

Reference conditions and surveillance monitoring in Norway

- Practical and theoretical challenges for assessment of reference conditions
- Definition of reference conditions in the preliminary Norwegian classification system for ecological status.
- Monitoring of reference conditions within the planned programme for surveillance monitoring.
- Common Nordic network of reference sites?

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Practical and theoretical challenges for assessment of reference conditions

- Practical challenges:
 - Finding sufficient number of reference sites for all types of rivers and lakes. What is sufficient?
 - Allocating sufficient financial resources to collect data from reference sites
 - Organising data collection and analyses

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Practical and theoretical challenges for assessment of reference conditions

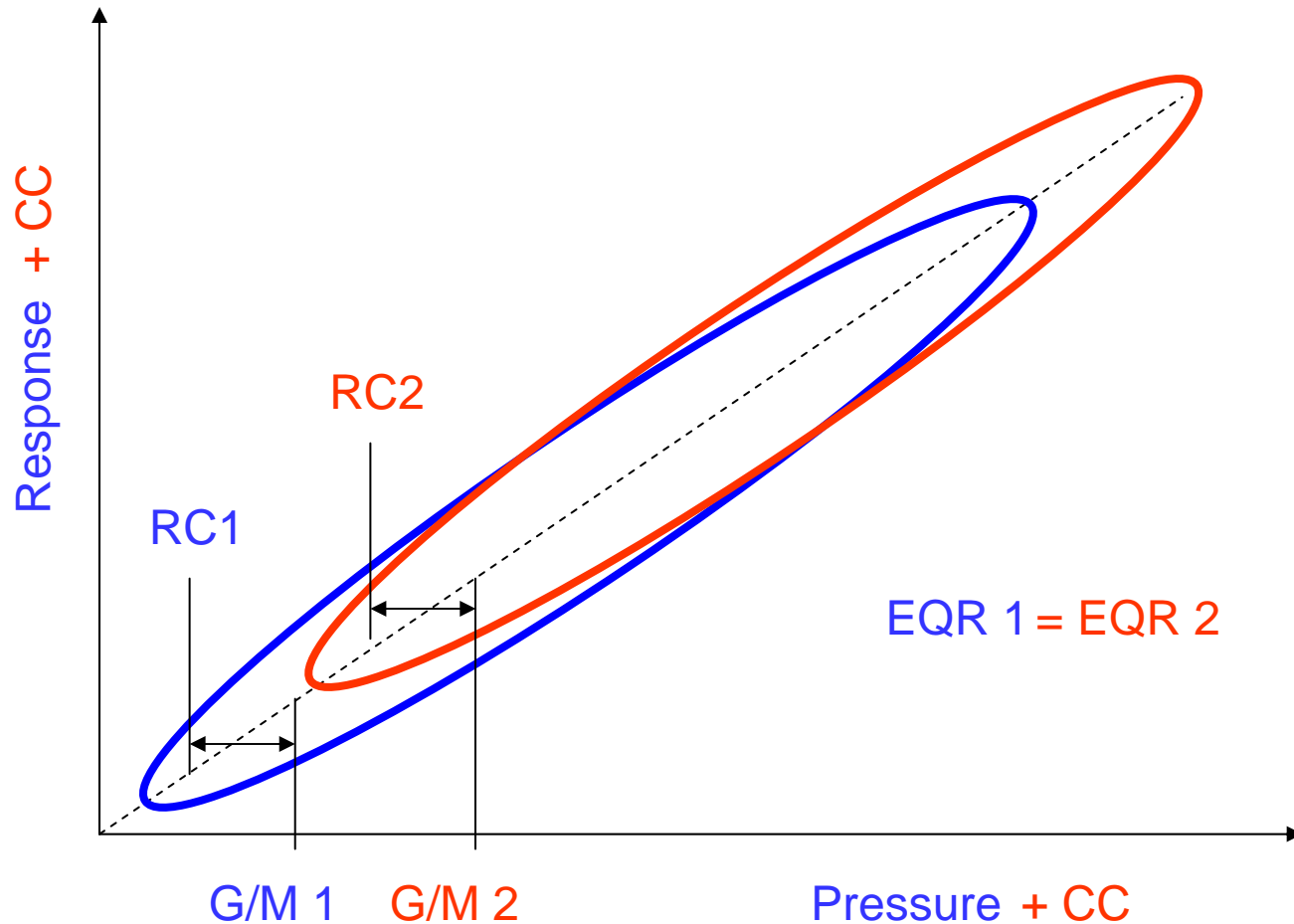
- Theoretical challenges:
 - Defining reference conditions: Validation of pressure criteria used in characterisation of water bodies (article 5) and intercalibration of classification systems
 - Developing relevant indicators for all quality elements and analyse datasets from reference sites statistically to assess the reference value and the H/G boundary
 - Developing and testing indirect methods for assessing reference conditions:
 - Paleo-ecological and other modelling methods for lakes
 - RIVPACS methods or riparian corridor analyses for rivers
 - For hydromorphological elements: testing the lake and river habitat survey methods (CEN standards, new guidance)
 - Assessing the impacts of climate change on reference conditions: (see slides from Ecostat presentation)

Impacts of climate change on reference conditions

- Warmer water
- Increased erosion and run-off, increased water flow in rivers
- Increased water level fluctuations
- Increased input of nutrients,
- Change of circulation patterns of lakes, longer summer stagnation in stratified lakes
- More biotic production
- Change of species composition (more Cyanobacteria, more Gonyostomum?), fewer cold-water species
- Increased biodiversity?

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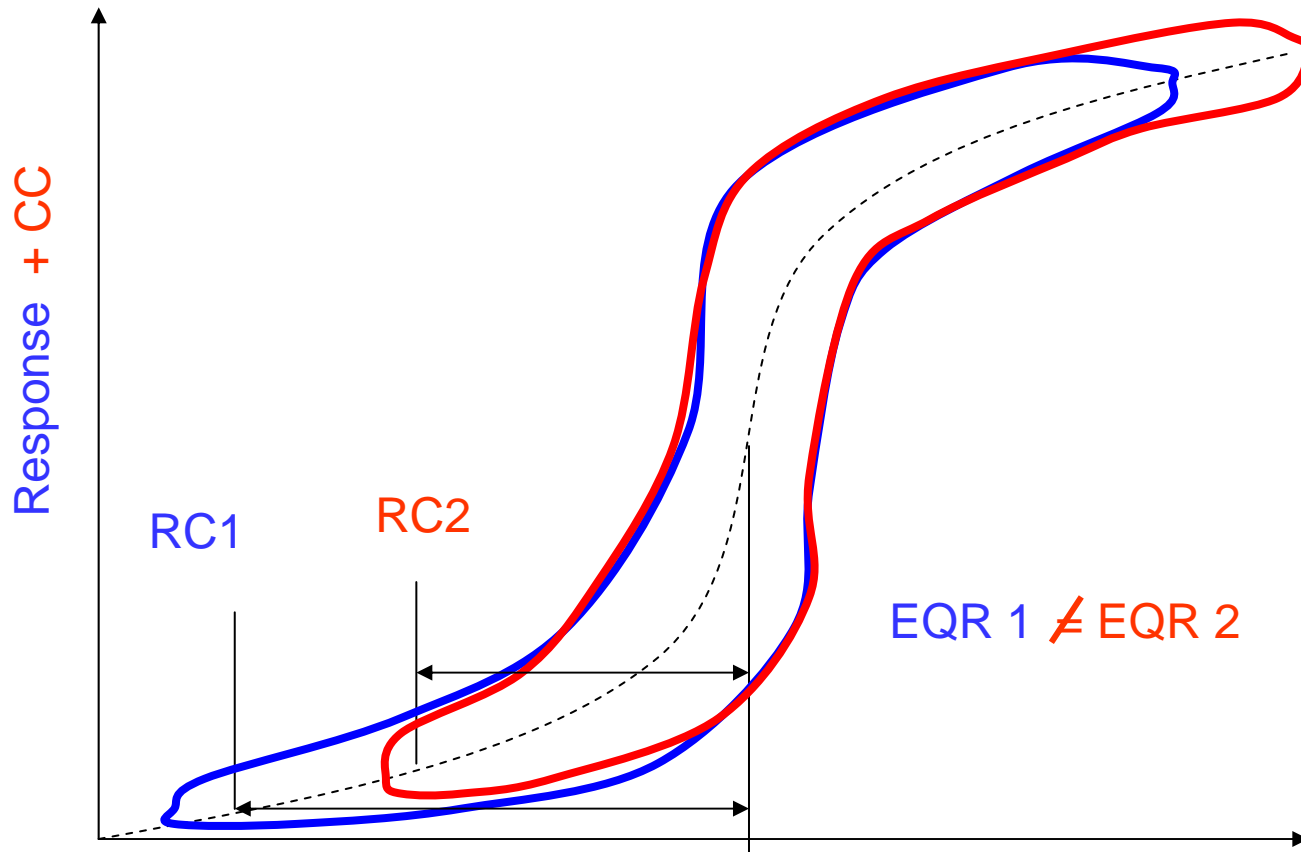
Possible impacts of climate change on reference conditions



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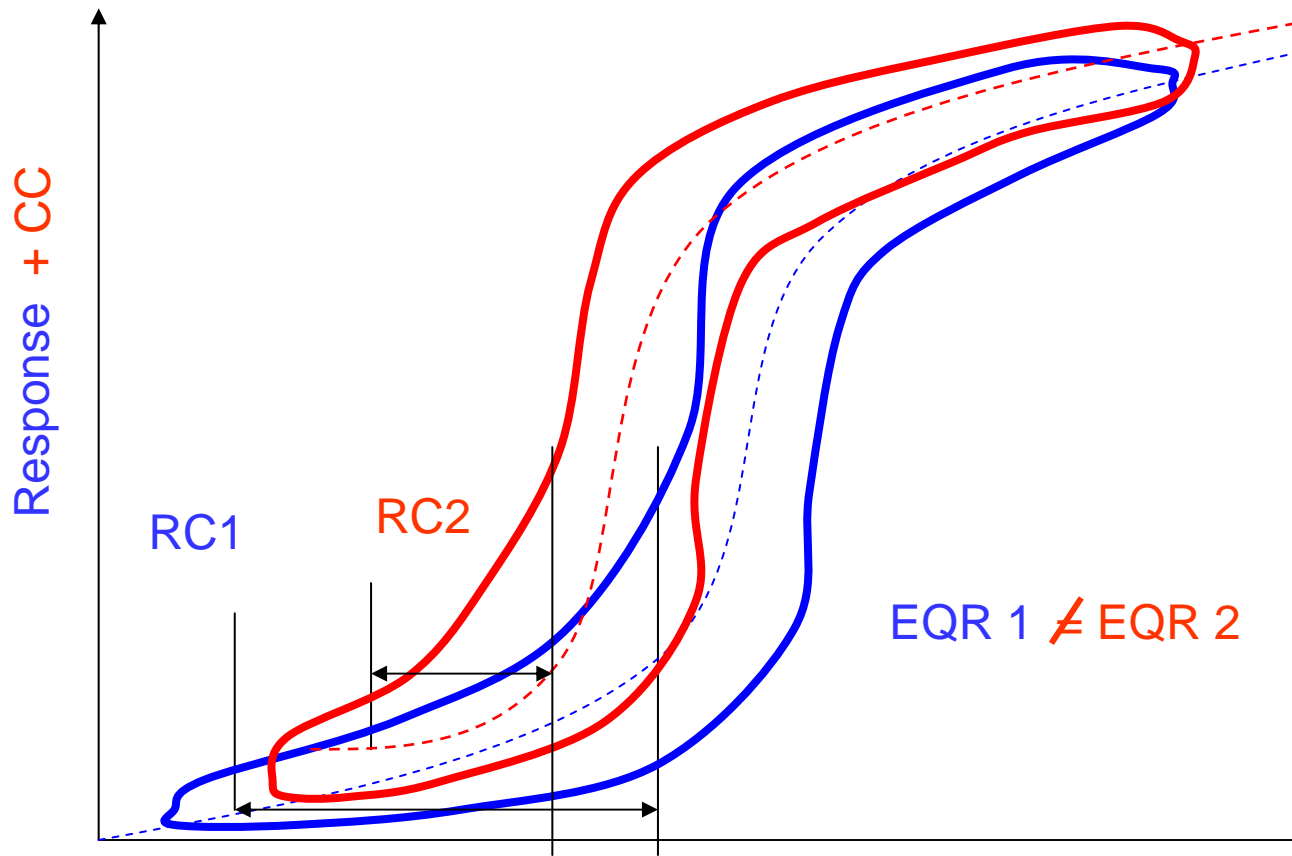
Possible impacts of climate change on reference conditions



$G/M1 = GM 2$ Pressure + CC
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Possible impacts of climate change on reference conditions – worst case scenario



$GM_2 < G/M_1$

Pressure + CC

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Definition of reference conditions in the preliminary Norwegian classification system for ecological status.

- Median value of datasets from reference sites
 - For phytoplankton chlorophyll a: Using the lower end of the range identified with common Nordic datasets
 - For total phosphorus: Using ref. chla and type-specific regressions from REBECCA project (Phillips et al. 2008)
 - For Secchi depth: Using previously established regression between chla and secchi depth in old classification system
- For quality elements and types with no or little data: expert judgement
- Example of classification table for one lake type

Classification table example

- Show xls-table

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Monitoring of reference conditions within the surveillance monitoring programme

- Current monitoring of biological reference conditions is minor: One river basin in mid-east Norway (Atna) has been monitored for 25 years.
- Monitoring of reference conditions is planned as a separate part of the surveillance monitoring programme, but has not started yet
- Lakes and rivers defined as "not at risk" in the characterisation work for article 5 have been used as a basis for selecting relevant water bodies:
 - 415 lakes have been identified as relevant, ca. 100 are included in existing monitoring (mainly chemical parameters), parameter list must be expanded to include more biological quality elements (see table 1 and fig. 1 in Schartau et al.)
 - 132 rivers have been identified, only 8 of these are currently monitored (mainly for chemical parameters)
 - 8 water bodies per type have been suggested as a minimum to get 80% power to distinguish ref. sites from impacted sites (only based on analysis of chlorophyll data). This requires at least 8 samples per site.

Norwegian reference lakes

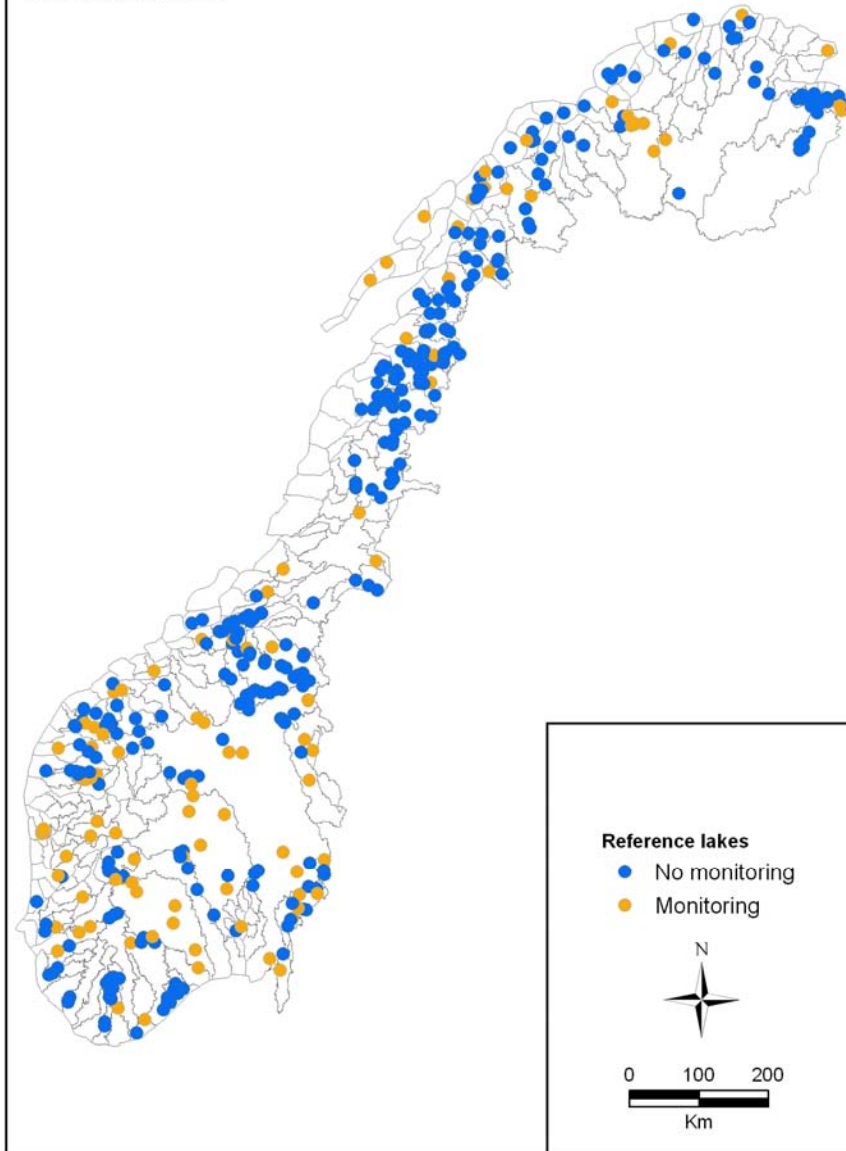
Number of Norwegian reference lakes per coretype (altitude x water type) and Ecoregion. Small and large lakes are combined.

Ecoregion	Altitude	Water type						Total	Total per ecoregion	
		very low alk		low alk.		moderate alk.				all alk. Glacial
		clear	humic	clear	humic	clear	humic			
Eastern	Lowland	0	0	10	5	0	1	16	70	
	Boreal	3	1	16	8	5	4	37		
	Highland	8	0	9	0	0	0	17		
Southern	Lowland	0	0	5	1	0	0	6	35	
	Boreal	13	0	9	1	0	0	23		
	Highland	3	0	3	0	0	0	6		
Western	Lowland	12	0	9	0	0	0	21	64	
	Boreal	11	0	10	2	0	0	23		
	Highland	10	0	9	1	0	0	20		
Central	Lowland	2	0	9	4	3	0	18	101	
	Boreal	12	0	10	10	11	5	4		52
	Highland	1	0	9	0	10	1	10		31
Northern - coastal	Lowland	0	0	9	8	10	7	34	107	
	Boreal	0	0	10	10	10	10	3		43
	Highland	0	0	10	0	10	0	10		30
Northern - inland	Lowland	0	0	2	5	3	0	10	38	
	Boreal	1	0	4	9	0	1	15		
	Highland	1	0	8	3	1	0	13		
Sum		77	1	151	67	63	29	27	415	

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Alle referanse innsjøer
All reference lakes



Norwegian reference lakes

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Norwegian reference rivers

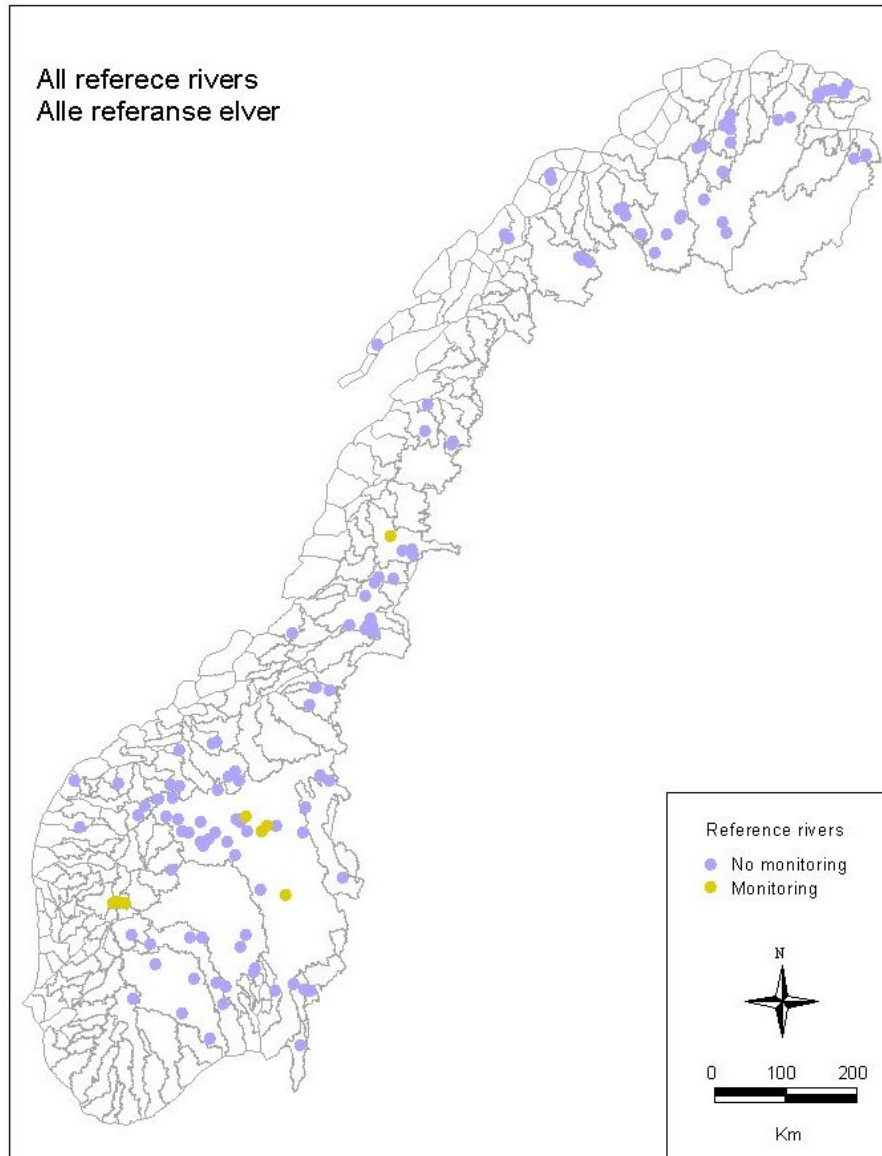
Number of Norwegian reference river sites per coretype (altitude x water type) and Ecoregion. Small-medium and large rivers are combined.

Ecoregion	Altitude	Water type							Total	Total per ecoregion	
		very low alk		low alk.		moderate alk.		all alk.			
		clear	humic	clear	humic	clear	humic	turbid	Glacial		
Eastern	Lowland				2					2	43
	Boreal	1	1	10	11		3			26	
	Highland	9		3		1			2	15	
Southern	Lowland									0	5
	Boreal	1			2					3	
	Highland		1		1					2	
Western	Lowland			1						1	13
	Boreal	4								4	
	Highland	7		1						8	
Central	Lowland			2						2	25
	Boreal		1	13	1	2				17	
	Highland	1		3		2				6	
Northern - coastal	Lowland				1	1				2	8
	Boreal			1	2		1			4	
	Highland			2						2	
Northern - inland	Lowland			2	1		1	1		5	38
	Boreal			2	10	2	8			22	
	Highland		1	6		1	3			11	
Sum		23	4	46	31	9	16	1	2	132	

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Norwegian reference rivers



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Common Nordic network of reference sites?

- The following number of Norwegian reference lakes and rivers has been proposed to be potential candidates for a common Nordic network of reference sites
 - 132 lakes
 - 61 rivers
- These reference sites belong to the common IC types and are from ecoregions of Norway that are comparable with the other Nordic countries (in terms of biogeographical patterns)

Norwegian lakes for a common Nordic network

Number of Norwegian reference lakes per IC type and Ecoregion suitable for integration in a Nordic reference network (Eastern Norway, Central Norway and Northern Norway inland). *: more sites would be present if L-N8 and the boreal type with equivalent water chemistry (Norwegian Lake type 15) are combined. L-N4 and L-N7 are excluded as IC-types but are included here for information.

Altitude	IC type	Ecoregion			Total
		Eastern	Central	Northern inland	
Lowland	L-N1		3	2	5
	L-N2	10	9	2	21
	L-N3	5	4	5	14
	L-N8*	1			1
Boreal	(L-N4)	5	10		15
	L-N5	9	10	4	23
	L-N6	8	10	9	27
Highland	(L-N7)	9	9	8	26
Sum		47	55	30	132

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Norwegian rivers for a common Nordic network

Number of Norwegian reference river sites per IC type and Ecoregion suitable for integration in a Nordic reference network (Eastern Norway, Central Norway and Northern Norway inland).

Altitude	IC type	Ecoregion			Total
		Eastern	Central	Northern inland	
Lowland	R-N1				0
	R-N2		1	2	3
	R-N3	2		1	3
Boreal	R-N5	10	10	1	21
	R-N9	11	1	10	22
Highland	R-N7	3	3	6	12
Sum		26	15	20	61

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Thank you for your attention



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Foto Knut Bjørndalen