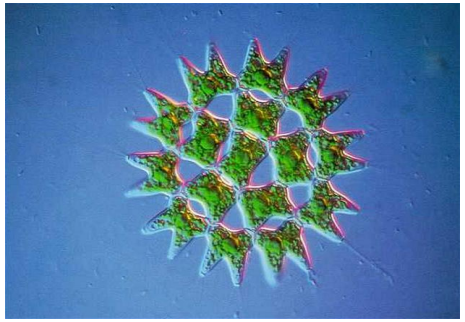
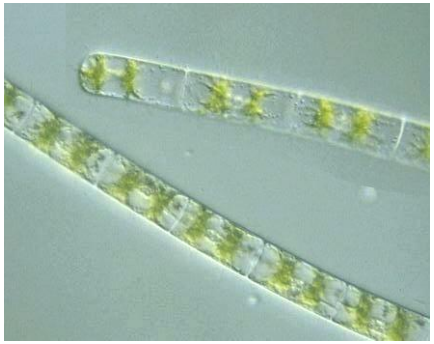
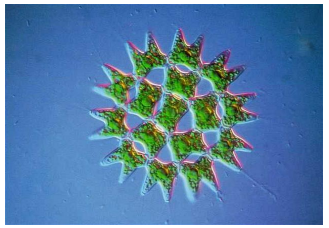
Development of the Norwegian WFD classification system for eutrophication

Phytoplankton and macrophytes in lakes and benthic algae and benthic fauna in rivers



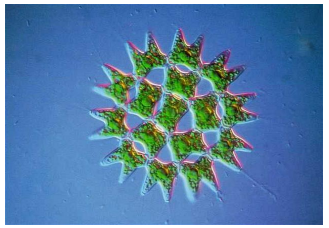


Phytoplankton in lakes



- Norwegian experts responsible: Pål Brettum, Robert Ptacnik, now Birger Skjelbred, NIVA
- Chlorophyll a: boundaries set for all IC types
- Biovolume: data exist from hundreds of lakes covering the whole eutrophication gradient. Boundaries are under development
- Taxonomic composition: new metric based on species scores along the eutrophication gradient is developed (optimum Total P) and is now being tested in practice. Boundaries are under development. The metric is published in Hydrobiologia 2009 special issue on WFD (Ptacnik et al)
- Combination rules not yet decided
- Further development will be done in dialogue with NGIG and WISER
- Completion of classification system in autumn 2010 or spring 2011 depending on outcome of IC phase 2

Phytoplankton chlfa class boundaries



IC type	Typebeskrivelse	Planteplankton i innsjøer, Klorofyll a klasser (interkalibrerte klassegrenser er uthevet med fet skrift)					
		Naturtilstand	Svært god	God	Moderat	Dårlig	Svært dårlig
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
LN2a	Kalkfattige, klare, grunne	1,5	<3	**3-5**	5-10	10-20	>20
LN2b	Kalkfattige, klare, dype	1,3	<2,5	**2,5-4**	4-7	7-15	>15
LN3a	Kalkfattige, humøse	2,5	<5	**5-7,5**	7,5-15	15-30	>30
LN1	Kalkrike, klare	2,5	<5	**5-7,5**	7,5-15	15-30	>30
LN8a	Kalkrike, humøse	3,5	<7	**7-10,5**	10,5-20	20-40	>40
LN5	Kalkfattige, klare	1,0	<2	**2-3**	3-7	7-15	>15
LN6	Kalkfattige, humøse	2,0	<4	**4-6**	6-12	12-25	>25
LN7	Kalkfattige, klare	0,80	<1,5	1,5-2,5	2,5-6	6-12	>12

EQR klasser for Planteplankton, Klorofyll a					
Naturtilstand	Svært god	God	Moderat	Dårlig	Svært dårlig
EQR	EQR	EQR	EQR	EQR	EQR
1,0	>0,5	**0,5 -0,29**	0,29- 0,15	0,015 - 0,075	<0,075
1,0	>0,5	**0,5 - 0,33**	0,33 - 0,21	0,21 - 0,10	<0,10
1,0	>0,5	**0,5 - 0,30**	0,33 - 0,16	0,16 - 0,08	<0,08
1,0	>0,5	**0,5 - 0,33**	0,33 - 0,17	0,17 - 0,083	<0,083
1,0	>0,5	**0,5 - 0,33**	0,29 - 0,175	0,175 - 0,088	<0,088
1,0	>0,5	**0,5 - 0,33**	0,33 - 0,14	0,14 - 0,067	<0,067
1,0	>0,5	**0,5 - 0,33**	0,33 - 0,17	0,17 - 0,08	<0,08
1,0	>0,53	0,53 - 0,32	0,32 - 0,13	0,13 - 0,067	<0,067

Total P class boundaries

IC type	Typebeskrivelse	Planteplankton i innsjøer, Klorofyll a klasser (interkalibrerte klassegrenser er uthevet med fet skrift)					
		Naturtilstand	Svært god	God	Moderat	Dårlig	Svært dårlig
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
LN2a	Kalkfattige, klare, grunne	1,5	<3	**3-5**	5-10	10-20	>20
LN2b	Kalkfattige, klare, dype	1,3	<2,5	**2,5-4**	4-7	7-15	>15
LN3a	Kalkfattige, humøse	2,5	<5	**5-7,5**	7,5-15	15-30	>30
LN1	Kalkrike, klare	2,5	<5	**5-7,5**	7,5-15	15-30	>30
LN8a	Kalkrike, humøse	3,5	<7	**7-10,5**	10,5-20	20-40	>40
LN5	Kalkfattige, klare	1,0	<2	**2-3**	3-7	7-15	>15
LN6	Kalkfattige, humøse	2,0	<4	**4-6**	6-12	12-25	>25
LN7	Kalkfattige, klare	0,80	<1,5	1,5-2,5	2,5-6	6-12	>12

EQR klasser for Planteplankton, Klorofyll a					
Naturtilstand	Svært god	God	Moderat	Dårlig	Svært dårlig
EQR	EQR	EQR	EQR	EQR	EQR
1,0	>0,5	**0,5 -0,29**	0,29- 0,15	0,015 - 0,075	<0,075
1,0	>0,5	**0,5 - 0,33**	0,33 - 0,21	0,21 - 0,10	<0,10
1,0	>0,5	**0,5 - 0,30**	0,33 - 0,16	0,16 - 0,08	<0,08
1,0	>0,5	**0,5 - 0,33**	0,33 - 0,17	0,17 - 0,083	<0,083
1,0	>0,5	**0,5 - 0,33**	0,29 - 0,175	0,175 - 0,088	<0,088
1,0	>0,5	**0,5 - 0,33**	0,33 - 0,14	0,14 - 0,067	<0,067
1,0	>0,5	**0,5 - 0,33**	0,33 - 0,17	0,17 - 0,08	<0,08
1,0	>0,53	0,53 - 0,32	0,32 - 0,13	0,13 - 0,067	<0,067

Secchi depth class boundaries

IC type	Typebeskrivelse
LN2a	Kalkfattige, klare, grunne
LN2b	Kalkfattige, klare, dype
LN3a	Kalkfattige, humøse
LN1	Kalkrike, klare
LN8a	Kalkrike, humøse
LN5	Kalkfattige, klare
LN6	Kalkfattige, humøse
LN7	Kalkfattige, klare

Siktedyp i innsjøer, klasser					
Naturtilstand	**Svært god**	**God**	**Moderat**	**Dårlig**	**Svært dårlig**
m	**m**	m	**m**	m	m
8	>6	6-4	4-2	2-1	<1
10	>8	8-5	5-3	3-1,5	<1,5
6	>4	4-3	3-1,5	1,5-0,7	<0,7
6	>4	4-3	3-1,5	1,5-0,7	<0,7
5	>3	3-2	2-1	1-0,5	<0,5
10	>8	8-6	6-3	3-1,5	<1,5
7	>5	5-3,5	3,5-1,7	1,7-0,8	<0,8
12	>9	9-7	7-3,5	3,5-1,7	<1,7

EQR klasser for Siktedyp					
Naturtilstand	**Svært god**	**God**	**Moderat**	**Dårlig**	**Svært dårlig**
EQR	EQR	EQR	EQR	EQR	EQR
1,0	>0,75	0,75 - 0,5	0,5 - 0,25	0,25 - 0,125	<0,125
1,0	>0,8	0,8 - 0,5	0,5 - 0,3	0,3 - 0,15	<0,15
1,0	>0,67	0,67 - 0,5	0,5 - 0,25	0,25 - 012	<0,12
1,0	>0,67	0,67 - 0,5	0,5 - 0,25	0,25 - 012	<0,12
1,0	>0,6	0,6 - 0,4	0,4 - 0,2	0,2 - 0,1	<0,1
1,0	>0,8	0,8 - 0,6	0,6 - 0,3	0,3 - 0,15	<0,15
1,0	>0,71	0,71 -0,5	0,5 - 0,24	0,24 - 0,11	<0,11
1,0	>0,75	0,75 - 0,58	0,58 - 0,29	0,29 - 0,14	<0,14

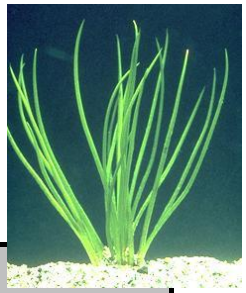
Macrophytes in lakes response to eutrophication

- Norwegian expert responsible: Marit Mjelde at NIVA
- Taxonomic composition: Trophic index (TI_c) based on difference between number of sensitive and tolerant taxa is developed. Boundaries are set for all IC types in IC phase 1:

$$TIc = \frac{N_s - N_T}{N} \times 100$$

- Lower growing depth: may be developed in 2010 based on new surveys done in 2009
- Combination rules not yet decided
- Further development will be done in dialogue with NGIG and WISER
- Completion of classification system in autumn 2010 or spring 2011 depending on outcome of IC phase 2

Macrophytes class boundaries for eutrophication



IC type	Typebeskrivelse
	Svært kalkfattige, klare
	Svært kalkfattige, humøse
LN2, LN5	Kalkfattige, klare
LN3a, LN6	Kalkfattige, humøse
LN1	Kalkrike, klare
LN8a	Kalkrike, humøse
	Svært kalkrike, klare
	Svært kalkrike, humøse

Vannplanter i innsjøer, TI (antall arter), klasser

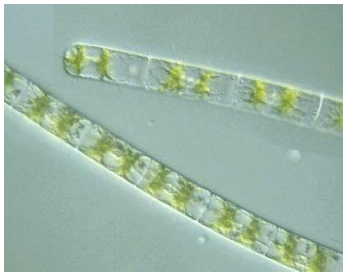
Naturtilstand	Svært god	God	Moderat	Dårlig	Svært dårlig
TI (antall arter)	**TI (antall arter)**	TI (ant arter)	**TI (ant arter)**	TI (ant arter)	TI (ant arter)
100	>94	94-30	30-5	5- ÷35	< -35
92	>75	75-30	30-5	5- ÷35	<-35
113	>100	**100-30**	30-5	5- ÷35	<-35
100	>92	**92-30**	30-5	5- ÷35	<-35
81	>65	**65-30**	30-5	5- ÷35	<-35
69	>52	**52-30**	30-5	5- ÷35	<-35
88	>73	**73-30**	30-5	5- ÷35	<-35
45	>43	43-30	30-5	5- ÷35	<-35

EQR klasser for Vannplanter, TI (antall arter),

EQR = (obs.verdi + 100) / (ref.verdi + 100)

Naturtilstand	Svært god	God	Moderat	Dårlig	Svært dårlig
EQR	EQR	EQR	EQR	EQR	EQR
1,0	>0,97	0,97 - 0,65	0,65 - 0,53	0,53 - 0,33	< 0,33
1,0	>0,91	0,91 - 0,68	0,68 - 0,55	0,55 - 0,34	< 0,34
1,0	>0,94	**0,94 - 0,61**	0,61 - 0,49	0,49 - 0,31	< 0,31
1,0	>0,96	**0,96 - 0,65**	0,65 - 0,53	0,53 - 0,33	< 0,33
1,0	>0,91	**0,91 - 0,72**	0,72 - 0,58	0,58 - 0,36	< 0,36
1,0	>0,90	**0,90 - 0,77**	0,77 - 0,62	0,62 - 0,38	<0,38
1,0	>0,92	**0,92 - 0,69**	0,69 - 0,56	0,56 - 0,35	<0,35
1,0	>0,99	0,99 - 0,90	0,90 - 0,72	0,72 - 0,45	<0,45

Benthic algae in rivers response to eutrophication



- Norwegian expert responsible: Eli-Anne Lindstöm Susi Schneider, NIVA
- Taxonomic composition for non-diatoms: new metric (PIT) based on species scores along the eutrophication gradient (optimum Total P) is developed and is now being tested in practice.

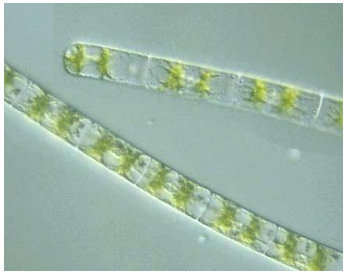
$$PIT = \frac{\sum_{i=1}^{n} IV_i}{n}$$

- Boundaries are set for H/G and G/M classes, the rest will be set when more data becomes available from highly eutrophied rivers
- Intercalibration will be done in dialogue with NGIG comparing the Norwegian metric for non-diatoms with the common diatom metric used in NGIG IC phase 1
- Completion of classification system in autumn 2010 or spring 2011 depending on outcome of IC phase 2

Benthic algae class boundaries for eutrophication

Preliminary system for all types,

not enough data to get type-specific class boundaries



PIT Klassegrenser (absolutt-verdier)

Natur-tilstand	Svært god	God	Moderat	Dårlig	Svært dårlig
2,29	<2,35	**2,34-2,6**	2,6-3,6	>3,6	ingen bentiske alger*

PIT Klassegrenser (EQR-verdier)

Natur-tilstand	Svært god	God	Moderat	Dårlig	Svært dårlig
1,00	>0,97	0,97-0,88	0,88-0,64	<0,64	ikke definert

Benthic Fauna in rivers response to eutrophication/organic load

- Norwegian expert responsible: Torleif Bækken, NIVA
- Taxonomic composition: ASPT index
- Boundaries are set for all classes, but is not type-specific yet
- Intercalibration has been done in NGIG comparing the Norwegian metric with the common metric (ICMi)
- Checking of refs cond and assessment of type-specific class boundaries are needed in IC phase 2

Benthic fauna class boundaries for eutrophication/organic load

Bunnfauna i elver, ASPT, klasser					
Naturtilstand	**Svært god**	**God**	**Moderat**	**Dårlig**	**Svært dårlig**
ASPT	**ASPT**	**ASPT**	**ASPT**	**ASPT**	**ASPT**
6,9	>6,8	**6,8-6,0**	6,0-5,2	5,2-4,4	< 4,4

EQR klasser for Bunnfauna, ASPT					
Naturtilstand	**Svært god**	**God**	**Moderat**	**Dårlig**	**Svært dårlig**
EQR	EQR	EQR	EQR	EQR	EQR
1,0	>0,99	**0,99-0,87**	0,87-0,75	0,75-0,64	< 0,64

Remaining work

- Macrophytes in rivers may be developed together with CBGIG
- Macrophytes in lakes for HYMO pressure ongoing in collaboration with NGIG and WISER
- Fish in lakes for eutrophication ongoing in collaboration with GIGs and WISER

Thank you for your attention