A Keystone Species



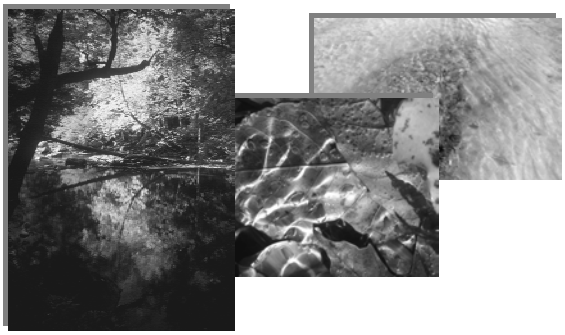
Wootton, J.T., M.S. Parker and M.E. Power. 1996. The effect of disturbance on river food webs. *Science* 273:1558-1560.

Trophic Levels And Energy Flow



From Odum, *Fundamentals of Ecology*, Saunders Pubs.1971

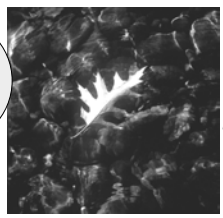
Energy Flow Into The River: The Role Of Leaves



Energy Considerations

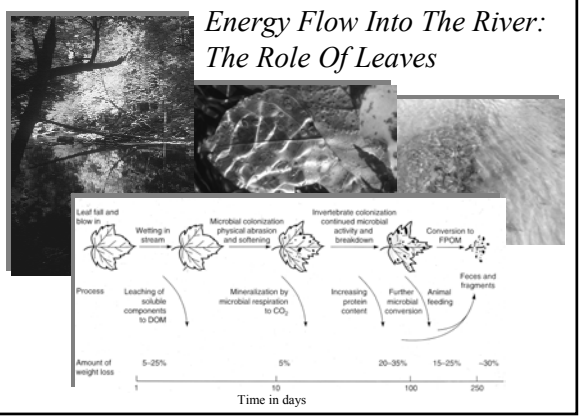
A: Sun's rays, 100 Units of dilute energy.

Sunlight



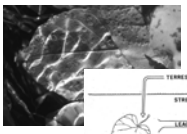
C: Oak Leaf, energy conversion system - 2 units of sugar. Concentrated energy.

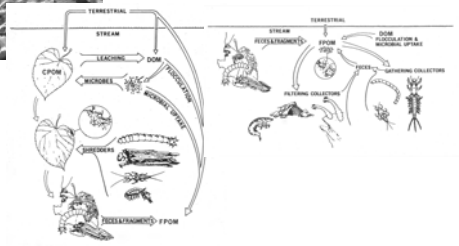
B: Reflected Heat, 98 units. Very dilute energy.



Energy Flow Into The River: The Role Of Leaves

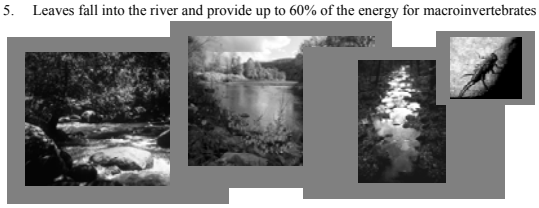
Macroinvertebrates And The Processing Of Leaves



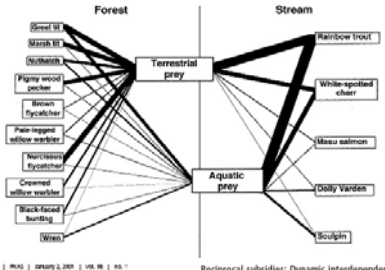


The Value Of Trees To The River

1. Trees have roots that hold the soil on the bank, retarding the erosion process
2. Trees shade the river moderating the ambient temperature
3. Trees provide shelter and niches for a wide variety of wildlife
4. Trees that fall into the river provide a long-term release of energy
5. Leaves fall into the river and provide up to 60% of the energy for macroinvertebrates



Food Webs: Competition Between Terrestrial And Aquatic Life Forms

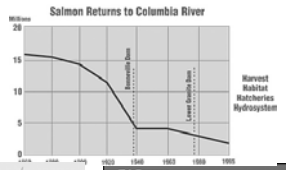


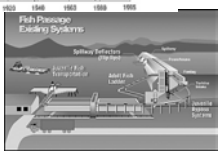
Reciprocal subsidies: Dynamic interdependence between terrestrial and aquatic food webs

Factors Having A Negative Affect On Productivity:

Nutrient Loading
Encroachment
Deforestation
Industrial Pollutions
Thermal Pollution

Effects Of Dams On Rivers: The Columbia River System





Floods

Drought

Pollutions:

Niagara River Area of Concern

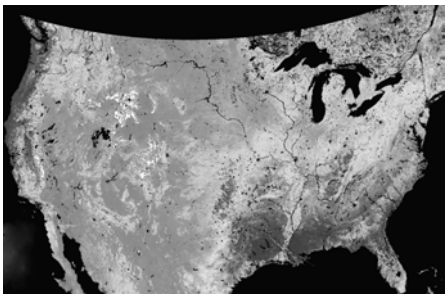
Beneficial Use Impairments

✓ Restrictions on Fish & Wildlife Consumption	Eutrophication or Undesirable Algae
Tainting of Fish & Wildlife Flavor	Restrictions on Drinking Water Consumption, or Taste & Odor
Degradation of Fish & Wildlife Populations	Beach Closings
✓ Fish Tumors or Other Deformities	Degradation of Aesthetics
Bird or Animal Deformities or Reproductive Problems	Degradation of Phytoplankton & Zooplankton Populations
✓ Degradation of Benthos	Added Cost to Agriculture & Industry
✓ Restrictions on Dredging Activities	✓ Loss of Fish & Wildlife Habitat

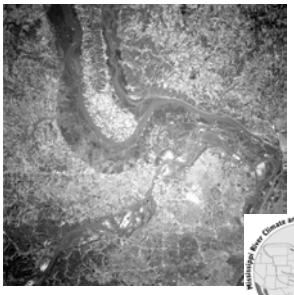
http://www.epa.gov/docs/grtlakes/aoc/niagara.html

Nutrient Loading

Mississippi-Missouri River

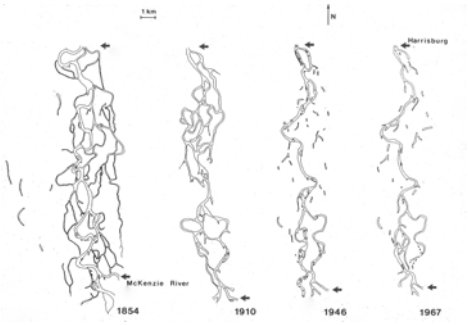


Mississippi-Missouri River



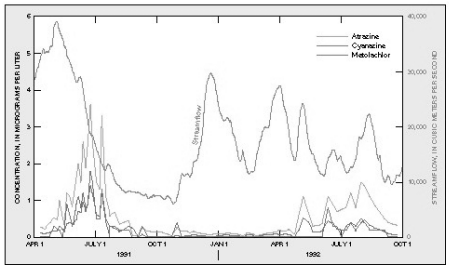
3,710 miles

Encroachment



Pollutions

Figure 42--*Herbicide Variations Through Time*



http://water.usgs.gov/pubs/circ/circ1133/images/fig42.jpeg

Encroachment

Figure 15--*Population Stress*

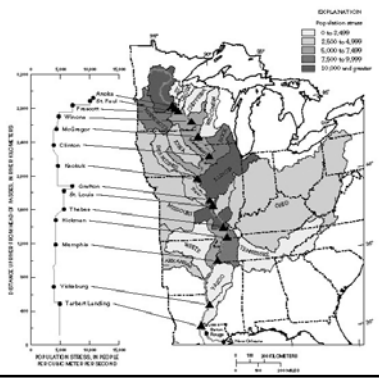
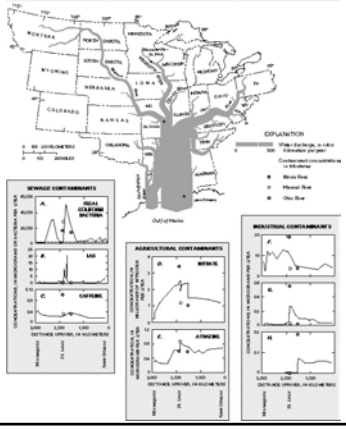


Figure 1--*Dissolved Contaminants*



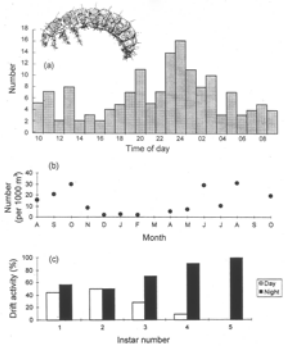
Welcome To The Dead Zone

The Gulf of Mexico Dead Zone
and
Red Tides

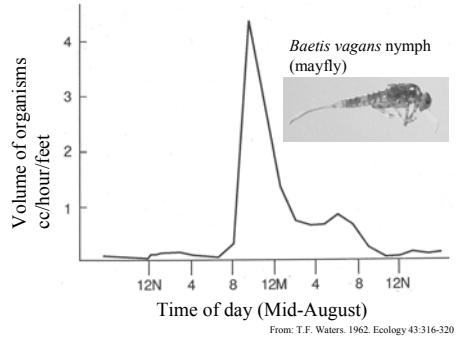
Its Getting Late

Macroinvertebrates

Macroinvertebrates: Development

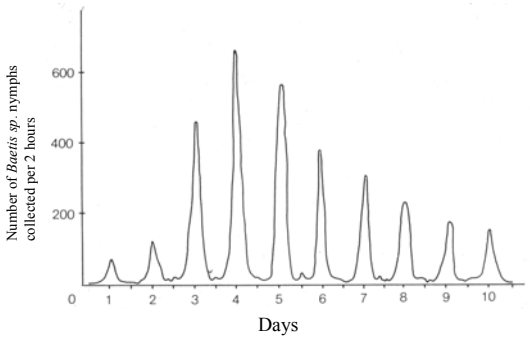


Drift



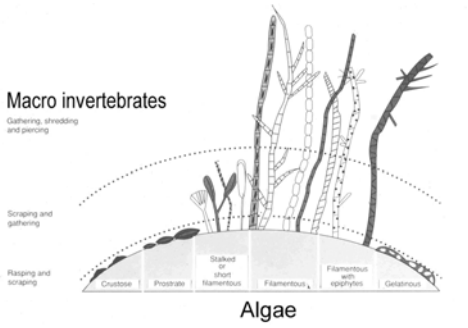
From: T.F. Waters. 1962. Ecology 43:316-320

Drift



Energy Flow Into The River

Life On A Rock



Effects Of Dams On Rivers:

The adverse effects of Hoover dam on the Colorado River