



The nature and functioning of river systems and the impacts of water-resource developments

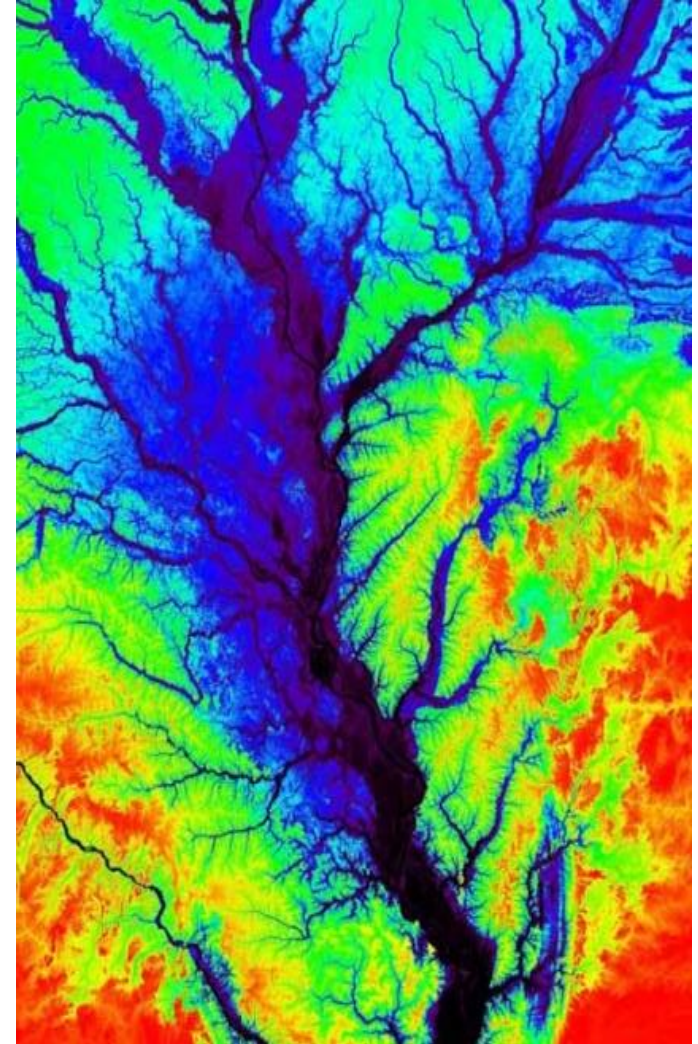
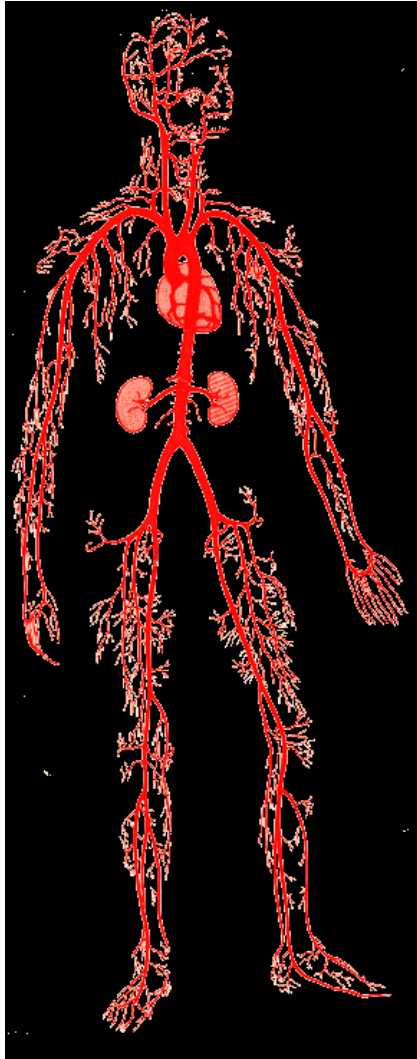
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WIO EFlows Guidelines
Workshop
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Cape Town



Rivers are the venous system of Planet Earth



Our bodies and Planet Earth

- Veins are lifelines of the human body
- Transport blood – essential for life
- Connect vital organs
- Carry life supporting elements
- Flow through organs that clean and protect the blood
- Veins, arteries and organs inter-connected and inter-dependent
- Complex multi-dimensional
- Different elements, velocities and flow for different functions

- Rivers are the lifelines of the landscape
- Transport water – essential for life
- Rivers connect vital ecosystems
- Carry life supporting elements
- Flow thorough systems that clean and protect the water
- Rivers, estuaries, aquifers and oceans inter-connected and inter-dependent
- Complex multi-dimensional
- Different elements, velocities and flow for different functions

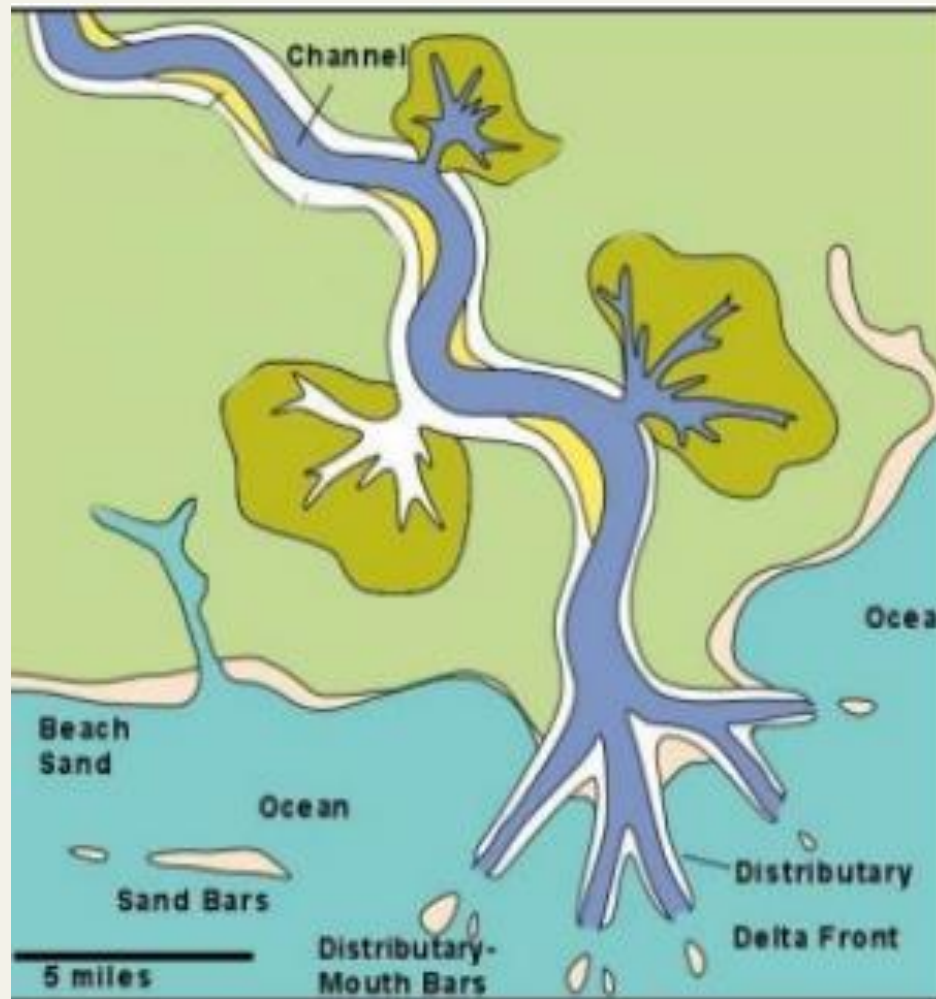


What happens to the body if ...?

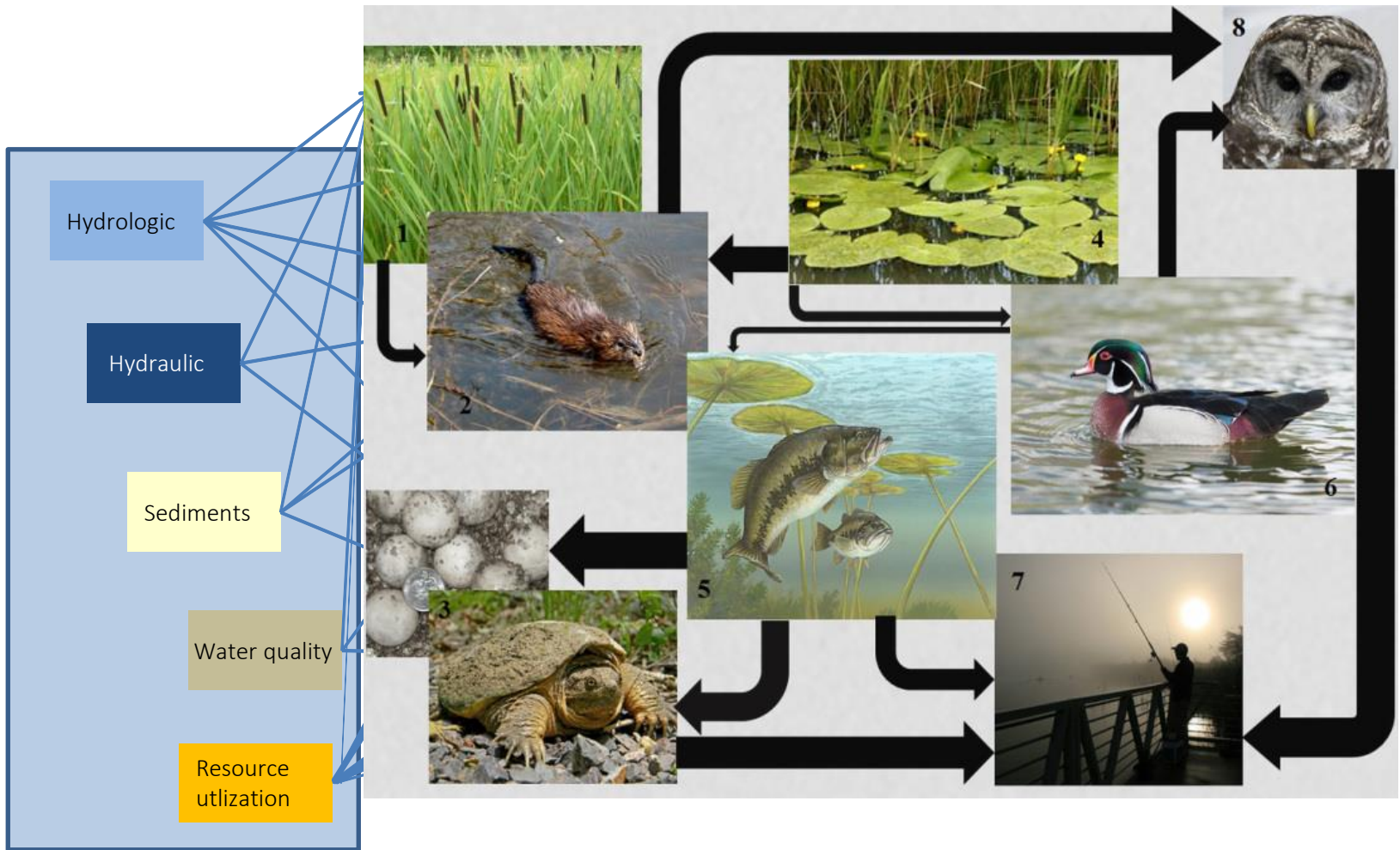
- Halve the amount of blood
- Too much pollution (fat or sugar)
- Blocked arteries
- Reduced or irregular flow to an organ

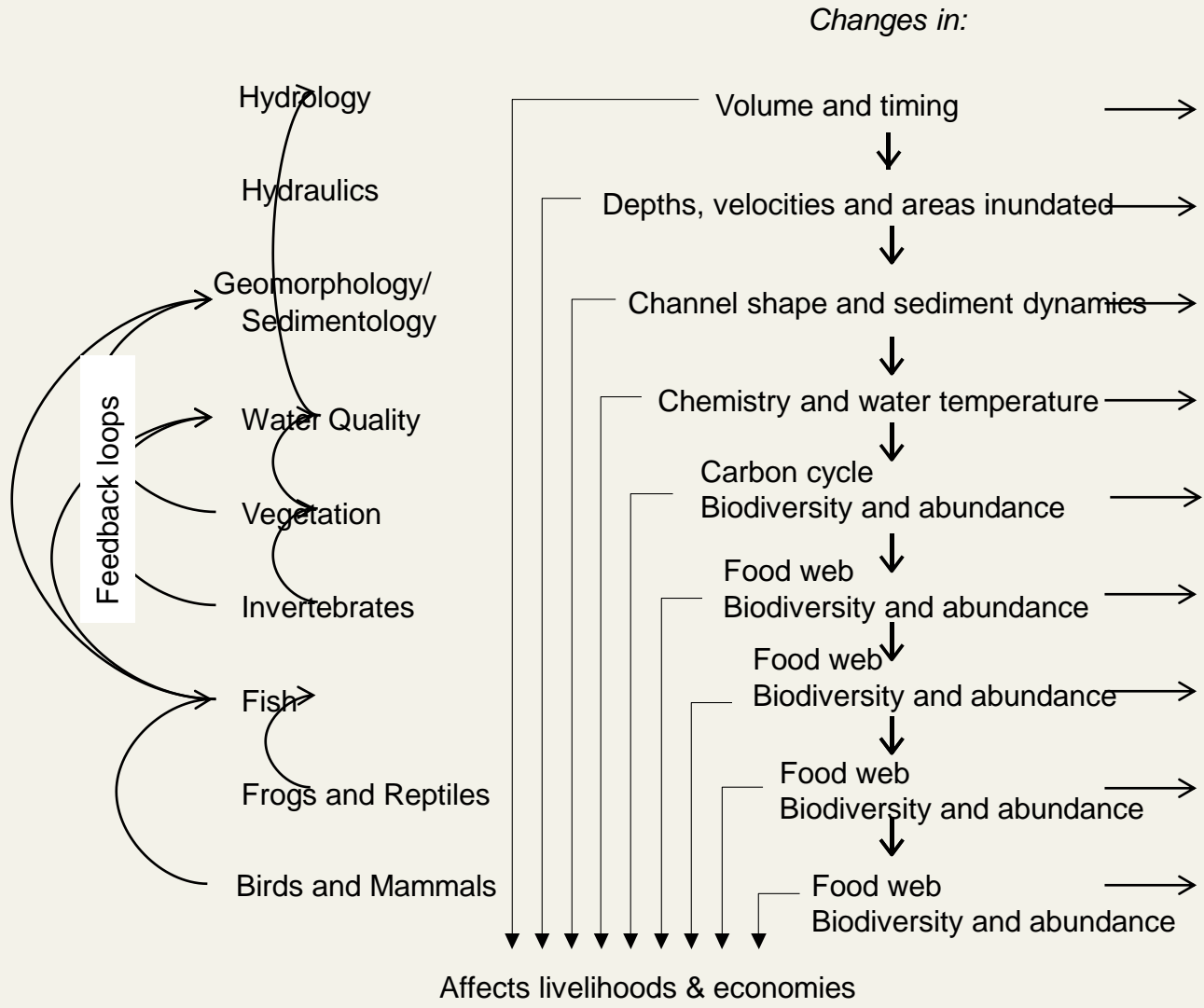


River systems are living systems



Inter-connected and inter-dependent

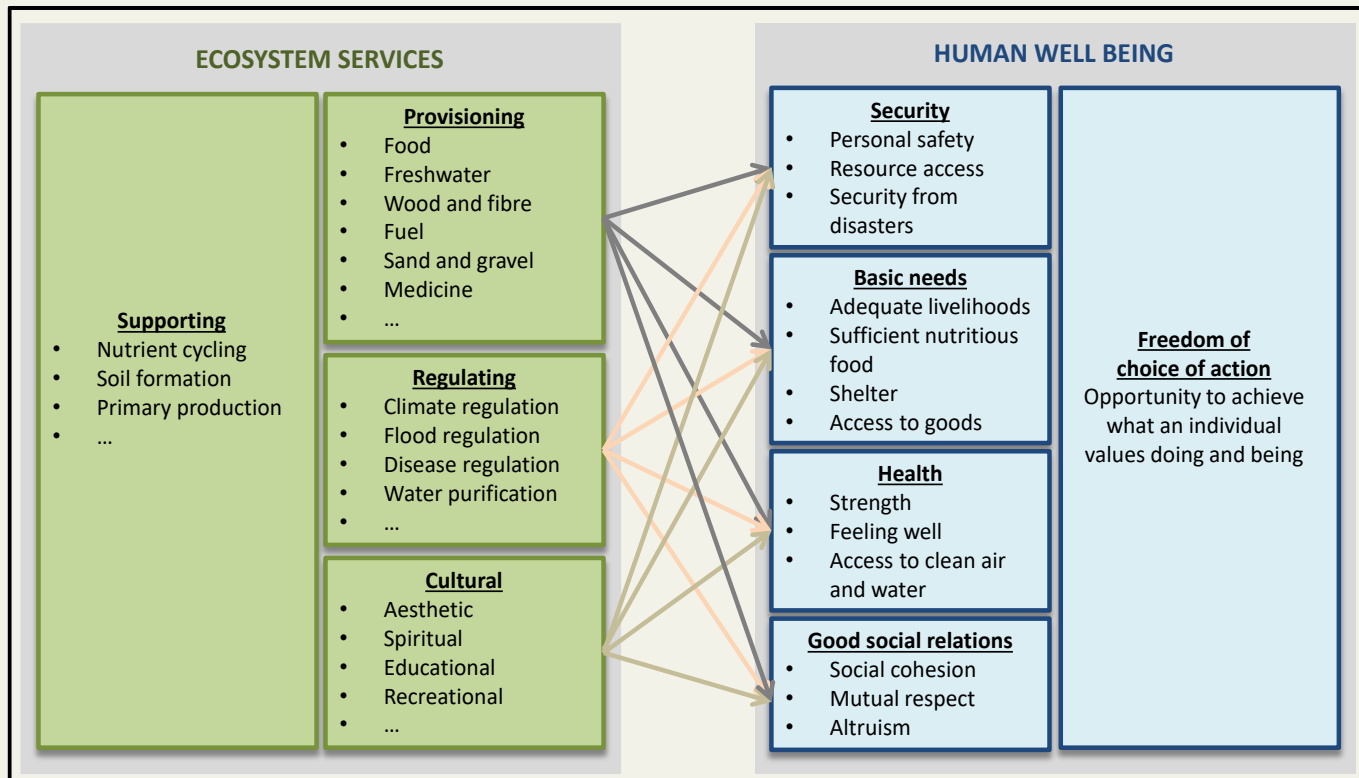




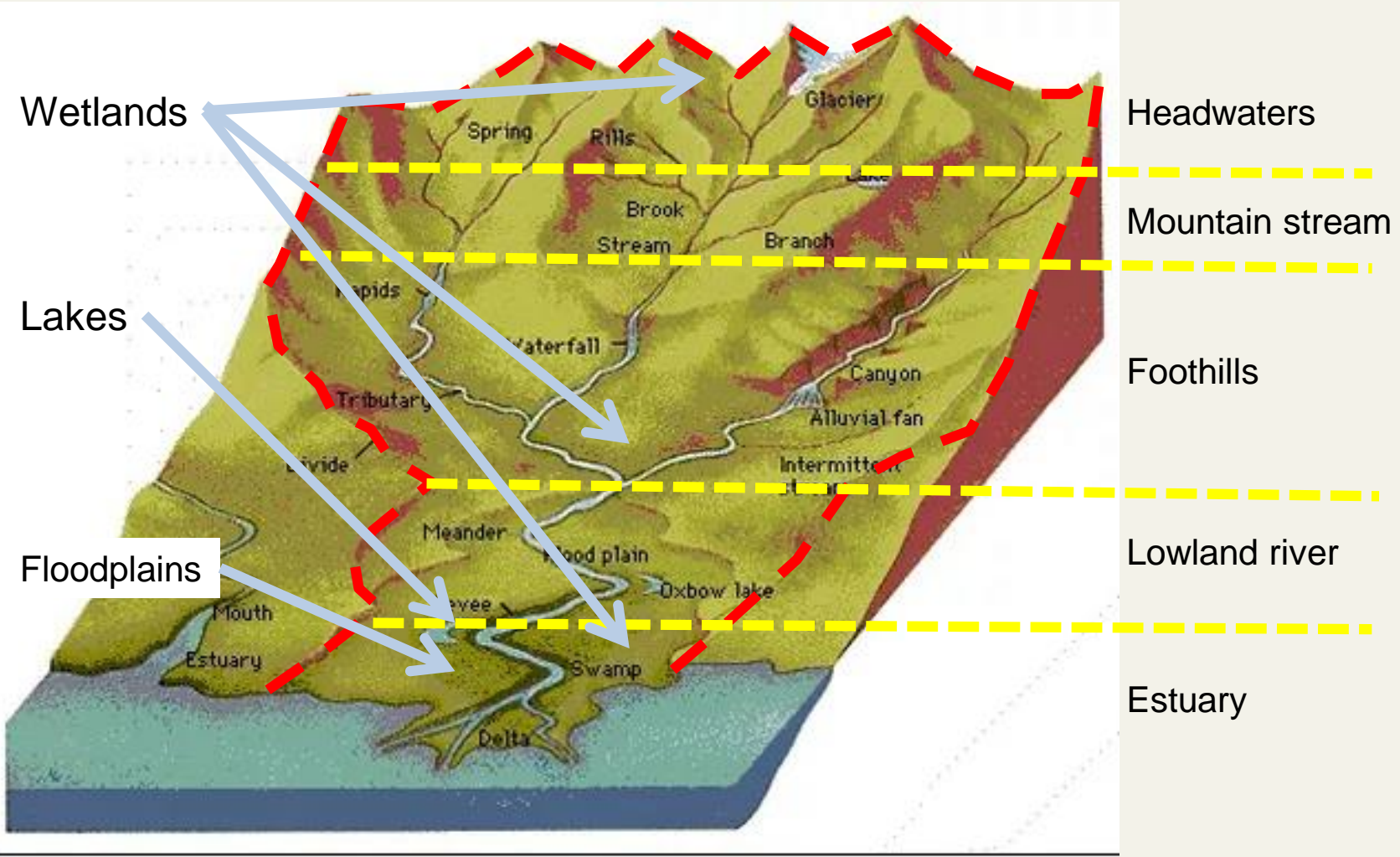
Overall changes in the nature and functioning of the river ecosystem

Ecosystem services

Ecosystem services are the benefits people obtain from ecosystems



River ecosystems



Ecosystem services

Estuaries:

- Supporting services, e.g.,
- Nursery for coastal fish
- Provisioning services, e.g.,
- Aquaculture
- Regulating services, e.g.,
- Erosion control (mangroves)
- Cultural services, e.g.,
- Tourism and recreation
 - Cultural activities

Floodplains, wetlands and lakes:

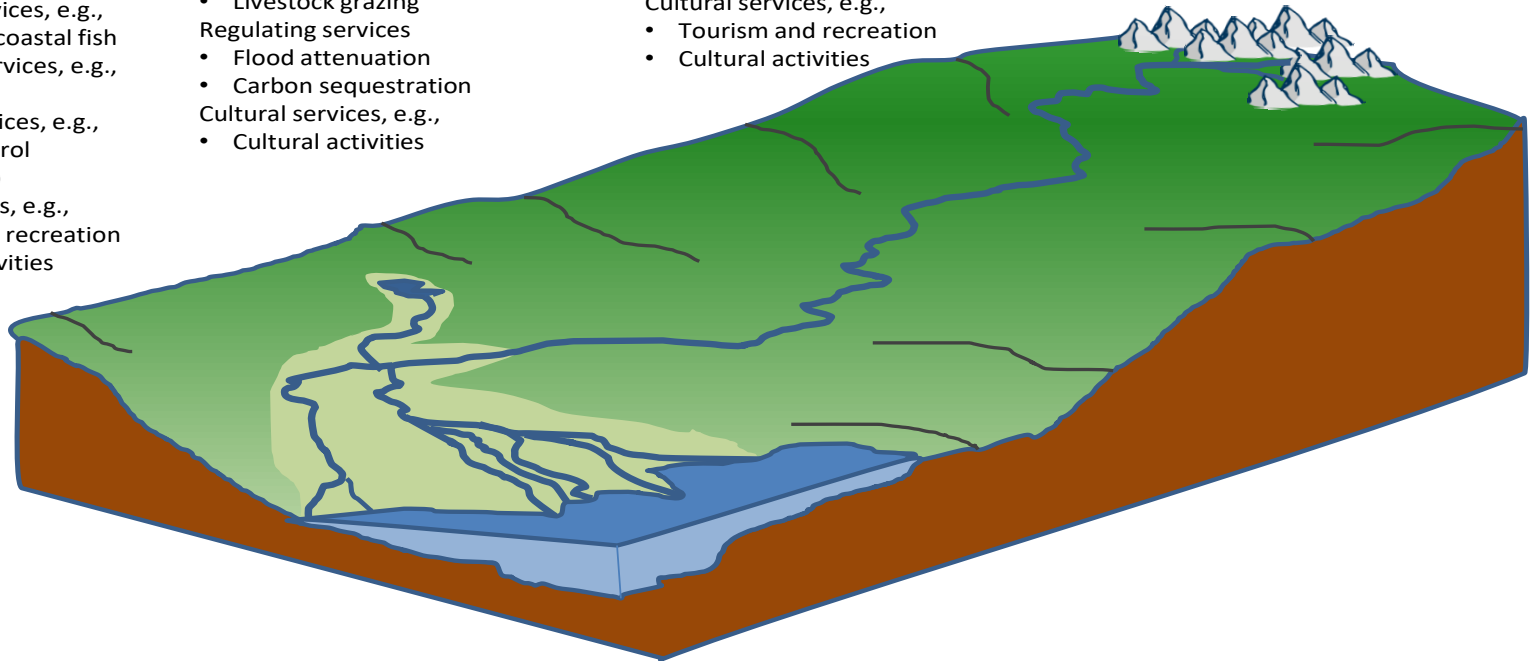
- Supporting services, e.g.,
- Nutrient recycling
- Provisioning services, e.g.,
- Building material
 - Aquaculture
 - Livestock grazing
- Regulating services
- Flood attenuation
 - Carbon sequestration
- Cultural services, e.g.,
- Cultural activities

Lowland river channels:

- Supporting services, e.g.,
- Nutrient recycling
 - Primary production
- Provisioning services, e.g.,
- Water
 - Navigation
 - Building and other materials
 - Wood and medicinal plants
- Regulating services, e.g.,
- Water purification
- Cultural services, e.g.,
- Tourism and recreation
 - Cultural activities

Mountain streams and foothills:

- Supporting services, e.g.,
- Primary production
- Provisioning services, e.g.,
- Water
 - Building and other materials
 - Wood and medicinal plants
- Regulating services, e.g.,
- Water purification
- Cultural services, e.g.,
- Tourism and recreation
 - Cultural activities



Links to marine environment

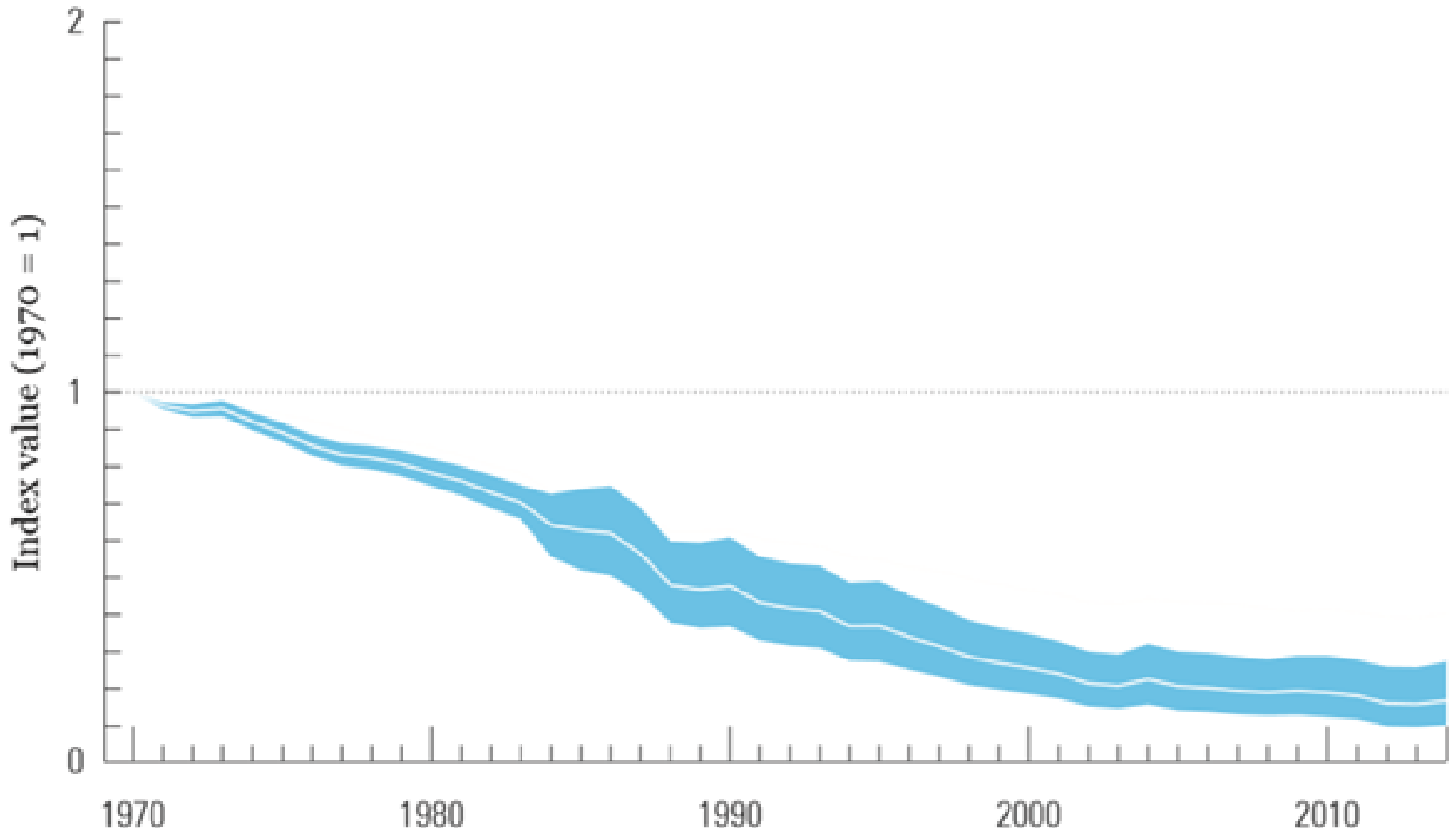


Support for ecosystems

- habitats
- microclimates
- life-stages
- productivity

Carbon sequestration

Freshwater Living Planet Index



Drivers of river ecosystems

- Hydrology (flow of water)
- Water quality:
 - temperature
 - nutrients
 - salinity
 - toxins
- Sedimentology/geomorphology (erosion, deposition, etc.)
- Connectivity (flow between different parts of the river system)
 - lateral
 - longitudinal
- Physical factors
 - vegetation
 - deforestation and canalisation
- Resource utilisation (Management issues):
 - sand mining
 - fishing

Human developments (incl. climate change) affect all of these



Drivers of river ecosystems

- **Hydrology (flow of water)**
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- **Sedimentology/geomorphology (flow of sediments)**
- **Connectivity (flow of animals and plants)**
 - lateral
 - longitudinal
- Physical alterations
 - landuse changes
 - removal of vegetation
 - channelisation and canalisation
- **Resource utilisation** (Management issues)
 - sand mining
 - fishing

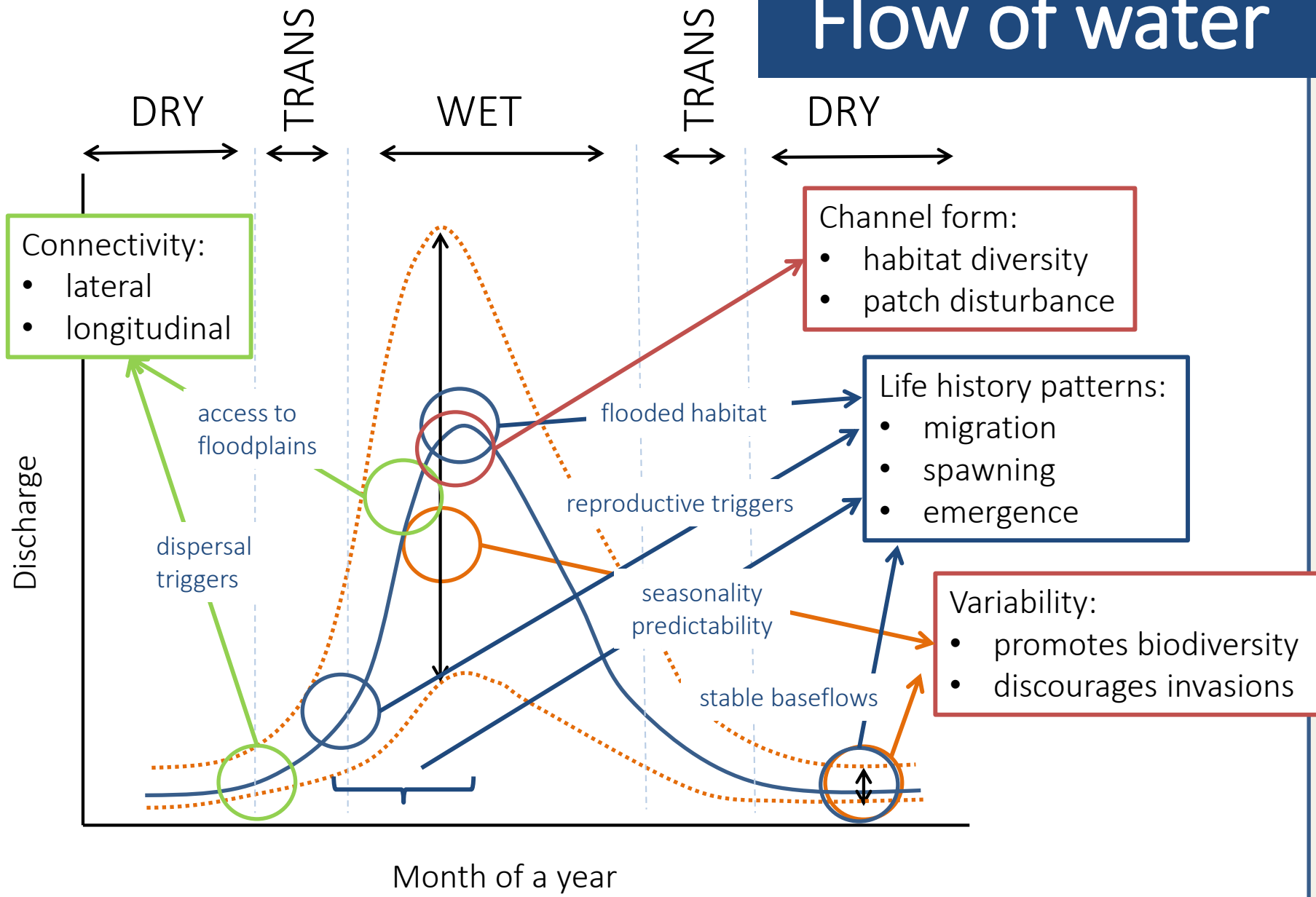


Drivers of river ecosystems

- **Hydrology (flow of water)**
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Flow of water



Connectivity:

- lateral
- longitudinal

Channel form:

- habitat diversity
- patch disturbance

Life history patterns:

- migration
- spawning
- emergence

Variability:

- promotes biodiversity
- discourages invasions

Discharge

Month of a year

DRY

TRANS

WET

TRANS

DRY

access to floodplains

dispersal triggers

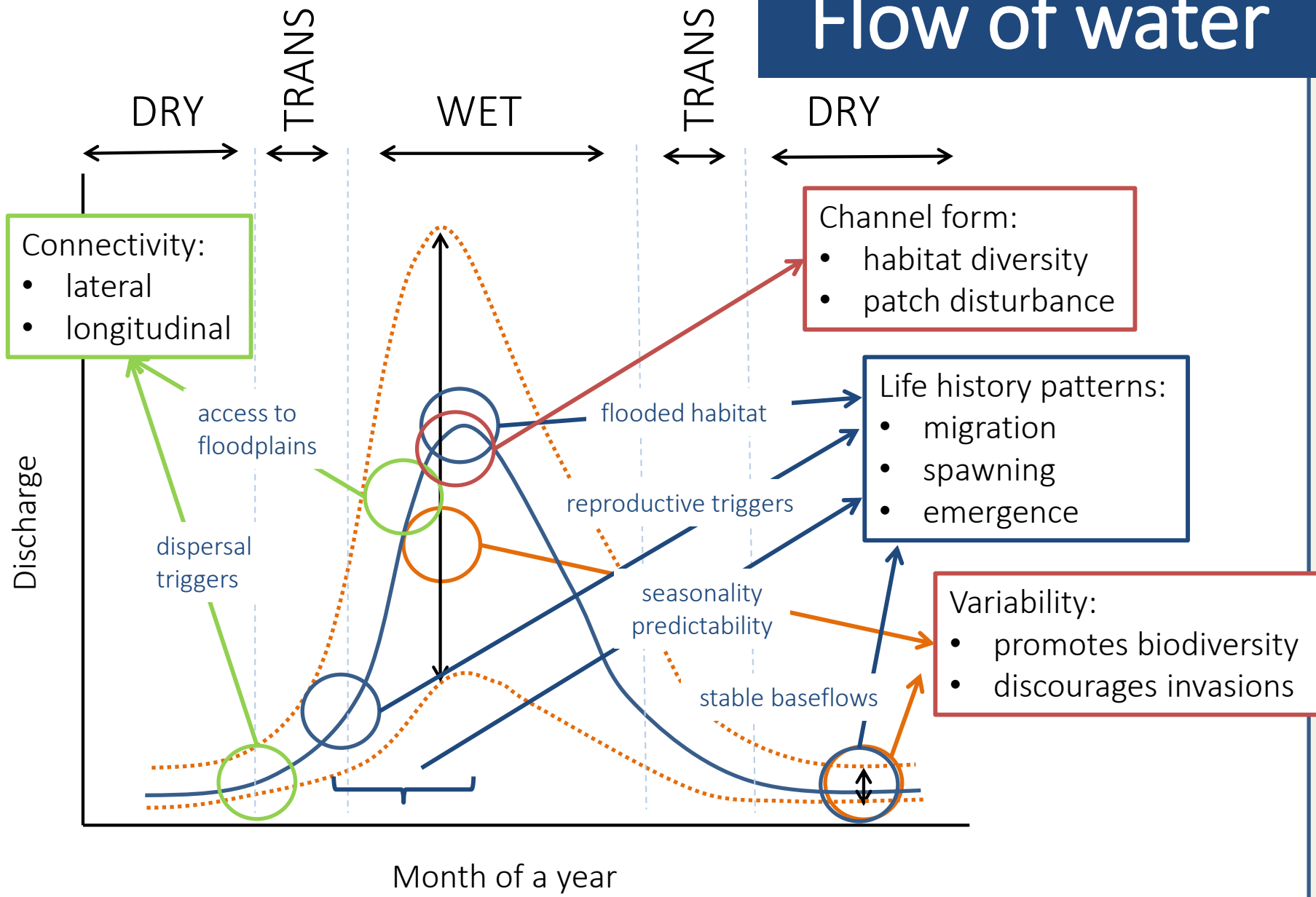
flooded habitat

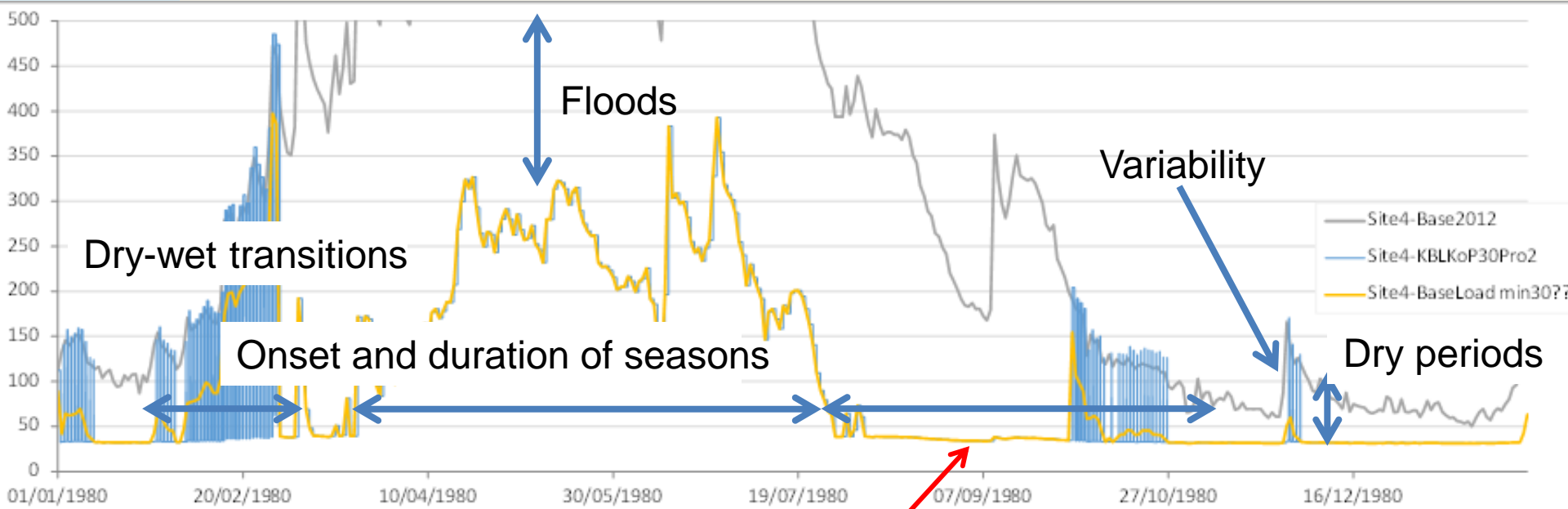
reproductive triggers

seasonality predictability

stable baseflows

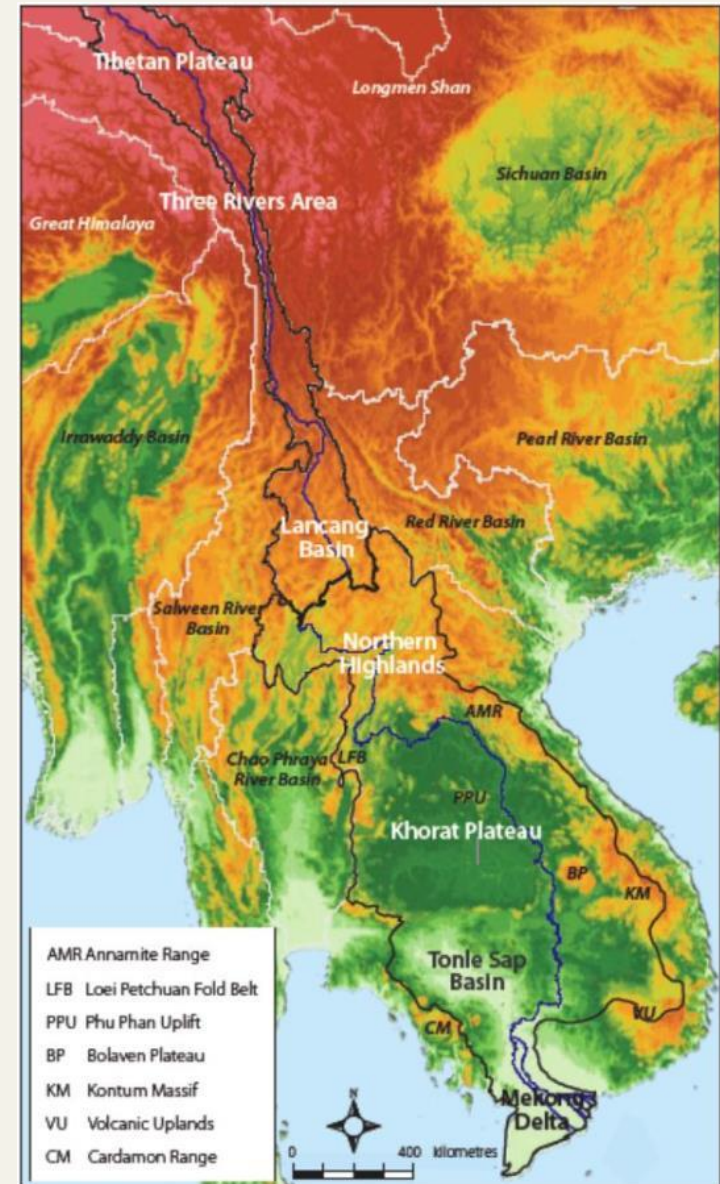
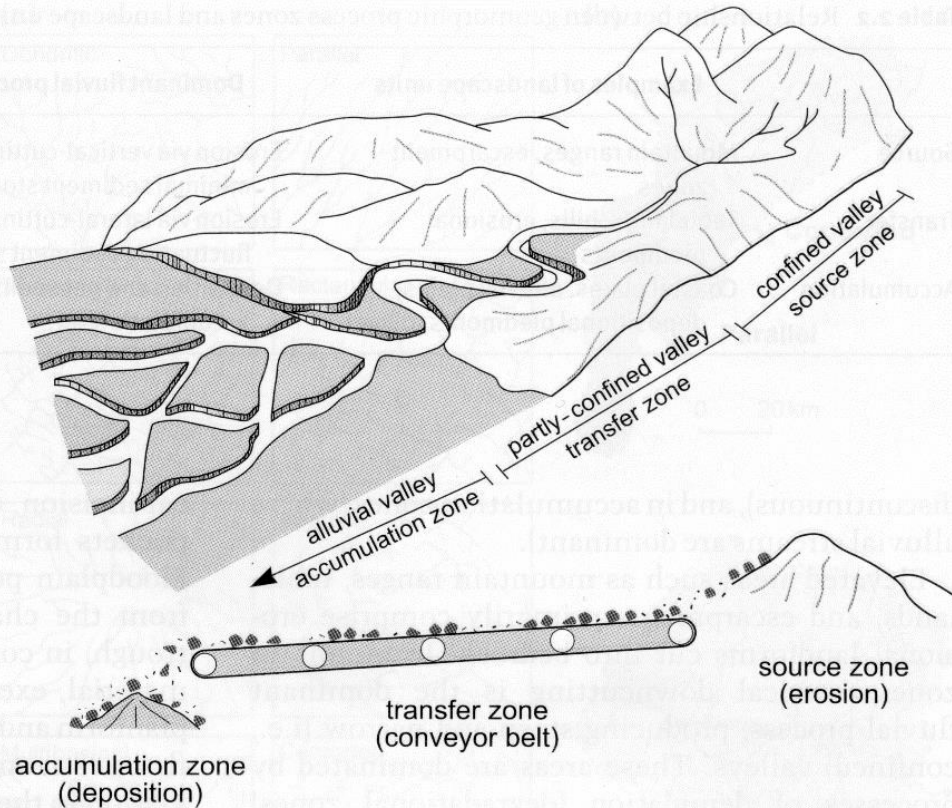
Flow of water

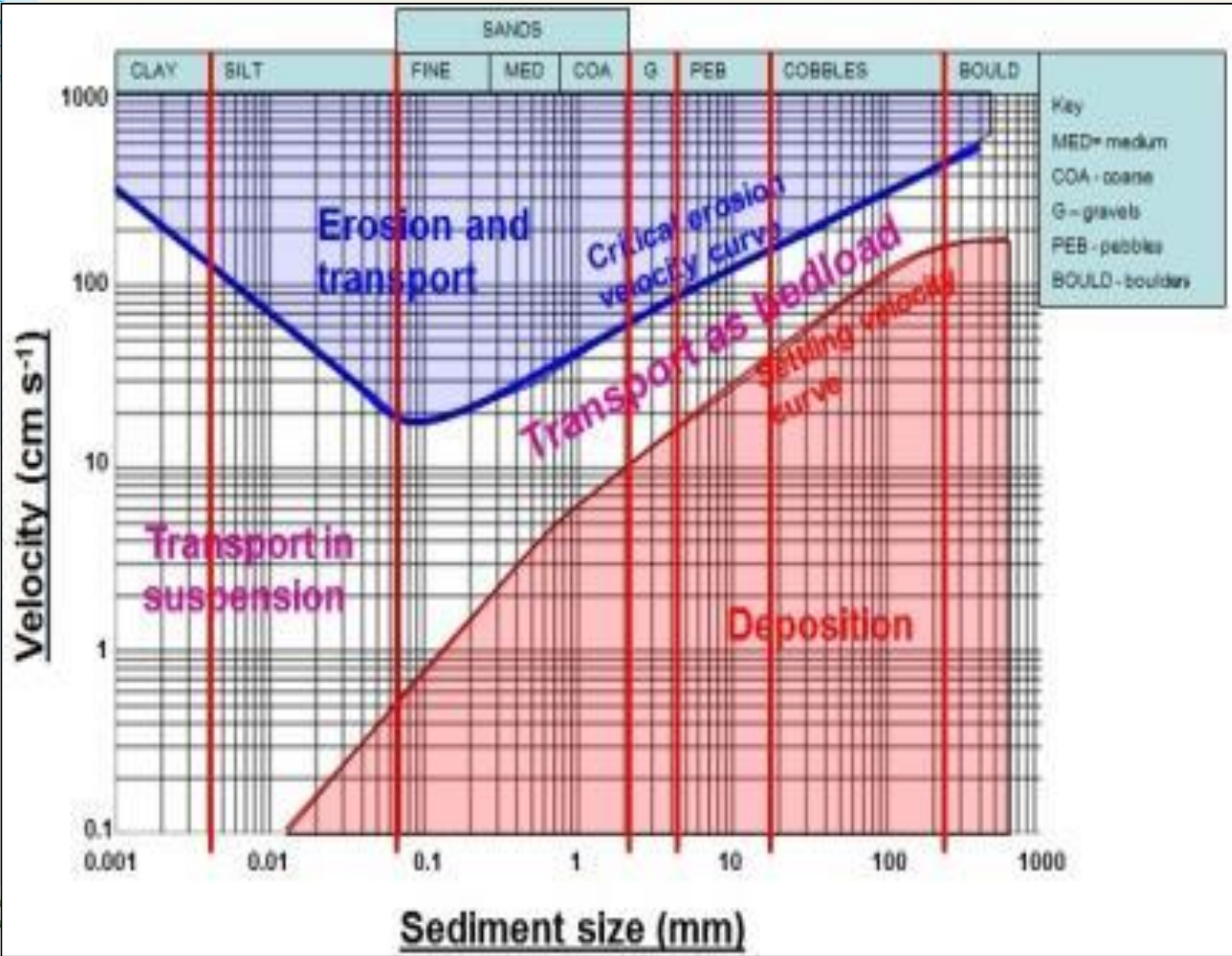




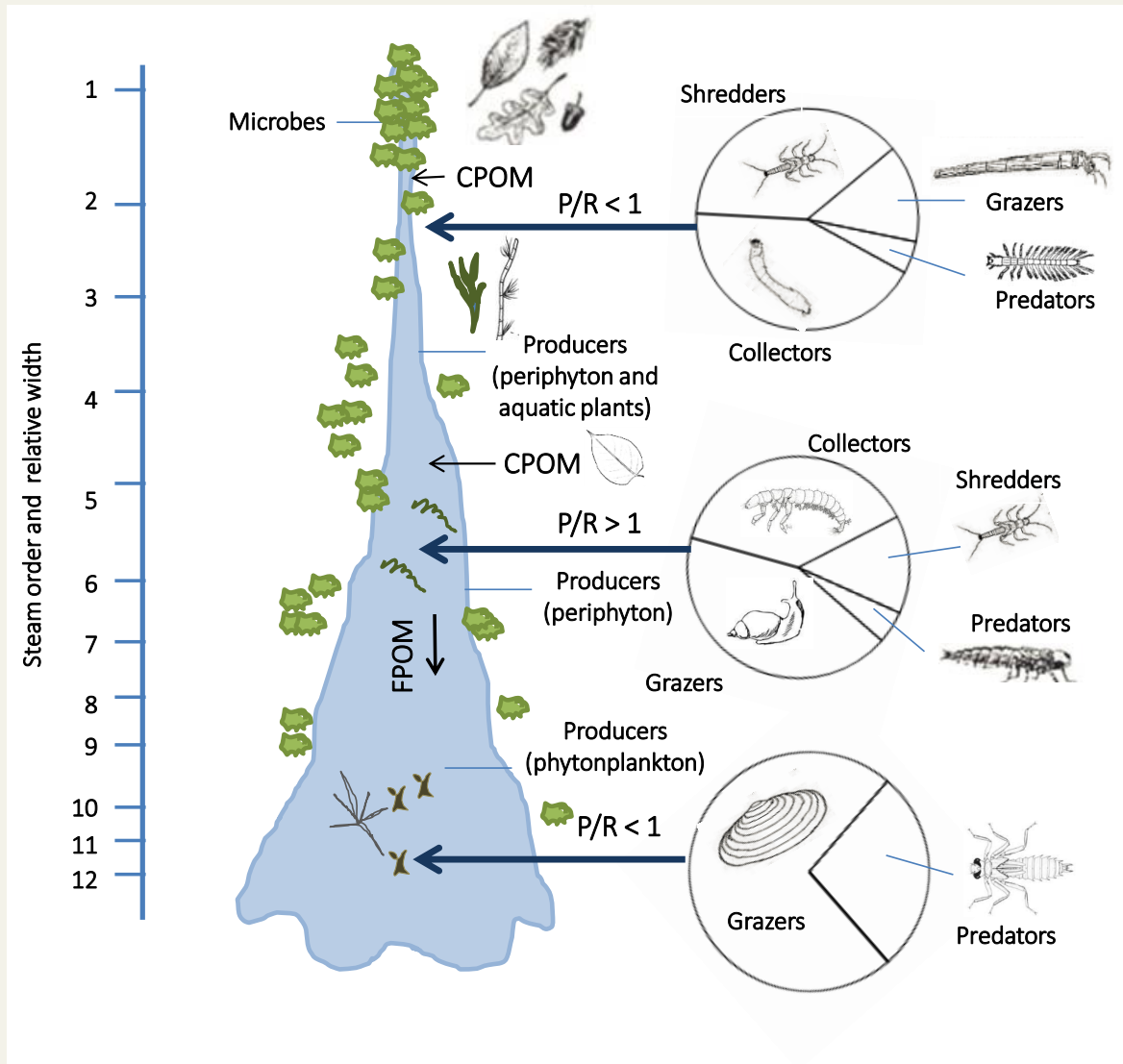
Flow of sediment

Rivers transport sediments and carve landscapes

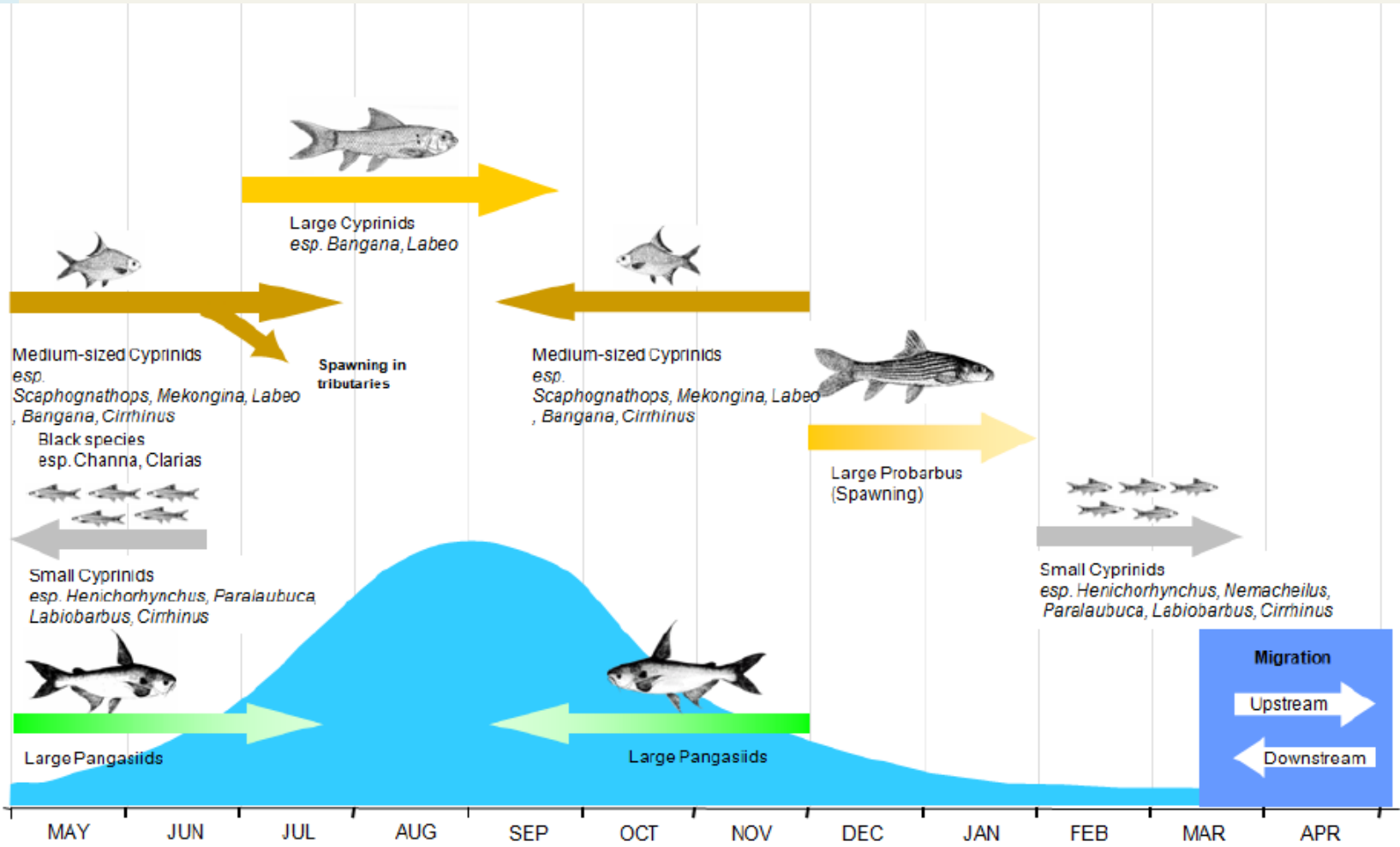




River continuum concept (Vannote et al. 1980)



Flow of animals and plants



Flow of animals and plants



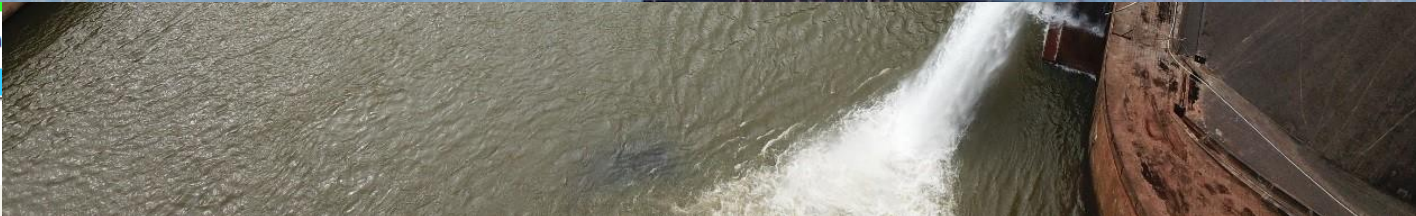
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acheilus,
Cirrinus
Migration
Upstream
Downstream

APR



Flow of animals and plants



Downstream

APR

Baird and Shoemaker 2007



Resource utilisation

- Ecosystem functioning affected by:
 - Land-use
 - Engineering of channels
 - Harvesting:
 - sediments
 - plants
 - animals



Climate change

- Climate
- Vegetation cover
- Runoff
- River flows
- Sediment supply
- Connectivity
- Resource use



Healthy river ecosystems are paramount in achieving the SDGs



Thank you

