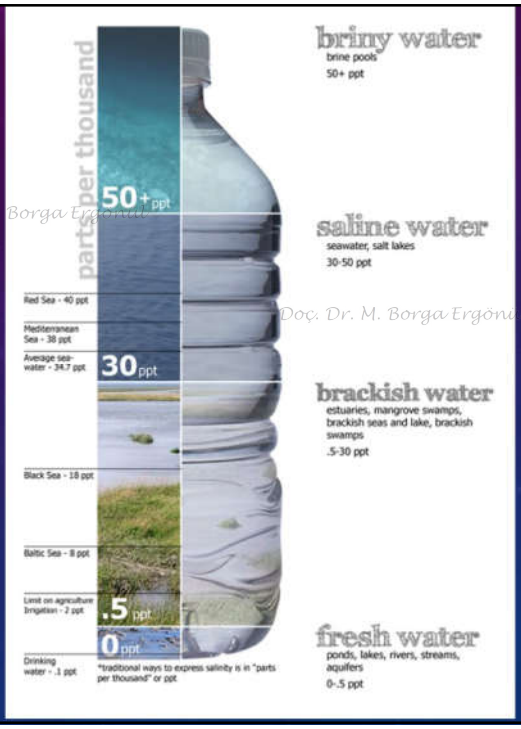

Freshwaters are naturally occurring waters on the Earth's surface in ice sheets, ice caps, glaciers, bogs, ponds, lakes, rivers and streams, or below the ground as groundwater in aquifers and underground streams. Freshwaters are generally characterized by having low concentrations of dissolved salts and other total dissolved solids.

Salinity



| | ppt |
|---|---|
| FRESHWATER | < 0.5 |
| BRACKISH / ESTUARY | 0.5 - 17 |
| BLACK SEA | 16 |
| OCEAN RANGE | 32 - 37 |
| OCEAN AVERAGE | 35 |




Freshwater ecosystems cover 0.8% of the Earth's surface and inhabit 0.009% of its total water. They generate nearly 3% of its net primary production*. Although, they cover a very narrow surface area compared to marine environments, freshwater ecosystems contain 41% of the world's known fish species. We know that marine communities contain more species in total. But, number of species per unit volume of water is quite high in freshwater ecosytems compared to the seas. Why could it be?

| Taxon | Marine | Freshwater | Terrestrial |
|---|---|---|---|
| Sponges | 9,000+ | 200–250 | 0 |
| Cnidarians | 10,000 | <50 | 0 |
| Bryozoans | 5–10,000 | <100 | 0 |
| Mollusks (Gastropods) | 50,000 | 4–5,000 | 25–30,000 |
| Mollusks (Bivalves) | 11,000 | 1,400+ | 0 |
| Mollusks (Cephalopods) | 800 | 0 | 0 |
| Nematodes | 35,000 | 2,000+ | $10^6$(?) |
| Arthropods (Insects) | 1,400 (includes intertidal) | 100,000+ | 5–9 x $10^6$ |
| Arthropods (Arachnids) | 1–2,000 | 5,000 (mostly mites) | $10^6$+ |
| Arthropods (Crustaceans) | 65,000+ | 12,000 | 4–5,000 |
| Platyhelminthes | 15–20,000 | 1,000 | 300–500 |
| Annelids (Polychaetes) | 9,000 | 500+ | 0 |
| Annelids (Oligochaetes) | <500 | 1,000+ | 100 |
| Echinoderms | 6–7,000 | 0 | 0 |
| Chordates (Mammals) | 125 | 100+ | 5,000 |
| Chordates (Fish) | 15,000 | 15,000 | 0 |
| Chordates (Other vertebrates: Amphibians, crocodiles, | <500 (excluding | 7,000+ | <20,000 |



Current Biology

Biodiversity in water and on land



Review > Biol Rev Camb Philos Soc. 2007 Aug;82(3):425-54.
doi: 10.1111/j.1469-185X.2007.00018.x.

**Why are there so many insect species? Perspectives from fossils and phylogenies**

Peter J Mayhew

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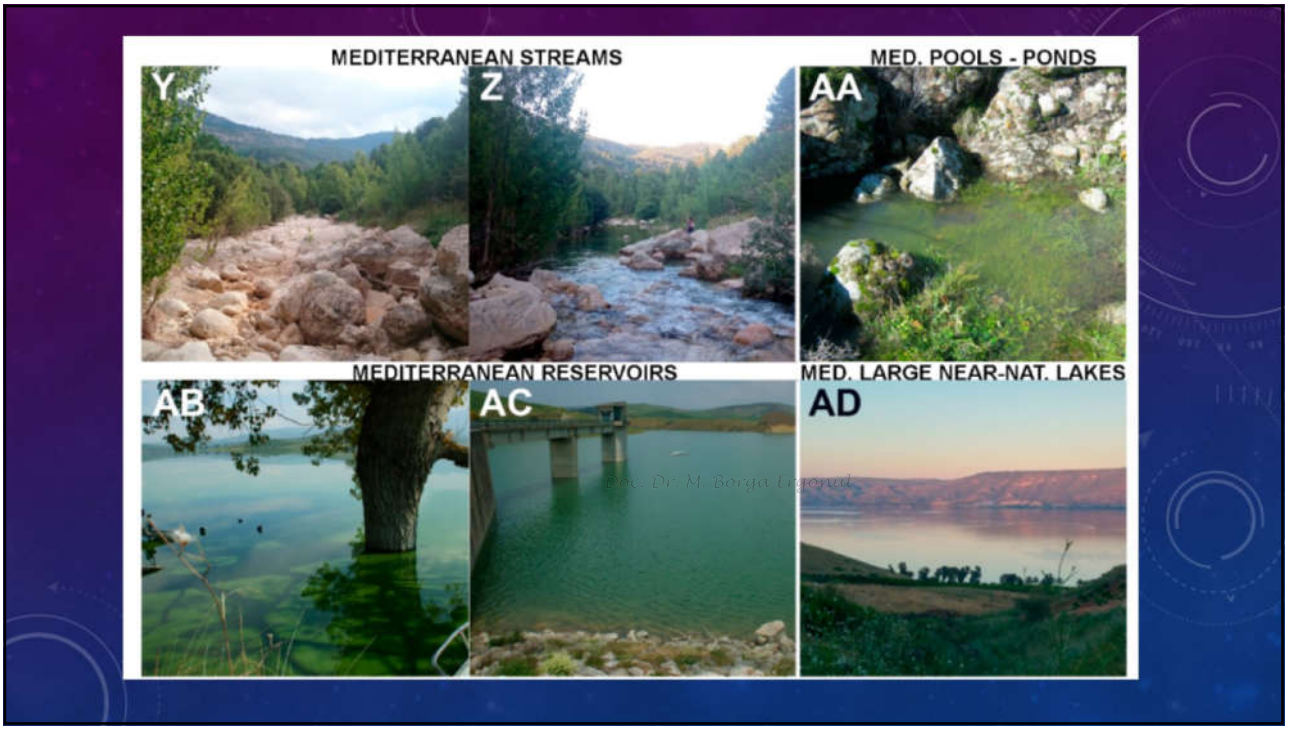
PMID: 17624962 DOI: 10.1111/j.1469-185X.2007.00018.x

**Abstract**

Over half of all described species are insects, but until recently our understanding of the reasons for this diversity was based on very little macroevolutionary evidence. Here I summarize the hypotheses that have been posed, tests of these hypotheses and their results, and hence identify gaps in knowledge for future researchers to pursue. I focus on inferences from the following sources: (i) the fossil record, normally at family level, and (ii) insect phylogenies, sometimes combined with: (iii) the species richness of insect higher taxa; and (iv) current extinction risks. There is evidence that the species richness of insects has been enhanced by: (i) their relative age, giving time for diversification to take place; (ii) low extinction rates. There is little evidence that rates of origination have generally been high or that there are limits on numbers of species. However, the evidence on macroevolutionary rates is not yet so extensive or coherent as to present unequivocal messages. As regards morphological, ecological, or behavioural hypotheses, there is evidence that diversity has been enhanced by (iii) flight or properties resulting from it like enhanced dispersal, (iv) wing folding, and (v) complete metamorphosis. However, in all these cases the evidence is somewhat equivocal.




A paranthesis here:

In ecology, primary production is the synthesis of organic compounds from carbon dioxide (either atmospheric or dissolved in aqueous media) through

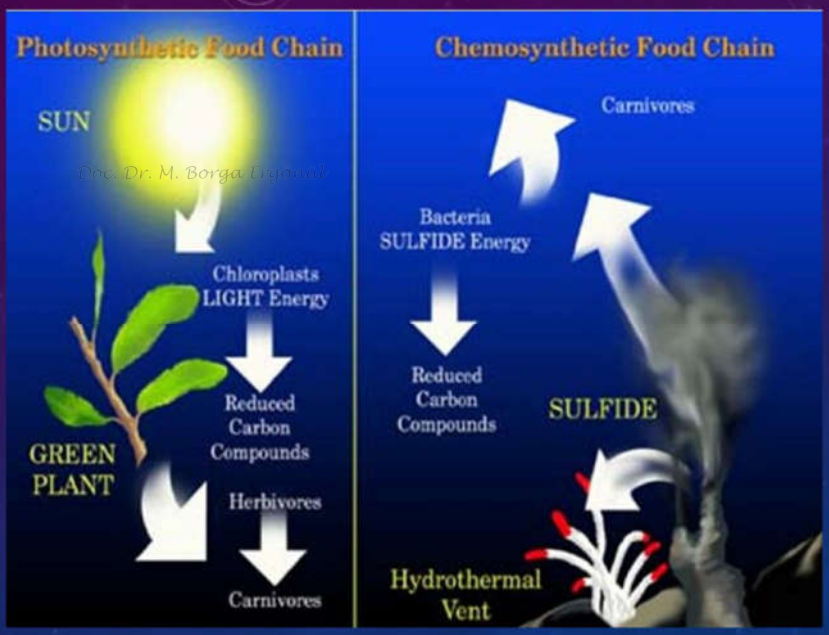
i. photosynthesis which uses sun light as a source of energy.

ii. or through chemosynthesis, which uses the oxidation or reduction of inorganic chemical compounds as a source of energy.

Nearly all of the life on earth relies directly or indirectly on primary producers or autotrophs (such as plants or algae or phytoplankton). Primary producers form up the base of the food chain.

Net primary production accounts for losses to cellular respiration.

Gross production = Net production + Losses (Cellular respiration)





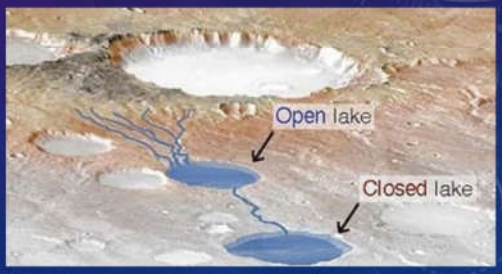

## Types of Freshwaters

There are 2 basic types of freshwater ecosystems: Lentic: (from the Latin *lentus*, meaning slow or motionless) stagnant or slow-moving water, refers to standing waters such as lakes and ponds (lacustrine), or swamps and marshes (paludal),. while *lotic* (from the Latin *lotus*, meaning washing), refers to running water (fluvial or fluviatile) habitats or rapidly-moving water such as rivers and streams.


If the water leaves the lake by a river or another outlet (either above or the below surface), it is said to be open. All freshwater lakes are open. If the water leaves the lake only by evaporation, the lake is closed. Closed lakes usually become saline, or salty.

## Open vs. Closed

| Open Lakes | Closed Lakes |
|---|---|
| • Freshwater | • Saline |
| • Water flows through lake system under all climate patterns | • Water does not flow through – evaporation is the only exit |

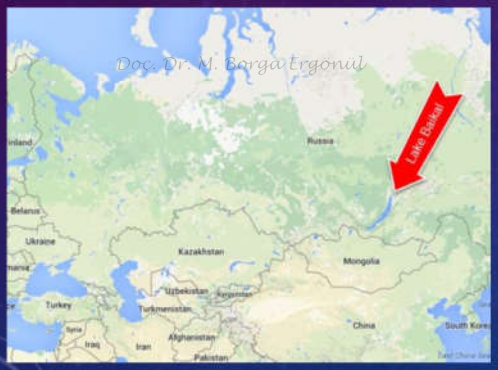



*The classic explanation of the salt content of closed lakes is that the salt load continuously accumulates due to evaporation.*

**Vernal pond = Vernal pool = Ephemeral pond**

Vernal pools, also called vernal ponds or ephemeral pools, are seasonal, very shallow pools of wetlands which are very important habitats for several plants and animals including amphibia and aquatic insects. Such habitats has a key role in the fate of such organisms. These organisms are not able to survive in permanent waters since they are vulnerable to predators (partciculalry fish). These pools are exposed to drought in spring and summer. So they are not a suitable place for fish to live.

The biggest freshwater lake on earth is the Lake Baikal with a maximum depth of 1640 meters (volume 23,000 $km^3$). It contains %22 of the freshwater on earth. The biggest lake is Caspian Sea (Hazar Gölü in Turkish). The «sea» indicates its size and salinity (%$13_0$). Its water also contains carbonate.





## Largest Lakes in Turkey

1- Van Lake, 3713 $km^2$, 451 m. Van, Bitlis (Saline, soda lake)

2- Tuz Lake, 1300 $km^2$, 1-2 m, Konya, Aksaray, Ankara (Saline)

3- Beyşehir Lake, : 656 $km^2$, 10 m. Konya, Isparta (Freshwater)

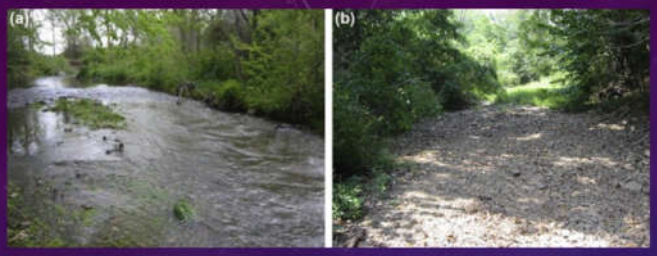
4- Eğirdir Lake, : 482 $km^2$, 14 m. Isparta (Freshwater)

5- İznik Lake, : 308 $km^2$, 80 m. Bursa (Freshwater)


Van Lake is also the largest soda lake on earth.

A river is a natural flowing (with the aid of natural elevation differences; gravity will make sure that the water is 'pulled' downhill to return to the sea) watercourse, usually freshwater (only with a few exceptions). The river may flow towards an ocean, sea, lake or another river. But in some cases a river flows into the ground and becomes dry at the end of its course without reaching another body of water. Such rivers are common in arid areas.

Although there is no official limits or definition, rivers or streams are larger than creek, broook or rivulets.




## Ephemeral rivers (Intermittent streams)

i. Ephemeral rivers possess no flow 25-75% of time. They origin for a short time due to heavy rainfall.
ii. An ephemeral stream is that which only exists following precipitation

## Ephemeral streams (Intermittent streams)

Temporary streams and rivers, also referred to as intermittent, are defined as waterways that cease to flow during certain periods of the year. They are characterised by alternating wet and dry periods over annual and inter-annual cycles, making them one of the most dynamic freshwater ecosystems. The extent of temporary rivers is increasing, as many formerly perennial rivers are becoming temporary due to increasing water demand, particularly for irrigation and several other anthropogenic pressures and climate change.


Freshwater Biology

SPECIAL REVIEW

Emerging concepts in temporary-river ecology

SCOTT T. LARNED*, THIBAULT DATRY†, DAVID R. ARSCOTT‡ AND KLEMENT TOCKNER§



**Largest rivers on earth**

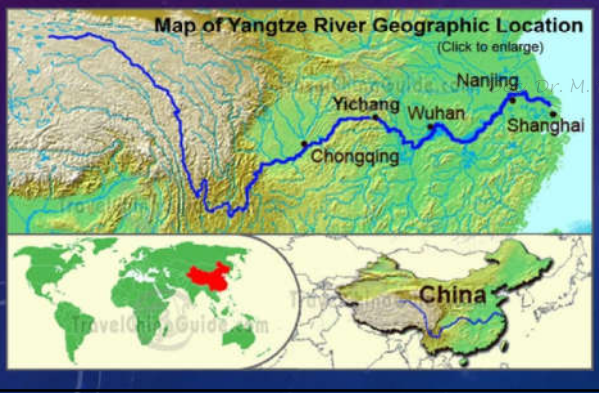
Nile, 6650 km

Amazon River, 6400 km (S. America)

Yangtze River, 6300 km (China)

Mississippi River, 6275 km (N. America)

Yenisei River, 5540 km (Russia)




## Largest Rivers in Turkey

The longest river flowing from Turkey is Euphrates River with a total length of 2800 km, but its Tukish part is approximately 1300 km. The longest river in Turkey draining to the Blacksea is Kızılırmak Rier (1350 km).





## Water Conflict



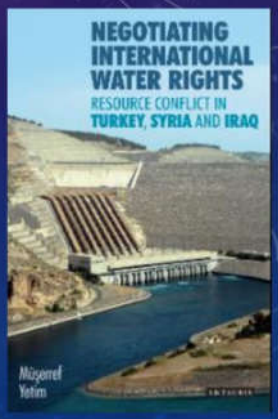
POLITICS

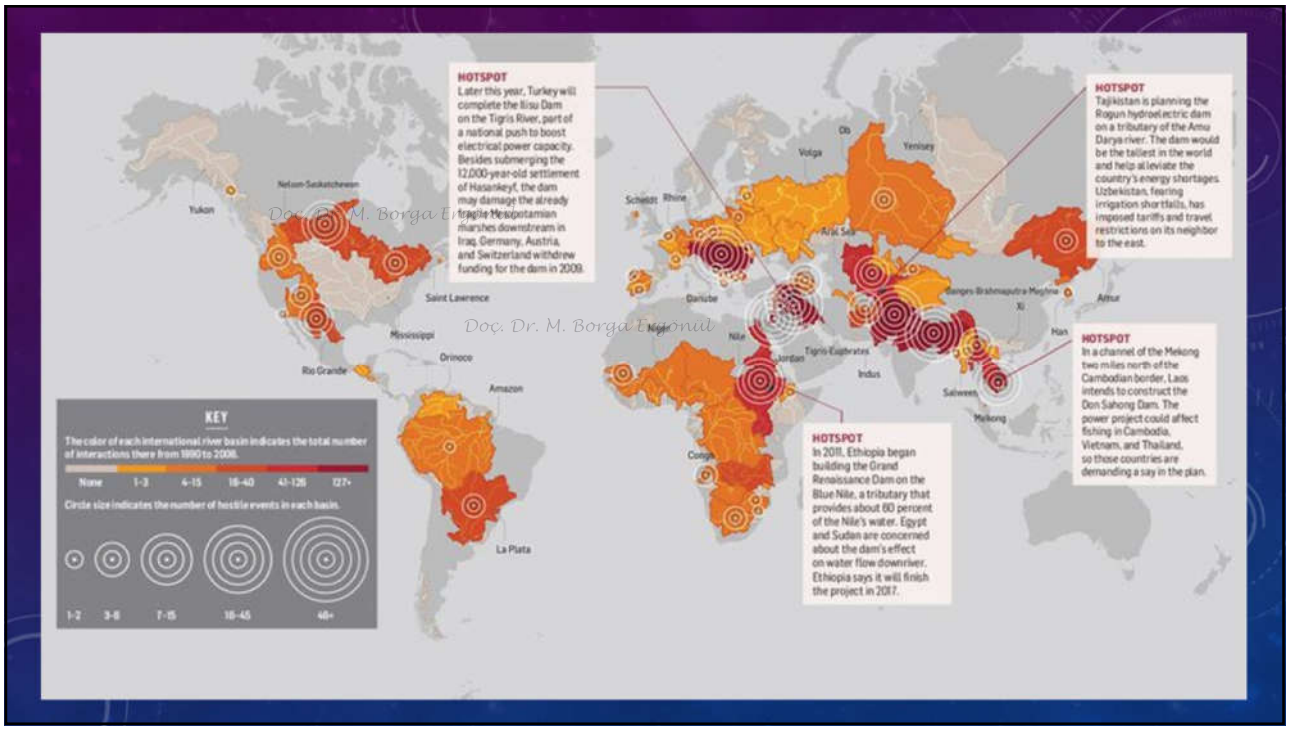
Turkey and Iraq organise a meeting to tackle the water conflict

On Thursday the Iraqi Prime Minister will visit Ankara to discuss Iraq's water quotas

Mariam Azarkan



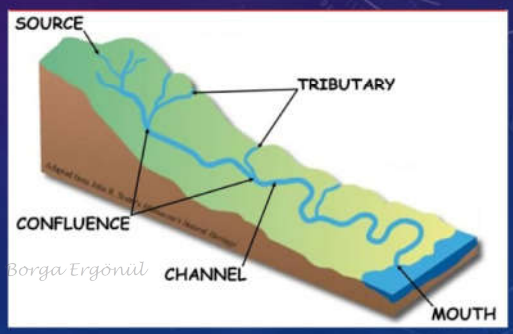




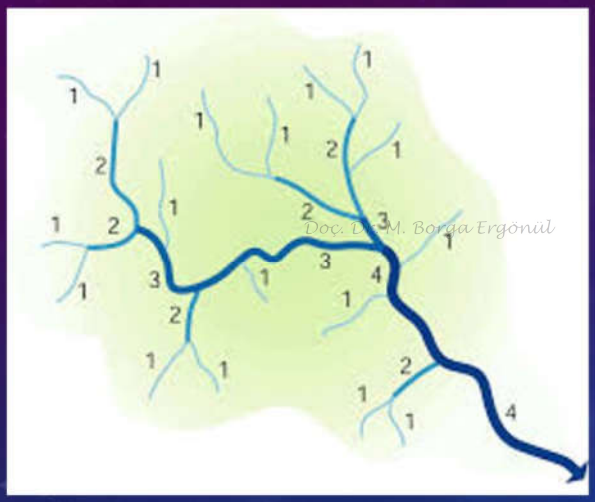

| | Stream | Brook |
|---|---|---|
| DEFINITION | Stream refers to any body of water flowing in a channel or watercourse | Brook refers to a small and shallow stream |
| SIZE | Include large rivers, small to medium-sized creeks as well as small brooks | Smaller than rivers and creeks |
| SHALLOWNESS | Include deep rivers as well as shallow brooks | Very shallow and easily forded |

Besides this informal classification there is a more scientific way of indicating the size of running waters: **Strahler's stream ordering system** is a well-known classification based on stream/tributary relationships. The uppermost channels in a drainage network (i.e., headwater channels with no upstream tributaries) are designated as first-order streams down to their first confluence.

Confluence Tributary

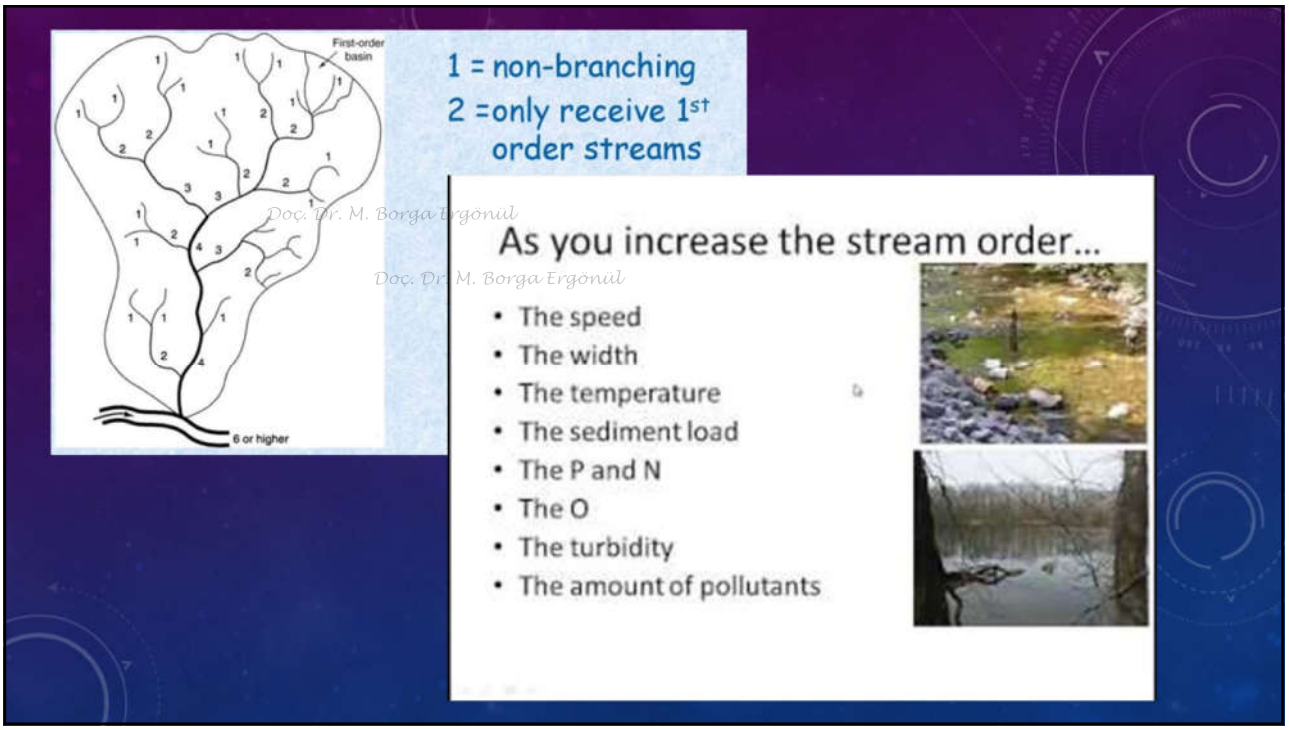






In this stream ordering system the headwaters are given the lowest number (1) and in each confluence they form up a new larger river and given a higher number (2, 3, and so on). There are several differences in each stream order, based on physical, chemical, biological, hydrological and hydrogeological features.


First-order basin
6 or higher
1 = non-branching
2 =only receive 1st order streams
As you increase the stream order...
• The speed
• The width
• The temperature
• The sediment load
• The P and N
• The O
• The turbidity
• The amount of pollutants
Doç. Dr. M. Borga Ergönül
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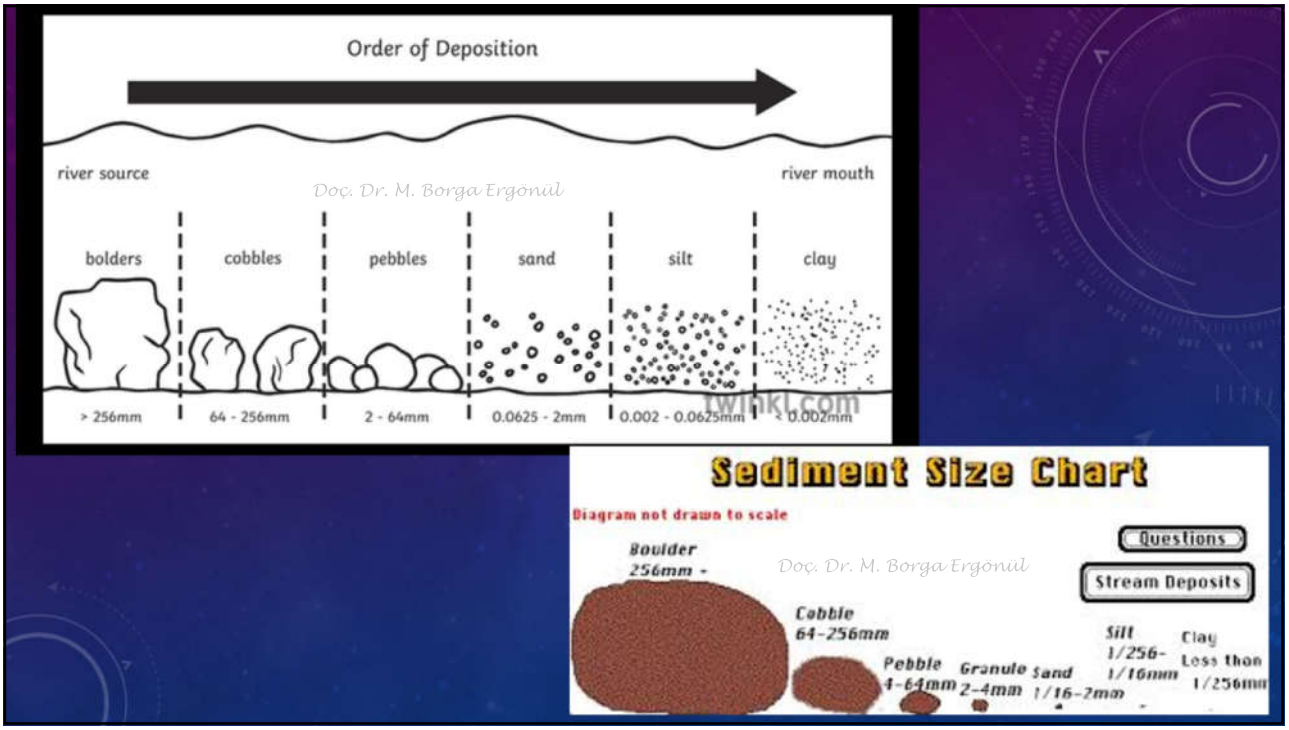
Order of Deposition
river source
river mouth
bolders
cobbles
pebbles
sand
silt
clay
> 256mm
64 - 256mm
2 - 64mm
0.0625 - 2mm
0.002 - 0.0625mm
< 0.002mm
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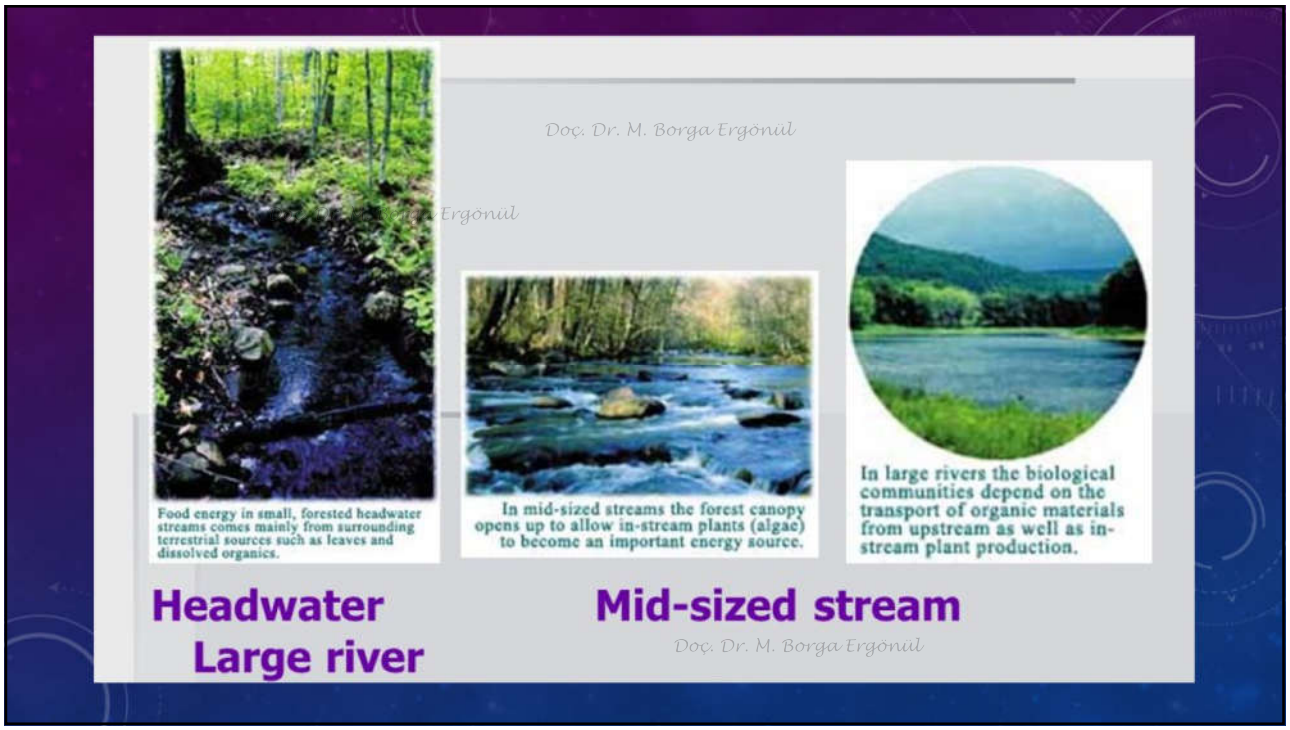
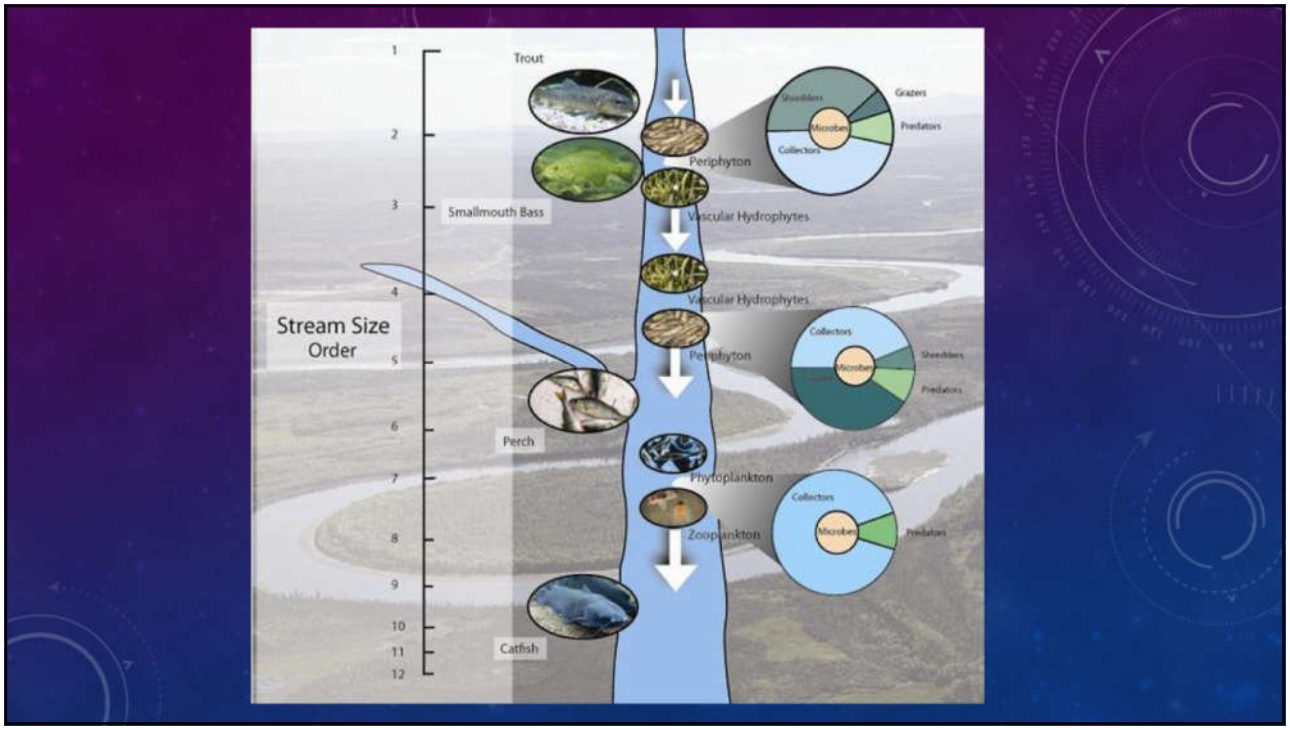
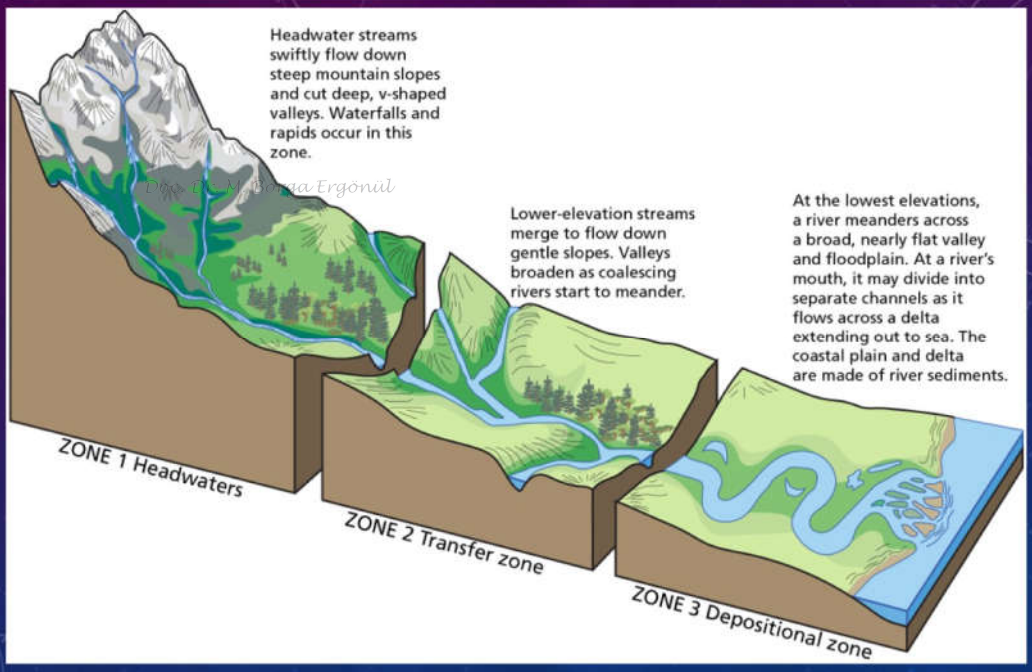
Sediment Size Chart
Diagram not drawn to scale
Boulder 256mm -
Cobble 64-256mm
Pebble 4-64mm
Granule 2-4mm
Sand 1/16-2mm
Silt 1/256-1/16mm
Clay Less than 1/256mm
Questions
Stream Deposits
Doç. Dr. M. Borga Ergönül


Doç. Dr. M. Borga Ergönül
Food energy in small, forested headwater streams comes mainly from surrounding terrestrial sources such as leaves and dissolved organics.
In mid-sized streams the forest canopy opens up to allow in-stream plants (algae) to become an important energy source.
In large rivers the biological communities depend on the transport of organic materials from upstream as well as in-stream plant production.
Headwater
Large river
Mid-sized stream
Doç. Dr. M. Borga Ergönül


Stream Size Order
1
2
3
4
5
6
7
8
9
10
11
12
Trout
Smallmouth Bass
Perch
Catfish
Periphyton
Vascular Hydrophytes
Vascular Hydrophytes
Periphyton
Phytoplankton
Zooplankton
Shredders
Grazers
Microbes
Predators
Collectors




The biological composition change is most distinguishable in fish communities when you go downstream from the headwaters. A river zonation (also called European Fish Zonation) based on the dominant fish species in longitidunal sections of rivers.

Salmon (Trout) fish zone

Thymallus (Grayling) fish zone

Barbus (Barbel) zone

Abramis (Bream) zone

*Hydrobiologia* **500**: 157–178, 2003.
K. Martens (ed.), *Aquatic Biodiversity.*


**Fish zonations and guilds as the basis for assessment of ecological integrity of large rivers**

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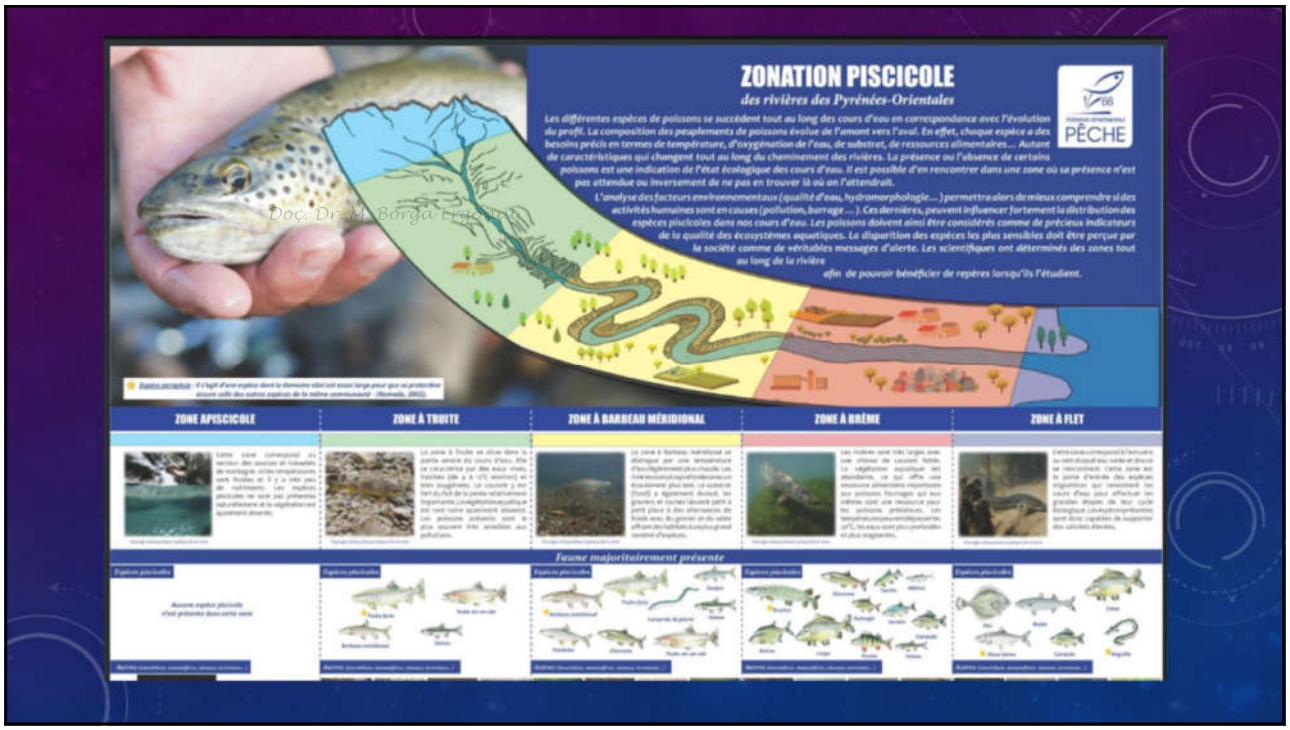


## Zonation (from headwater to estuary) [edit]

### Trout zone [edit]

This zone has a characteristic steep gradient, fast flowing water and cool temperature. The fast flow rate causes turbulence which keeps the water well oxygenated. Fish species found in this zone usually lay adhesive eggs that can stick to the substrate, this is to help prevent eggs being carried down stream by the water flow.

Characteristic fish species are:

- Brown trout (*Salmo trutta*)
- Atlantic salmon (*Salmo salar*)
- Bullhead (*Cottus gobio*)
- Loach (*Barbatula barbatula*)

### Grayling zone [edit]

Similar in physical characteristics to the Trout zone, although the temperature is usually slightly higher. Fish species in this zone also lay adhesive eggs.

Characteristic fish species include all of the above species, with the addition of;

- Grayling (*Thymallus thymallus*)
- Minnow (*Phoxinus phoxinus*)
- Chub (*Leuciscus cephalus*)
- Dace (*Leuciscus leuciscus*)

### Barbel zone [edit]

This zone is essentially lowland, but retains some characteristics of upland rivers. It has a gentle gradient with a moderate water flow and temperature. It also has a good oxygen content and a mixed substrate of silt and gravel in which plants can take root. Most of the fish species found in this zone lay their eggs in the vegetation on the river bed, this provides them with good protection and allows the eggs a good supply of oxygen given off from photosynthesis in the plants.

Characteristic fish species include all of the species from the previous zones with addition of;

- Barbel (*Barbus barbus*)
- Roach (*Rutilus rutilus*)
- Rudd (*Scardinius erythrophthalmus*)
- Perch (*Perca fluviatilis*)
- Pike (*Esox lucius*)
- Eel (*Anguilla anguilla*)

### Bream zone [edit]

The true lowland zone, has a very gentle gradient and slow flowing water, there is usually good oxygen content but the temperature is much more variable than in the other zones. This zone has a silty substrate and is often turbid. Fish species found in this zone lay adhesive eggs in the weeds. Most upland fish species can not survive in this zone.

Characteristic fish species include only a few species from the Barbel zone (Roach, Rudd, Perch and Pike), with the addition of:

- Bream (*Abramis brama*)
- Tench (*Tinca tinca*)
- Carp (*Cyprinus carpio*)