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Size & site matter
The case of rivers

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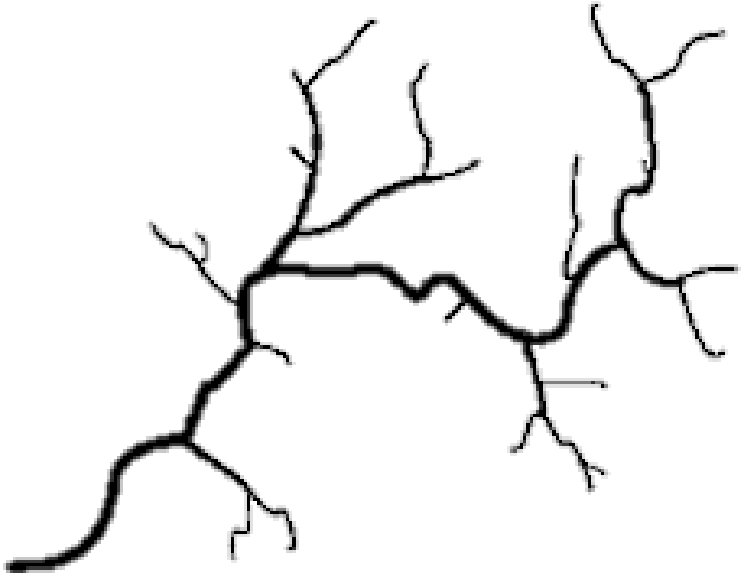
LCA DF50 - 4 Dec. 2012



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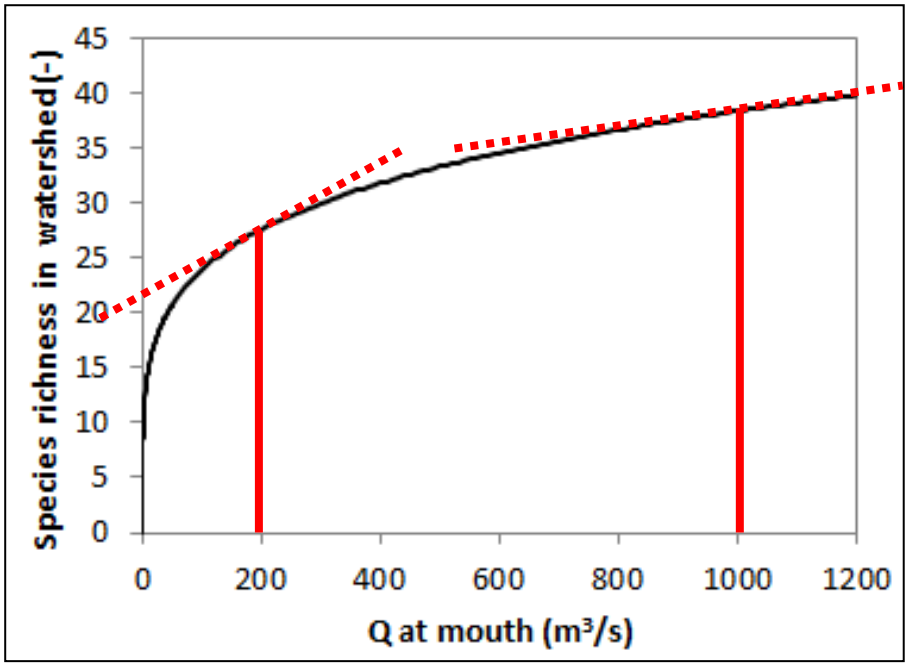
The case of rivers

- 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- Biodiversity in a smaller river is more affected than in a larger river, for the same amount withdrawn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…

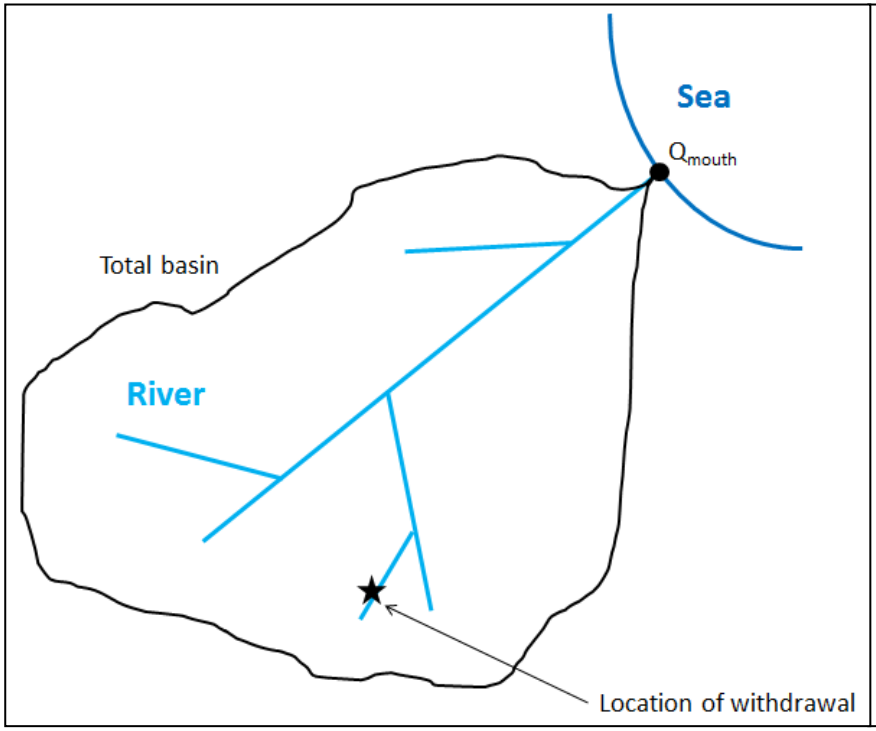
  → **Size of river matters?**

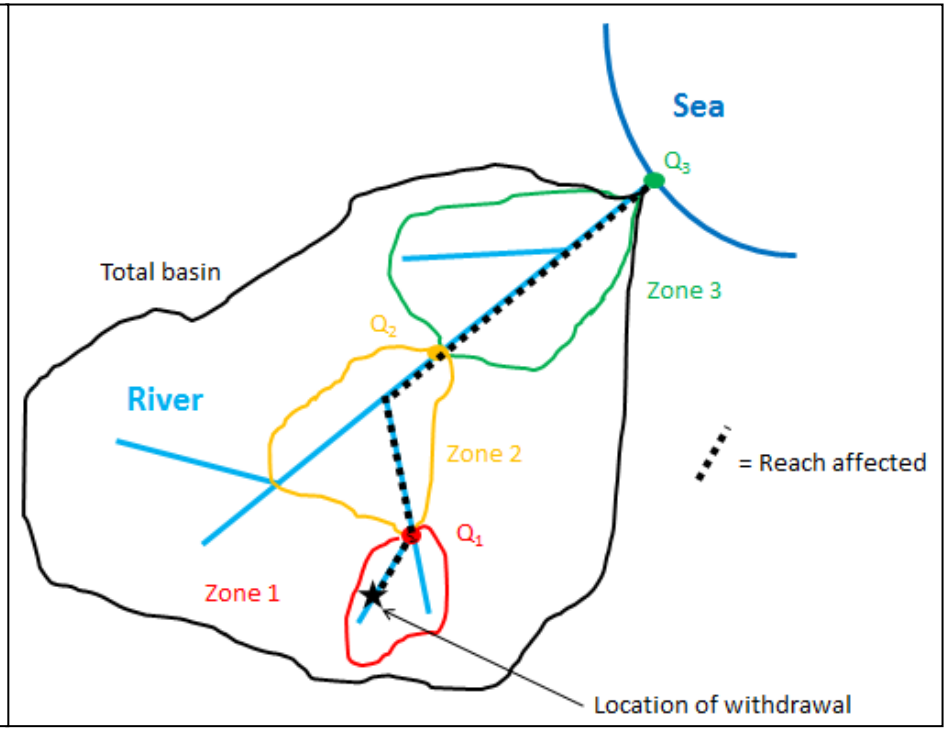
- Biodiversity in basin may be less affected by a withdrawal close to mouth than by a withdrawal near headwaters
  - Smaller portion of river affected downstream & lack of water is not transferred upstream

  → **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)



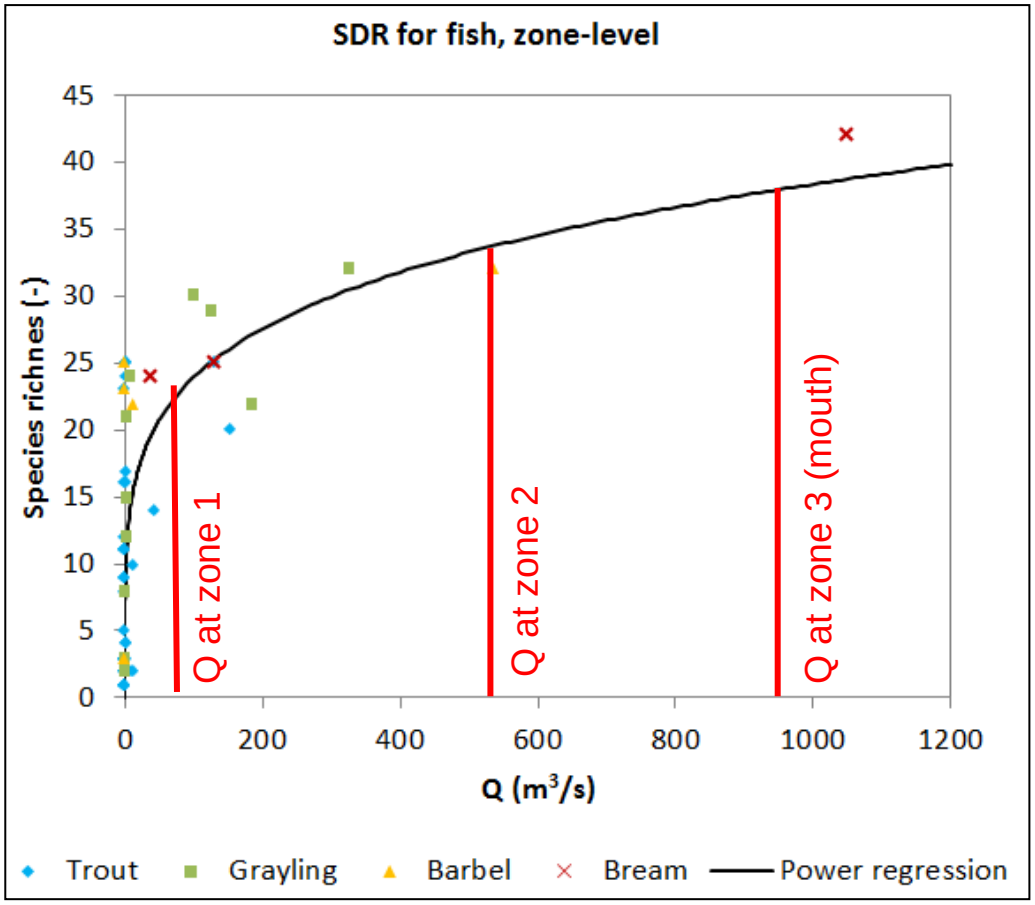


Adapted SDR

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

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

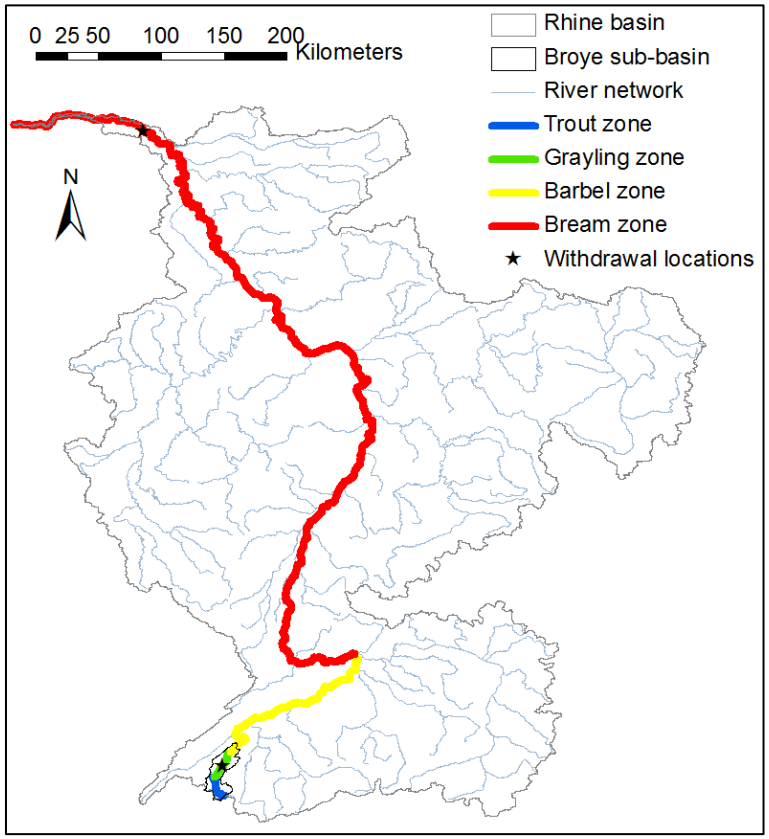
- Impact = potential species lost, as equivalents of global extinctions «GSEE»



Application example

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

→ **Variation within basin ≈ variation between global basins?**



*AGWAM project, NRP61: 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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