

Water and Ecology

What is Ecology

It is the scientific study of how organisms interact with each other and with their environment. This includes relationships between individuals of the same species, between different species, and between organisms and their physical and chemical environments.



Aquatic Ecology

It includes the study of these relationships in all aquatic environments, including oceans, estuaries, lakes, ponds, wetlands, rivers, and streams. The most important of these are:

1. River Ecology

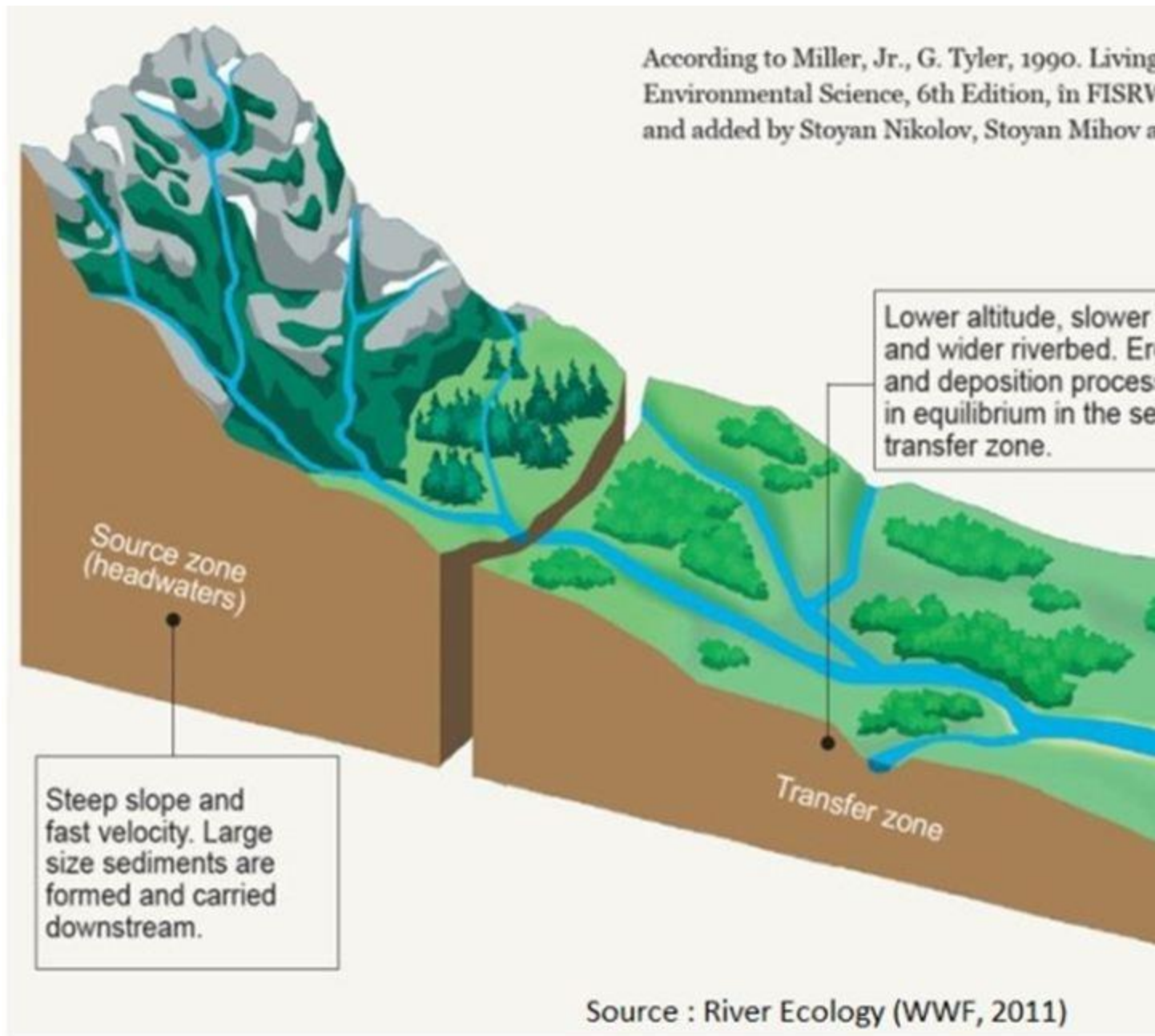
2. Wetlands
3. Coastal Ecology

River Ecology

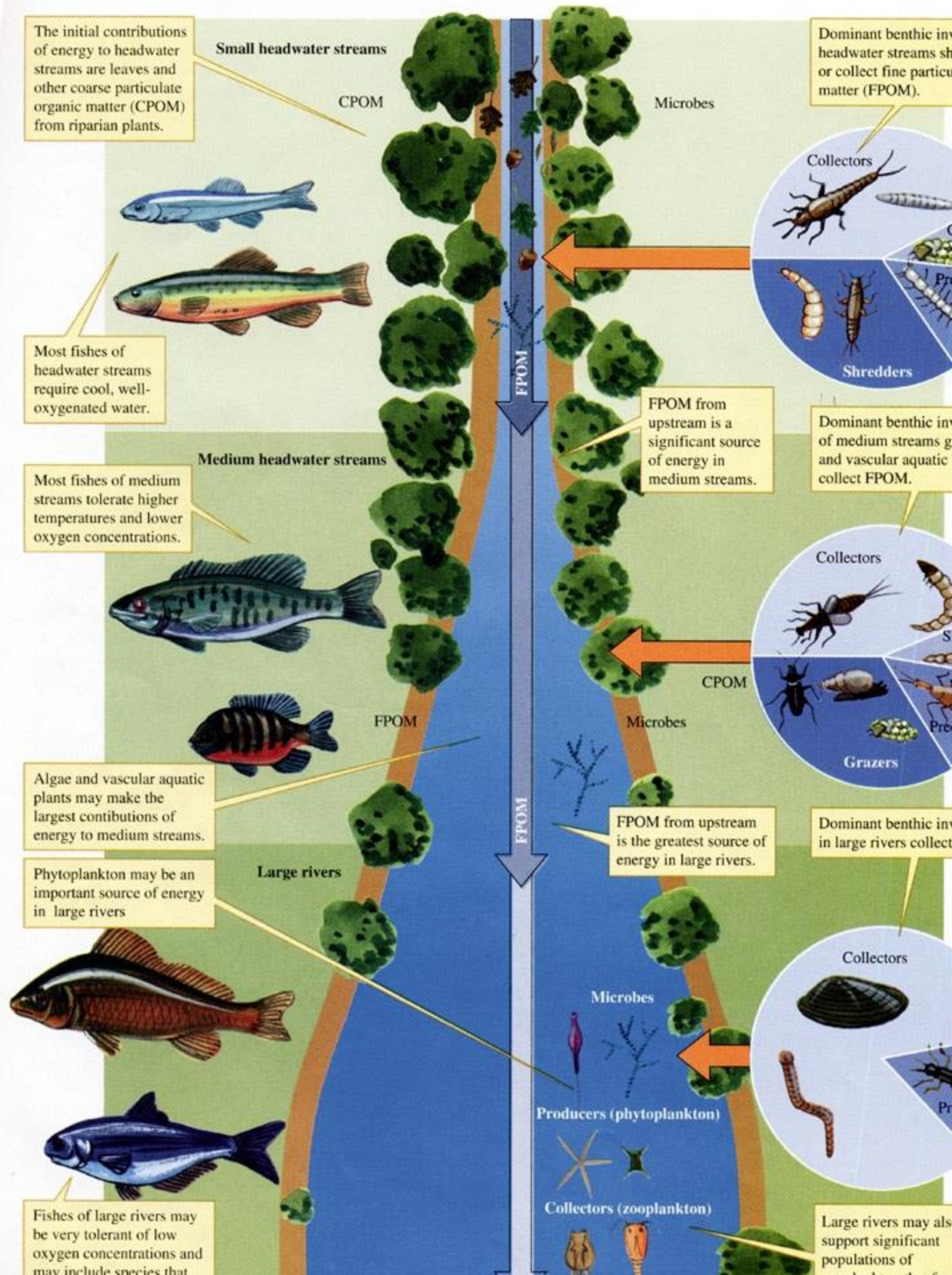
River Ecology is a system comprising of the river itself and the land alongside it. It's the zone where the non-living components of the river like water, rocks, sediment etc are intrinsically connected to living organisms like fish, plants, microbes etc. The river ecology comprises of four dimensions namely the Length, Width, Depth and Time of the river flow.

Length of river flow (upstream - downstream)

The physical characteristics of the river changes as it flows from mountain to ocean. The characteristics are depicted below:



With change in physical characteristics of river along its length, the biota (living organisms) changes too. The River Continuum Concept (RCC), attempts to generalize and explain observed longitudinal changes in stream ecosystems.



Shredders have chewing mouthparts which allow them to feed on large pieces of organic matter, such as leaves and twigs that fall from trees and other plants in the riparian zone.

Scrapers or grazers remove attached algae and detritus from rock and wood surfaces in the current.

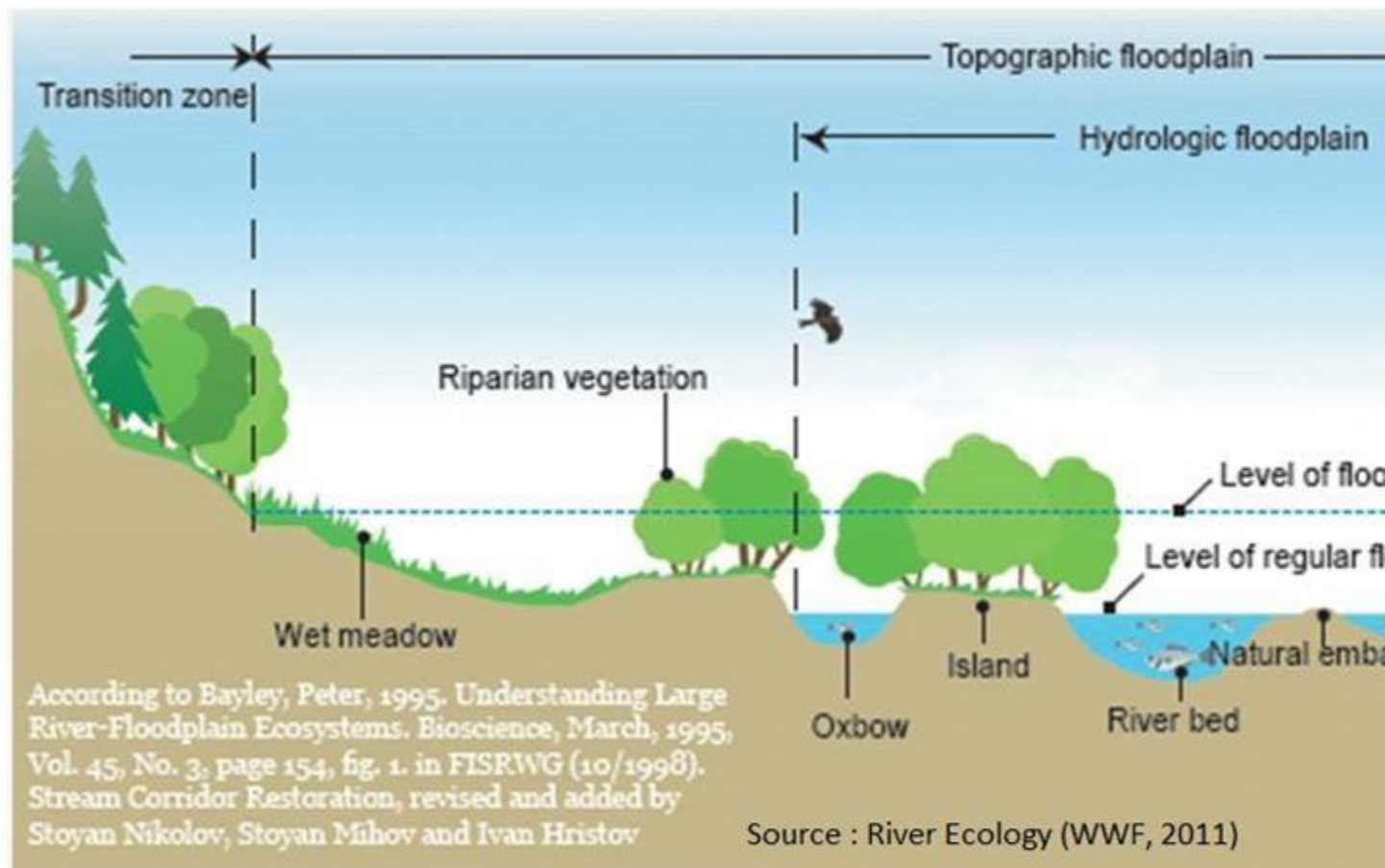
Collectors eat fine particles of organic matter.

Predators consume other macroinvertebrates.

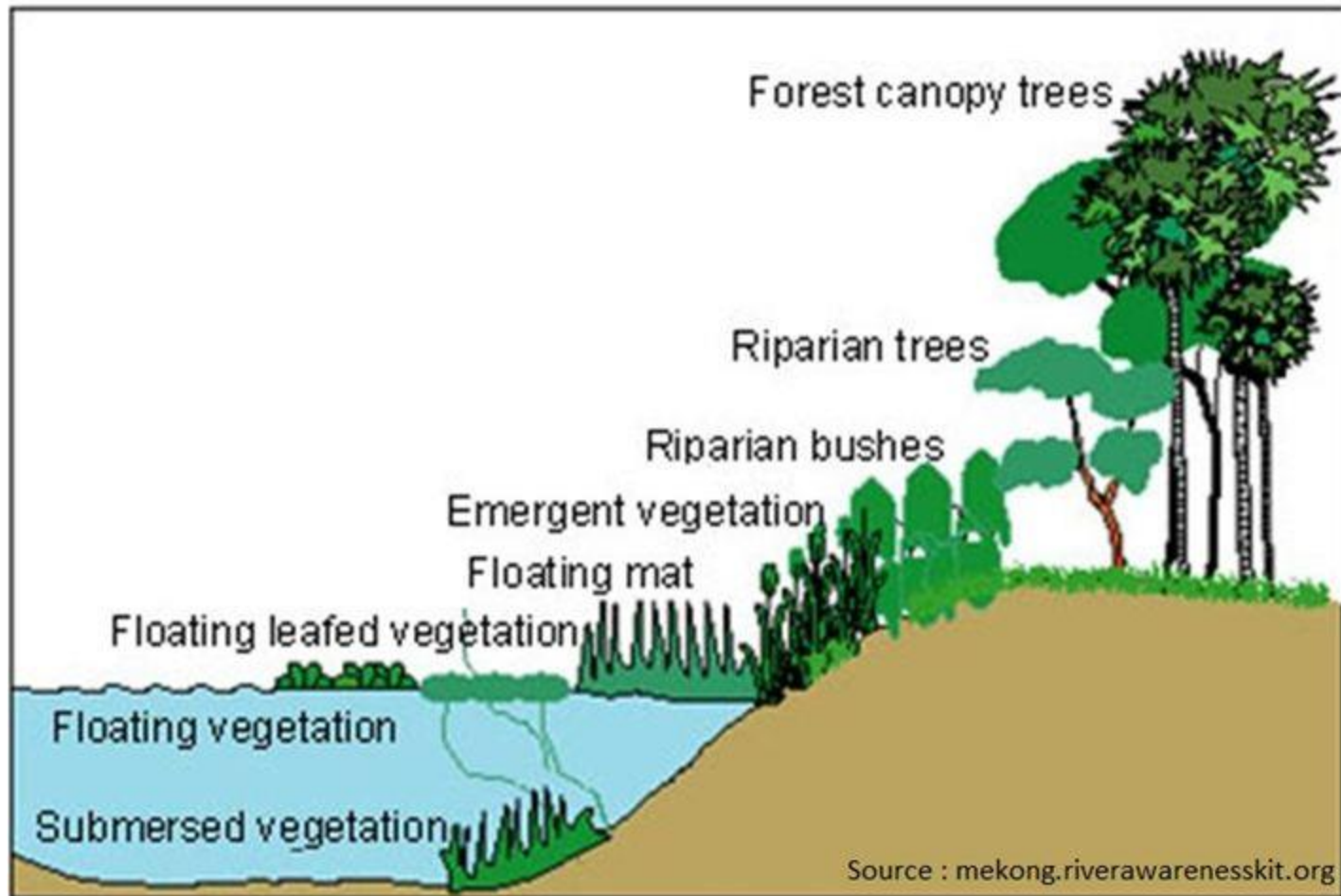
Width of river flow (main channel - flood plain)

The ecosystem of River width wise can be categorized in two main components:

- River Bed
- Floodplain - roughly the area covered by water during regular floods.

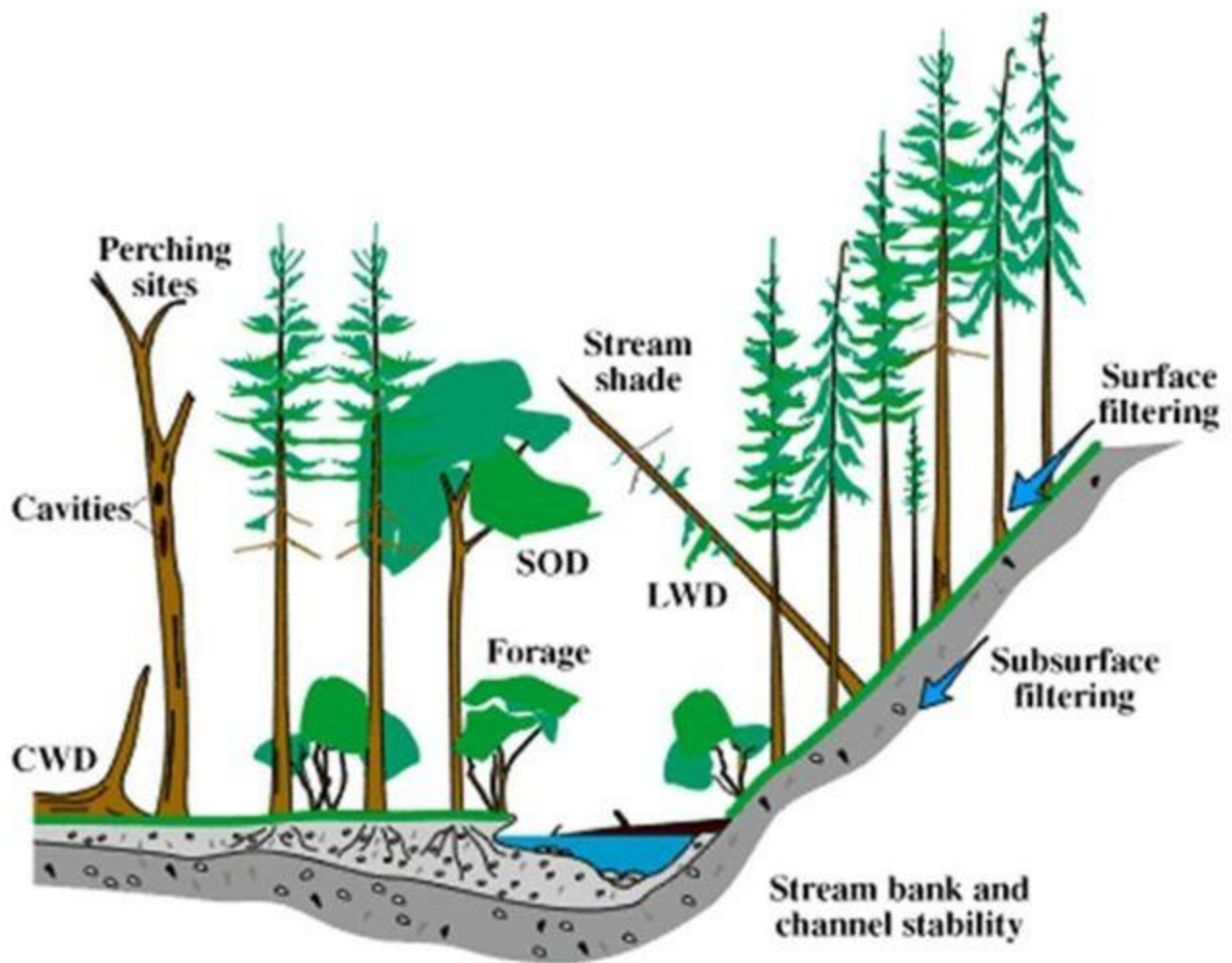


Unlike along the length of River, the ecosystem along the width of the river cannot be generalised. The flora of a floodplain vegetation can be approximately classified as shown below :



Zonation of riparian zone according to different types of vegetation.

However, the stream bank vegetation plays a very important ecological function listed below:



Source : www.env.gov.bc.ca

- Regulation of the physical structure of the stream channel by determining the input and characteristics of large woody debris (LWD) which partly controls sediment storage and transport; local flow characteristics; and the creation of fish habitat.
- Maintenance of bank and channel stability by provision of solid root mass and ground cover.
- Regulation of stream temperature by providing shade.
- Regulation of in-stream biological production by determining the inputs of small organic debris (SOD) (leaves, detritus, terrestrial insects, large woody debris, dissolved organic carbon) to the channel.
- Regulation of in-stream algal production by controlling the amount of sunlight (for photosynthesis) reaching the stream.

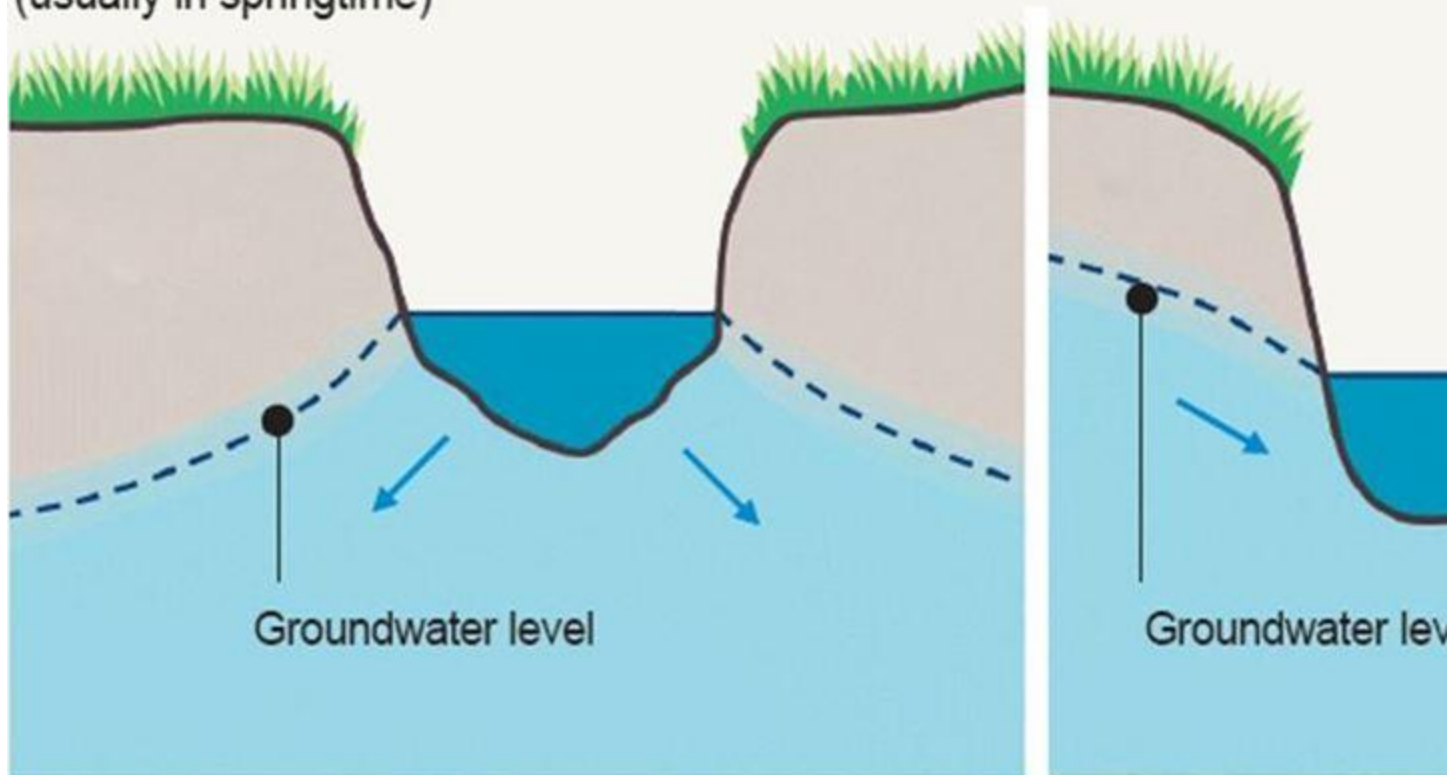
- Buffering the stream from fine sediments by intercepting surface flow.
- Provision of wildlife habitat features, including coarse woody debris (CWD), wildlife trees, nest and perch sites, and summer and winter shelters.
- Provision of summer and winter forage for terrestrial fauna.

Depth of river flow

The seasonal increase of water level has an important role in supporting river ecosystems. Rivers often link to adjacent wetlands only at high water level, which is often the only possibility for fish populations to migrate.

Apart from this, the depth of flow also affects the Groundwater level of the adjacent aquifers.

The river saturates the land
(usually in springtime)



Stream Corridor Restoration: Principles, Processes, and Practices - The Federal Interagency Stream Restoration Working Group (FISRWG) (15 Federal agencies of the US gov't). GPO Item No. 0120-A; SuDocs No. A 57.6/2: EN 3/PT.653

Time of river flow

The volume of water flowing in a river at a particular point (runoff) varies with time. The increase in runoff leads to flooding which provides very important ecosystem service.



Source: winnebagoforest.org

The processes of erosion, sediment transport, and deposition interacting with vegetation make river corridors very dynamic ecosystems.

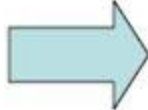
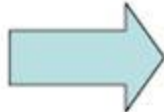
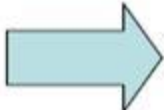
The discussion on River Ecology would be incomplete without the discussion on Minimum Environmental Flow.

Environmental (or instream) flows are flows that are left in, or released into, a river system with the specific purpose of managing some aspect of its condition. Their purpose could be as general as maintenance of a 'healthy' riverine ecosystem, or as specific as enhancing the survival chances of a threatened fish species. They could be targeting the river channel and its surface waters, groundwater, the estuary, linked wetlands or floodplains, the riparian zone, and/or a subset of the plant and animal species associated with any of these system components.

(JM King, RE Tharme & MS de Villiers)

However, there are more than 200 methodologies for determining the Minimum Environmental Flow depending upon the purpose of such determination. Few examples are as follows :

Categories of environmental flows methodologies and approaches

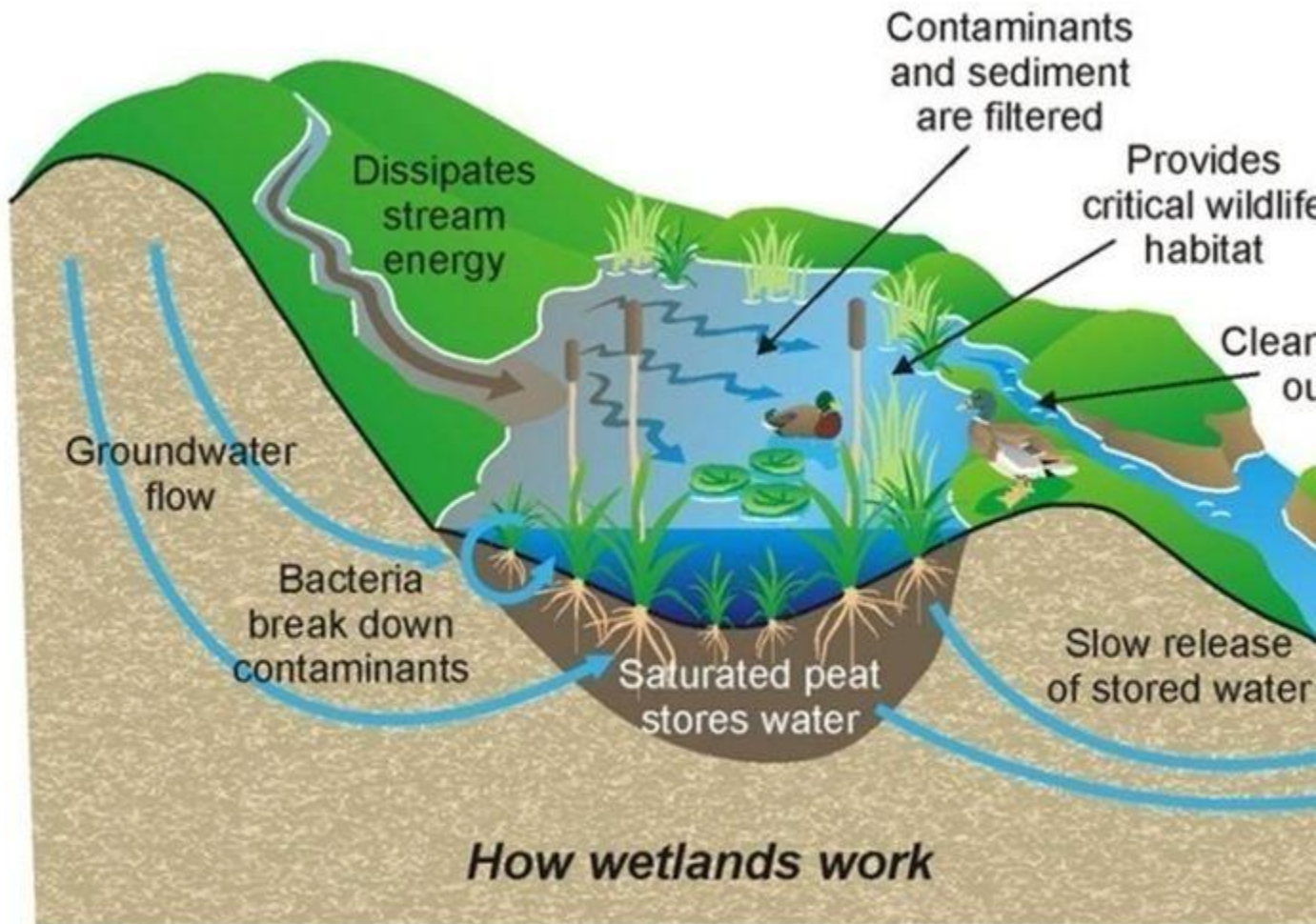
- | | | |
|-----------------------|--|---|
| 1. Hydrologic |  | <ul style="list-style-type: none">• Tennant• Q_{90} |
| 2. Hydraulic rating |  | <ul style="list-style-type: none">• Wetted perimeter |
| 3. Habitat simulation |  | <ul style="list-style-type: none">• IFIM• PHABSIM |
| 4. Holistic methods |  | <ul style="list-style-type: none">• Building Block Methodology |

Source: Tharme, 2003

Wetland Ecology

Wetlands are areas where water is the primary factor controlling the environment and the associated plant and animal life. They occur where the water table is at or near the surface of the land, or where the land is covered by water. There are several types of wetlands like Swamps, Marsh, Bogs and Fens etc.

Wetlands are often called the "kidneys of the landscape" since, like kidneys, they filter out harmful materials.



Source

Wetlands support a rich food web, from Microscopic algae and submerged vascular plants to great blue herons and otters.



Coastal Ecology

Coastal zones are terrestrial areas dominated by oceanic influences and marine aerosols & marine area where light penetrates throughout.

The coastal ecosystem comprises of several entities like life on rocky coasts, life in sediments, Mangroves, Estuaries, Seagrass bed, kelp forest, coral reef etc. Few of them are discussed below :

Mangroves

Mangrove swamps are found in tropical and subtropical tidal areas. Mangrove forests consist of diverse, salt-tolerant tree and other plant species, ranging from small shrubs to tall trees.



Sunderban Mangroves : home to the Majestic Bengal Tigers

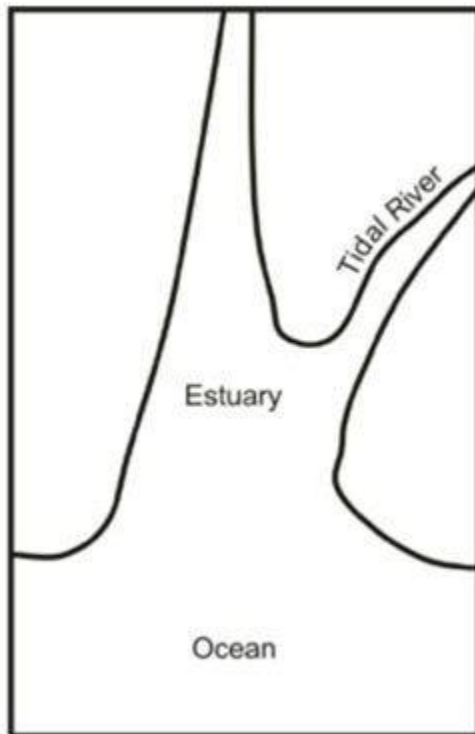
They are important to man as a source of timber, charcoal and tannin, their stabilizing properties protect coastlines from major erosional damage by tropical storms and they provide an important nursery ground for many commercially important fish and shellfish. Apart from this it also provides important ecosystem services like :

- Water purification
- Groundwater recharge

- Shoreline stabilization & storm protection
- Sediment & nutrient retention
- Tourism

Estuaries

Estuaries can be defined as semi-enclosed bodies of coastal water which retain a free connection with the open sea and within which sea water is measurably mixed with fresh water of terrestrial origin (Pritchard, 1967).



Sketch of an Estuary



Narmada Estuary

The biota in the Estuaries is sparse because of highly stressful environment due to salinity. However, it still provides very important ecosystem services like :

- Stabilize shorelines and protect coastal areas, inland habitats and human communities from floods and storm surges from hurricanes.

- Act like huge sponges, soaking up the excess water during floods.
- Protects streams, river channels and coastal shores from excessive erosion caused by wind, water and ice.

Coral Reefs

Coral reefs are large underwater structures composed of the skeletons of coral, which are marine invertebrate animals.



Coral Reef

The Coral Reefs provide following ecosystem services :

- Spawning, nursery, breeding, and feeding grounds for numerous organisms.

- Buffers shorelines from currents, waves, and storms, helping to prevent loss of life, property damage, and erosion.
- The fish that grow and live on coral reefs are a significant food source for over a billion people worldwide.
- Source of medicine.
- Recreation and Tourism.