Comparison of freshwater nutrient boundary values

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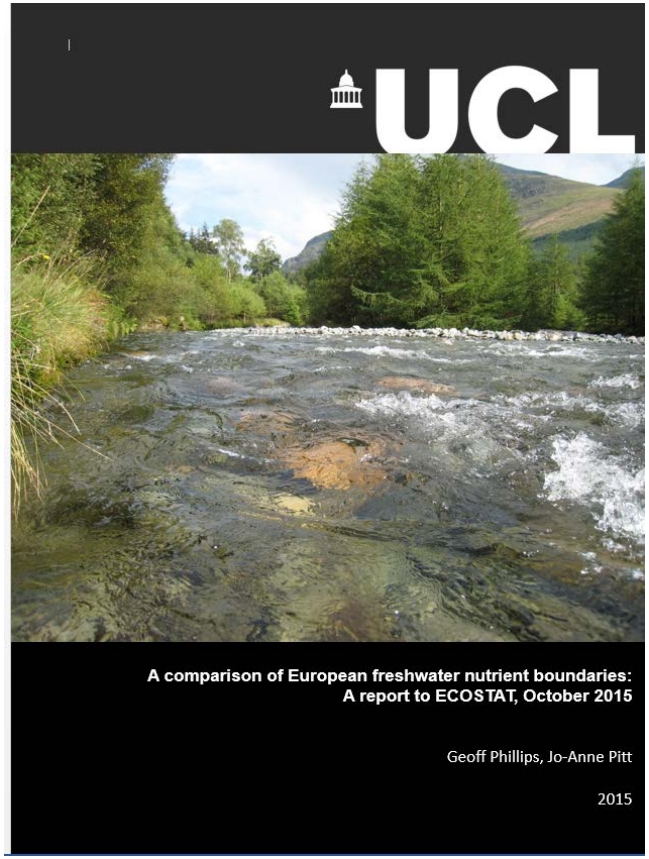
- Good response from all countries for freshwater
- Draft report circulated for comment to nutrient experts April 2015
  - Several changes in allocation of MS types to broad typology
  - Corrections to boundary values
- Final report now produced
  - Relatively wide variation of boundary values
  - More variation for rivers than lakes
  - More variation for N than P



Comparison of phosphorus

- Simple comparison for lakes, all countries use a mean for total P except ES (75th percentile)
- For rivers 5 countries use 90th percentiles (halved value for comparison), 4 countries only use soluble P.
- Three countries (FR,SE,UK) use water body specific rather than type specific values (mean of type used for comparison)

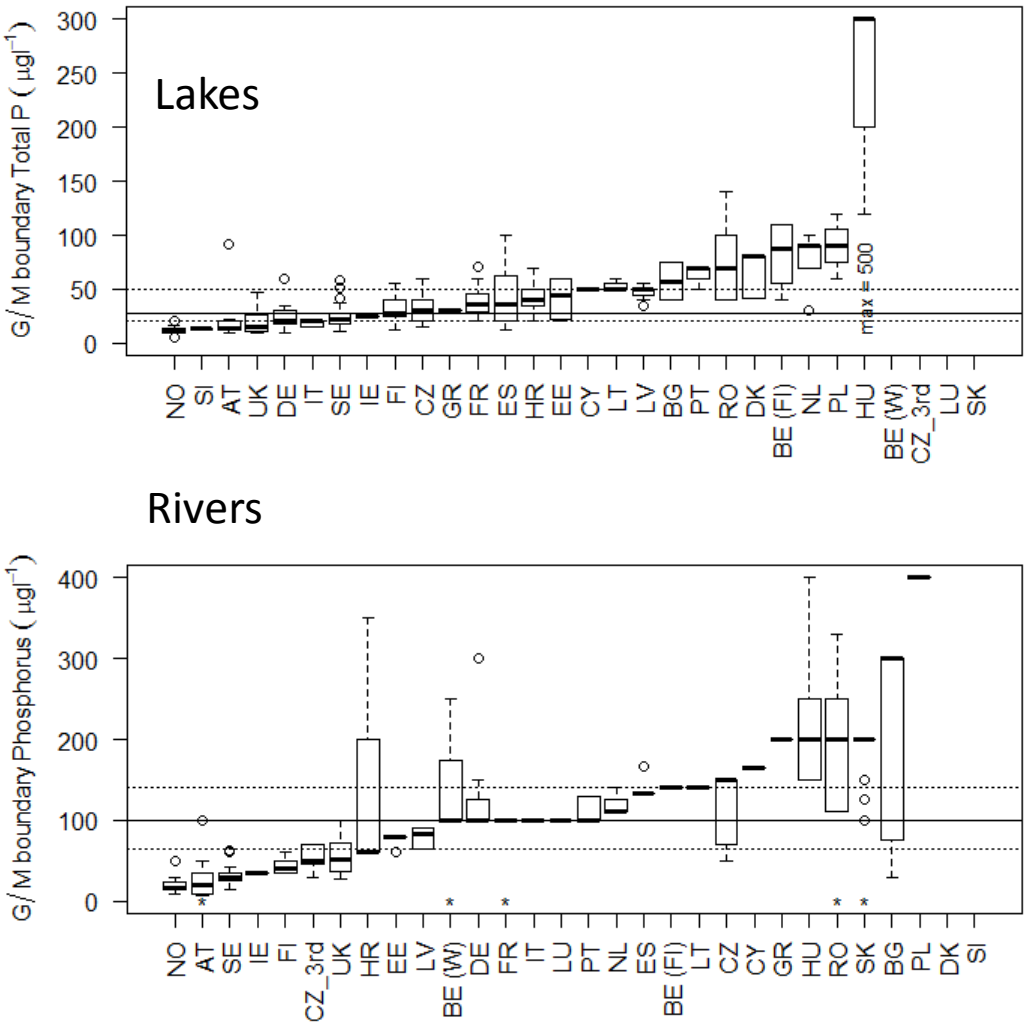
Category	Parameter Code	Period	Not specified	Percentiles			geometric mean	mean	median
				75th	90th	95th			
Lakes	SRP	Annual						2	
		Growth Season						1	
	TP	Annual		1			2	8	
		Growth Season		1				13	2
Rivers	SRP	Annual	1		4			6	1
		Growth Season						2	
	TP	Annual			4			14	3
		Growth Season						3	
	TRP	Annual				1		2	

How to make comparisons

- Country
  - Different types
- Intercalibration type
  - Most comparable water bodies, but fewer countries contributing
- Broad type
  - Less comparable water bodies, more countries contributing
- Average difference by country
  - Allow for type differences

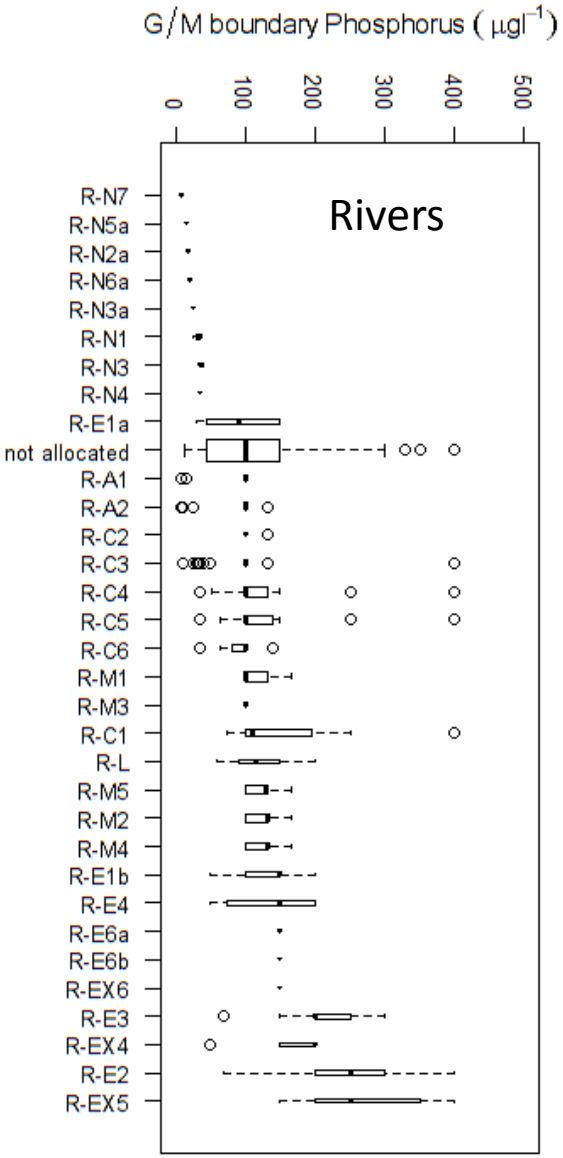
Comparison of G/M phosphorus boundaries, lakes & rivers

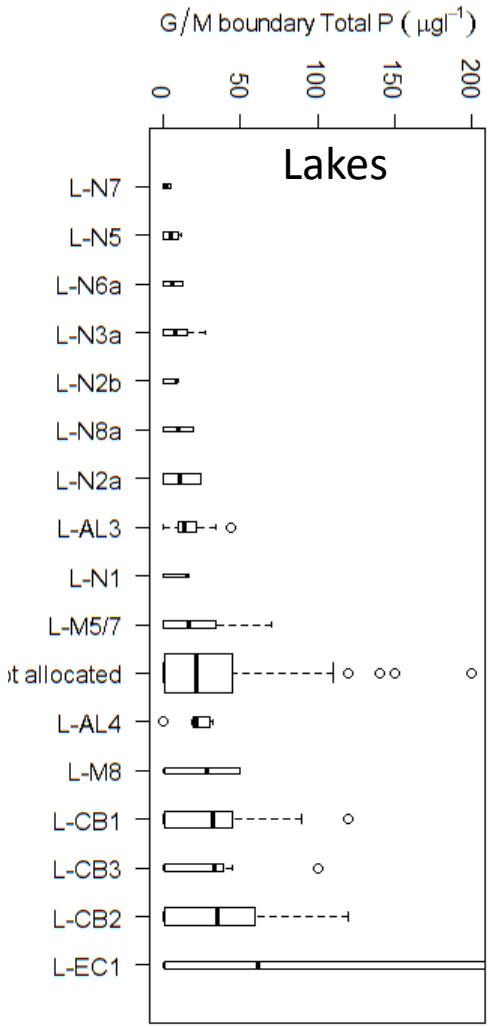
- Values lower in lakes than in rivers
  - majority lake values < 100ug/l
  - 50% lake values < 50 ug/l
- Range of values smaller in lakes than in rivers
- Fewer different boundary values for rivers, despite more types
  - More single values applied to all types
- Boundary setting more variable in rivers than in lakes



P comparison by intercalibration type

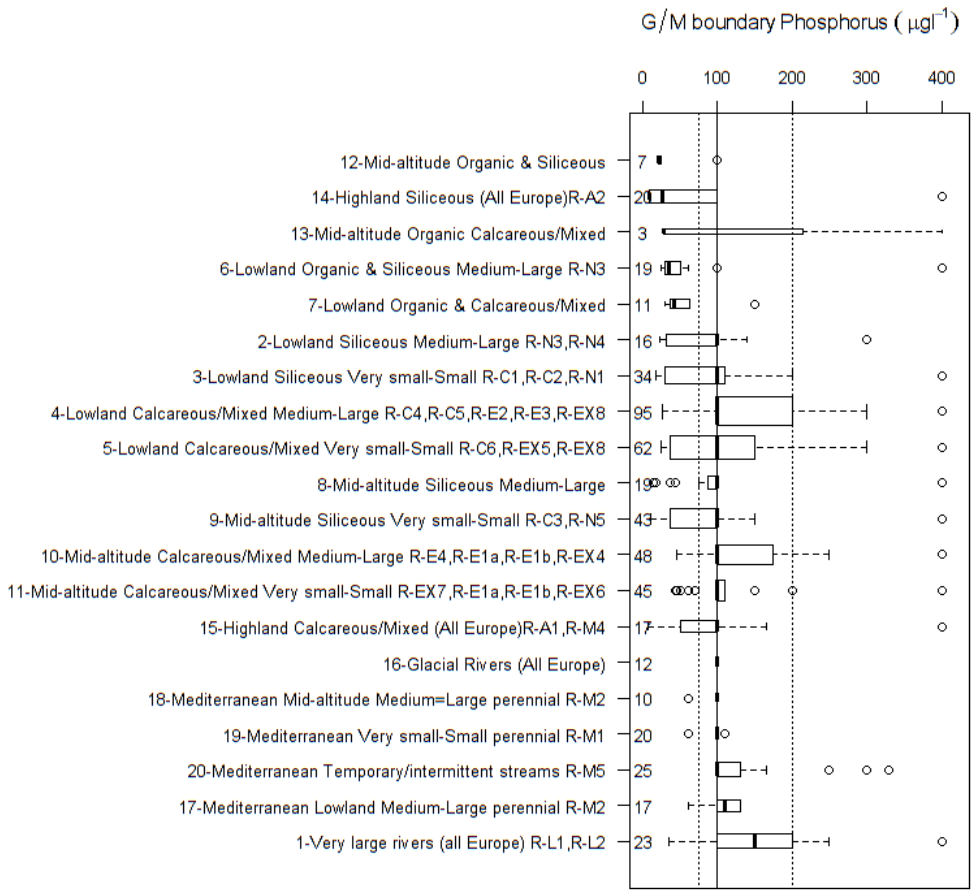
- Small range where few countries contribute to type
- Rivers range 50 to >100µg/l
- Lakes range 30 to <100µg/l



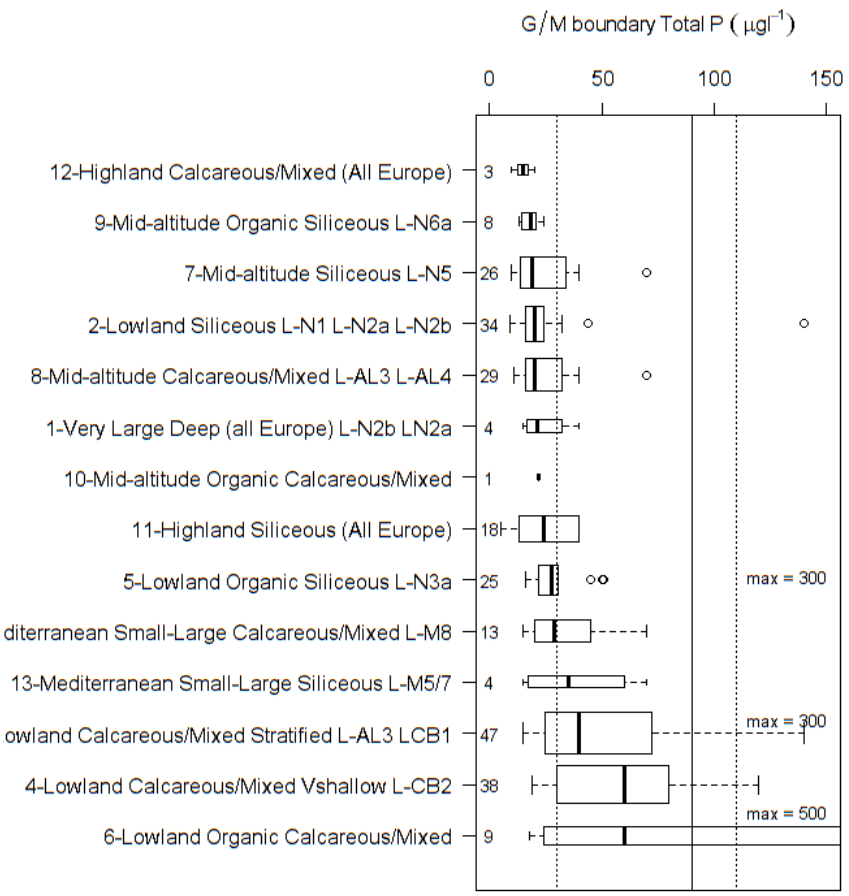


P comparison by broad type

Rivers



Lakes



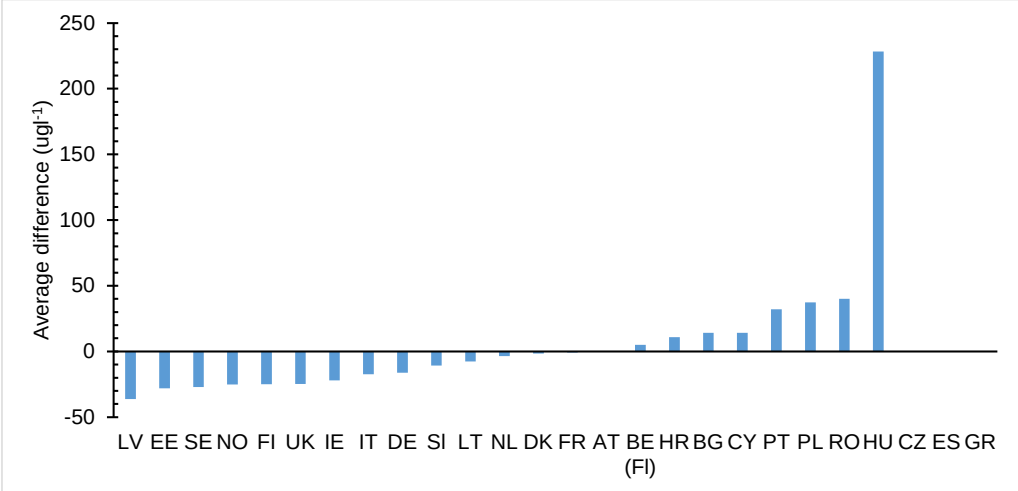
Similar conclusions using Broad types. Range rivers 75-100µg/l, lakes 30-50µg/l

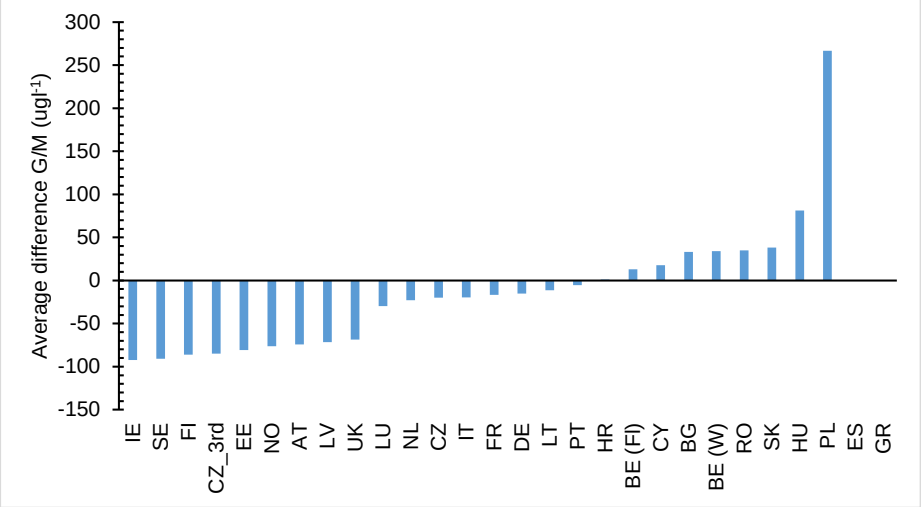
Comparison by country

Calculate:

1. average boundary value by broad type
2. national difference for each broad type
3. average difference by country

Lakes most differences ± 30 ug/l
Rivers differences > ± 50 ug/l





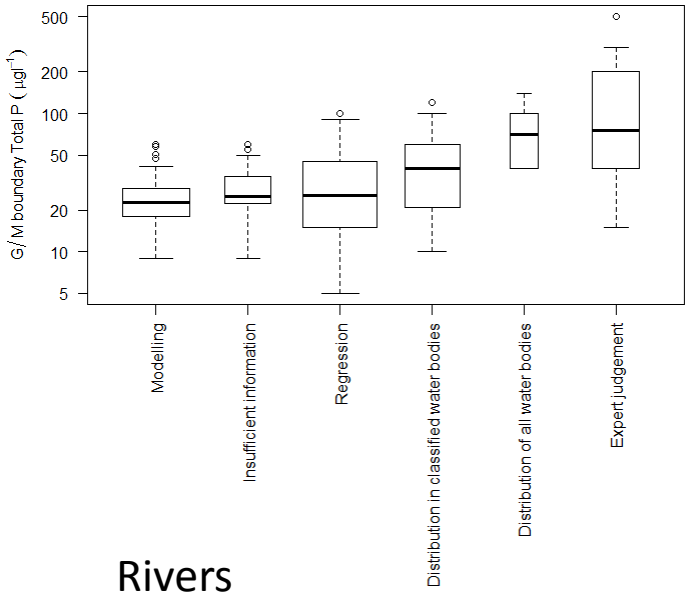
Comparison by method

Approximate order of resulting boundary values in lakes & rivers

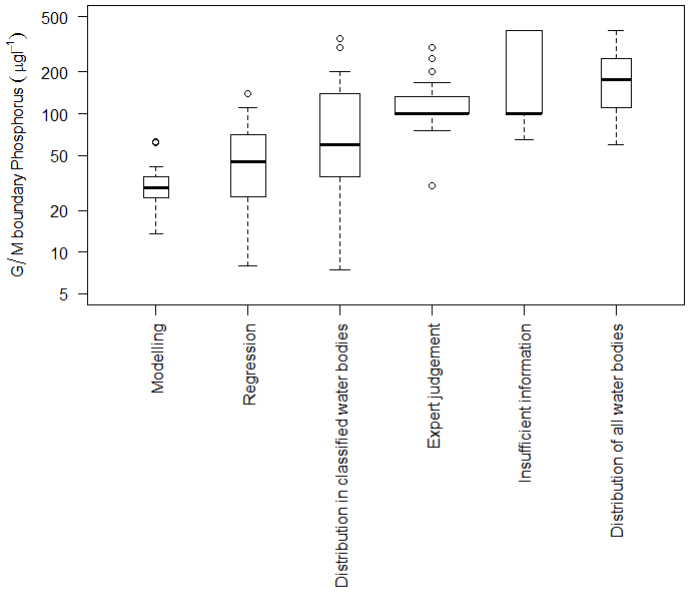
1. Modelling,
2. Regression,
3. Distribution of P in classified WBs
4. Distribution in all WBs
5. Expert Judgement

Objective methods directly related to ecological status produce lower boundary values

Lakes



Rivers



Comparison of Nitrogen

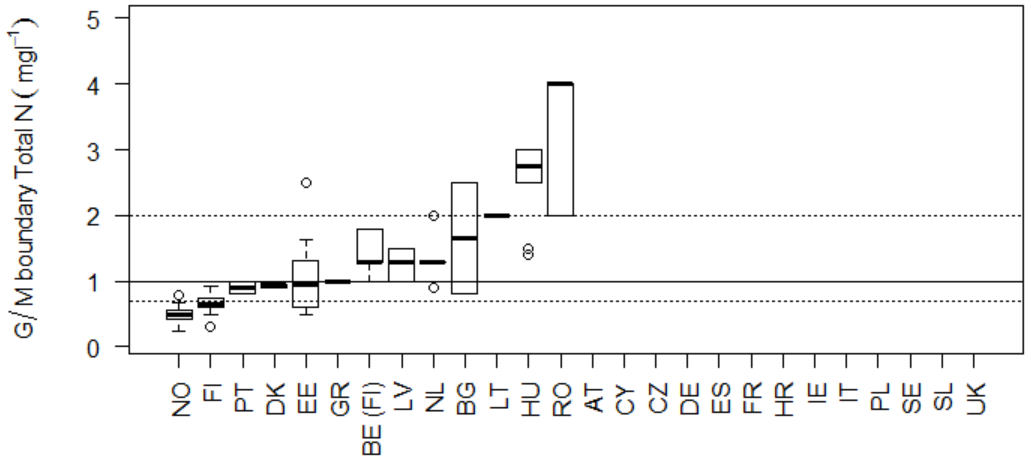
- More complicated comparison, fewer countries use Total N
- For rivers 6 countries use 90th percentiles (halved value for comparison), 11 countries only use nitrate.
- Majority use annual summary metrics

Category	Parameter	Period	Not specified	90th percentile	maximum	mean	median
Lakes	Nitrate N	Annual				3	
		Growth Season			1	2	
	Total N	Annual				5	
		Growth Season	1			9	
Rivers	Nitrate N	Annual	1	6	1	8	3
		Growth Season				1	
	Total N	Annual		2		7	1
		Growth Season				3	

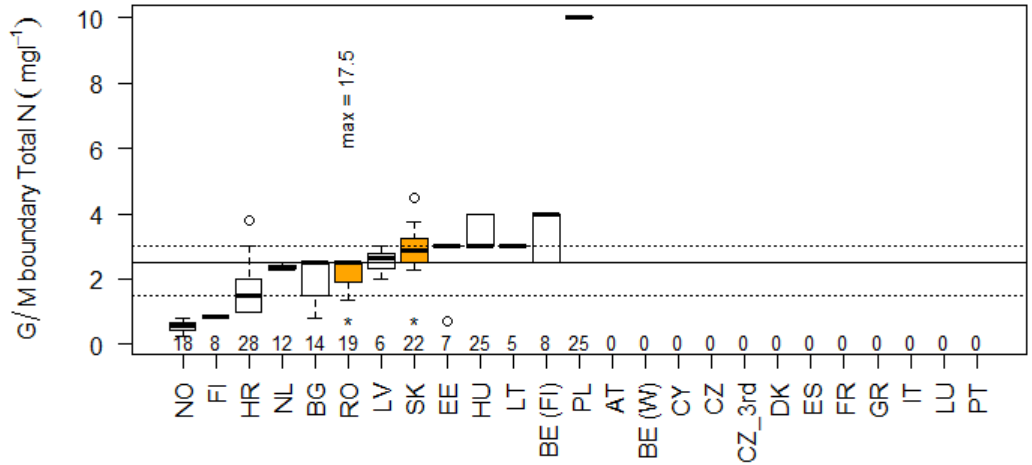
Nitrogen

- Fewer countries with boundary values
- More widespread use of upper percentiles in rivers (orange shading)
- Values in lakes < rivers
- Fewer different values in use
- Several countries report values for nitrate derived from drinking water standards

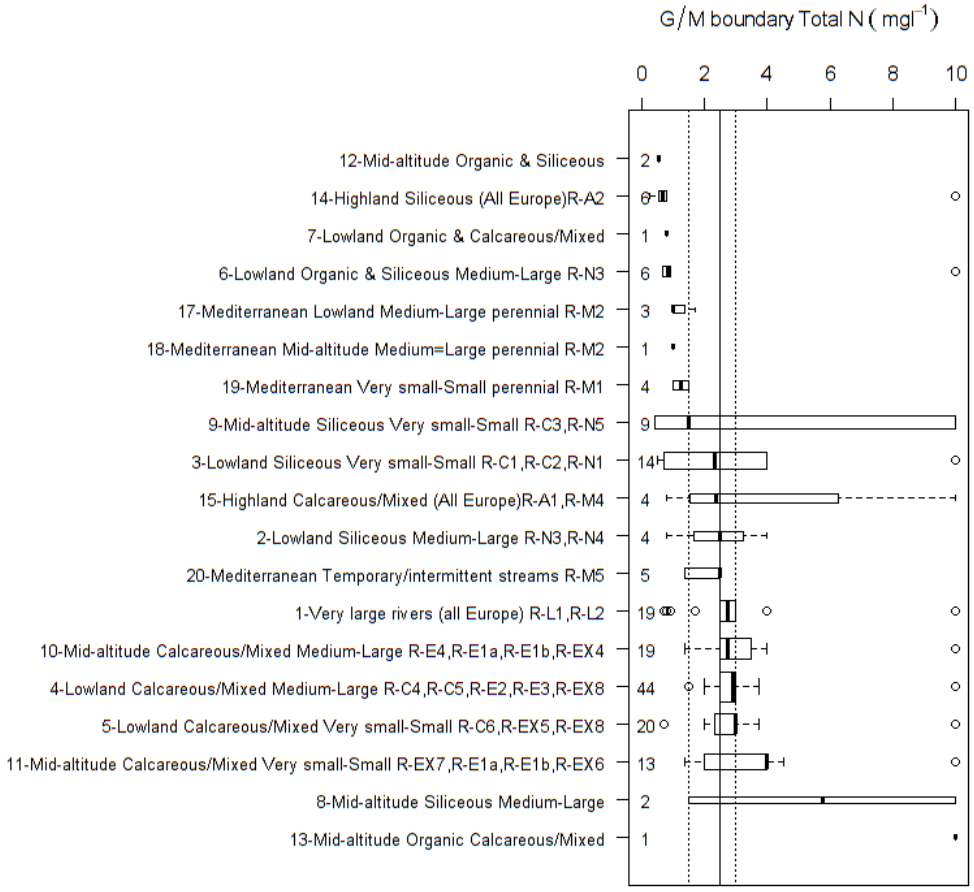
Lakes

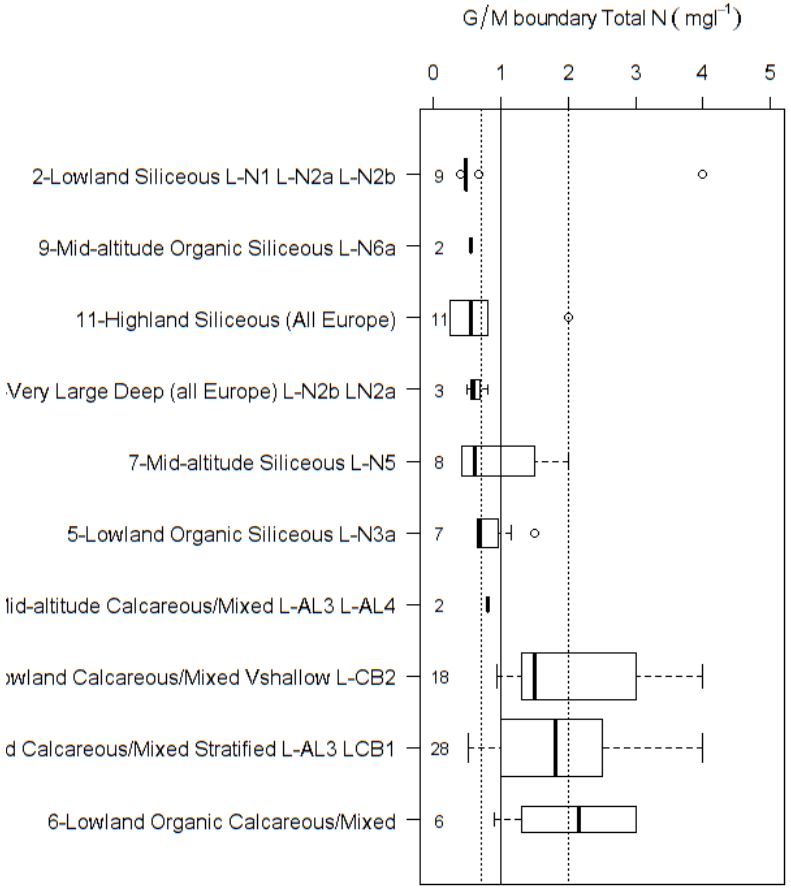


Rivers



Comparison of Total N boundaries



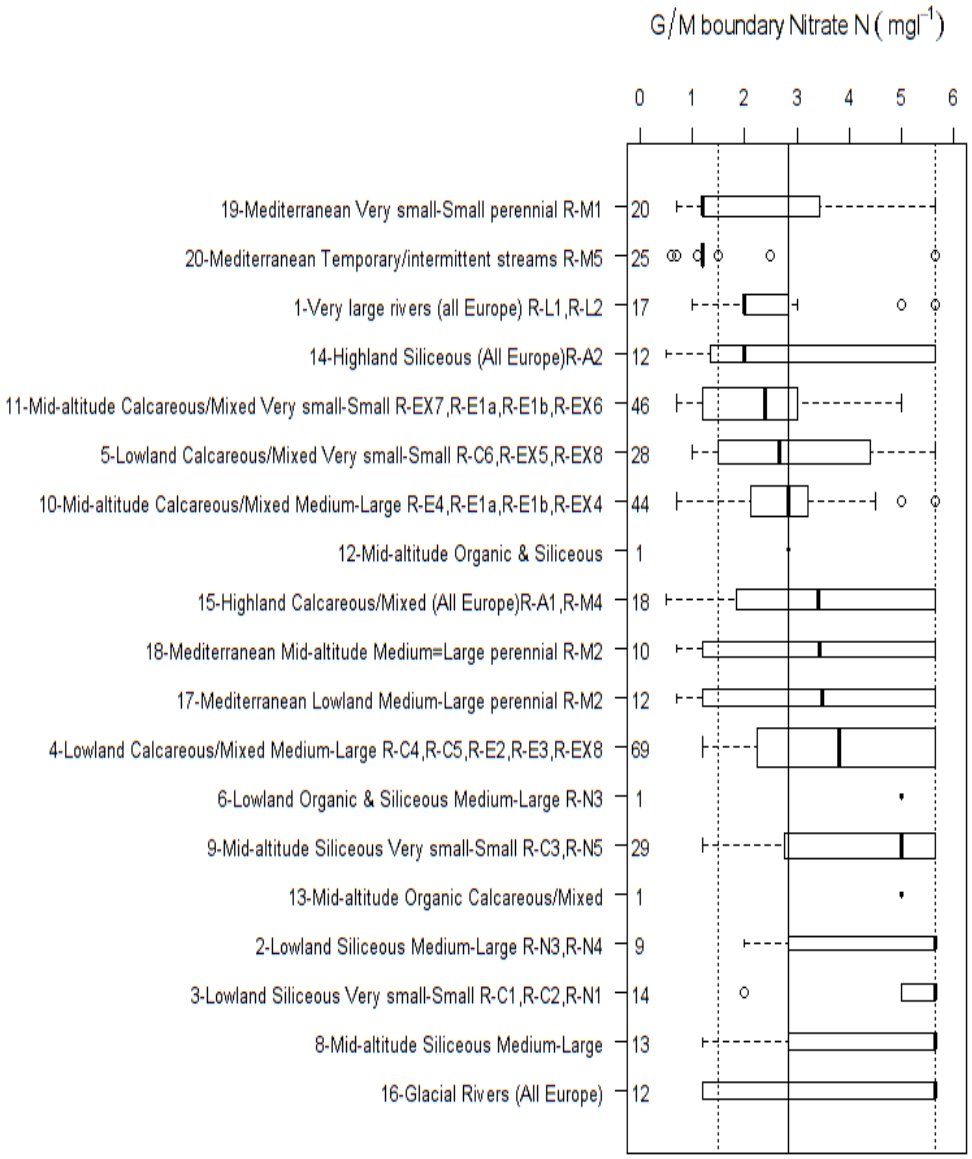


Influence of outliers obvious in rivers

Calcareous lakes have higher boundary values that siliceous types

Nitrate N in rivers

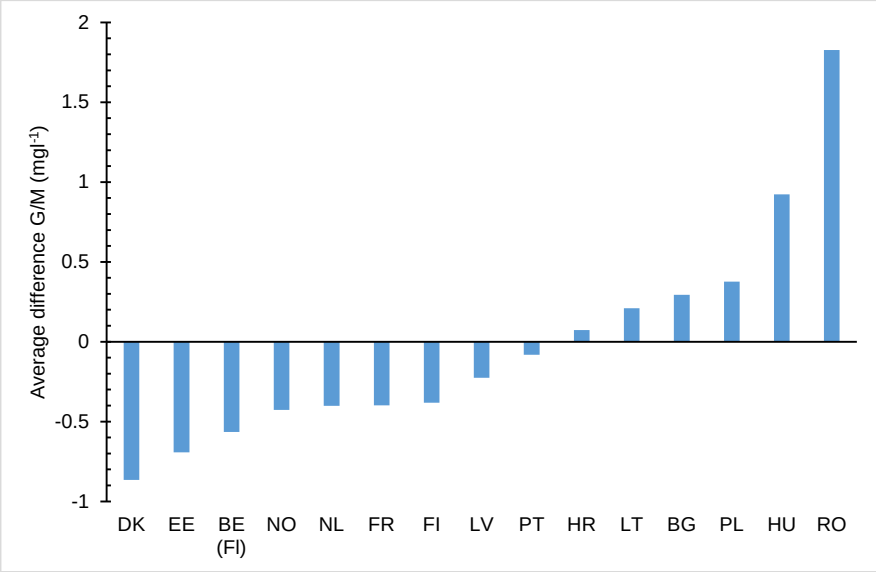
Wider range of values and clear influence of 5.63 mgN/l value used by some countries regardless of type (drinking water directice)

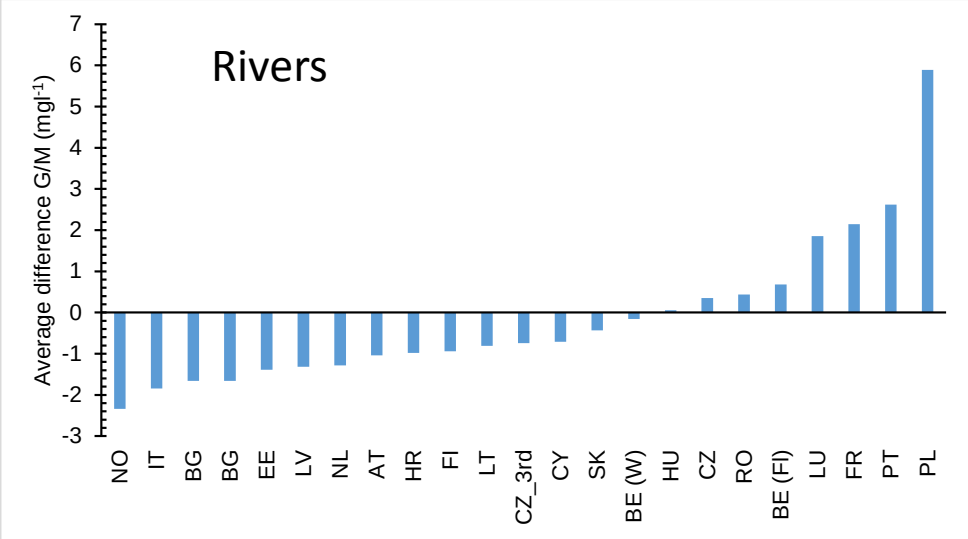


Comparison nitrogen by country

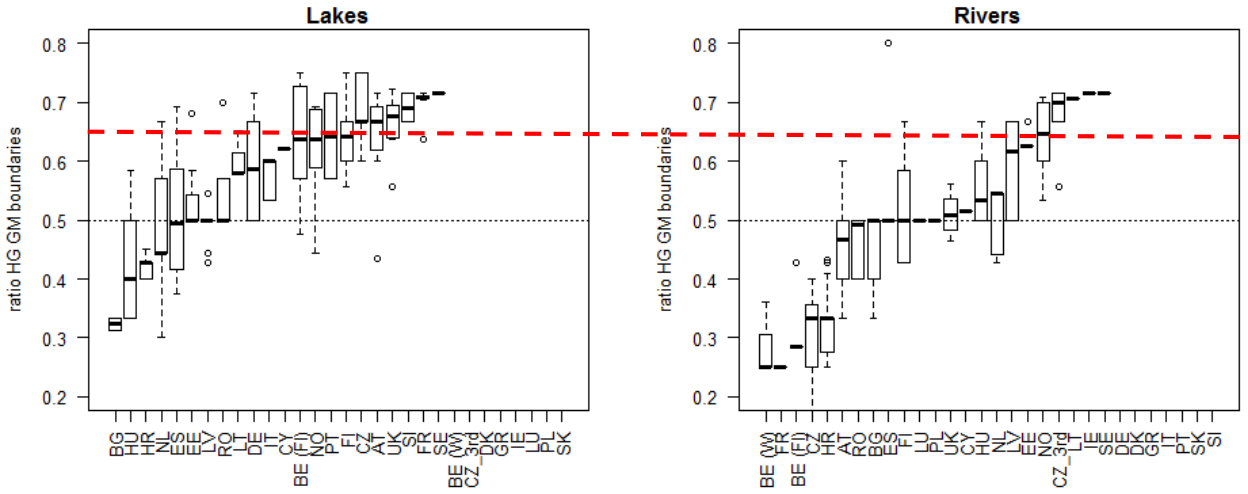
Similar to results for phosphorus
Lakes ± 0.5mgN/l
Rivers ± 1.5mgN/l

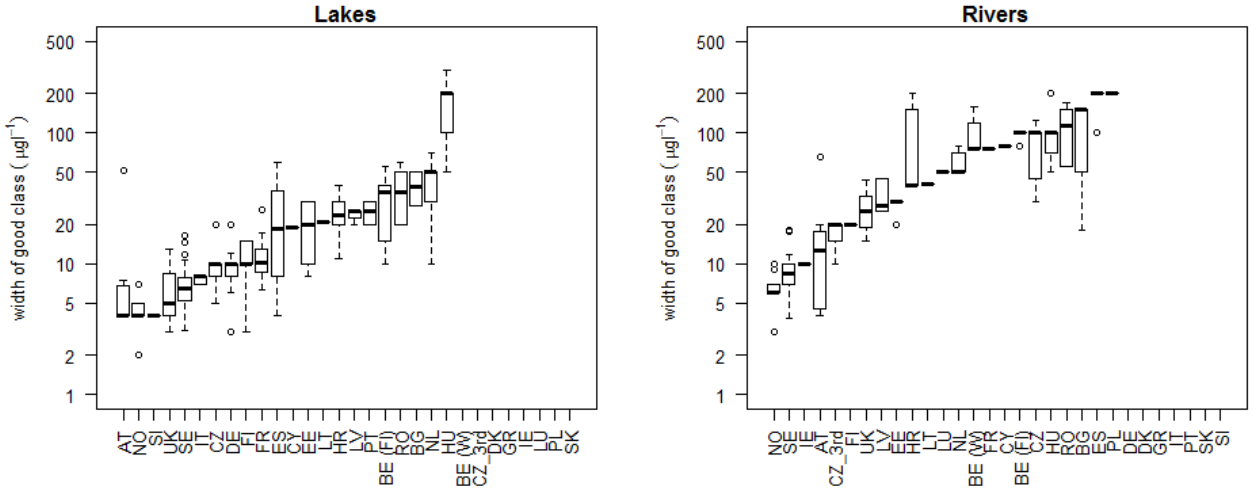
Lakes





Comparison with undisturbed conditions (H/G boundary values)





OSPAR proposed change of 50% from reference represented undesirable disturbance

Represents a ratio of 0.66

For lakes some countries have similar level of change

For rivers majority have a higher level of change

What is realistic and is this a useful indicator?

Conclusions

- Different values for N & P used for boundary setting across Europe, result from
  - Differences in water body types
  - Different methods used to establish boundary values
  - Different data

    BQE used, summary metrics, sampling strategy, soluble and total nutrient, random effects from use of small data sets.
  - Different interpretation of similar methods

    (more about this when we discuss pressure response models)
- Boundaries for lakes more similar than those for rivers
- Boundaries for P more similar than those for N
  - How similar might we expect values to be ?
- What are the most appropriate methods to establish boundary values

Personal Perspective

- Nutrient impacts in lakes is sufficiently strong to allow objective boundaries to be set.
  - Need pressure gradients covering at least Moderate – High status, extrapolation is dangerous !
- Differences in boundary values are a result of
  - Methodology
    - Objective methods, where biological status is related to nutrients in some way
    - Expert judgement, where link is unclear
  - True typological differences (siliceous or calcareous; upland or lowland) reflecting sensitivity and reference conditions
  - Random factors, sampling strategy, summary metrics, small data sets etc

    i.e. noise in the data
  - Perspectives on the **purpose** of the boundary value
    - Minimise mismatch of classifications (eg <15%), but no bias
    - Minimise chance of pressure causing a problem, lower precautionary nutrient boundary values at the cost of higher mismatch of class
    - Minimise chance of nutrients causing class to be downgraded, biology is more important, also at the cost of higher mismatch of class
- Nutrient impacts in rivers is much less clear (multiple pressures)
  - Amplifies the above issues and results in higher variation of boundary values
  - Misclassification is >>10% ?
- Greater attention might need to be given to the relative relationship between nutrient concentrations in undisturbed conditions and at moderate status & perhaps further consideration of what represents ecosystem ***functioning***