

STREAM ECOLOGY

Sometimes, if you stand on the bottom rail of a bridge and lean over to watch the river slipping slowly away beneath you, you will suddenly know everything there is to be known.

— (A.A. Milne, *Winnie the Pooh*)

Sit by a river. Find peace and meaning in the rhythm of the lifeblood of the Earth.

—Anonymous.

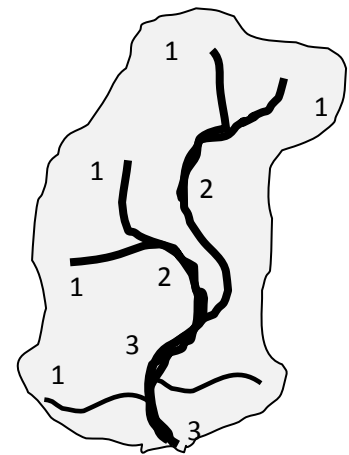
WHY STUDY STREAM ECOLOGY?

Rivers have some fundamentally different properties than other systems, including:

- Rivers are among the most imperiled and important ecosystems in the world.
- Under water. Duh. River ecosystems are, by definition, wet. However, this changes things. Some things are easier (e.g., to get water), some things are harder (e.g., to get oxygen, deal with force of moving water). Aquatic ecosystems are fundamentally different than terrestrial ecosystems.
- Flow downhill. Duh. Water flows downstream. However, we often forget about the connections that are driven by this.
- Integration
 - Because water flows downstream, the characteristics of the river you look at will be a function of local and upstream dynamics.
 - Rivers are an integration of the upstream watershed
- Propagation
 - Downstream water movement will propagate materials (e.g., sediment), organisms, etc. to the downstream environment.
- Structure
 - *Dendritic* networks—river systems generally are dendritic (tree-like). This governs the movement of plants, animals, and materials.

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- Dynamic.—Rivers change across space and time. This variability controls their ecology. It also makes it difficult to study them.
 - Spatial—Rivers differ dramatically across space. They are often very “patchy”
 - Temporal—Rivers usually change dramatically through time on short and long time-scales.
 - Spatio-temporal variability--In reality, rivers are always changing in space and in time. Patches appear and disappear.
 - How do we understand something that is always changing?
 - Scales of science and perception will influence the results.



River structure

- *Drainage basin*.—the area that drains into a river. Watershed.
- *River/stream network*.—the layout of river system.
Stream networks are characterized by being:
 - *Nested*—e.g., Many small streams drain into larger streams, tiny creeks drain into small streams.
 - *Hierarchical*—branching structure means that there is a progressive nestedness in streams.
- *River*.—a larger stream. Not a clear distinction between streams and rivers
- *Stream*.—Smaller system with running water. I will often use the words river or stream interchangeably.
- *Hyporheic*—the river beneath the river. Water flows through sediment by the river.
- *Stream order*—a method of classifying streams. Streams increase order when two join together of equal order. See diagram above.
 - Small streams drain small areas, large rivers drain large areas.
 - The vast majority of running water habitats are small.
 - E.g., Of 5.2 million stream km in the US, nearly half are first order.

Hierarchical perspective of stream habitat

Frissell introduced the concept that streams should be considered from a hierarchical nested organization. This helps plan sampling as well as understanding the temporal scales of variation.

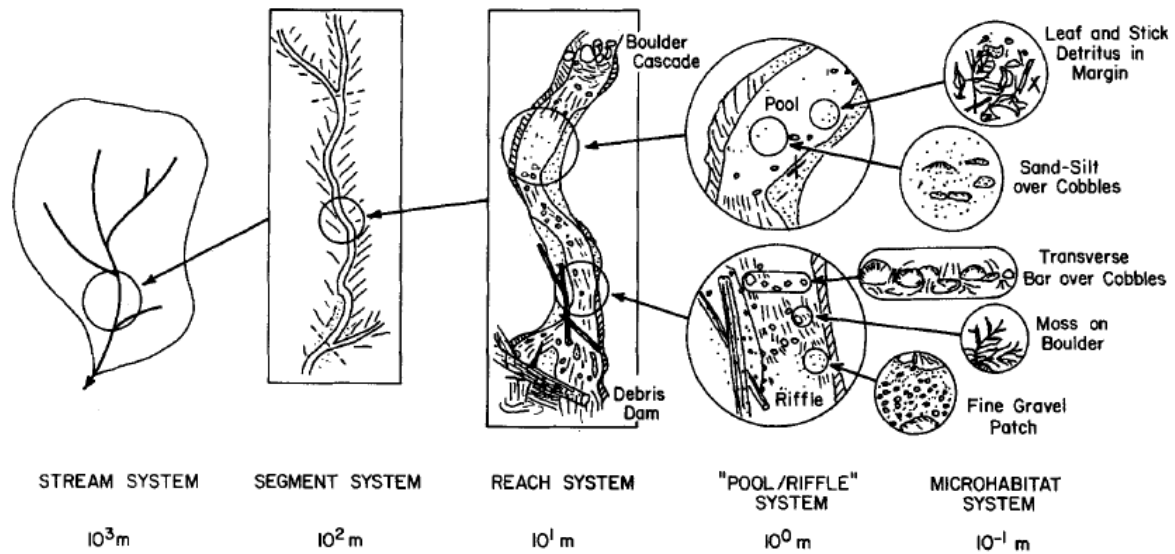


Figure 2. Hierarchical organization of a stream system and its habitat subsystems. Approximate linear spatial scale, appropriate to second- or third-order mountain stream, is indicated.

These habitats will change over time. In general, we would predict that the larger elements of rivers (e.g., location of drainage basin) would change unpredictably due to large-scale disturbances such as tectonic action/major landslides, while finer scale habitats may change very often.

Physical—rivers change across space and time. Life in riverine ecosystems is strongly governed by abiotic (non-living) dynamics and structure. Our aim is to get a better sense for this “stage” or “template”.

Different forms of riffle/pool systems.

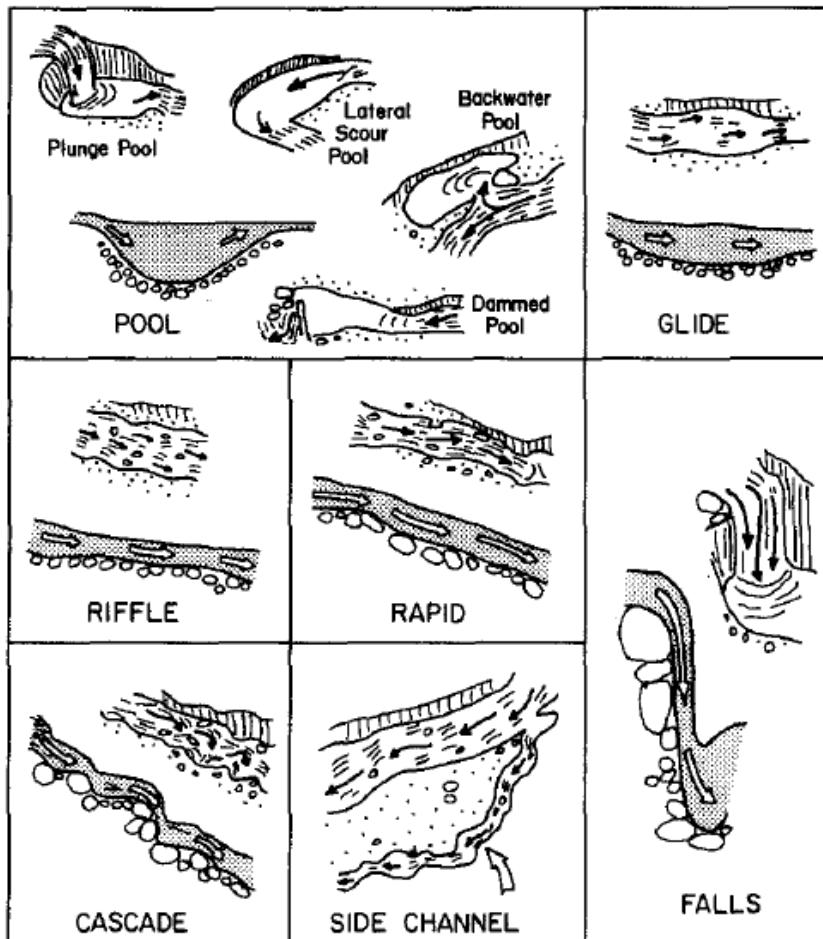


Figure 7. Fundamental pool/riffle forms, reflecting bed topography, low water surface slope, hydrodynamic pattern, and position in relation to the main channel. Longitudinal profile (*shaded*) and oblique views are shown. Modified from Bisson and others (1982).