Stream and River Ecology

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Streams and rivers contain flowing or lotic water.

The word **“stream”** can be used to describe all flowing natural waters. Water flow in streams is called stream flow. The word **“river”** usually refers to a large stream.

Stream ecology encompasses the study of these aquatic organisms, but also the study of the riparian zone, sediment transport, the movement of energy and nutrients within the stream, and a host of other aspects of stream ecosystems.

Three main types of streams:

- **Ephemeral** streams
  - regularly exist for short periods of time, usually during a rainy period.
- **Intermittent** streams
  - flow at different times of the year, or seasonally, when there is enough water from either rainfall, springs, or other surface sources.
- **Perennial** streams
  - streams that flow year-round.

ABIOTIC FACTORS

- Precipitation
  - Important in formation of streams and rivers.
  - Amount of precipitation in an area determines which type of stream should be present at that area.
- Current
  - It will determine the substrate at the bottom of the stream or river.

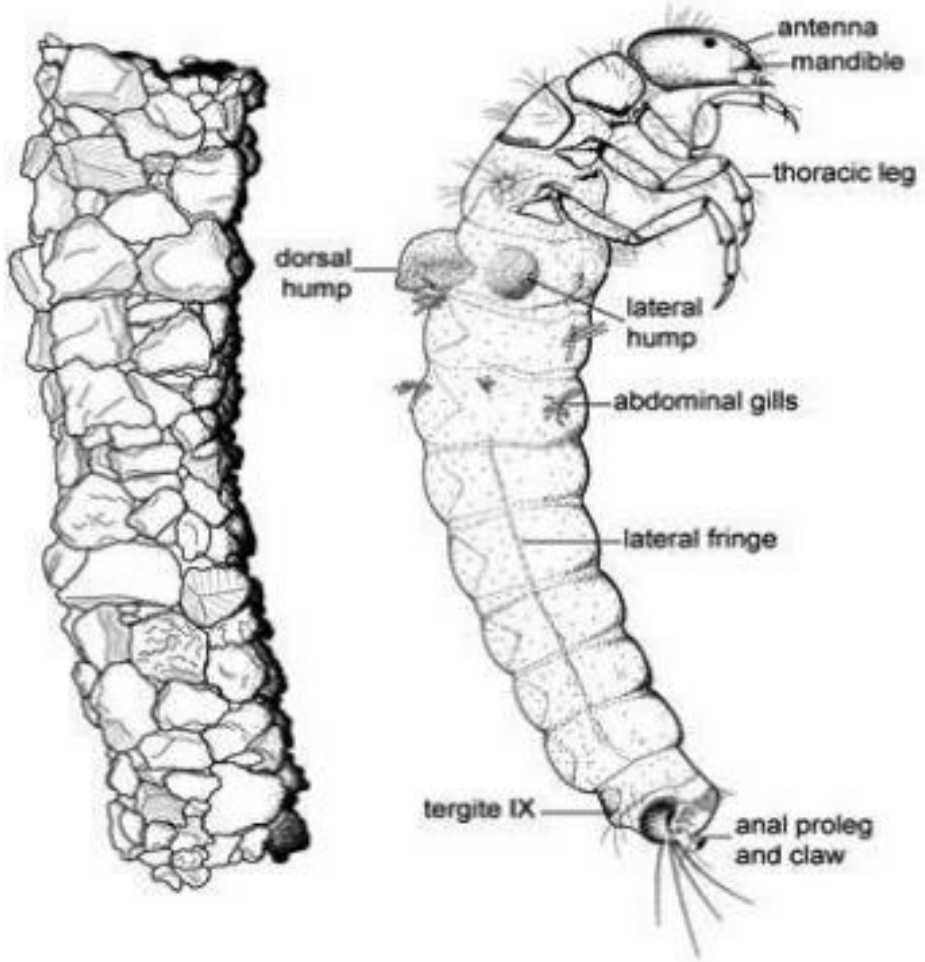
ABIOTIC FACTORS

- Landscape
  - The direction of stream flow is dependent upon the slope and obstructions of the landscape.
- Temperature
  - Affects the organisms living in streams and rivers.
  - Affects growth and development of organisms.
  - Reproduction
    - Different organisms reproduce at different temperatures

Biotic Factors

Four major groups of inhabitants (according to feeding habits)

- Shredders
  - Feed on coarse particulate organic matter (CPOM)
    - CPOM – mostly leaves that fall into the stream and are softened by water and colonized by bacteria and fungi.



Casemaker caddisfly

- Filtering and gathering collectors
  - Feed on the fine particulate organic matter (FPOM)
    - FPOM – leaves that are broken down by the shredders, partially decomposed by microbes, and invertebrate feces that drift downstream and settle on the stream bottom.

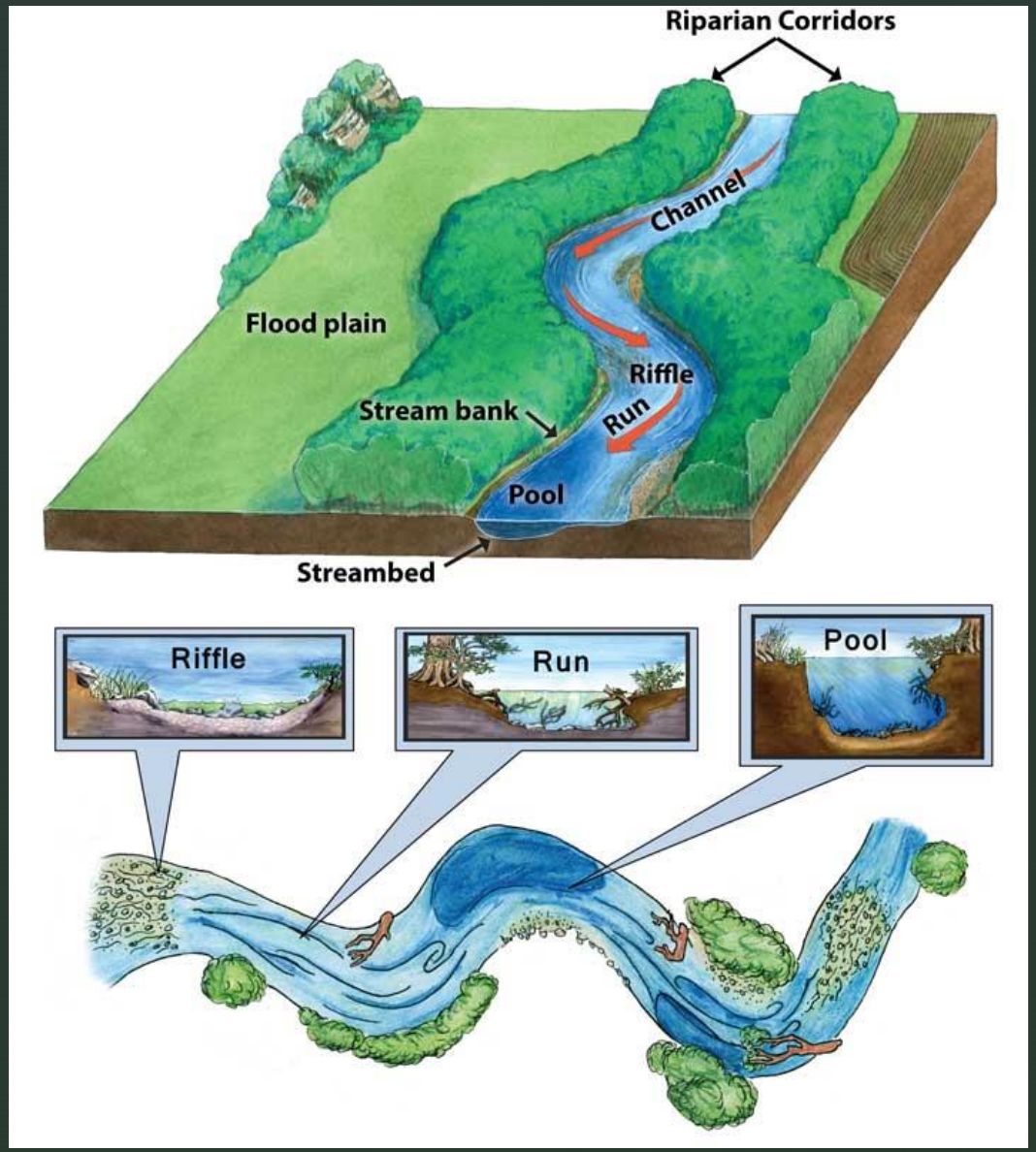
Freshwater mussels

- Grazers
  - Another group that feed on the algal coating of stones and rubble

Water penny

Since there is little aquatic plant growth at the headwaters, animals at the bottom of the food web depend on the leaves, stems, and animals that may fall into the stream from the land. Aquatic insects, such as stonefly nymphs, chew and tear leaves and stems into tiny bits. They are called shredders. Small pieces not eaten by shredders are eaten by filtering and gathering collectors. Grazers (snails, for example) appear further downstream as the channel widens. Here sunlight strikes the stream bottom allowing algae to grow on rocks and plant stems. Grazers feed on the algae. Productivity increases as you go downstream. Food becomes more abundant and diverse, and so does the aquatic community.

Most fish that live in headwater streams are small predators such as darters or minnows that are able to hug the bottom and keep from being washed downstream. They feed on smaller animals, such as aquatic insect nymphs and larvae. Since the fish also eat shredders and collectors, they search for areas where there are lots of these kinds of insects.

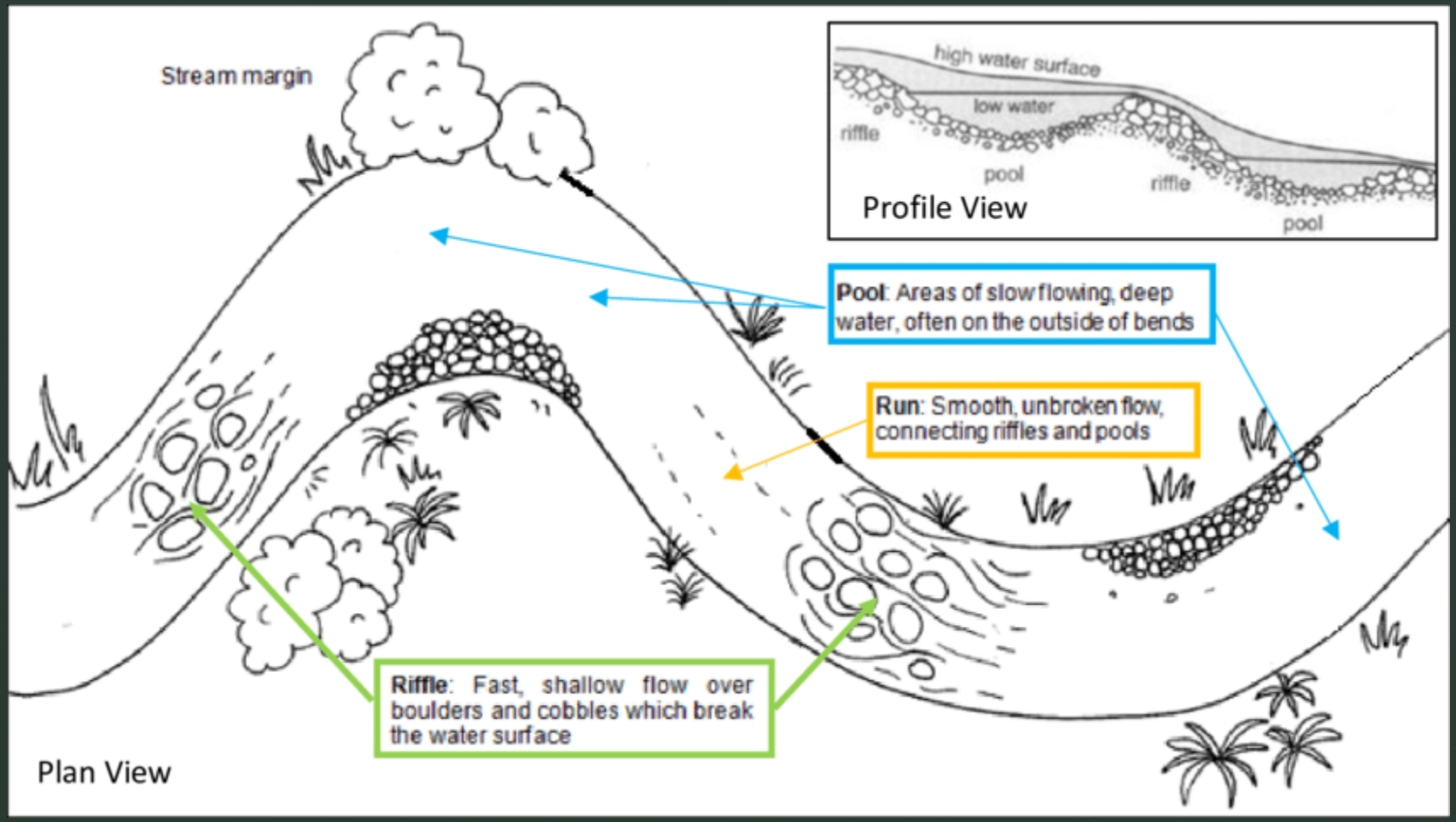


Parts of a stream

When most people think of a stream, they're usually thinking of the stream channel. (Fig. 1) .

The channel is the deep part of the stream where water collects to flow downstream.

Stream channels always run downhill. In a straight stretch of stream, the main force of the current is in the middle.


Stream margin
high water surface
low water
riffle
pool
riffle
pool
Profile View
Pool: Areas of slow flowing, deep water, often on the outside of bends
Run: Smooth, unbroken flow, connecting riffles and pools
Riffle: Fast, shallow flow over boulders and cobbles which break the water surface
Plan View

Areas where the stream flow slows and water depth increases are called **pools**.

Shallower, faster-flowing stream areas are called **riffles**. These areas can usually be identified by looking for small waves seen on the surface.

The fast moving water between riffle areas and pools is called a **run**.

Rapids may form where the water flows downhill very fast and pushes up against underwater obstacles. Rapids are where you see very turbulent water flow.

In naturally flowing streams it’s common to see **riffle-run-pool-run-riffle** sequences. Alternating slow and fast moving waters make great homes for aquatic life.

The channel is only one part of the stream. The **stream banks** are the sides of the stream channel. Stable stream banks have plants growing on them. The roots hold soil in place and minimize stream bank erosion. When a stream bank erodes, it can cover the stream's bottom with sediment, or fine particles of soil. Sedimentation can smother aquatic organisms and destroy their habitat.

Plants growing in the **riparian zone** help keep the stream healthy in many other ways. Trees shade and cool the water, which increases the amount of dissolved oxygen the water can hold. Shaded stream segments may be as much as 10 degrees cooler than segments exposed to direct sunlight. Roots help hold the stream banks together, reducing stream bank erosion. Leaves and land insects falling into the water from vegetation on the banks provide organic matter for aquatic food webs.

The relatively flat land extending outward on both sides of a stream or river is called the **floodplain**. During a flood, the large amounts of additional water overflow the stream banks and spread out to cover the floodplain. Flooding is a natural characteristic of all streams. By allowing excess water to spread out, floodplains reduce the floodwater's speed. As a result, less damage occurs in the stream and to areas downstream.

Stream order and aquatic communities

Precipitation first collects at the top of the watershed, in the headwaters of each stream. From there water flows downhill in tiny trickles. As these trickles or runoff begin to combine they first carve out a small stream channel by erosion. **This first small stream channel is called a first-order stream.** This is a small stream with no tributaries coming into it. First-order streams combine to form larger streams, called second-order streams. These larger, second-order streams combine to form even bigger third-order streams and so on.

First-and second-order streams. In the headwaters of a stream the water is shallow, the stream bottom is often rocky, and there are few aquatic plants. A lack of food limits the number of animals that can live there. In early order streams the benthic community of organisms, called benthos, is a key part of the food web. These include benthic macroinvertebrates, such as mussels, aquatic insects, and other invertebrates visible without the aid of a microscope.


1
Black willow
Orangethroat darter
Sycamore
1
Mayfly
Caddisfly larva
Central stoneroller
Smartweed
Gilled snail
Crayfish
Fathead minnow
2
2
Silver maple
Prairie cord grass
Bottonbush
Green sunfish
Stonefly
Algae
3
3
Guadalupe bass
Box elder
Largemouth bass
Crayfish
Sycamore
4
4
Water willow
Snail
Damselfly
Bluegill
5
5
Coontail
Mayfly
Channel catfish
Pickerel weed
Blue sucker
Longnose gar
Plankton
Scud
6
6
Bald cypress
Gilled snail
Algae
Fishfly
Blue catfish
7
7
Silver maple
Gizzard shad
Alligator gar
Sycamore
Mussel
Aquatic worm
Bowfin
Flathead catfish
8
Mayfly
Cottonwood
Headwaters – 2nd order
3rd – 5th order
> 6th order

Third- through fifth-order streams. Mid-level streams have both rooted and floating aquatic plants and algae. In these larger streams more types of animals have niches in which to live. Grazers such as snails and water pennies eat the growing number of plants. Collectors increase with the varied plant life. As the plant diversity increases, shredders begin to decrease. A large variety of fish species live in the deeper and more varied mid-level streams.

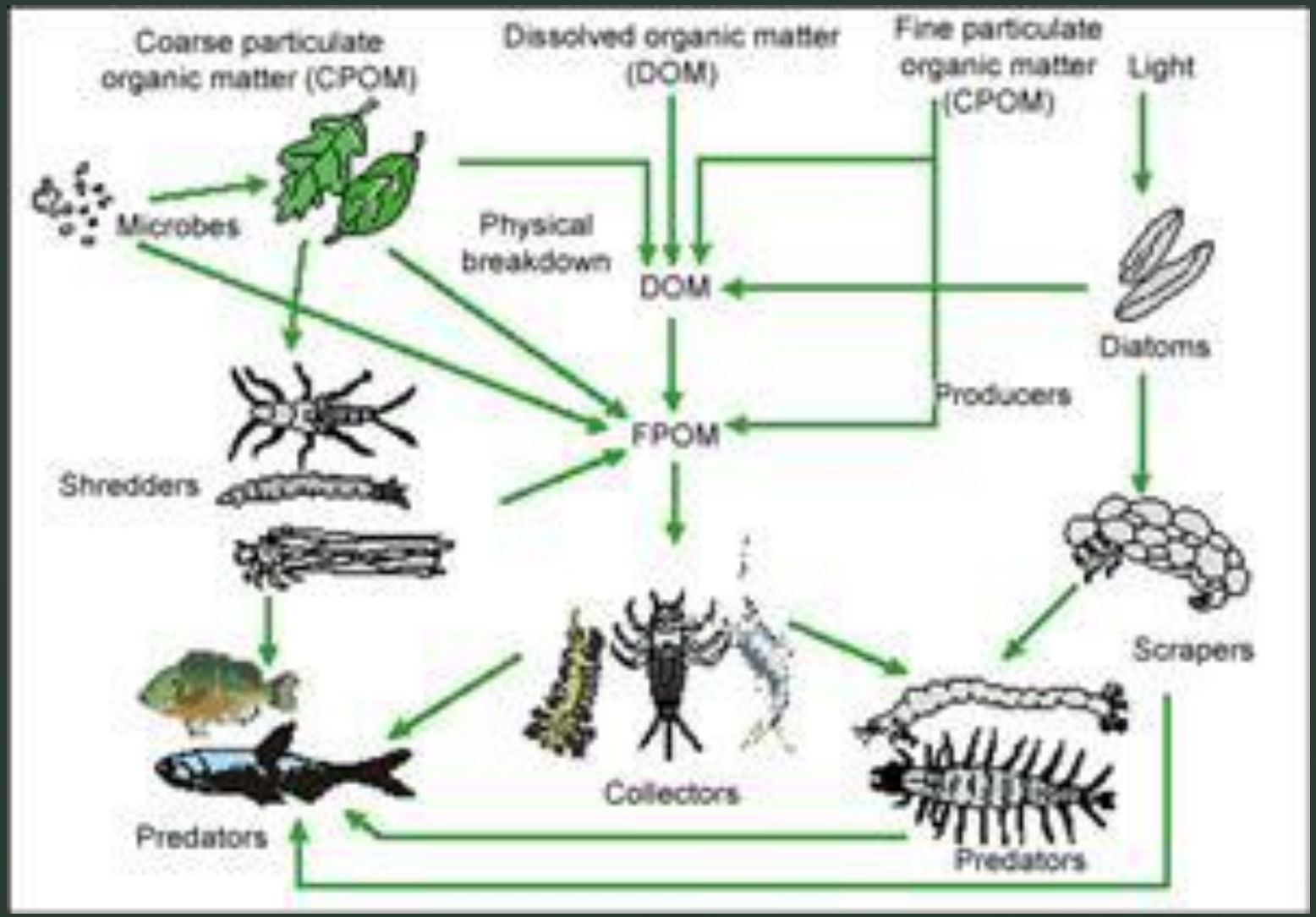
When two streams come together, the waters mix and flow downstream together. Individual characteristics of the streams and nutrients from each watershed combine and form a still larger stream or river.

High-order streams. In very large rivers, few rooted plants may grow because the water is too deep and turbid (cloudy). Here, there are more collectors than shredders. One major group of collectors in big rivers is mussels living in the river’s benthic zone.

Food Chains and Ecosystem Structure

The bank of a stream or river is called the riparian zone, a place where overhanging foliage provides shade and the tree roots of undercut banks provide shelter. The deep shade produced by riparian foliage limits photosynthesis and primary production of organic nutrients. Much or most of the organic matter that nourishes the stream habitat originates as foliage that falls into the water, ranging from leaves, twigs, and seeds to fallen trees.

Aquatic food chains in first-order streams thus begin with coarse particulate organic matter. This matter enters the food chain by way of aquatic bacteria and fungi that decompose it, and animals classified as shredders that tear it into finer particles.

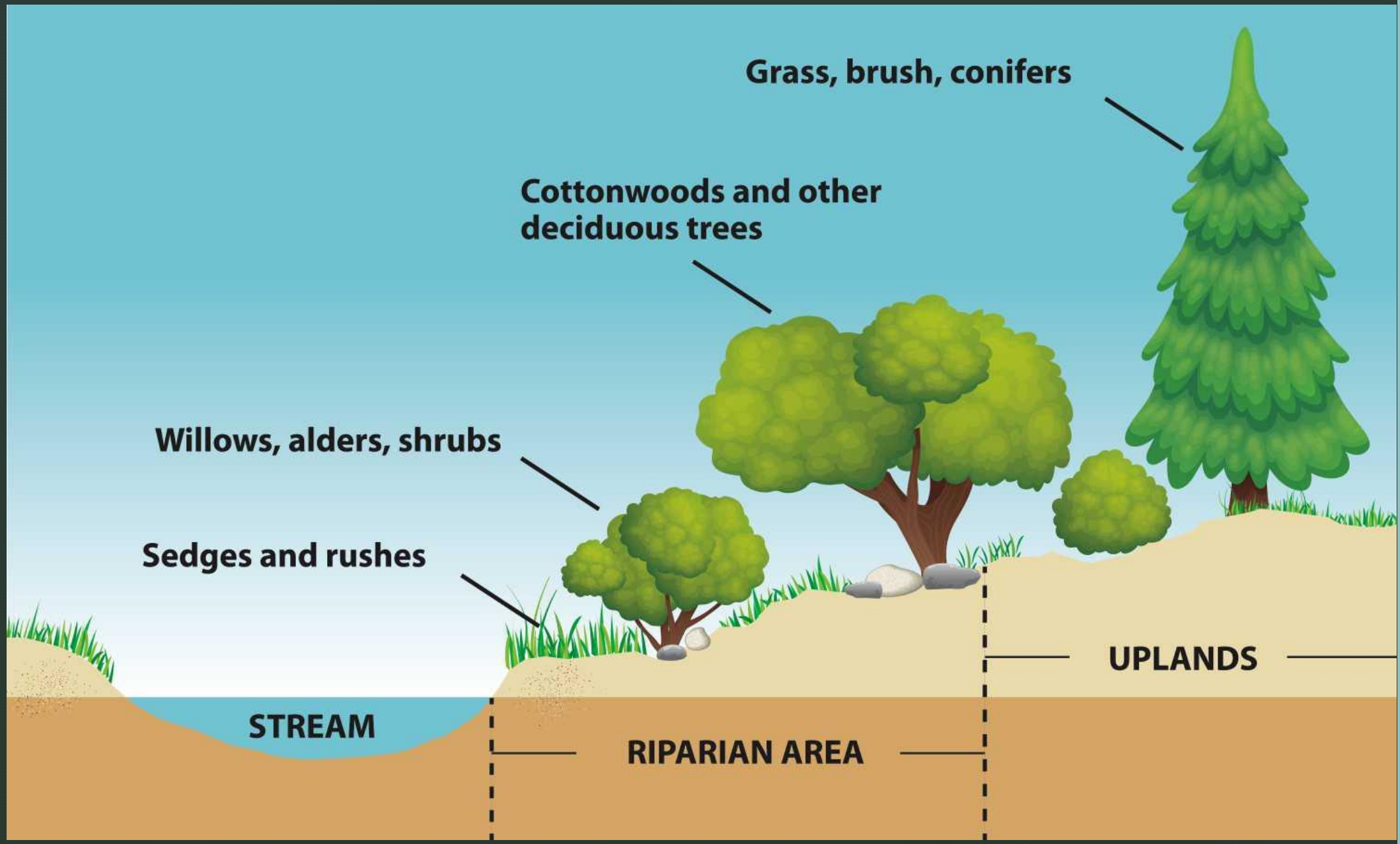

Coarse particulate organic matter (CPOM)
Dissolved organic matter (DOM)
Fine particulate organic matter (CPOM)
Light
Microbes
Physical breakdown
DOM
Diatoms
Producers
FPOM
Shredders
Scrapers
Collectors
Predators
Predators

Shredders produce nutrient-rich faeces that, in turn, are eaten by collectors. Farther downstream where there is more light, algae grow on rocks and other submerged surfaces and support a small community of animal grazers. Most shredders, collectors, and grazers are aquatic insects, but snails, bivalves, and crustaceans also play a part. The total population of these invertebrates is relatively small, however, so there are few predators in headwater streams; there is not enough for them to eat.

RIPARIAN ZONES

A riparian zone is land alongside creeks, streams, gullies, rivers and wetlands. These areas are unique and diverse, and are often the most fertile parts of the landscape.

In a natural or well managed state, riparian areas are important for many reasons. They can support diverse vegetation, help maintain bank stability, and increase ecological and economic productivity. These conditions support cleaner water, reduce disease and pests, and retain important nutrients and soil. Healthy land supports healthy waterways


Grass, brush, conifers
Cottonwoods and other deciduous trees
Willows, alders, shrubs
Sedges and rushes
UPLANDS
STREAM
RIPARIAN AREA

Riparian areas are vulnerable and easily degraded. Damage can be caused by uncontrolled stock access, clearing for agriculture or urban development, invasion by pests and feral animals such as rabbits, weeds such as privet, or from overuse by recreational activities. Waste from stock such as cows and sheep can contribute pollution, and trampling can destroy vegetation, soil structure, and result in loss of valuable soil and land.

The importance of managing riparian land well is increasingly being recognised, and protection, rehabilitation and restoration work is being undertaken across the catchments

Unhealthy Riparian Zone

Healthy Riparian Zone

Ecological functions of riparian areas

- Riparian areas are among the most diverse, dynamic, and complex ecological systems in the world.

- Vegetation best illustrates the ecological linkage of aquatic and terrestrial ecosystems in riparian areas.

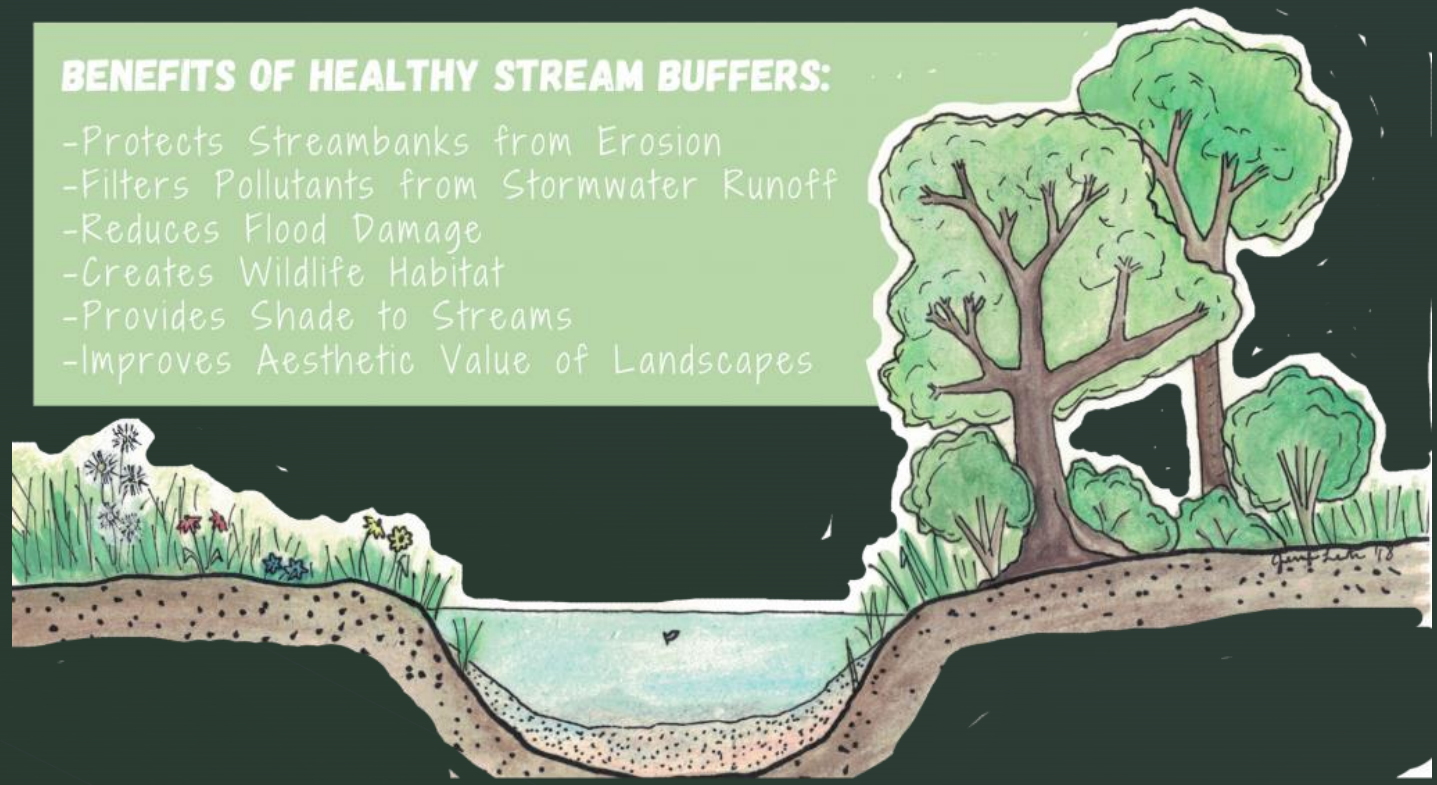
- Plant species diversity is often high in riparian areas because the mosaic of soil types and stream flooding disturbance (particularly scour) creates a range of soil and site conditions that favour coexistence of many different plant species in a small area.

- Riparian vegetation in turn influences aquatic ecosystems by shading stream channels and regulating water temperatures, by providing leaves which form the base of the stream food web.

- Riparian areas have important ecological functions in the landscape and are valued as buffers that protect and enhance water resources.

- Riparian areas may act as filters of sediments and nutrients from uplands, transformers of toxins, nutrients, and microclimate, sources of species and energy, sinks for excess nutrients, and as habitat and movement corridors for organisms.
- Riparian areas help control nonpoint source pollution by holding and using nutrients and reducing sediment.
- Riparian areas are often important for the recreation and scenic values.

- Worldwide, riparian areas have been degraded by deforestation, grazing and urban development. Recognition of the important ecological functions of riparian areas has stimulated efforts to restore and enhance these diverse and dynamic systems in many areas of the world.



Benefits of Buffers

- Streambank stabilization
- Erosion and sediment control
- Filtration of nutrients and other pollutants
- Reduces the impact from floods
- Habitat and food for wildlife and pollinators
- Shade for streams

Riparian Management

• Limit clearing of vegetation, including both standing and downed timber, to that which is absolutely necessary for construction purposes. •
Heavy equipment use within the riparian corridor should be restricted to minimize vegetation destruction and compaction of soils.

General application of pesticides, herbicides, or fertilizers within the riparian corridor should be prohibited to avoid water contamination due to overspray or runoff.
• Riparian areas located down slope of construction zones should be physically screened with sediment controls, such as silt fences or filter strips.