

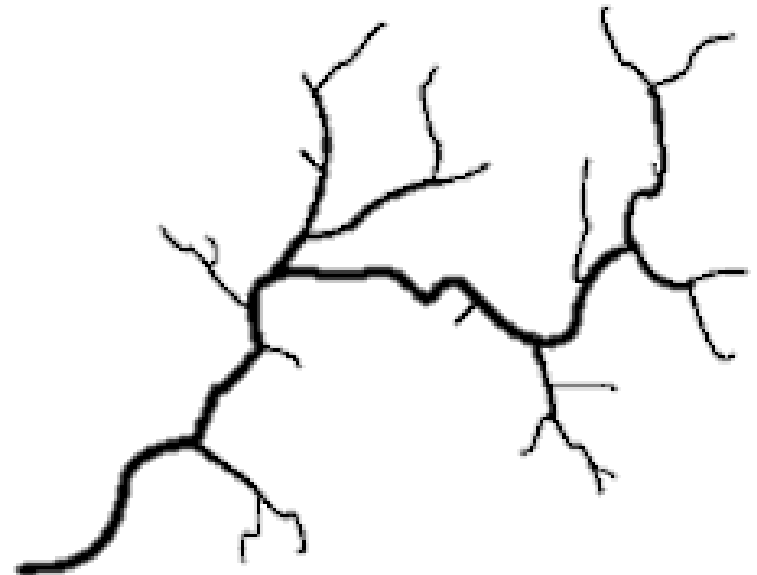


# Size & site matter

## The case of rivers

D.Tendall

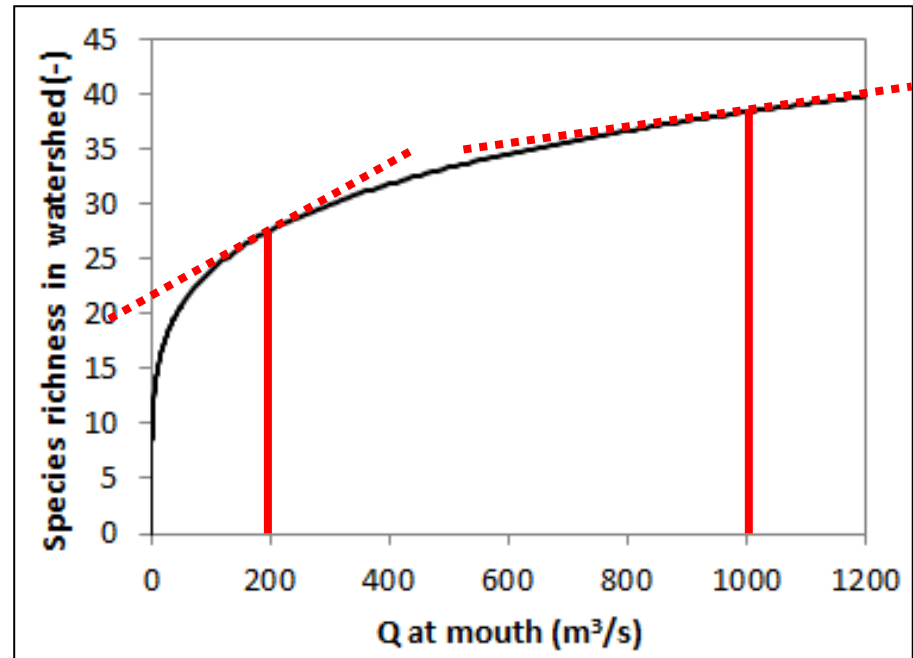
LCA DF50 - 4 Dec. 2012



# The case of rivers

- Impacts of river water withdrawals on aquatic biodiversity (fish)
- Based on species-discharge relationship (SDR)
- Assumptions:
  - Marginal effect
  - Discharge at mouth = best case
  - Total volume, wherever the withdrawal

$$CF = \frac{dQ}{dW} * \left( \frac{dR}{R * dQ} * V \right) \quad [PDF * m^3 * y / m^3] \quad *$$



\*Hanafiah, M.M. et al. *Characterization factors for water consumption and greenhouse gas emissions based on freshwater fish species extinction*. Environ. Sci. Tech., 2011.



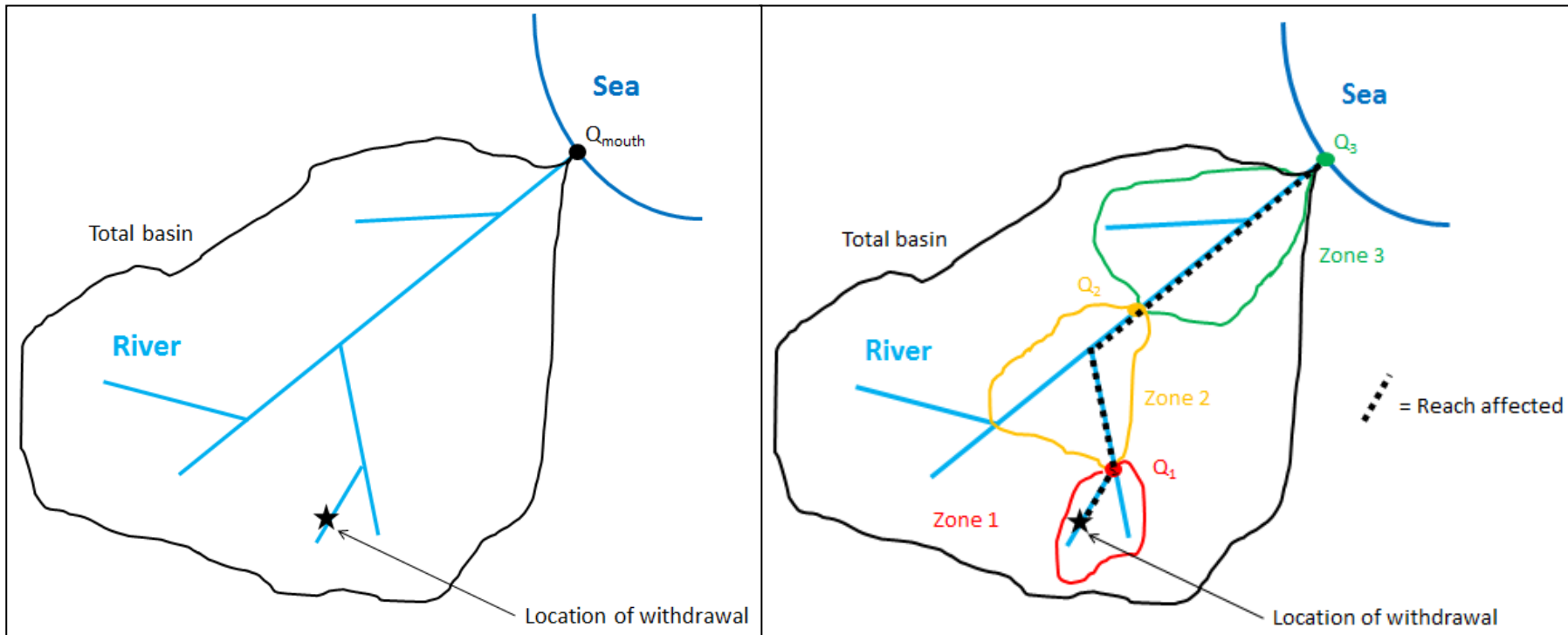
# Size and site

- Biodiversity in a smaller river is more affected than in a larger river, for the same amount withdrawn
  - But only «best-case» effect is considered...  
→ **Size of river matters?**
- Biodiversity in basin may be less affected by a withdrawal close to mouth than by a withdrawal near headwaters
  - Smaller portion of river affected downstream & lack of water is not transferred upstream  
→ **Site of withdrawal important?**



# Possible solution

- Assume withdrawal only affects downstream river portion
- Aggregate effects occurring downstream:
  - Higher impact for a withdrawal located further upstream
- Zones: assume distinct species (eg. Huet et al. 1949 for Europe)

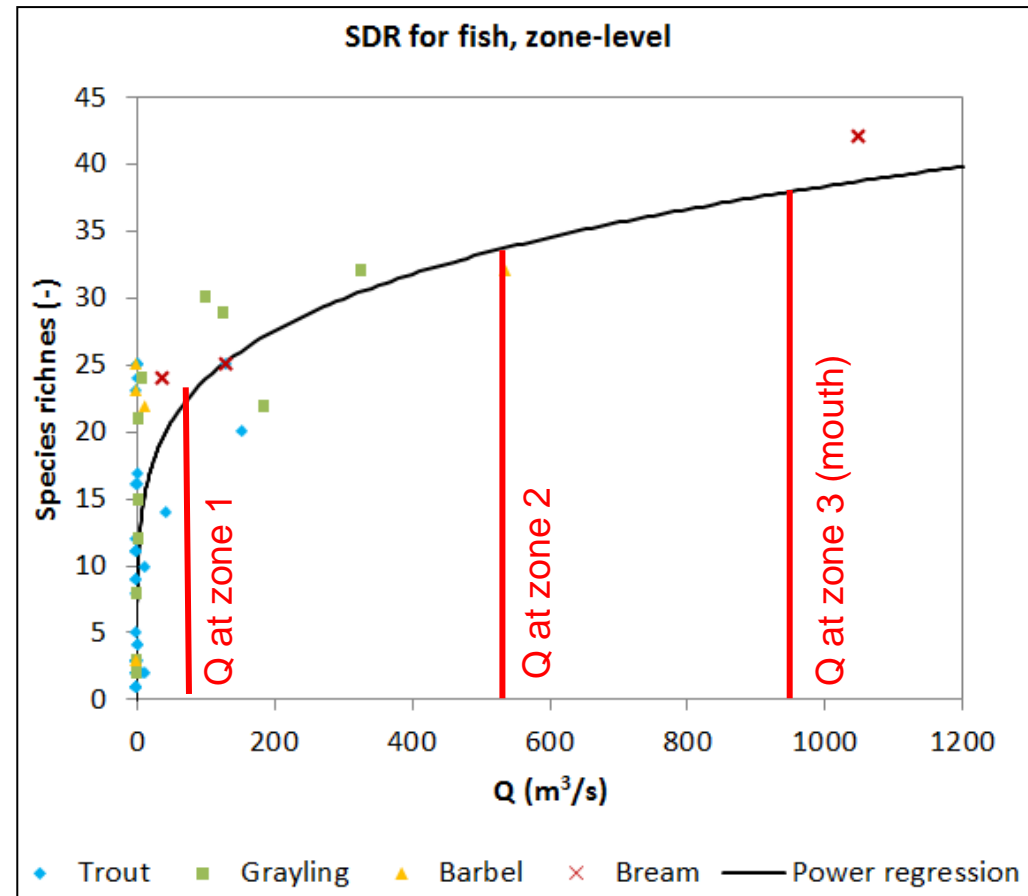


# Adapted SDR

- SDR verified also for zones rather than basins (for CH)
- Can aggregate impacts for each zone downstream (eg. 1, 2, 3) without double-counting

$$CF_j = \sum_{i=j}^{mouth} \left( \frac{dSR_i}{dQ} \cdot ARF_i \right)$$

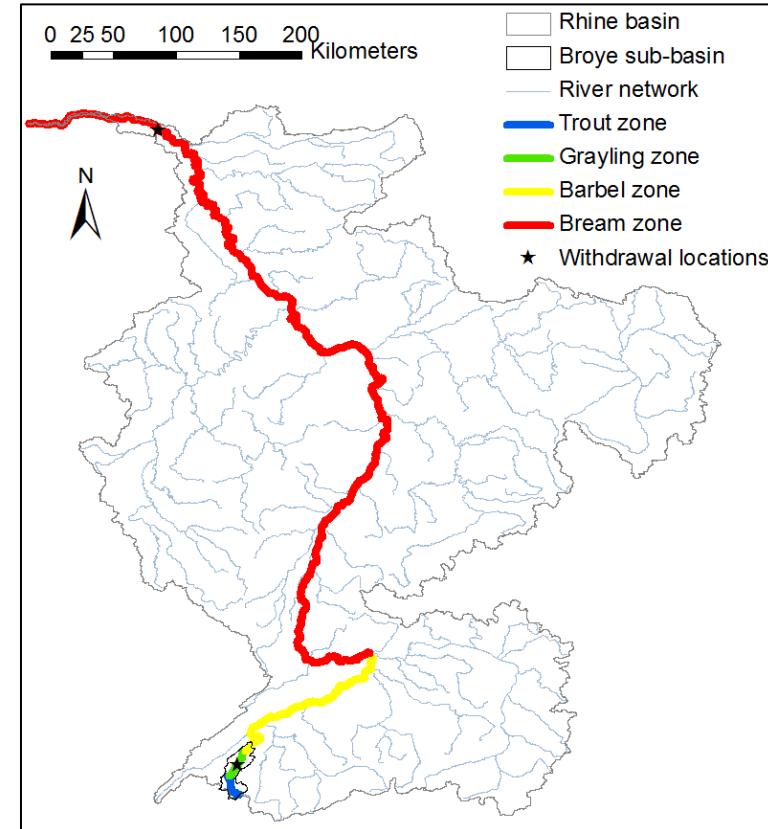
- Impact = potential species lost, as equivalents of global extinctions «GSEE»





# Application example

- Withdrawals for irrigation in Broye sub-basin (Rhine) x40 in 2050\*:
    - $1.46\text{m}^3/\text{s} = 12\%$  Broye (non-marginal),  $0.06\%$  Rhine (marginal)
    - Impact:  $1.34\text{E-}4$  GSEE
    - If withdrawn near mouth of Rhine:  $5.13\text{E-}5$  GSEE
    - Difference  $\sim 1$  order of magnitude
  - Variation between global basins (original method): also  $\sim 1$  order of magnitude
- **Variation within basin  $\approx$  variation between global basins?**



\*AGWAM project, NRP61: [www.nrp61.ch](http://www.nrp61.ch)



# Implications

- **Characterization factors:**

- Is zonation possible for other regions/taxa?
- Is the SDR for zones verified for other regions/taxa?
- Spatially explicit CFs (eg. raster) for each withdrawal location = zone in each river.

- **Impacts:**

- In global species extinction equivalents rather than fraction lost \* volume affected
- Can be aggregated if using a consensus unit...

- **Inventory:**

- Need to know water source type (river)
- Need to know spatial location



# Discussion points

- Impact modeling of river water use in LCA:
  - Should be regionalized... but just how much?
  - How complete should pathway coverage be?
    - Still a lot of effort to cover missing pathways...
  - How can impacts from different models be compared?







**Thanks!**

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