

A simple index for assessing ecological status of fish stocks



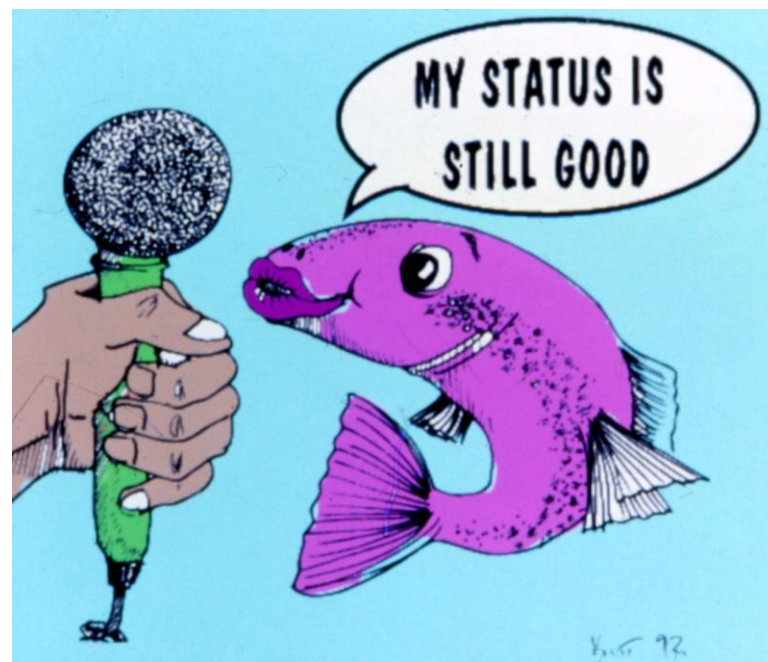
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&
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Background

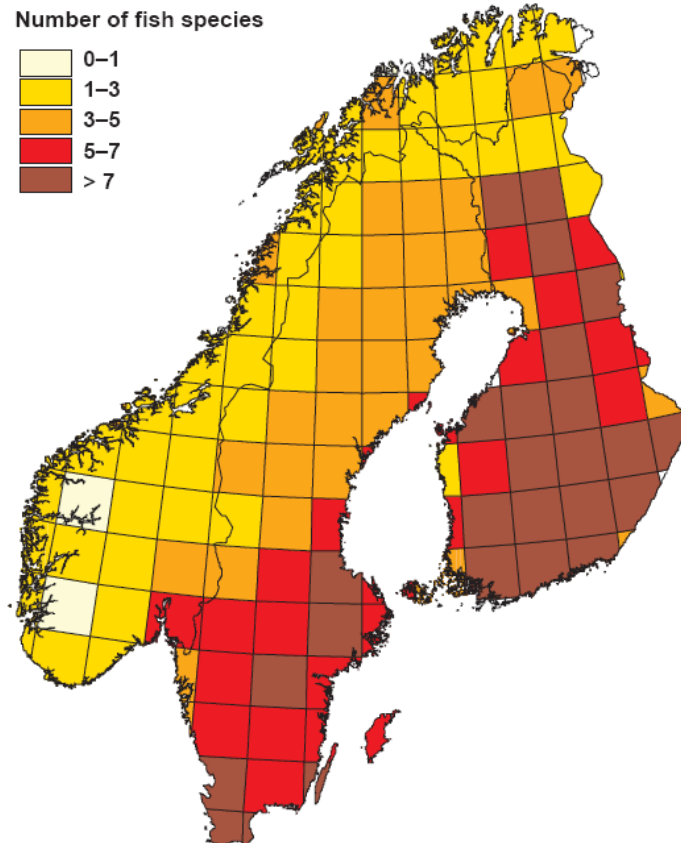
- The WFD requires assessment of ecological status for several quality elements, including fish
- Norway has a large number of lakes containing fish that should be assessed. Standardized sampling with gill-nets is very time-consuming, and costly
- Asked to develop a simple index which does not rely on test-fishing
- Make comparison between the Norwegian Index and that of the indexes developed in Finland and Sweden; EQR4 and EQR 8, based on test-fishing

Data in species occurrence and their status are obtained from different sources

- Interviews are the main source
- Reports (old and new)
- Test-fishing
- Water chemistry, and dose-response
- Models for species occurrence



Regional distribution of the mean number of fish species in lakes in the Nordic countries



The index requires data on species occurrence, their evenness, both historically= reference condition, and present, and their status in terms of losses and changes in abundance (reduced or increased) for different categories. We weight the data according to abundance - and status-category.

Abundance category	Weight for species abundance (Reference)	Weights for lost stocks	Weights for reduced or increased stocks
Dominant	1.0	1.0	0.75
Subdominant	0.75	0.75	0.50
Rare	0.50	0.50	0.25

Data needed to estimate the Norwegian Fish index

Species No	Reference (Historically)	Present	Introduced
1	Dominant	Subdominant	No
2	Subdominant	Dominant	No
3	Rare	Subdominant	No
4	Non-existing	Rare	Yes

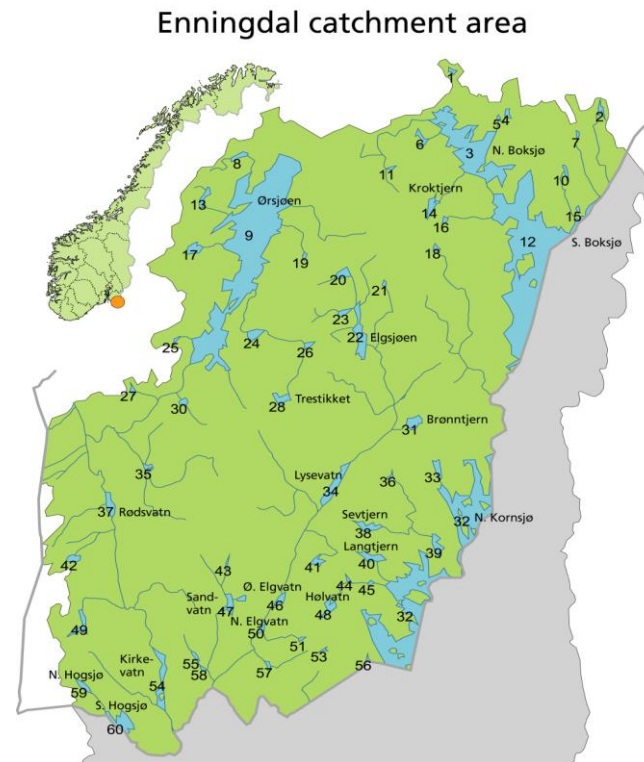
How to estimate the Fish Index (FI)

The fish index FI is defined as the relative deviation from the reference condition (REF), by evaluating the effects of STATUS (S) due to reduction, increase, losses, and introductions

$$FI = \frac{REF - S_{CRed} - S_{CInc} - S_{Lost} - S_{Intro}}{REF}$$
$$= \left(1 - \frac{S_{CRed}}{REF} - \frac{S_{CInc}}{REF} - \frac{S_{Lost}}{REF} \right) - \frac{S_{Intro}}{REF}$$

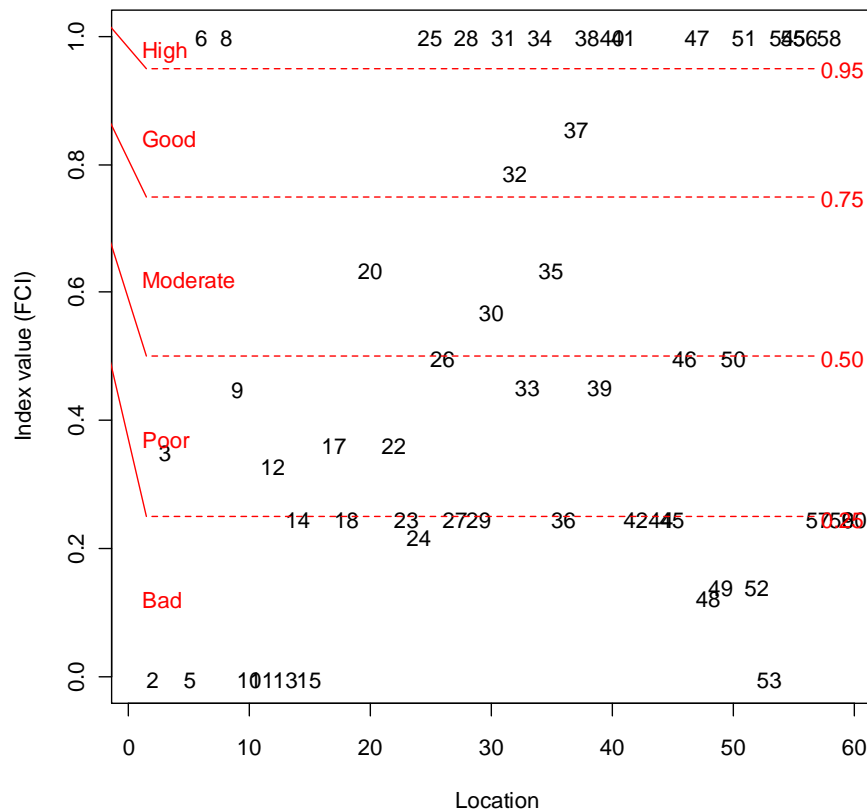
Testing the index, based on data from Enningdal

- Data from 54 lakes in Enningdal watershed in southeastern Norway
- Lakes above the marine limit are highly acidified
- Thus, many fish stocks have suffered large damage
- Number of fish species relatively high, ranging from 1 to 8.


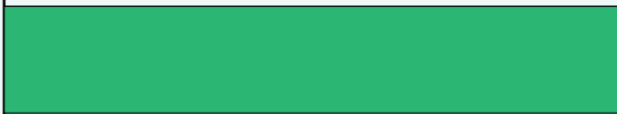





Fish status for lakes in Enningdal based on the Norwegian Fish Index

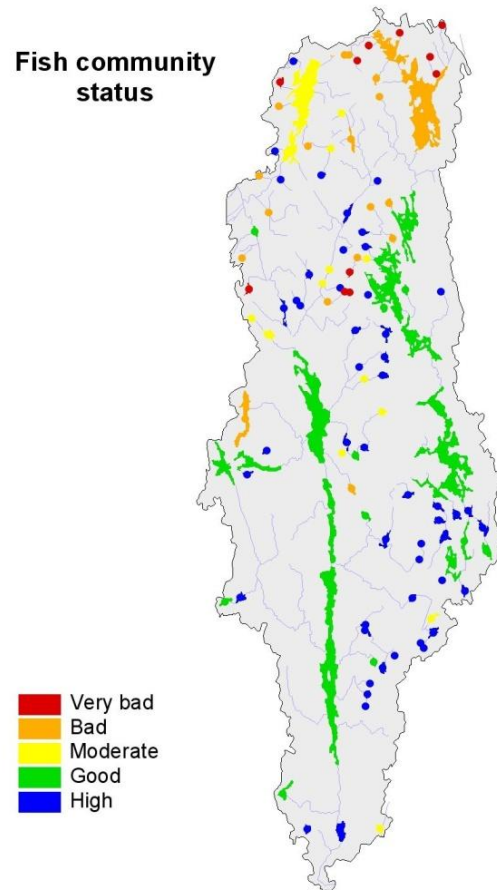
60 lakes - Mars 2011



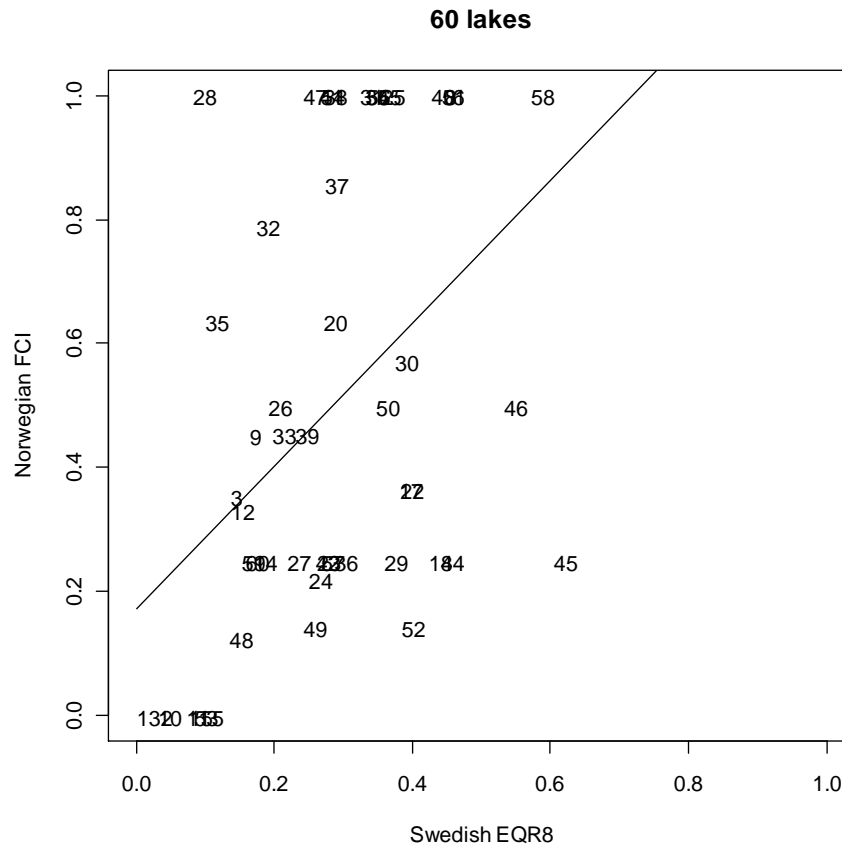
Classes for ecological status and their boundaries

Ecological status	Symbol	Class boundaries
High		1.0-0.95
Good		0.95-0.75
Moderate		0.75-0.50
Poor		0.50-0.25
Bad		<0.25

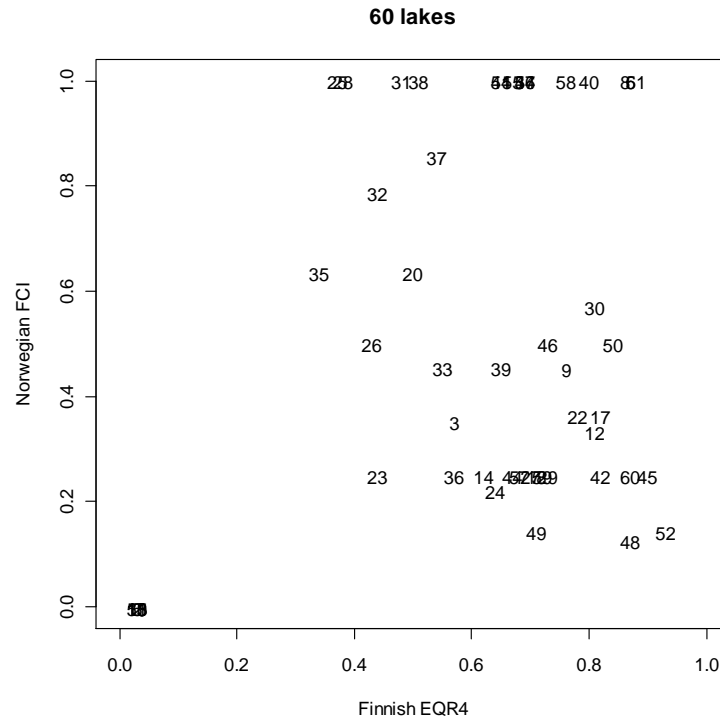
Fish community status for lakes in Enningdal, based on the Fish Index



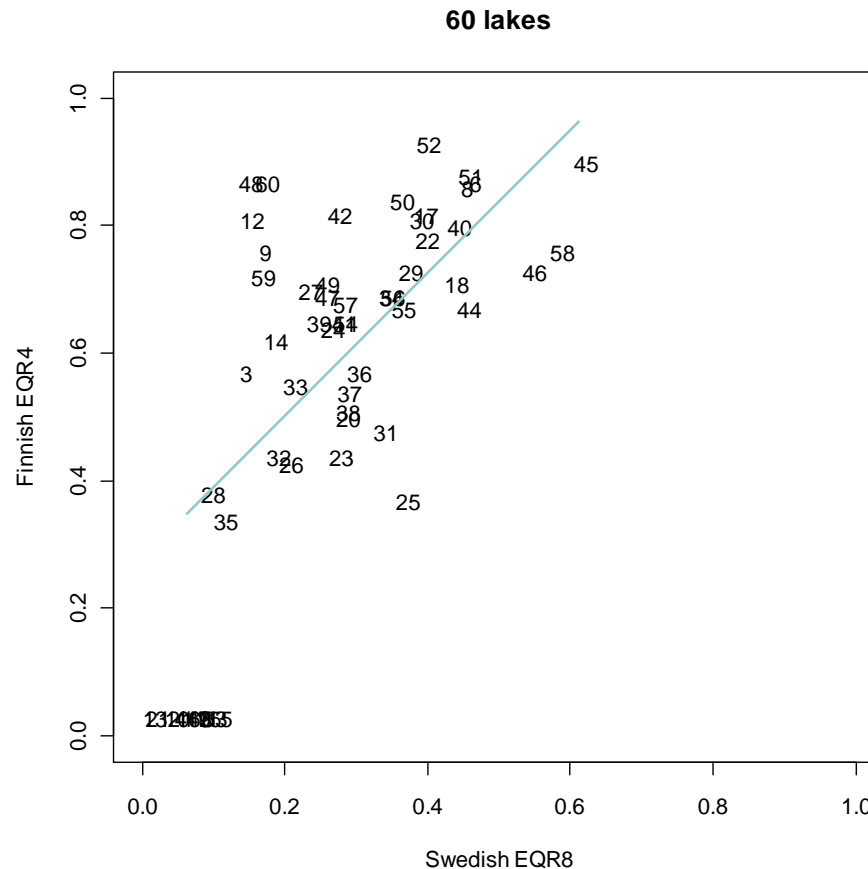
Relationship between the Norwegian Fish index (FCI) and the Swedish EQR8



Relationship between Norwegian FCI and Finnish EQR4.

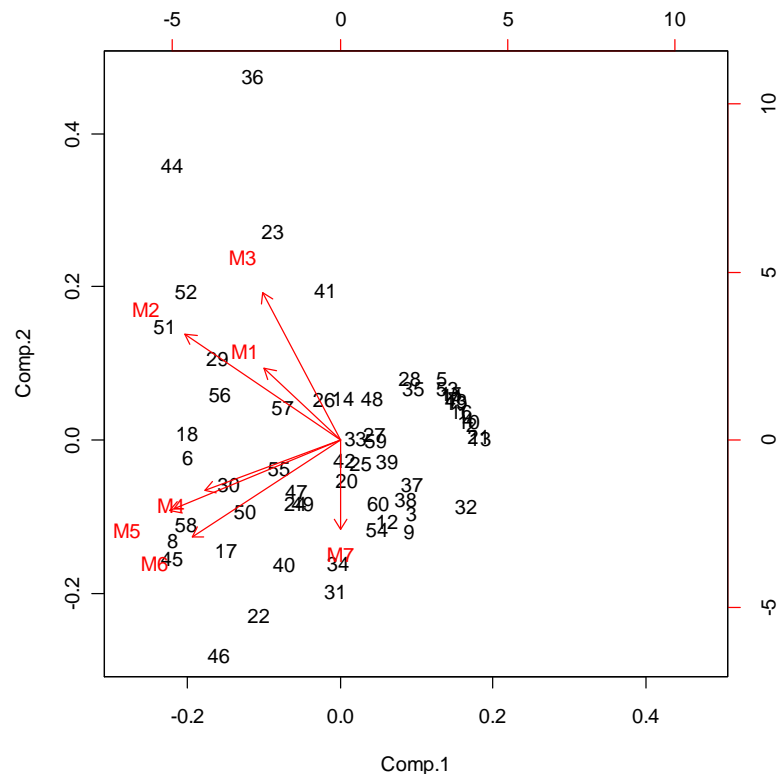


Relationship between the Finnish EQR4 and Swedish EQR8



To see the correlation structure in EQR8, we carried out a PCA

- **Intercolleration 1**
- M1 (Native species N)
- M2 (Simpson No)
- M3 (Simpson Biomass)
- **Intercolleration 2**
- M4 (Native species B)
- M5 (Native species , N)
- M6 (all species, Mean B)
- **Independent**
- M7 (Prop piscivorous)
- **Explanation: 56%**



Conclusions

- The Norwegian index is simple to use
- Historically data can be obtained; and REF condition is site-specific
- Obvious limitations, especially in lakes containing many species
- Can not be intercalibrated with EQR 4 and EQR8
- These indexes are developed for more species-rich communities
- REF conditions seems to vary highly
- Based on the EQR8, almost no community got a value > 0.5

How to estimate the fish index

The fish index FI is defined as the relative deviation from the reference condition (REF), taking into effects of STATUS due to damage (lost or reduced), increase and introductions

$$FI = \frac{REF - S_{CRed} - S_{CInc} - S_{Intro}}{REF}$$
$$= \left(1 - \frac{S_{CRed}}{REF} - \frac{S_{CInc}}{REF} \right) - \frac{S_{Intro}}{REF}$$

Cooperation and expertise for a sustainable future

