Ecological quality of Lake Peipsi in the light of WFD

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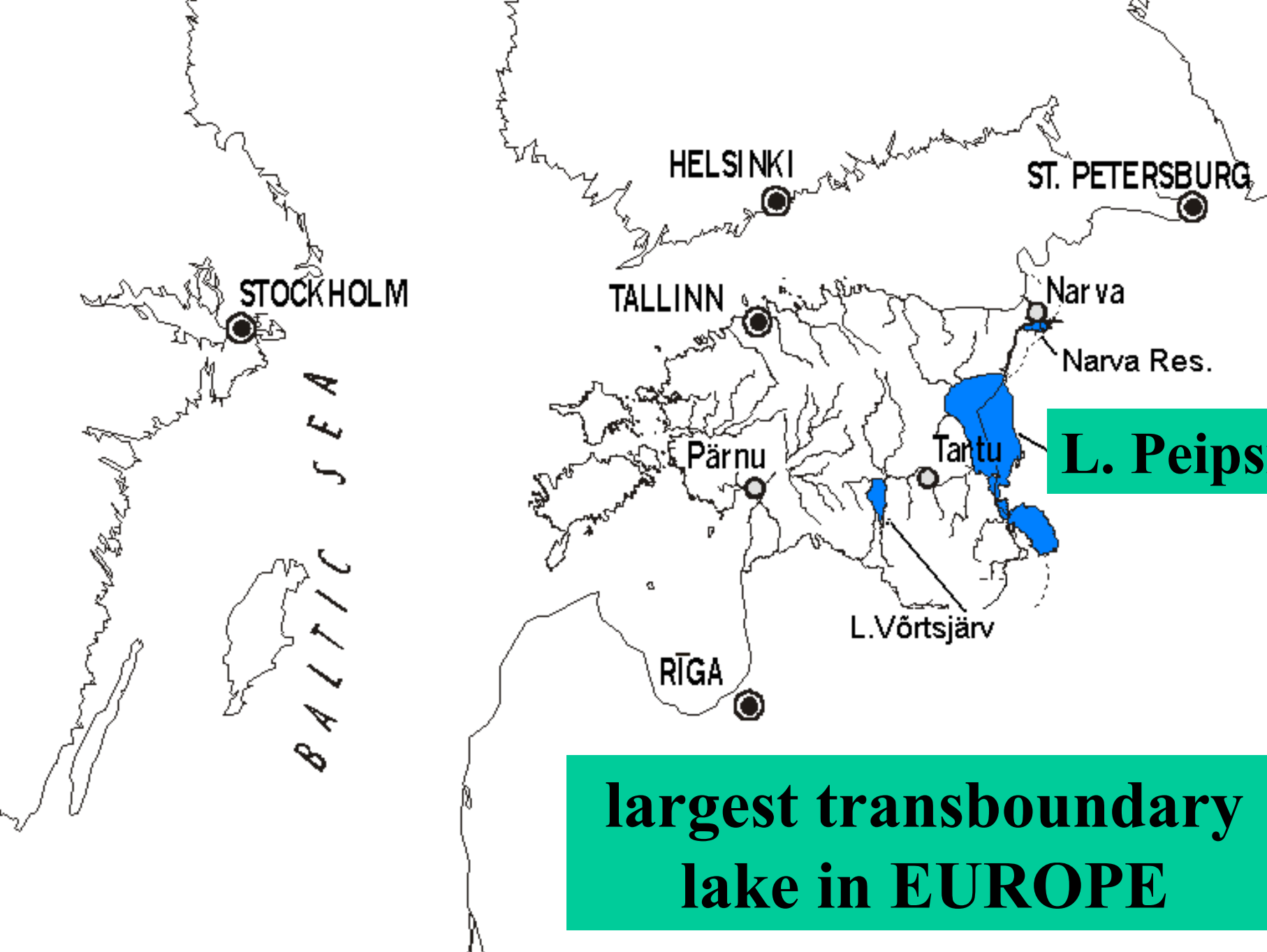
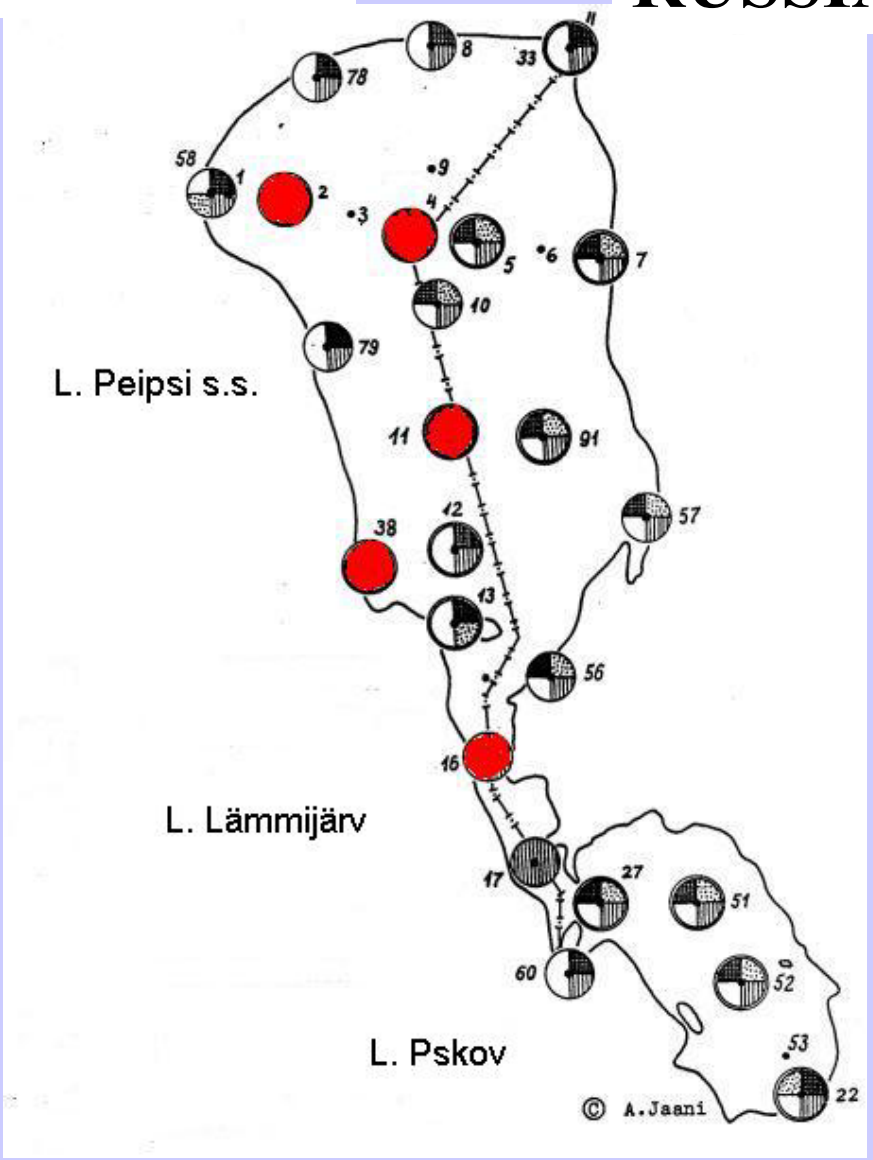


largest transboundary lake in EUROPE

ESTONIA

RUSSIA



Lake Peipsi

Area, km^2	3555
Watershed, km^3	47,800
Mean depth, m	7.1
Max depth, m	15
Mean Secchi, m	1.8
Mean TP, µg/l	40
Mean TN, mg/l	0.7
Mean Chl,	18

Mean fish catch 16 kg $ha^{-1}y$

● **present Estonian monitoring**

‘natural scientist’ knows

what lake is

information

integration

‘social scientist’ knows

what lake means

Lake Peipsi is the largest transboundary lake in Europe

⇓

L. Peipsi is important

⇓

implementation of WFD on L. Peipsi is important

MANTRA-East 2001-2004

"Integrated Strategies for the Management of Transboundary Waters on the Eastern European fringe – The pilot study of Lake Peipsi and its drainage basin"

indicators and criteria

for L. Peipsi

WFD requests

determination of water quality

as the range of deviation

from the ‘pristine status’

associated to type-specific

‘reference conditions’

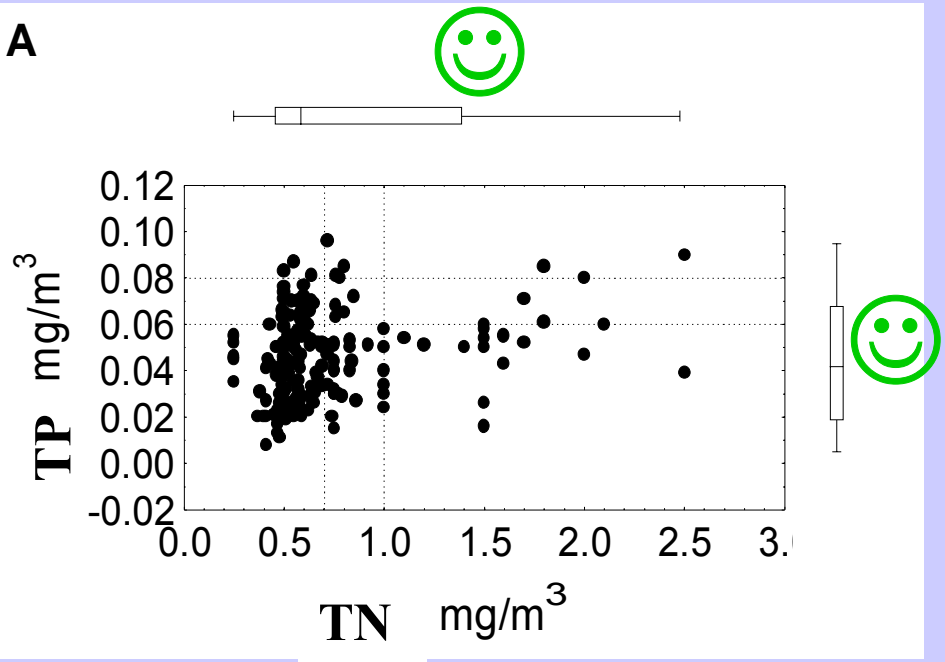
ECOLOGICAL STATUS OF L. PEIPSI

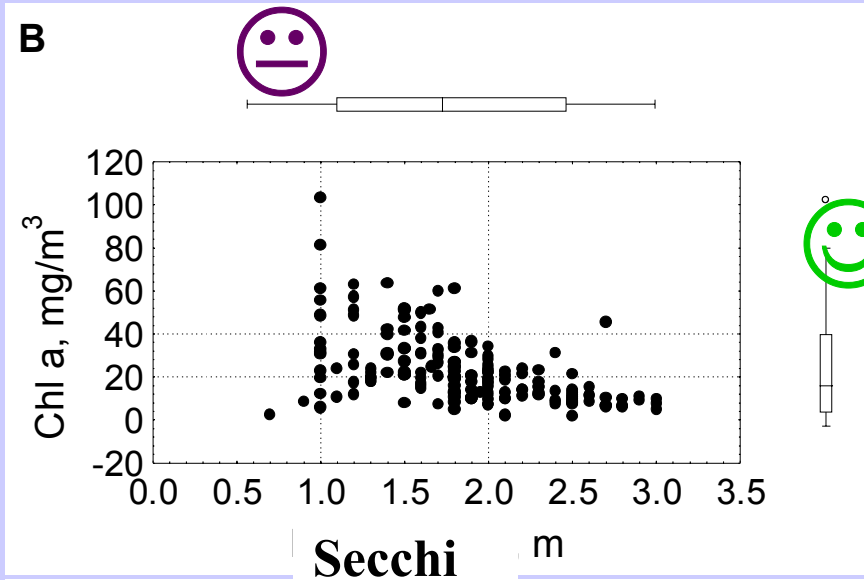
considering range of deviation

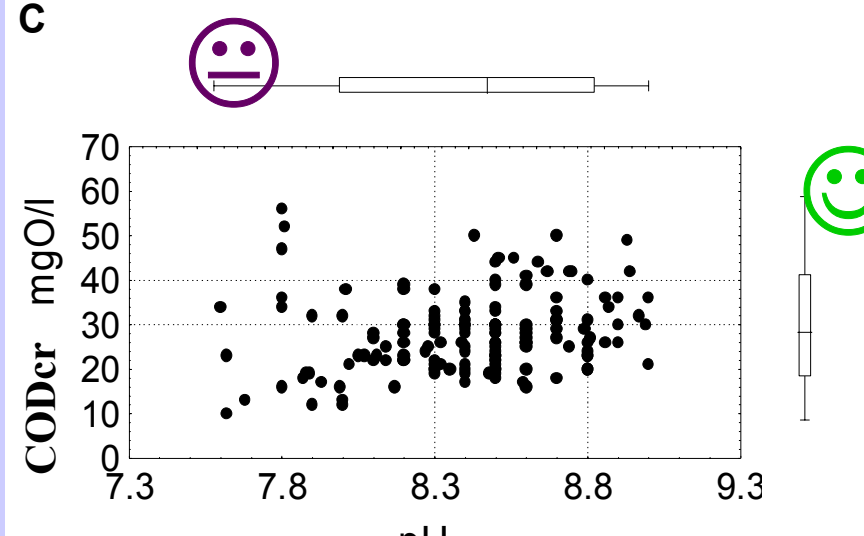
Classification of the water quality of light-coloured Estonian lakes

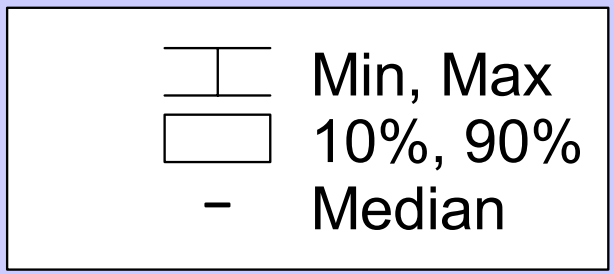
Parameter	I Class excellent	II Class good	III Class moderate	IV Class poor	V Clas bad
ecchi depth, m	>3	2-3	1-2	<1	<1
H at surface	7-8	8-8.3	8.3-8.8	8.8-9; 6-7	9>; <6
P, µg/l	<30	30-60	60-80	80-100	>100
N, µg/l	<500	500-700	700-1000	1000-1300	>1300
COD_{Cr}, mgO/l	<15	15-30	30-40	40-50	>50
ulphate concentration mg/l	<10	10-50	10-50	10-50	>50
hlorophyll a mg/m^3	<10	10-20	20-40	40-50	>50

Some ‘chemistry’ on L. Peipsi
‘Moderate’ status between the borders





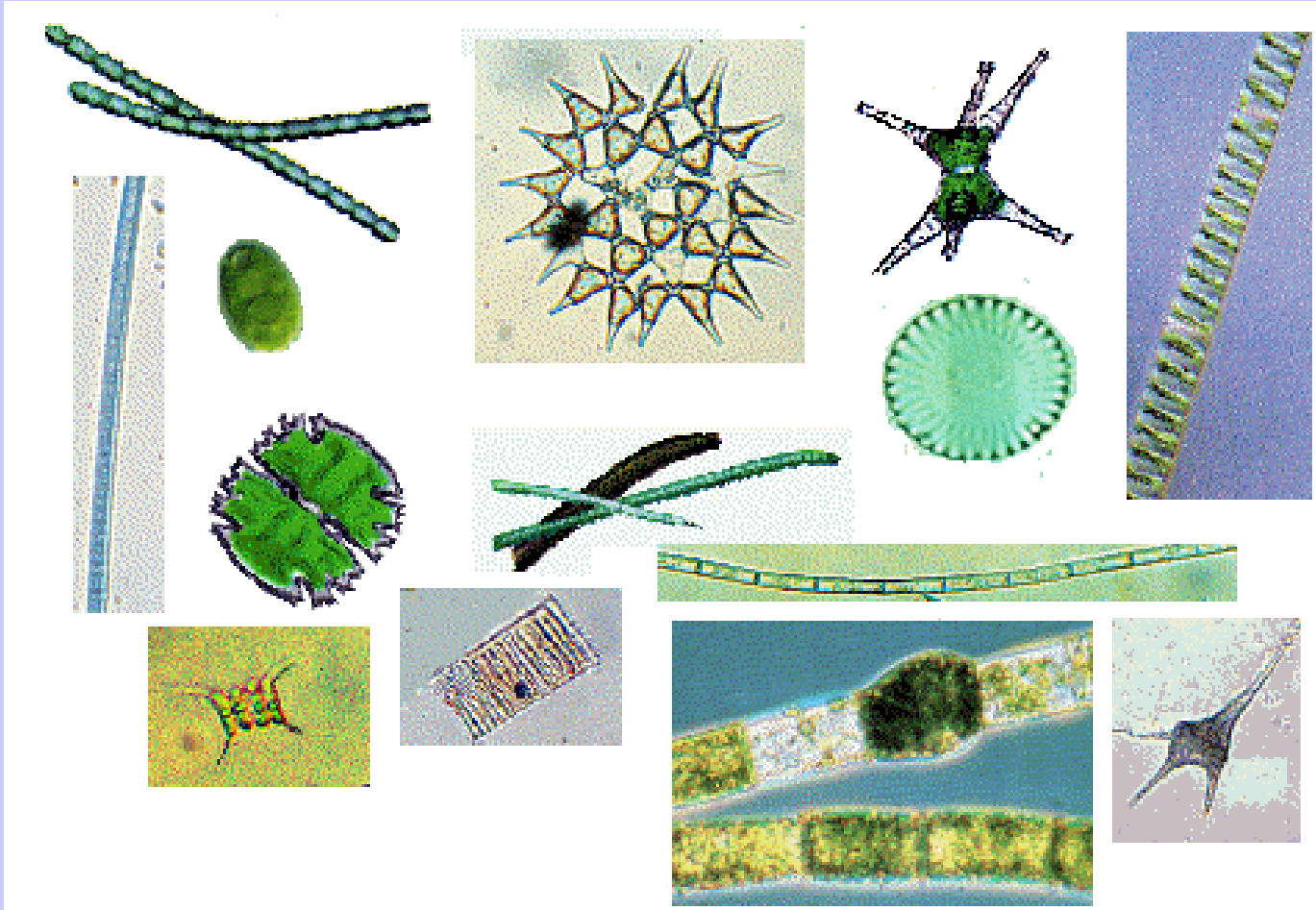




Phytoplankton

☺ **small ‘plants’ who start food chain**

☹ **if too many – make lake turbid**



Phytoplankton dominants

- **L. Peipsi *s.s.***
  - *Aulacoseira islandica, Stephanodiscus astraea, Gloeotrichia echinulata,* chrysophytes
    - **characteristic of moderately eutrophic waters**
- **L. Pihkva, Lämmijärv**
  - *Aulacoseira granulata, Stephanodiscus binderanus, Anabaena* spp., *Aphanizomenon flos-aquae,* green algae
    - typical of highly eutrophic or hypertrophic waters

generally remained same since 1900s

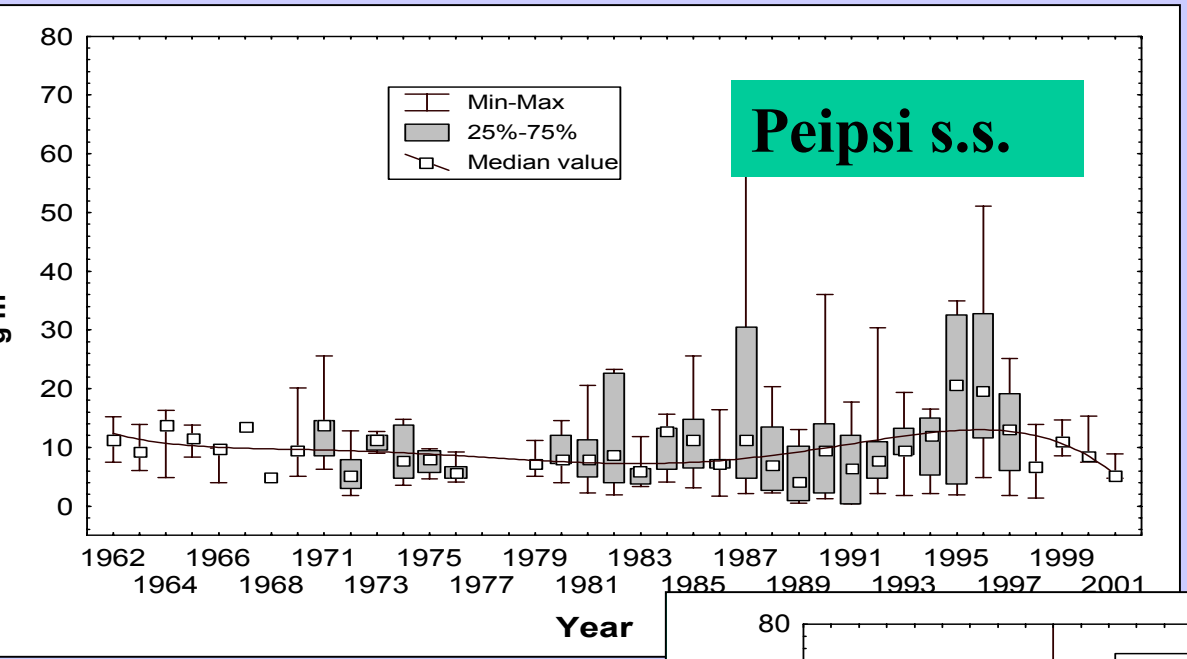
Phytoplankton composition

Since 1960s

- difference between north and south decreased
- hypertrophic species *Planktothrix agardhii & Limnothrix redekei developed* in 1988 and 1989
- *Aphanizomenon flos-aquae, Anabaena, & Stephanodiscus binderanus* increased
- *Aulacoseira italica* diminished remarkably

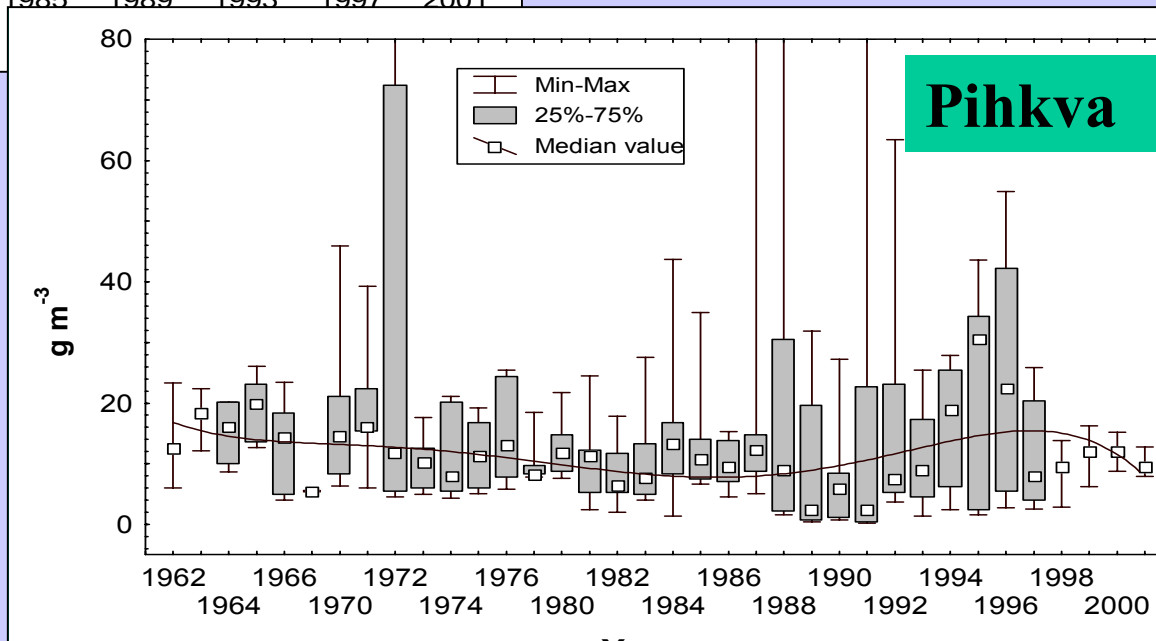
 **slight changes ⇒ 'good' status**

Phytoplankton abundance



generally same level

May, July, October
Estonian & Russian data



Water blooms

- *Gloeotrichia echinulata* already in **1895**
- *Anabaena flos-aquae* & *Microcystis aeruginosa* in **1912**
- *A. flos-aquae, A. spiroides* and *G. echinulata* in L. Pihkva in **1929**
- *A. flos-aquae* in **1934** in all lake parts
- yearly blooms common in the **1930s**
- bloom-caused fish-kills
  - in L. Pihkva in **1959**
  - in L. Peipsi in **1972**

no significant differences in frequencies and species

'good' status

reduced nitrogen loading
in 1990s caused N-limitation and
favoured blooms
of N_2 fixing cyanobacteria

Poster

Reduced nitrogen loading enhance cyanobacterial blooms in Lake Peipsi

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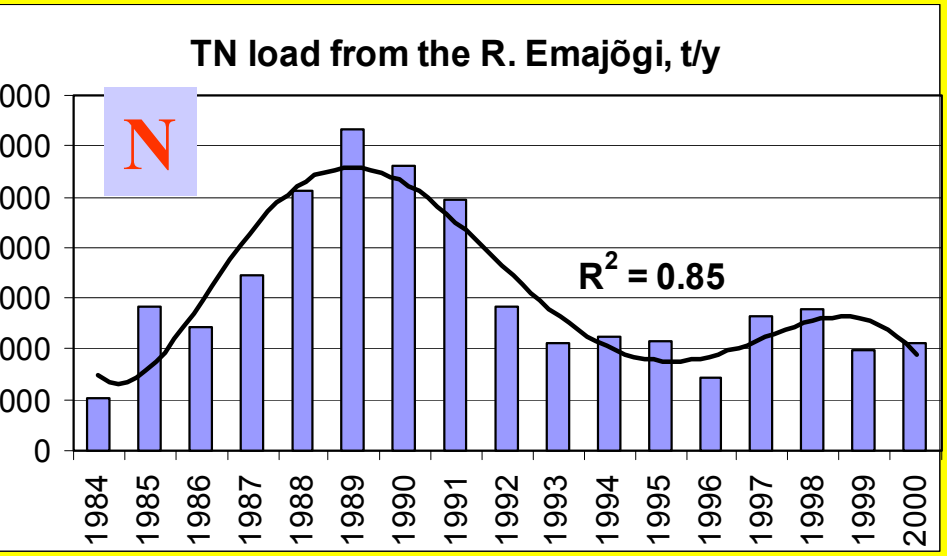
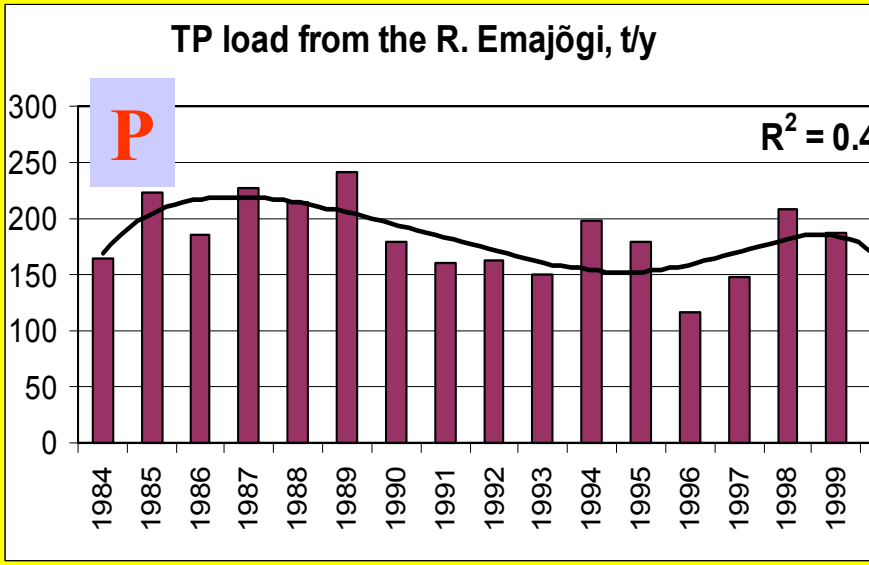
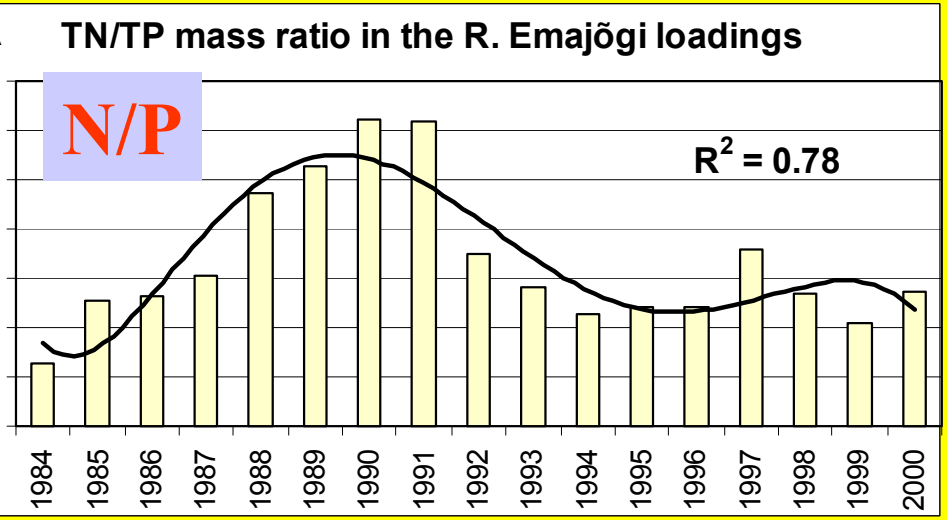
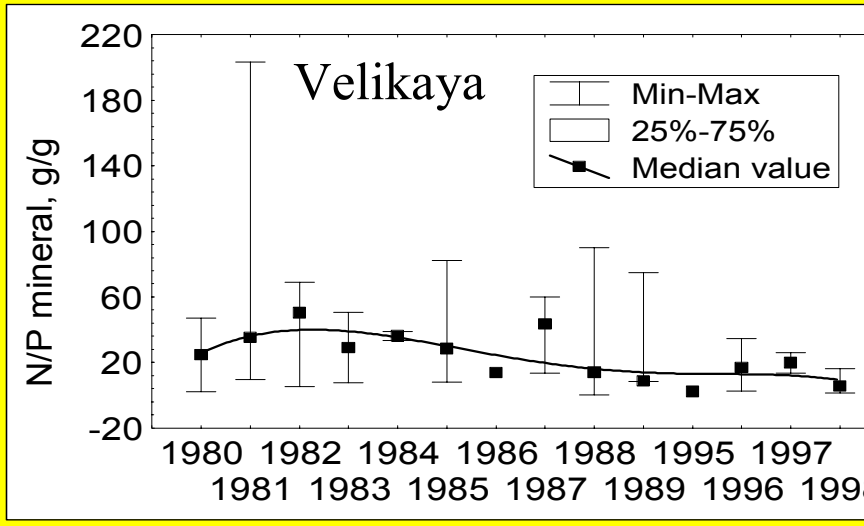
Poster

Changed loadings

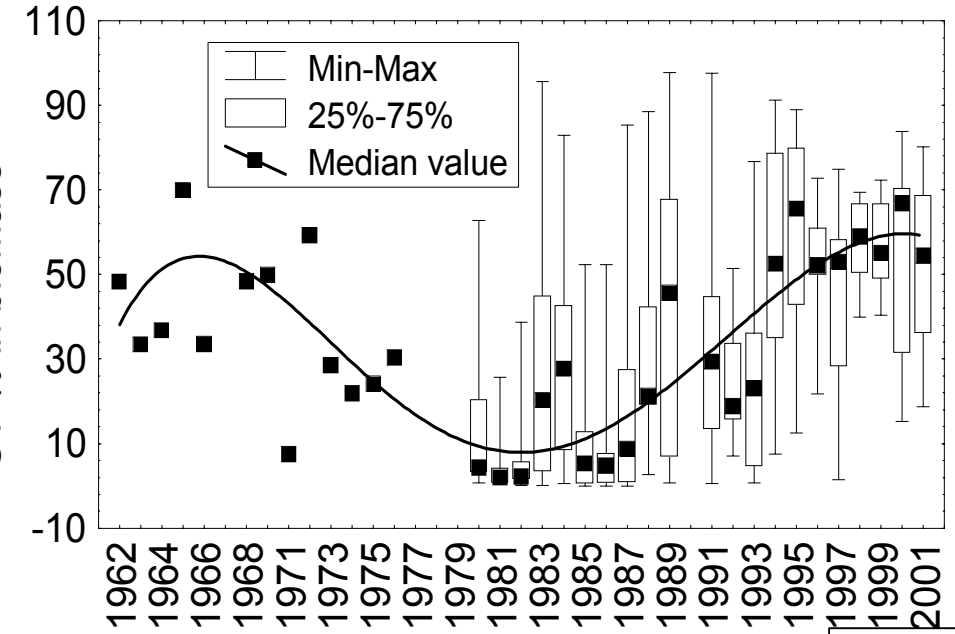








L. Peipsi *s.s.*, July & August

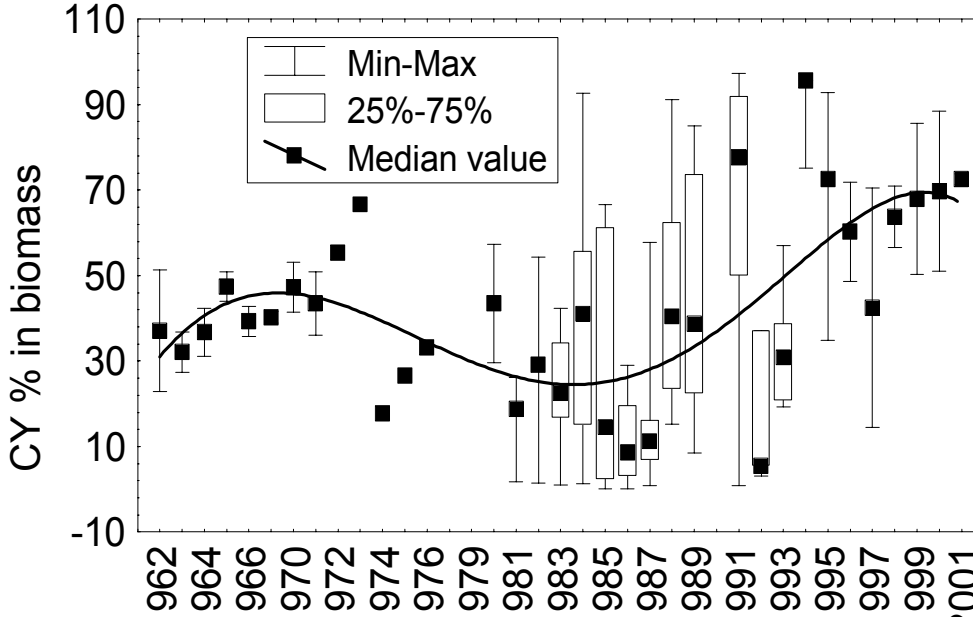


present situation reminds 1960s

CY% decresed at heavy N loading in 1980s

Poster

L. Pihkva & Lämmijärv, July & August



‘pristine’ conditions

???

Maybe

?

reduced nitrogen loading

is driving the ecosystem

closer to ‘pristine’ conditions

⇓

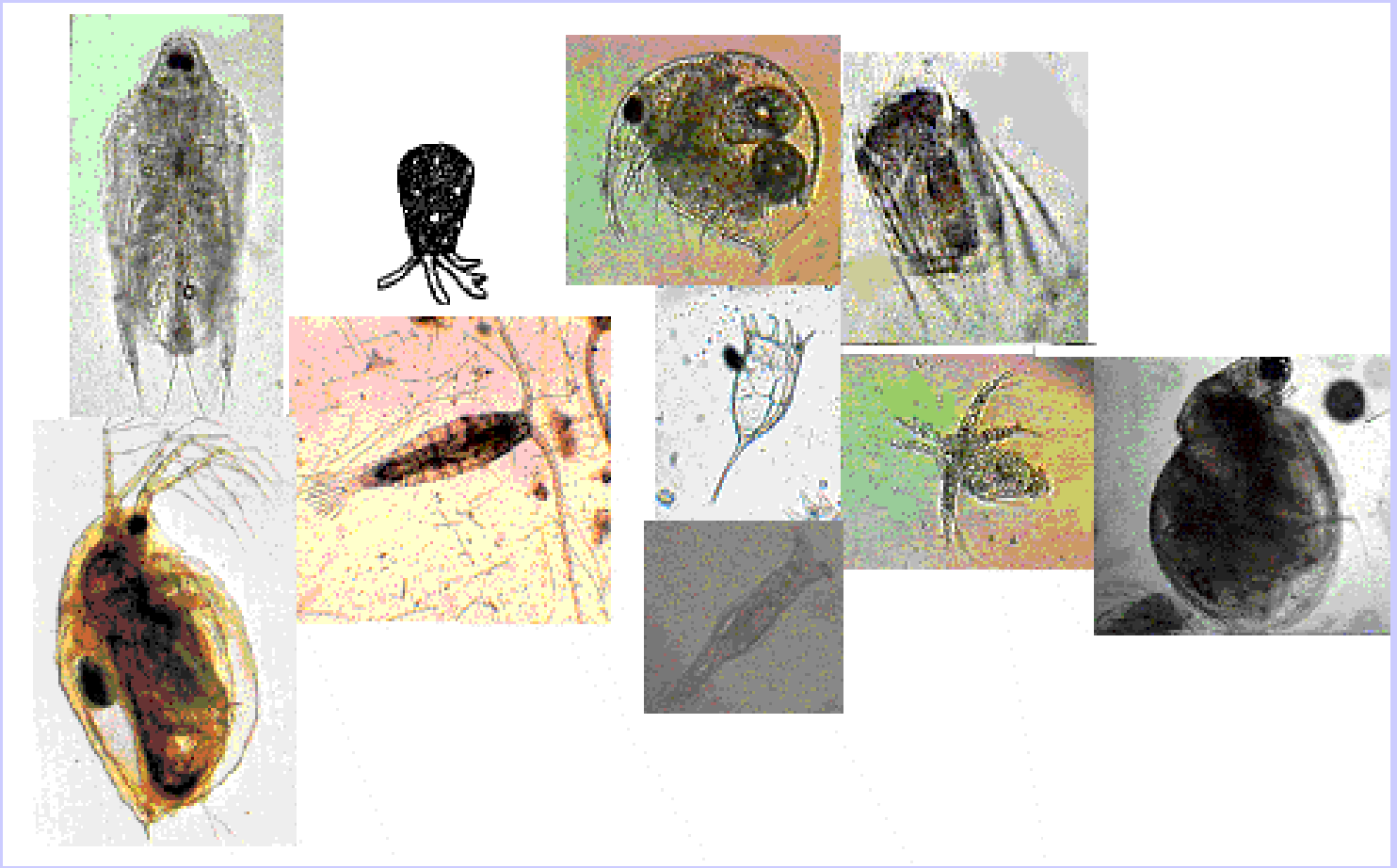
blooms may not always indicate the declining water quality

⇓

paleolimnology and modelling needed

Zooplankton – small animals

- eat phytoplankton
- food for fish



Zooplankton

key link

between phytoplankton and fish

determins the efficiency

of the aquatic food web

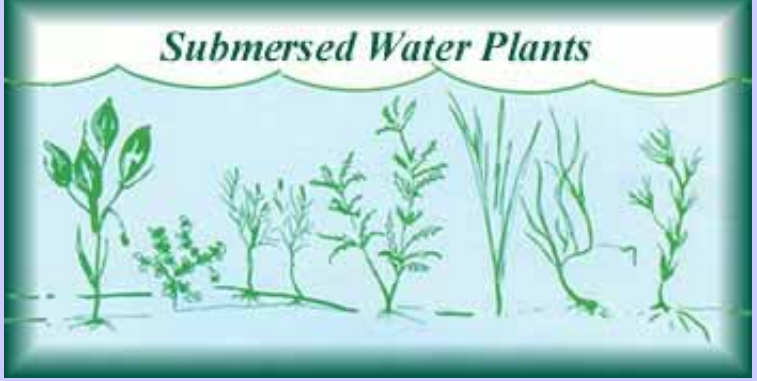
lacking from WFD ☹

Zooplankton of L. Peipsi

- oligotrophic indicators *Holopedium gibberum* and *Asplanchna herricki* found in early 1900s disappeared
- dominating complex has remained same for the last 40 years
- increasing degree of domination by rotifers
- rising number of small-sized crustaceans
- decreasing mean individual weight
- decreasing zoopl. to phytopl. biomass ratio

slight disturbance ⇒'good' status

Macrophytes



Dominating species:

- *Potamogeton perfoliatus*, submerged
- *Phragmites australis* (reed), emergent

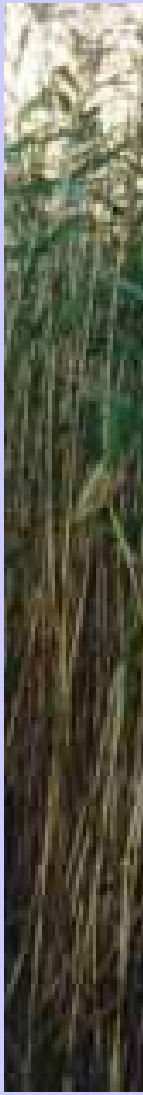
Since 1970s

- reed belt of L. Peipsi *s.s.* expanded
- reed increased *P. perfoliatus* decreased
- species from L. Pihkva expanded to L. Peipsi s.s.
- most sensitive taxa e.g. *Isoëtes setacea, Subularia aquatica* disappeared
- abundance of filamentous green algae increased

ecological status 'good'- 'moderate'

☺😐

Reed



Macrozoobenthos

- **Since 1960s**
  - + ***Chironomus plumosus*** **has not increased**
  - + **high species diversity has not decreased**
  - + **oligo-mesotrophic species still there** ***Monodiamesa bathyphila, Potthastia longimana, Paracladopelma rolli***
  - + **small bivalves (*Pisidiidae, Sphaeriidae*) abundant**
  - - **increasing of zebra mussel (*Dreissena polymorpha)***
    invader from 1935 (but !clean water species!)
  - - **gammaridean amphipod *Gmelinoides fasciatus* was introduced accidentally from L. Baikal in 1970s**

    ⇒replaced completely native *Gammarus lacustris*

😐 **benthic fauna strongly modified ⇒ 'moderate' status**

☺ **high species diversity & survival of sensitive species ⇒ high quality**

Fishes of L. Peipsi

Historically heavily exploited fish stock

- Baer, 1852: overfishing has reduced bream cacthes
- 70-150 yr ago smelt was the main commercial fish
  - large fluctuations caused by climate, oxygen, algal blooms
- sharp decrease of vendace in 1990s
  - siltation of the spawning grounds
  - winter oxygen depletion
  - increased predation by pikeperch
- sharp increase of pikeperch from late 1980s-late 1999s
  - overfishing ⇒ decrease of pikeperch and perch in last years
    ⇒ increase of ruffe endangering the eggs of vendace

decrease of sensitive species (vendace, whitefish), episodic fish kills, decrease of older age classes of top predators, increse of omnivores and habitat generalists (ruffe)

⇓

'moderate' status

Water quality of Lake Peipsi

☺ P, N, Chl, phytoplankton, zooplankton, macroinveretebrates

⇓

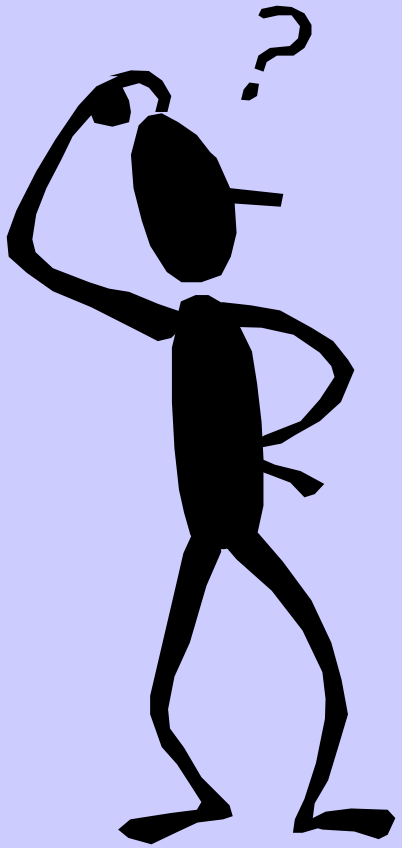
'good'

😐 Secchi depth & fish fauna

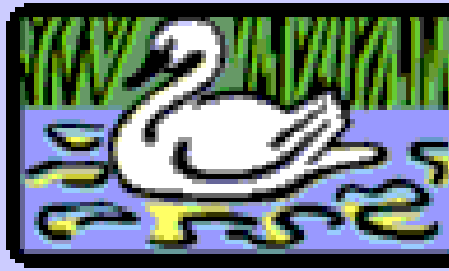
⇓

'moderate'

So, and …?



‘natural scientist’:
not too bad!



‘social scientist’:
what to do with all that?

‘people’:
turbid water!
too few fish!

Suggestions

- **Examine what people need**
- **Explain to people & politicians**
  - **keep loadings low**
  - **! keep phosphorus loading low !**
  - **protect carnivorous fish**
  - **wait and pray that we were right !**

Thank you all !

and

- Estonian program of environmental monitoring
- EC projects
  - –ECOFRAME (contract EVK1-CT-1999-39)
  - –MANTRA-East (contract EVK1-CT-2000-00076)
- Estonian Science Foundation

for financial support !