

Warmer water - an overlooked factor affecting freshwater fish

Marijan Govedič

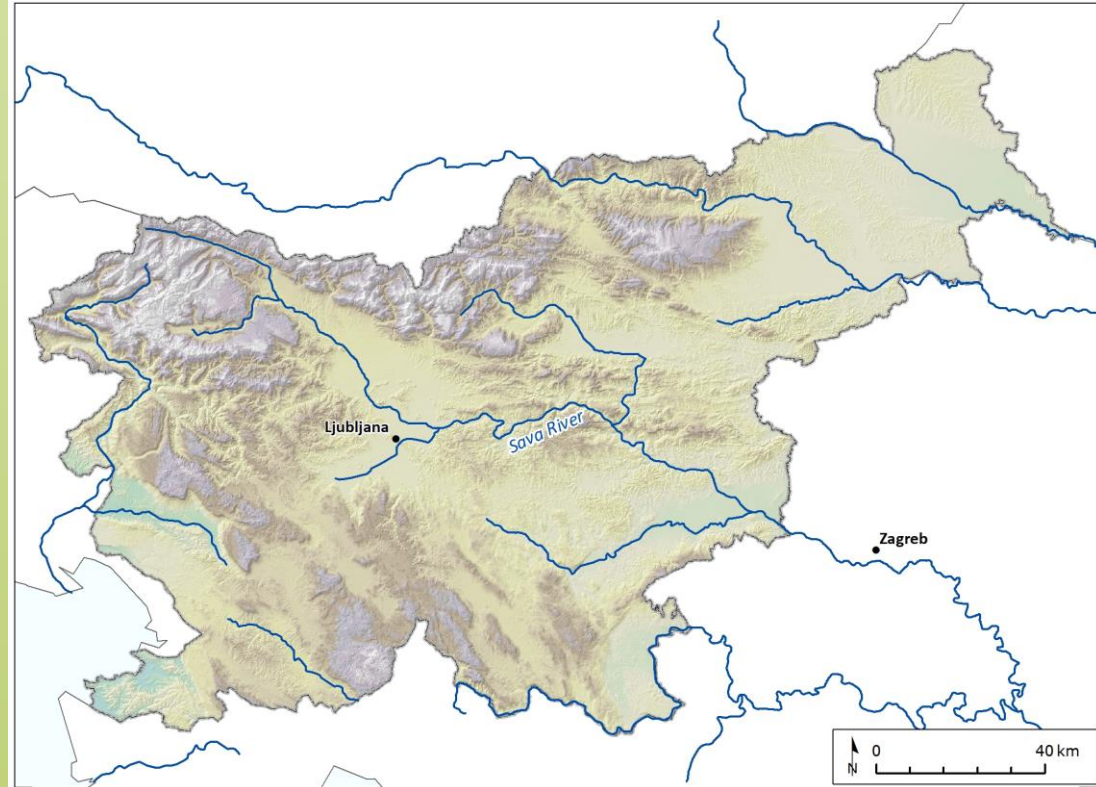
Climate change impact on recreational fisheries:
building resilience; 7.9.2021



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FAVNE IN FLORE

Distribution of cold-water freshwater fish (Danube salmon, grayling, brown trout, bullhead) – Local extinctions



- Visible changes (regulations, water regime)
- Invisible changes (chemical compounds, hormones, oxygen, temperature?)

Importance of water temperature?

- Oxygen, eutrophication, eutrophication oxygen depletion
- Water temperature affects nearly every other water quality parameter – it can alter the physical and chemical properties of water

Water temperature is the most important physical property

- Tolerance, mortality
- Metabolic activity (oxygen), growth, feeding,
- Reproduction, embryonic development
- Diseases and parasites

- Distribution (species area), density, biodiversity

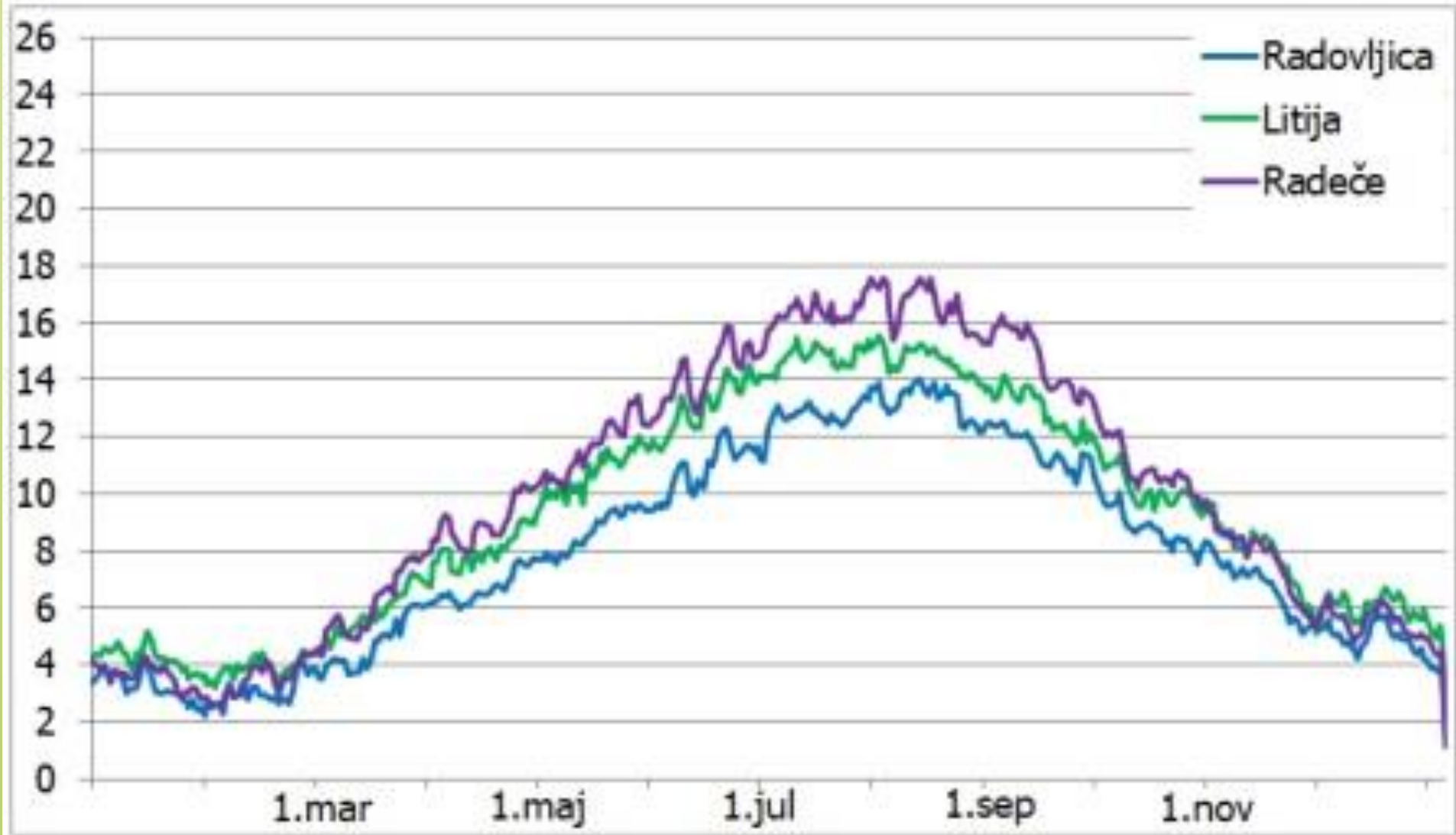
- On average 2°C higher water temperature of rivers (average air temperature growth)

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Average or a maximum?



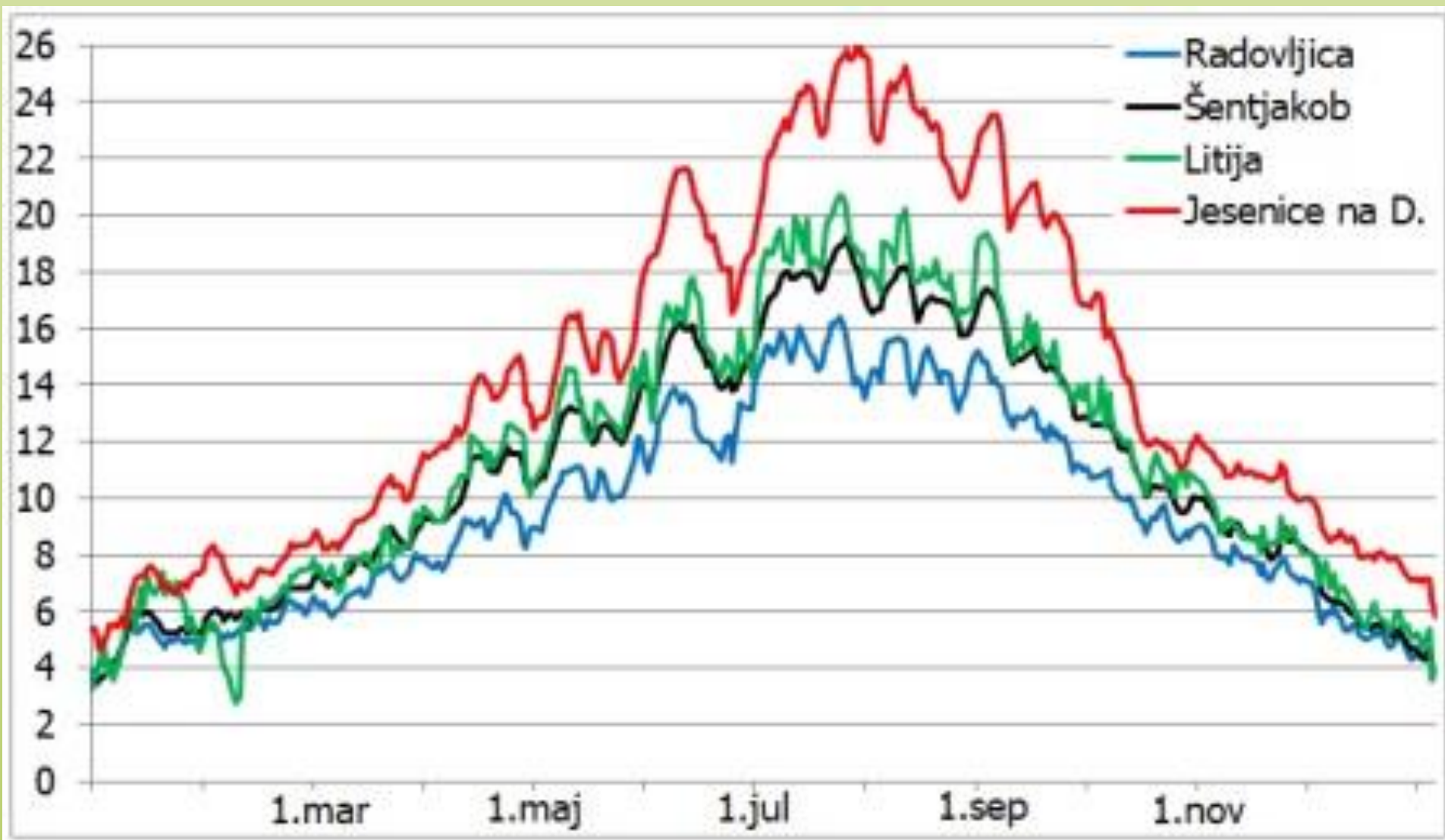
Sava River: 1953-59



Sava River: 1991-1998



Sava River: 2015-2016



Changed temperature regime

- Water abstractions?
- River regulations?
- Thermal pollution?
- Climate change (precipitation, discharge, snow melting, air temperature)?
- Resilience?

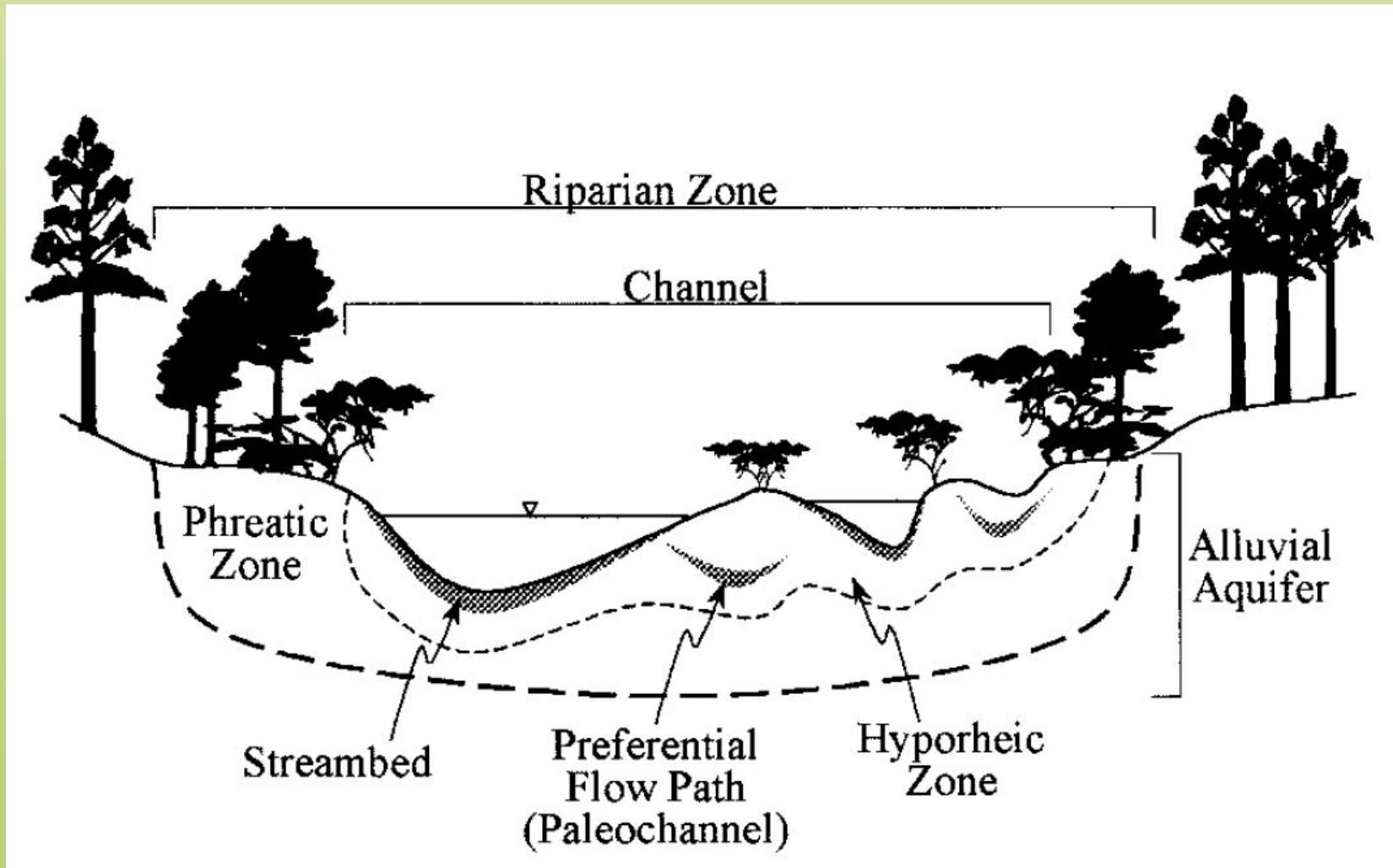
Human impact

- Riverbed morphology (size, depth, length, gravel abstraction)
- Riverbank vegetation

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River > Channel; River = Riparian zone + Aquifer

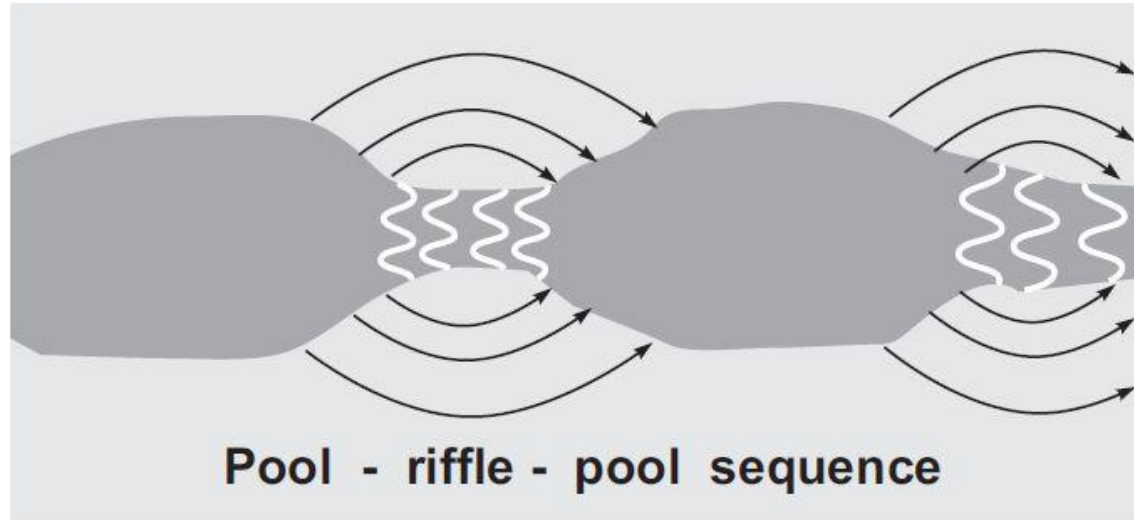


Alluvial aquifer

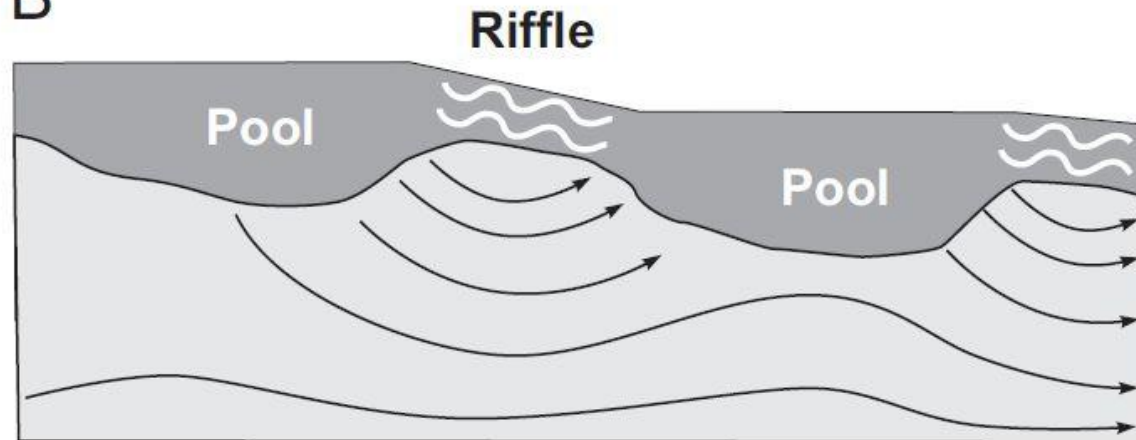
- Interstitial water
- Water in river channel = fish habitat
- Interstitial water = drinking water
- Natural cooling system, buffer system
- **Natural resilience system (water and temperature storage)**

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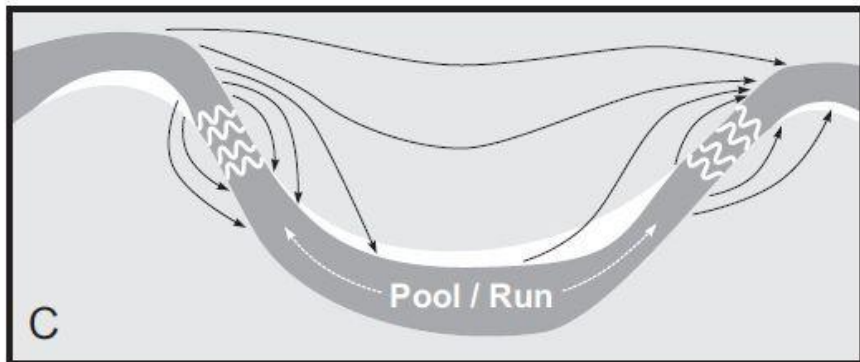
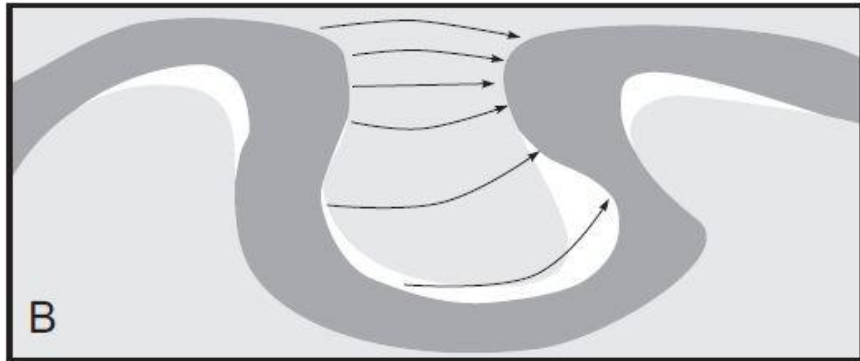
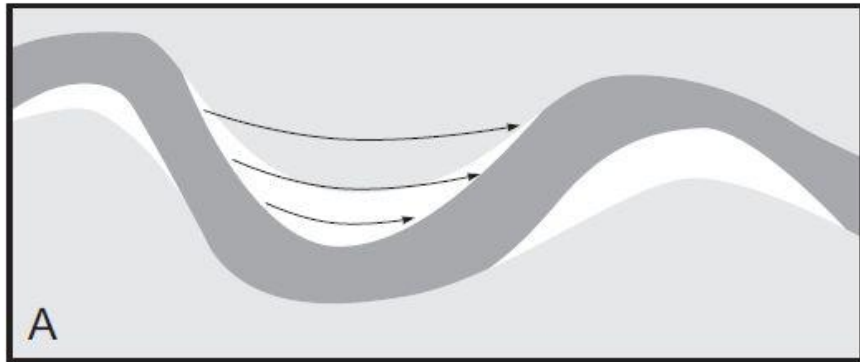
A



B



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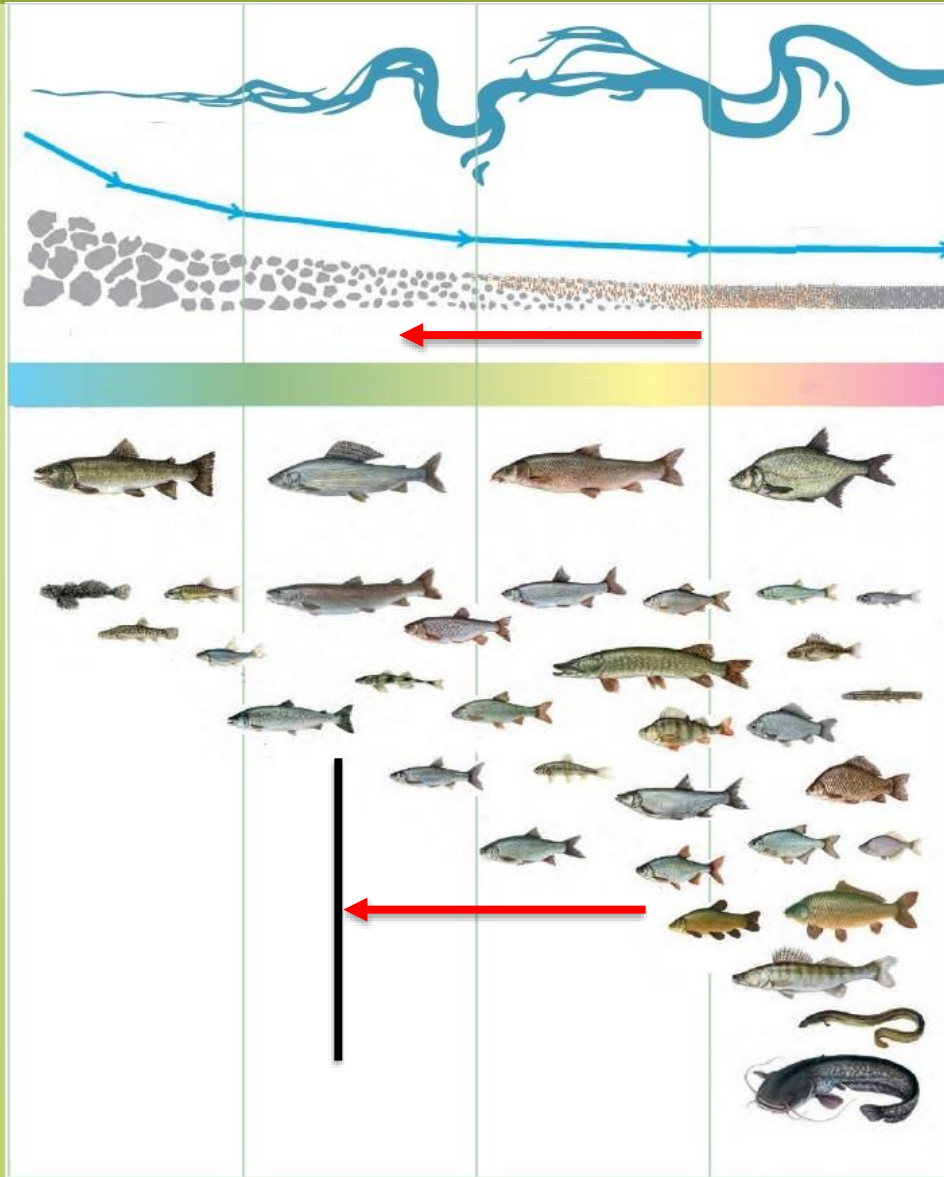
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Fish response on higher temperature

- Early spawning
- Higher growth rate, higher mortality
- Acclimatization
- Stress (Higher metabolic rate - higher oxygen consumption)
- Lethal temperature
- chronic exposure
- behavioral response - movement– fish passes, refuge habitats (pools), optimal feeding habitat
- physiological response – decrease of activity, larger predation

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Conclusions

- Water temperature increase (average, maximum)
- Water temperature does not affect only on oxygen level and eutrophication
- Changed species distribution – „empty space“
- Destruction of natural resilience
- Climate change scenarios – temperature increase, precipitation extremes

Large scale river restorations for (Re)building resilience

