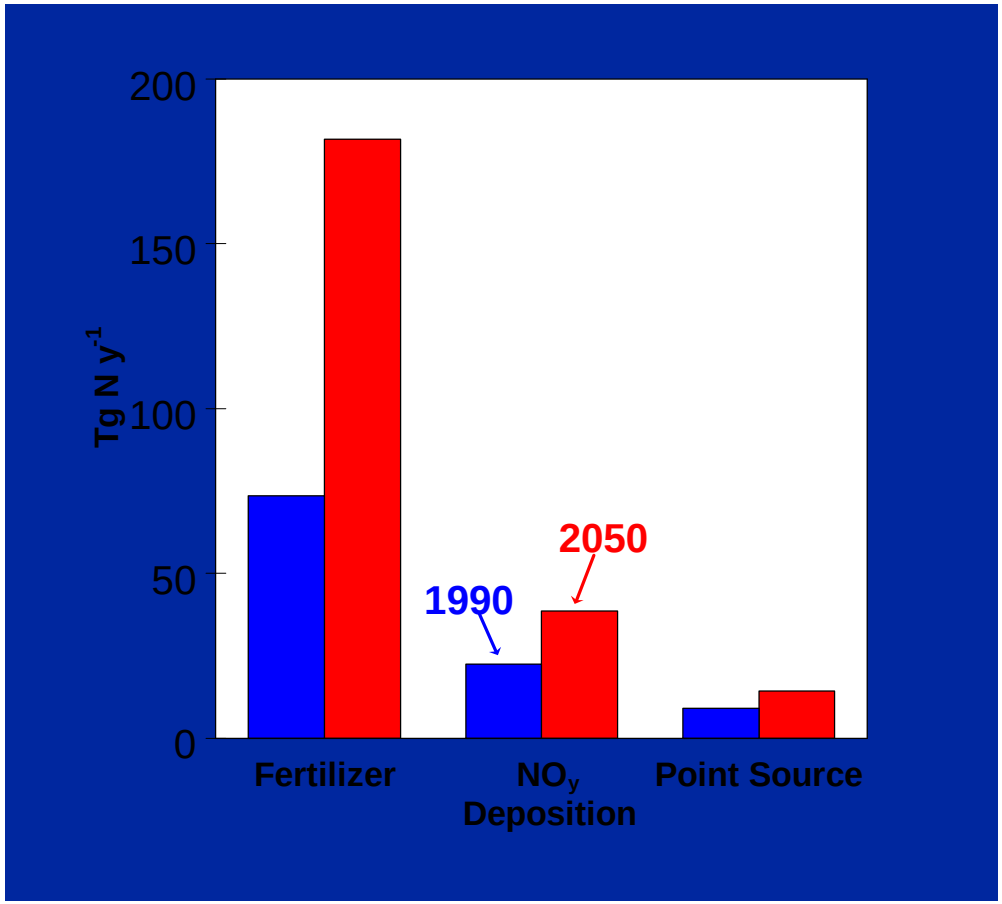
Scenario results for Lake Peipsi

Per Stålnacke and Geoffrey Gooch

MANTRA East

1990 and 2050 (predicted BAU) N Inputs to Global Watersheds

Tg N y^{-1}



Kroeze & Seitzinger, 1998

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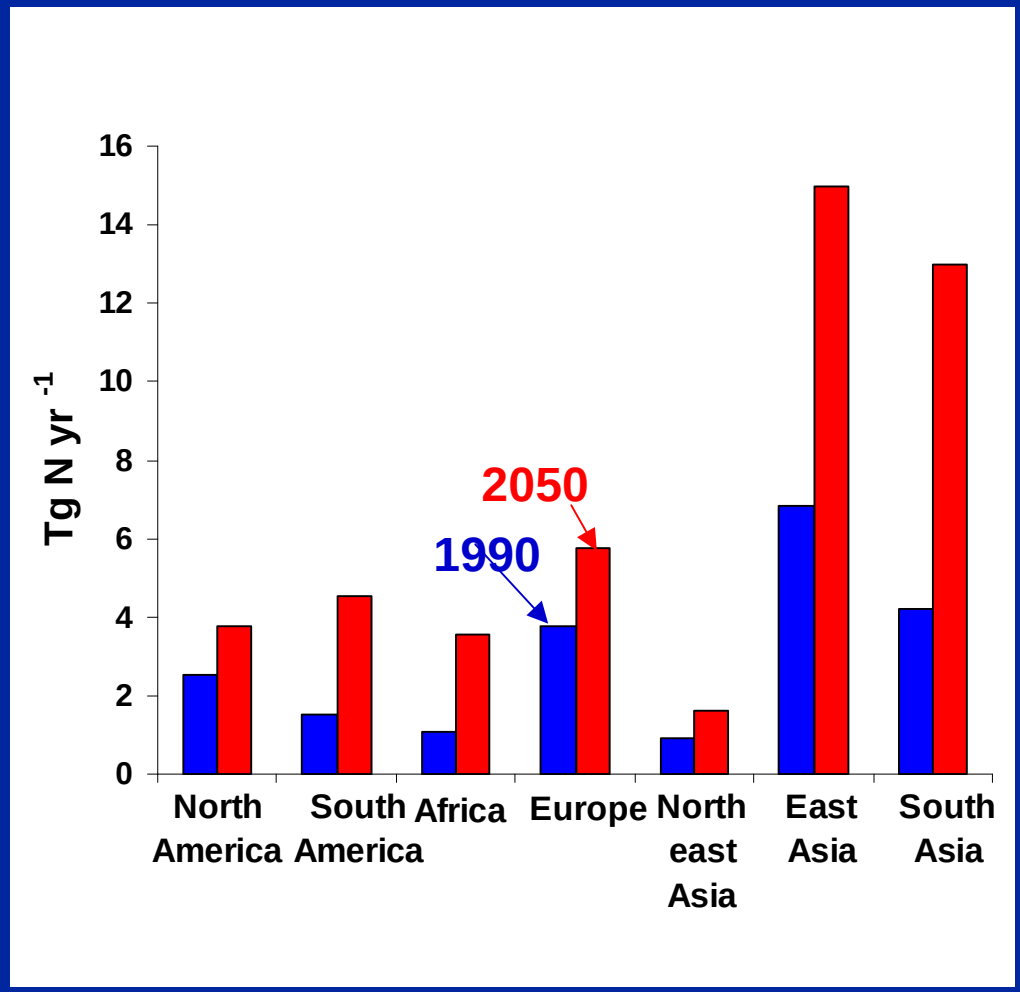
Future Projections (year 2050) of Inorganic N Export by Rivers for World Regions (BAU Scenario)



Kroeze & Seitzinger, 1998

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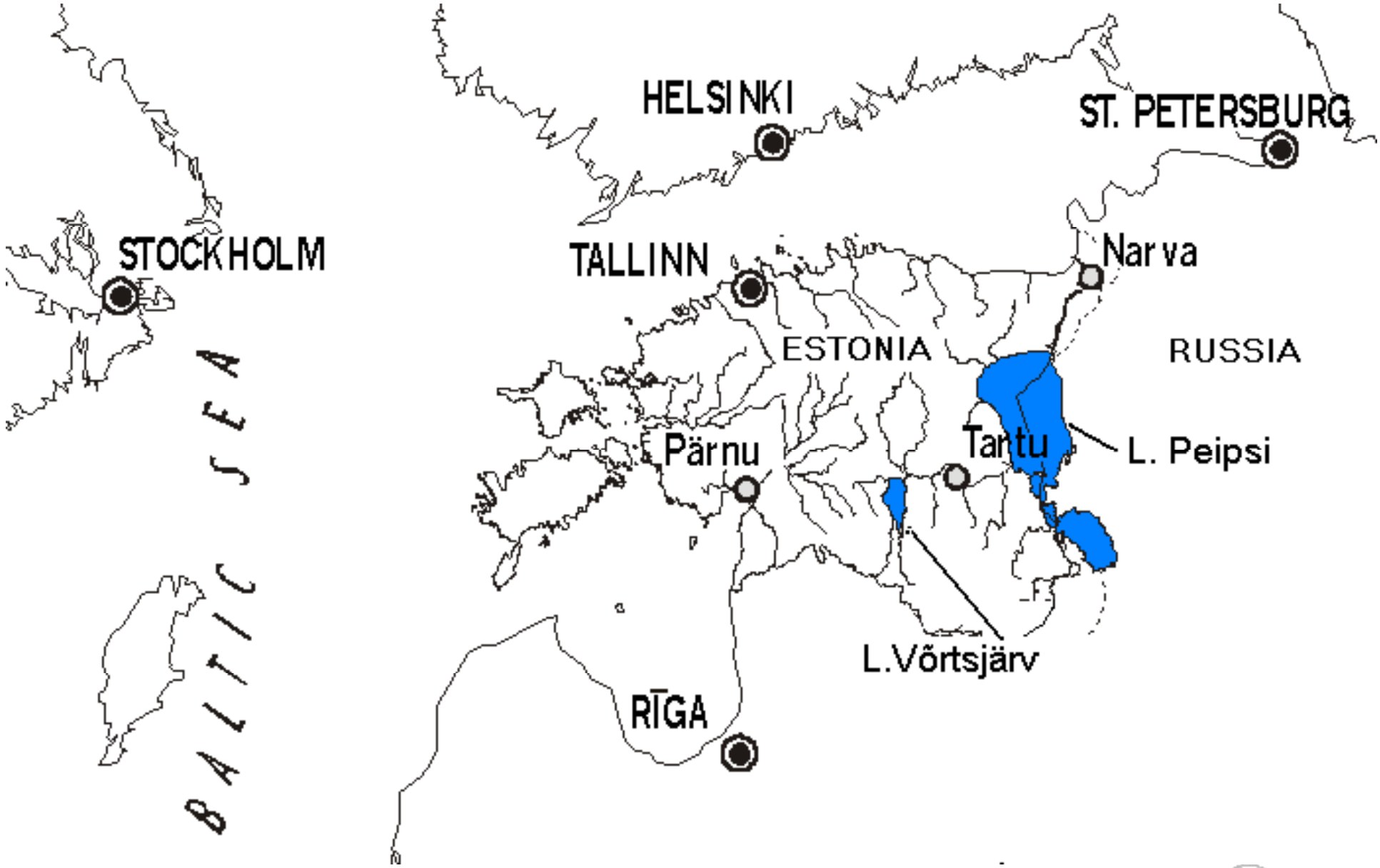
HELSINKI
ST. PETERSBURG
STOCKHOLM
TALLINN
Narva
ESTONIA
RUSSIA
Pärnu
Tartu
L. Peipsi
L.Võrtsjärv
RĪGA
BALTIC SEA

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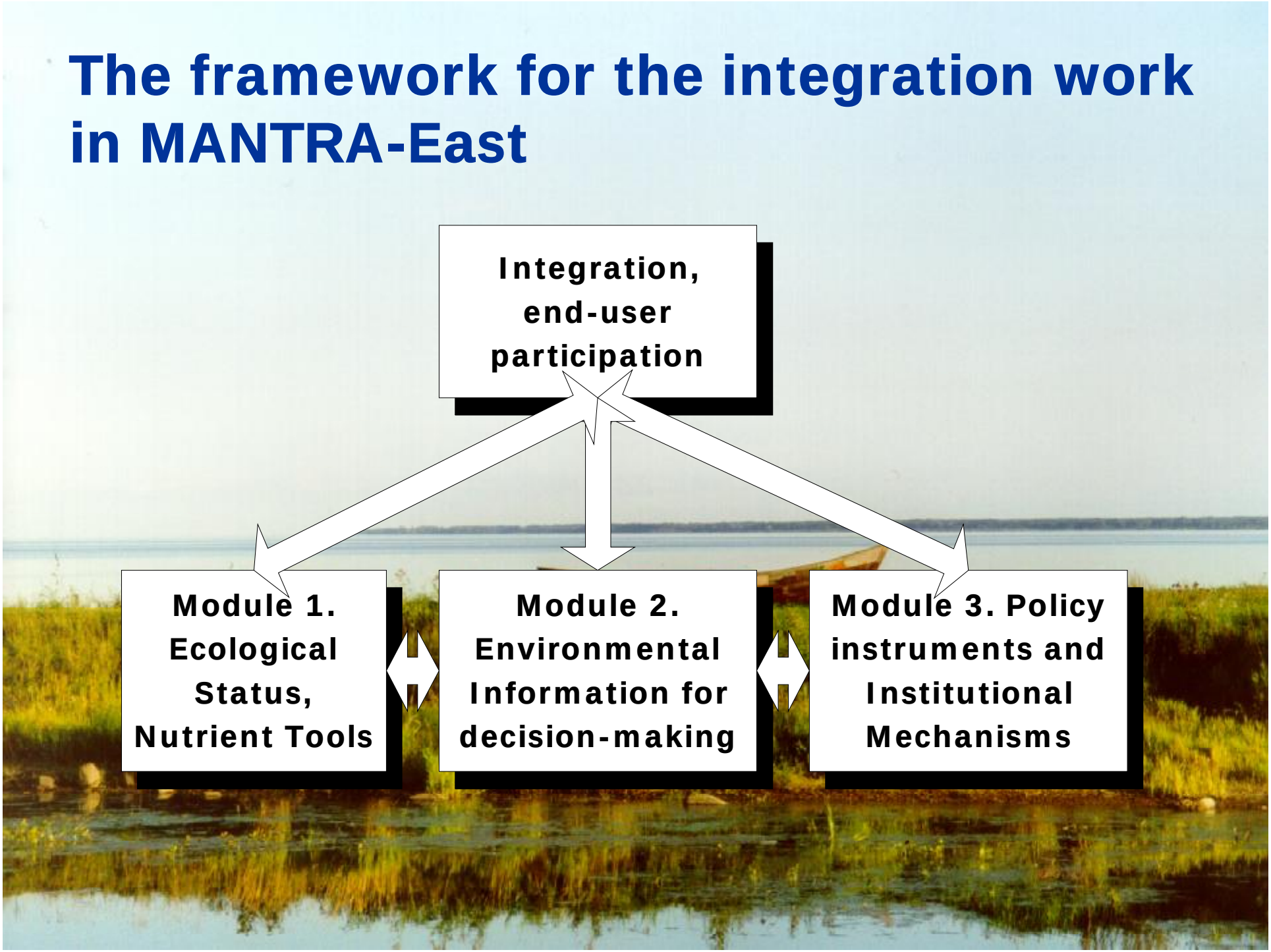
The framework for the integration work in MANTRA-East



Scenarios, the key to integrated strategies?

In MANTRA-East we decided that 4-5 scenarios should be produced and will be the operational tool for the integration (i.e. interdisclipinarity)

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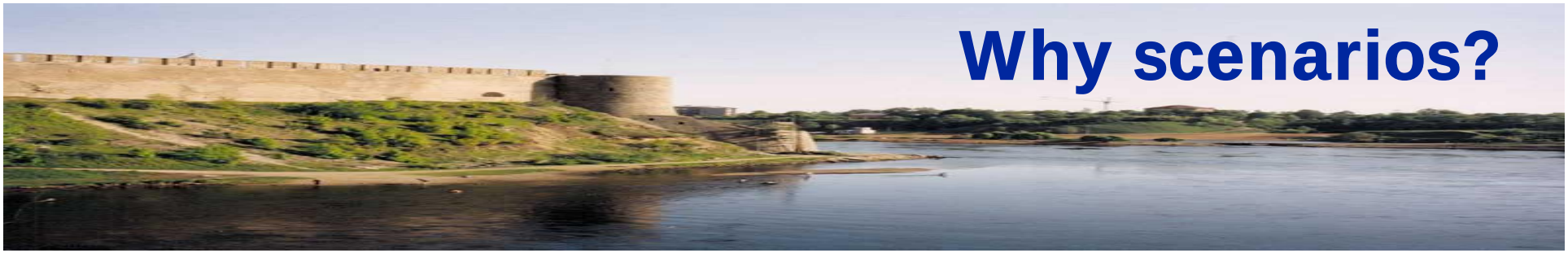
Pillars for the scenarios:

- Water quality in the lake
- Regional socio-economic development
- Transboundary cooperation
  - consequences for nutrient emissions / riverine loads and lake water and ecological quality



Why scenarios?

- Can shed light on and offer insights about possible future developments
- The future will always be shrouded by uncertainty and therefore accurate prediction is not a feasible goal
- Scenarios can be useful to generate potential policy options
- Scenarios are in the interest for the decision-makers, stakeholders and end users;
- The scenarios should besides the environmental issue be built on a framework that also take into account the social dimensions and impacts.

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Procedure (DPSIR framework)

Step 1	Create 2 - 4 qualitative scenarios for likely/plausible future in the case areas DRIVING FORCES	WP 1, WP 2
Step 2	Translate these qualitative scenarios into quantitative GIS layers DRIVING FORCES/ PRESSURES	WP 2, WP5, WP 8
Step 3	Model the nutrient fluxes in the Lake Basins using POLFLOW and MIKE Basin: Output N and P loads to the Lake Peipsi and Vistula Lagoon PRESSURES	WP4, WP5
Step 4	Model the transformation of nutrients in the Lake and Lagoons using AQUASIM and Delft 3D models STATE / ECOLOGICAL IMPACT	WP 3, WP 6
Step 5	Analyse the policy and socio-economic implications of the modeling re-sults SOCIETAL IMPACT/ RESPONSE	WP 1, WP 2
Step 6	Analysis of the value of scenarios fom an information perspective	WP 7, WP 1

Scenario story-lines (scripts) produced by social/policy scientists (Gooch, 2003)

I. 'Business as usual scenario (BAU)'.

Continuation of present trends: The economical situation will remain the same and pollution loads and emission in end of 1990s remain at present level.

II. 'Target/fast development scenario'.

Estonia: fast adaptation to the EU. Russia: domestic fast economic and social development

III. 'Crisis scenario'.

Conditions radically deteriorate into 'crisis' in both countries

IV. 'Isolation scenario'

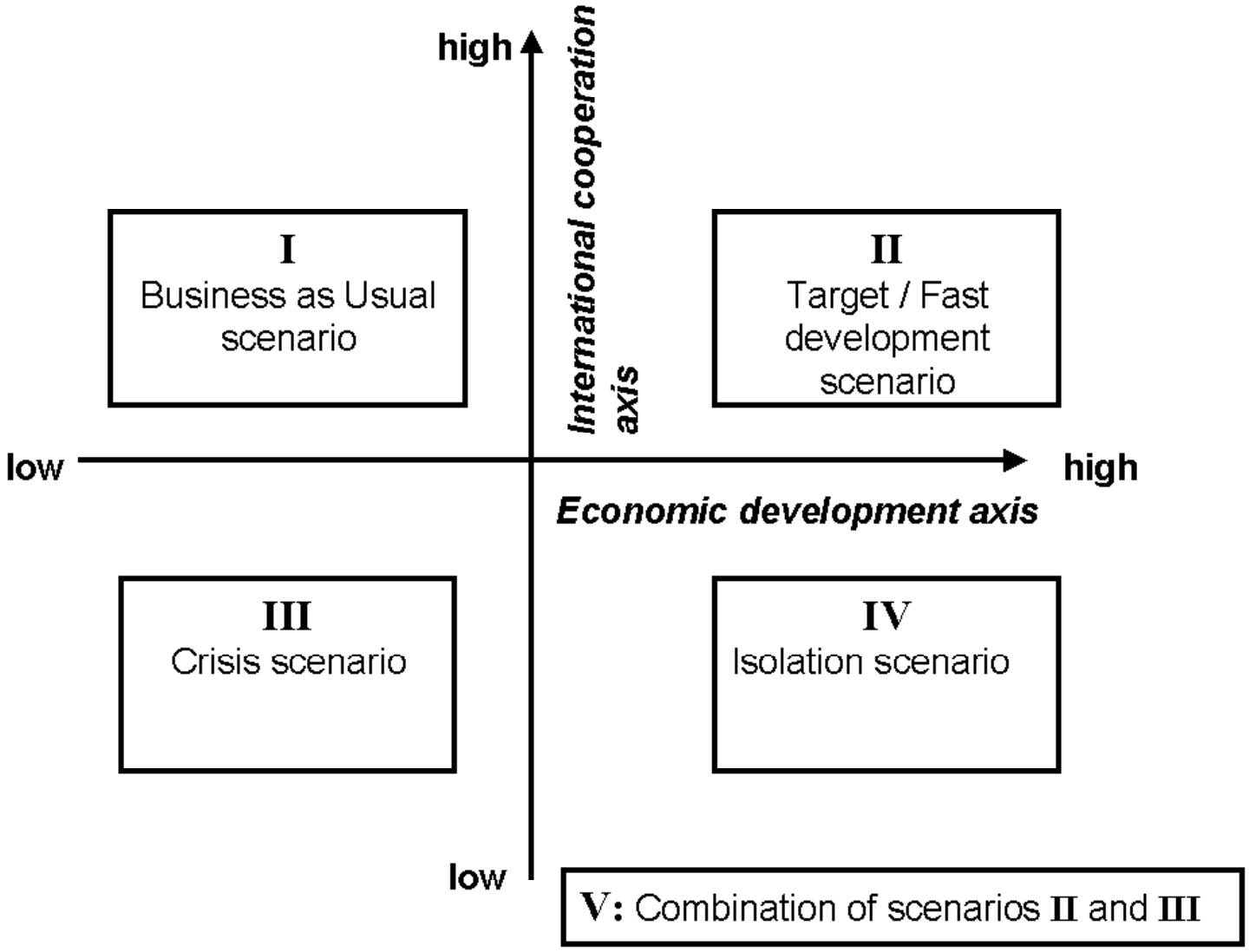
Estonia: slow, unwilling adaptation to the EU.

Russia: isolation from Europe and a growth of nationalist sentiment.

V. Combination of II. and III.

Estonia: fast development. Russia: Crisis

The 4 scenarios (Gooch, 2003)



Driving force variables

- Population
- Wastewater treatment connection rate
- Fertiliser use
- Livestock amount
- Crop yields
- Atmospheric deposition
- Amount of agricultural land.

Scenario I. and II.

Scenario	Population	WWTP connection	Fertiliser use	Livestock amounts	Crop yields	Atmospheric deposition	Amount of Agricultural land
I Business as Usual	Constant in Tartu and Pskov EST/LAT: Rural: 8 % decrease RUS: 5 % decrease	No changes	EST/LAT: Increasing from 14 kg/ha/yr N and 1.1 kg/ha P to 50 kg/ha/yr N and 2 kg/ha/yr RUS: no change	EST/LAT: 10 % increase RUS: no change	EST/LAT: 25 % increase RUS: no change	No change	Tartu and Pskov counties: only 85 % left from 1980ies land Other counties: only 60 % left
II Target/Fast Development	Tartu and Pskov: growth of 10 %. Rural: growth of 5 %	EST/LAT: only in settlements, treatment will improve one step RUS: only in settlements > 10000 inhabitants	Increasing from 14 kg/ha/yr N and 1.1 kg/ha/yr P to 130 kg/ha/yr N and 15 kg/ha/yr	100 % increase	EST/LAT: 40 % growth. Industrial crops: 70 % increase RUS: no change	Changes from 7.7 kg/ha/yr to 15 kg/ha/yr (N) and from 0.05 kg/ha/yr to 0.08 kg/ha/yr (P)	Same amount as in 1980ies

Scenario III. and IV.

Scenario	Population	WWTP connection	Fertiliser use	Livestock amounts	Crop yields	Atmospheric deposition	Amount of Agricultural land
III Crisis	Tartu and Pskov: decrease of 5 % EST/LAT: Rural: decrease of 25 % RUS: 30 %	EST/LAT: no change RUS : Collapse of current systems	EST/LAT: no change (14 kg/ha/yr N and 1.1 kg/ha/yr P) RUS: decrease with 80 % to 2.8 kg/ha/yr N and 0.22 kg/ha/yr P	EST/LAT: 50 % decrease RUS: 75 % decrease, except for milk cows: 100 % increase	50 % decrease	No change	EST/LAT: 50 % decrease RUS: 80 % decrease
IV Isolation	No change	EST/LAT: only in settlements, treatment will improve one step. RUS: no change	EST/LAT: 50 % increase (to 21 kg/ha/yr N and 1.65 kg/ha/yr P). RUS: no change	EST/LAT: 30 % increase RUS: no change	EST/LAT: 40 % increase RUS: no change	Changes from 7.7 kg/ha/yr to 15 kg/ha/yr (N) and from 0.05 kg/ha/yr to 0.08 kg/ha/yr (P)	EST/LAT: 10 % decrease RUS: 60 % decrease

Modelling nutrient fluxes
(PolFlow; de Wit, 1999)

INPUT

A. Maps (e.g. land cover, DEM, soil texture, hydrogeology, rivers)

B. Statistics, aggregated for administrative units: livestock numbers, Crop yields, wastewater treatment connection percentages, population numbers

Step 1: *spatial distribution, balance calculation*

Step 2: *Hydrological modelling*

OUTPUT

Diffuse emissions (soil surface surplus) and point emissions

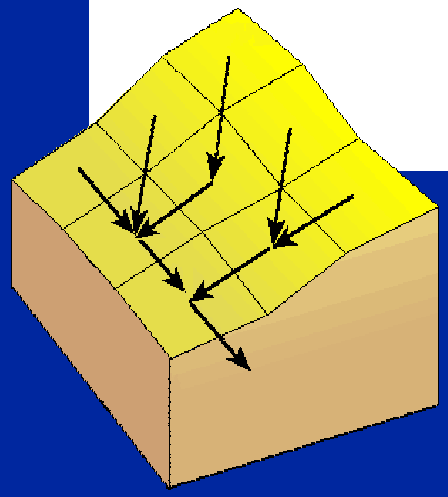
OUTPUT

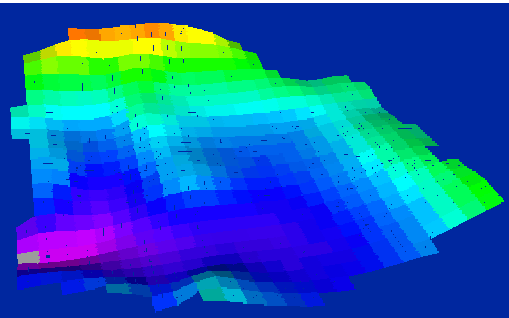
Long-term hydrological fluxes and residence times

Step 3: *routing of nutrients through the soil / groundwater system and the river network*

OUTPUT

Nutrient loads in rivers and into the lake





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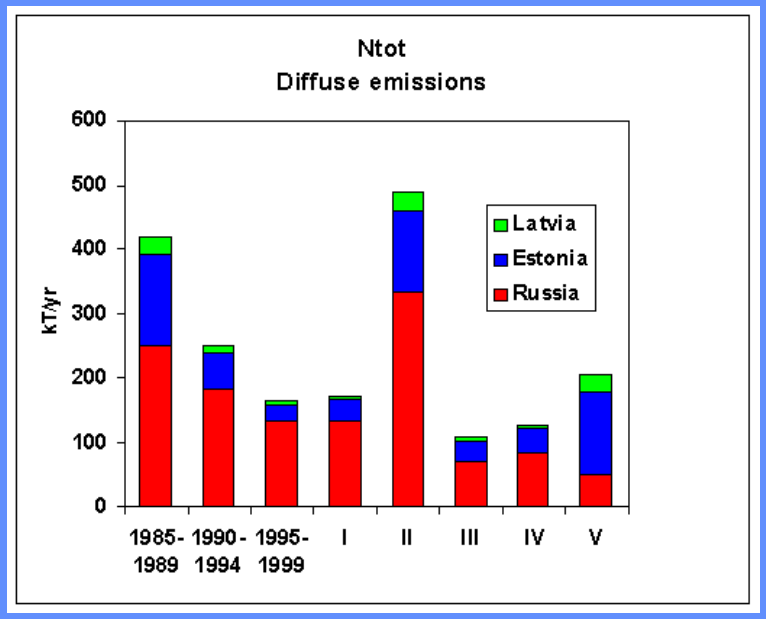
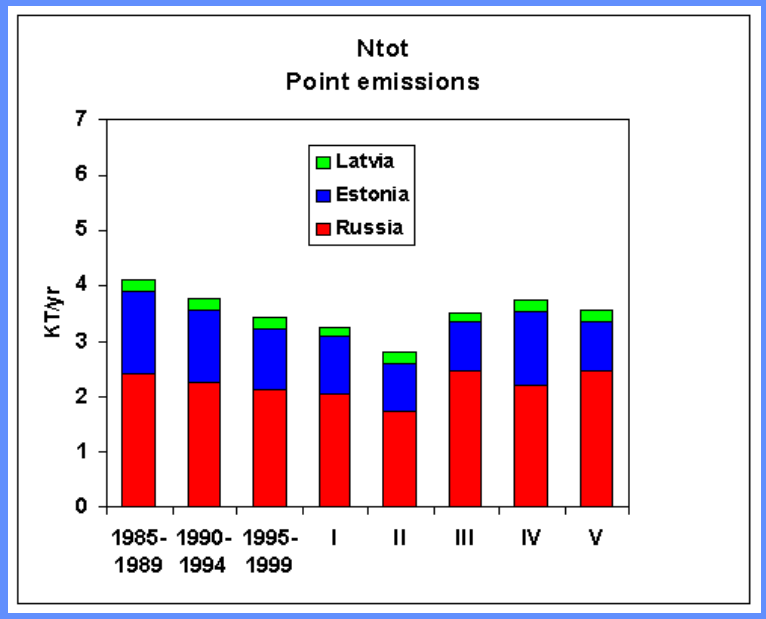
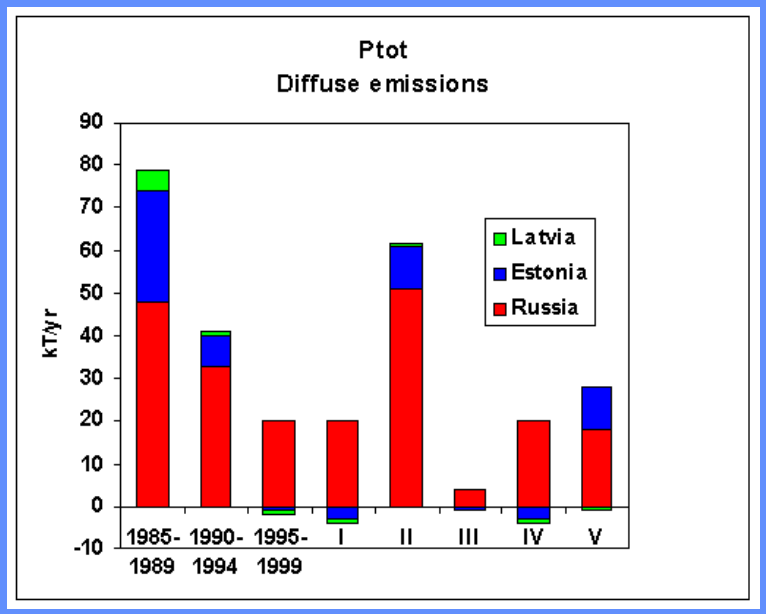
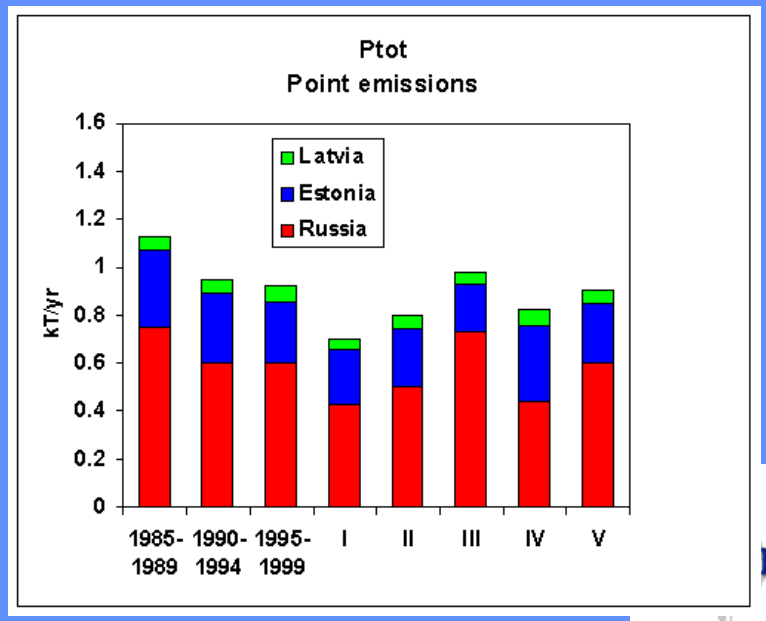
Source emissions changes 1985-1999 vs. 2015-2019



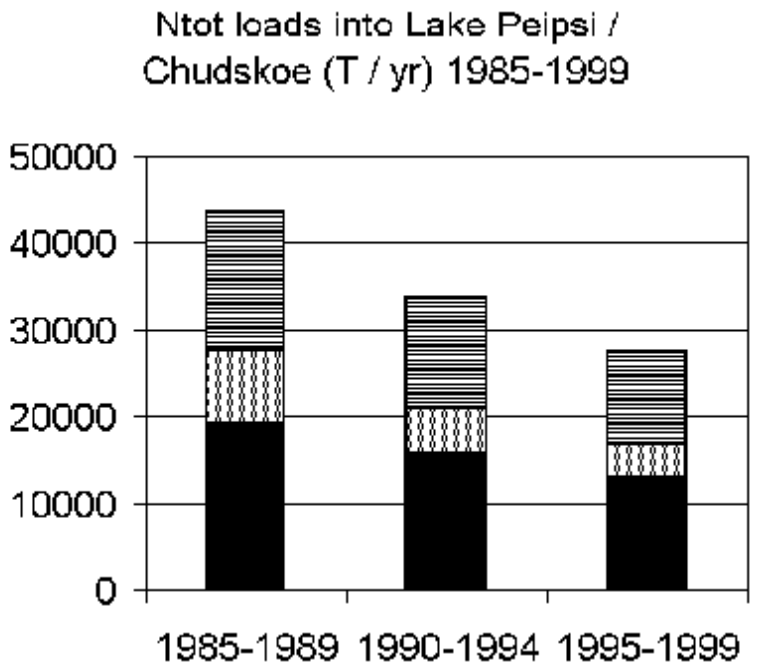


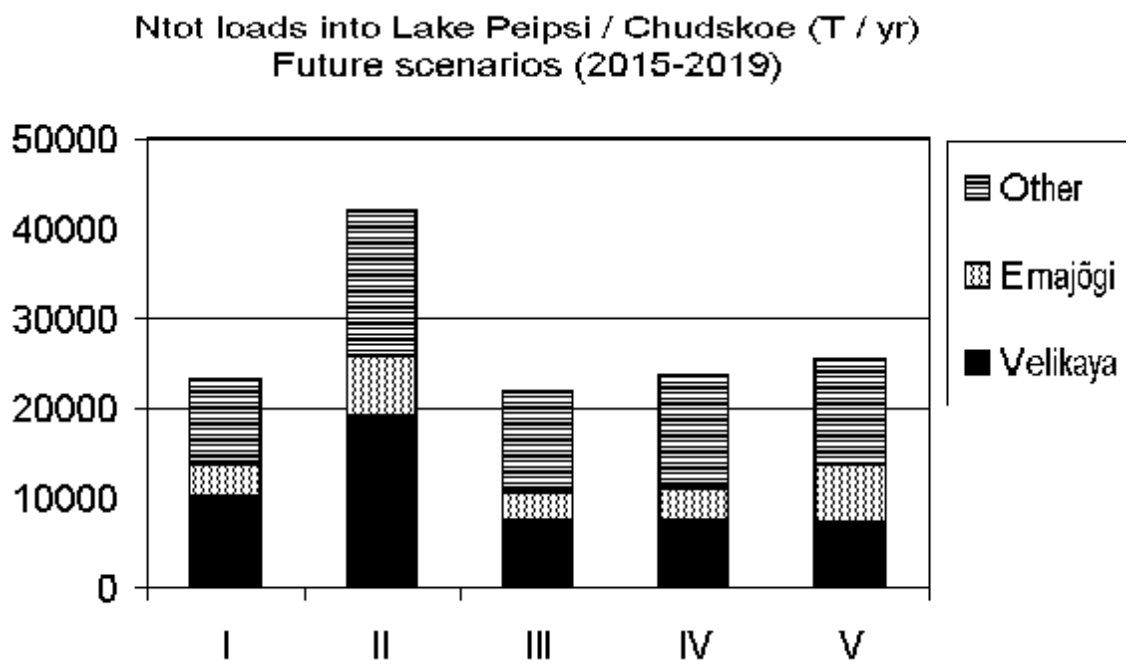




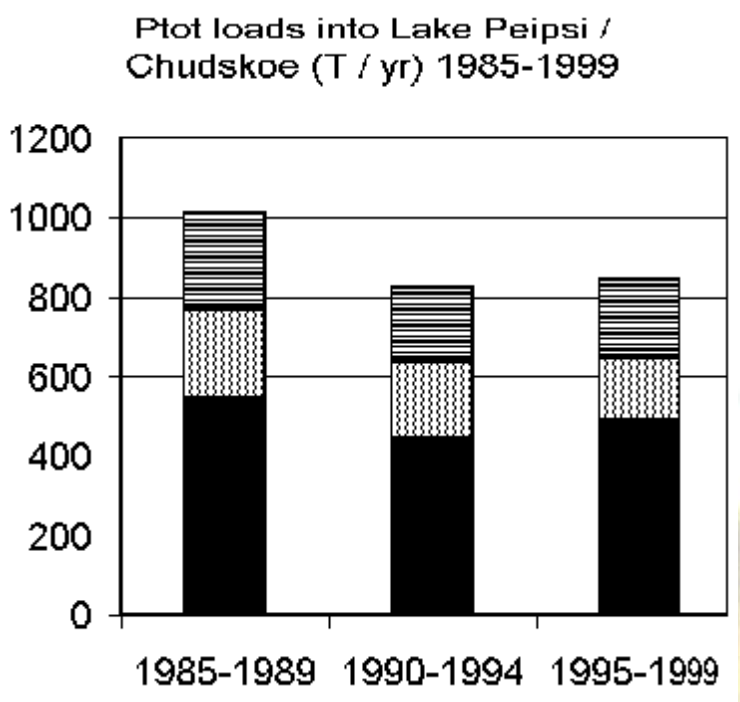
RA East

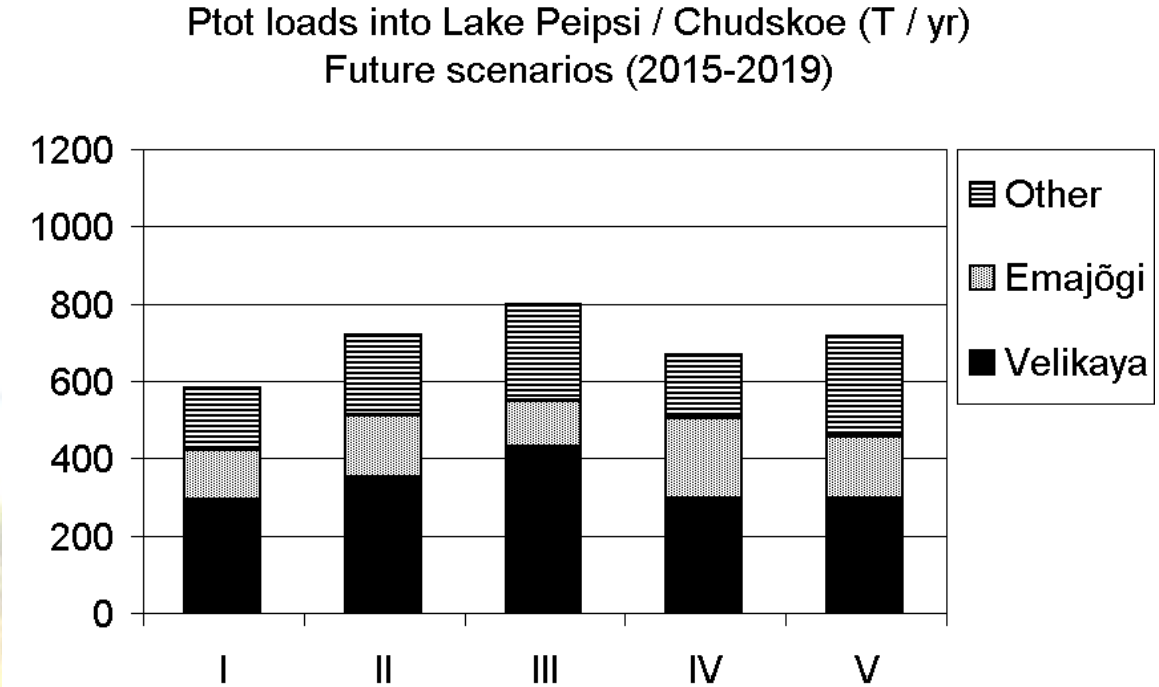
Nitrogen load 1985-1999 and 5 scenarios for 2015-2019 (Mourad et al., 2003)





Phosphorus load 1985-1999 and 5 scenarios for 2015-2019 (Mourad et al., 2003)

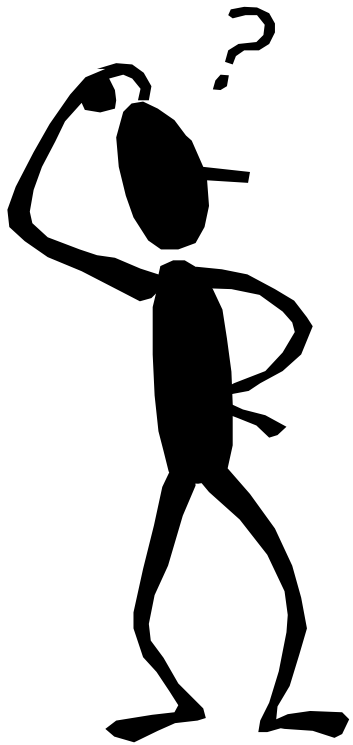




Summary of riverine loads scenarios

- **Loads of the eighties are never reached (= No scenario predicts larger nutrient loads than in the communist period)**
- **Given the 5 scenarios of the future regional development, the riverine nutrient loads into the lake will generally decrease.**
- **The *target / fast development* scenario (II) results in a substantial larger Ntot input to the lake.**
- **The *Crisis* scenario (III) yields the largest Ptot load.**

- **What is the reaction of the ecosystem to changed nutrient loadings?**



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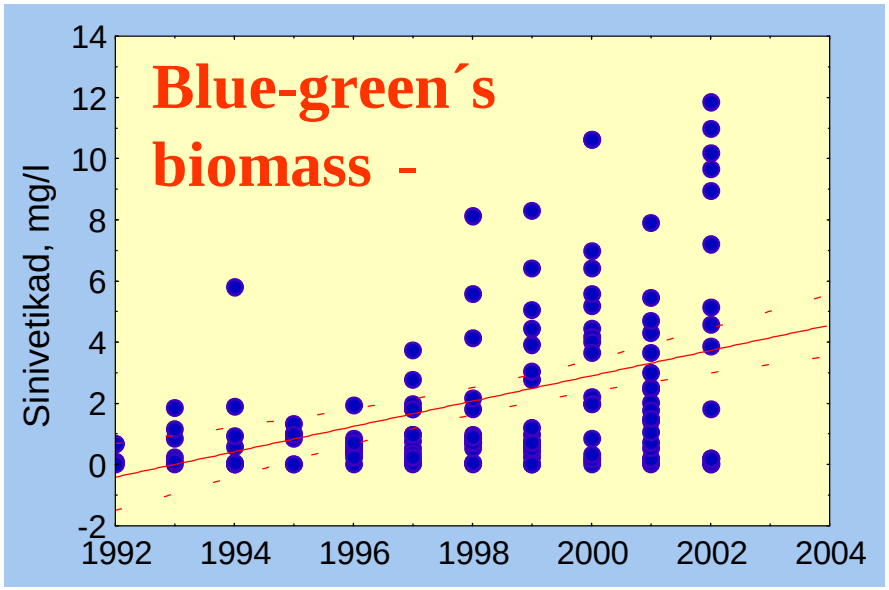
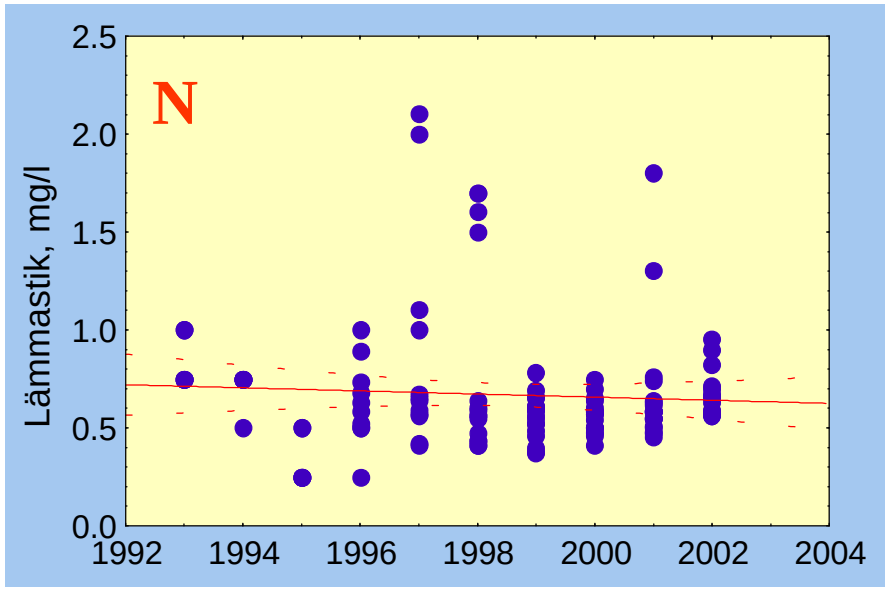
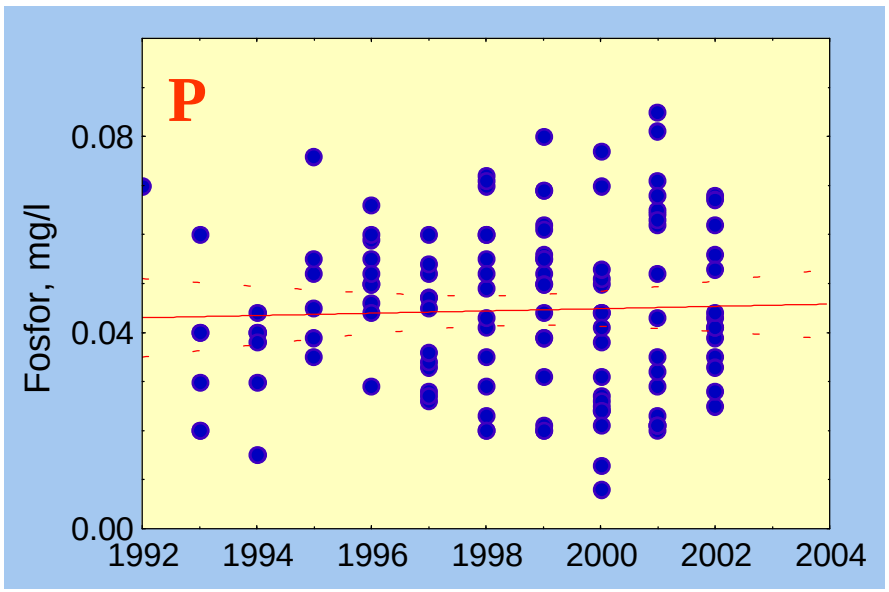
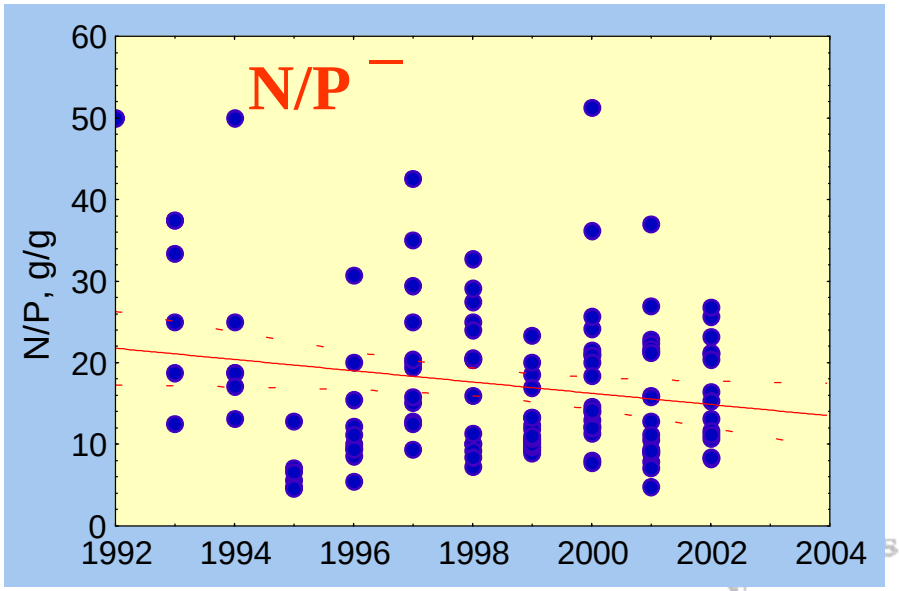
Nõges et al. (2003)

L. Peipsi, central and northern part



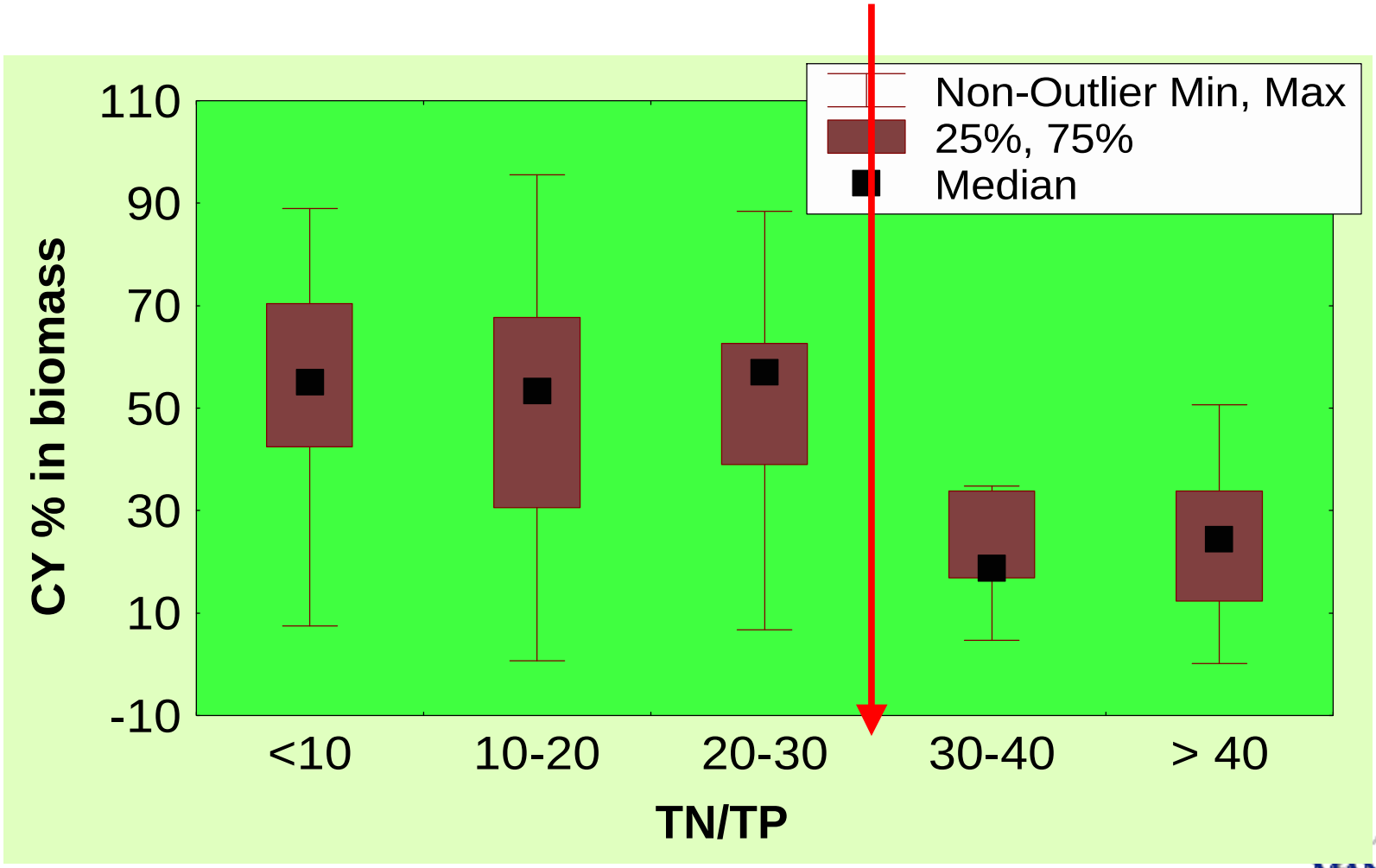






Nõges et al. (2003)

In L. Peipsi blue-greens tends to increase at N/P< 30



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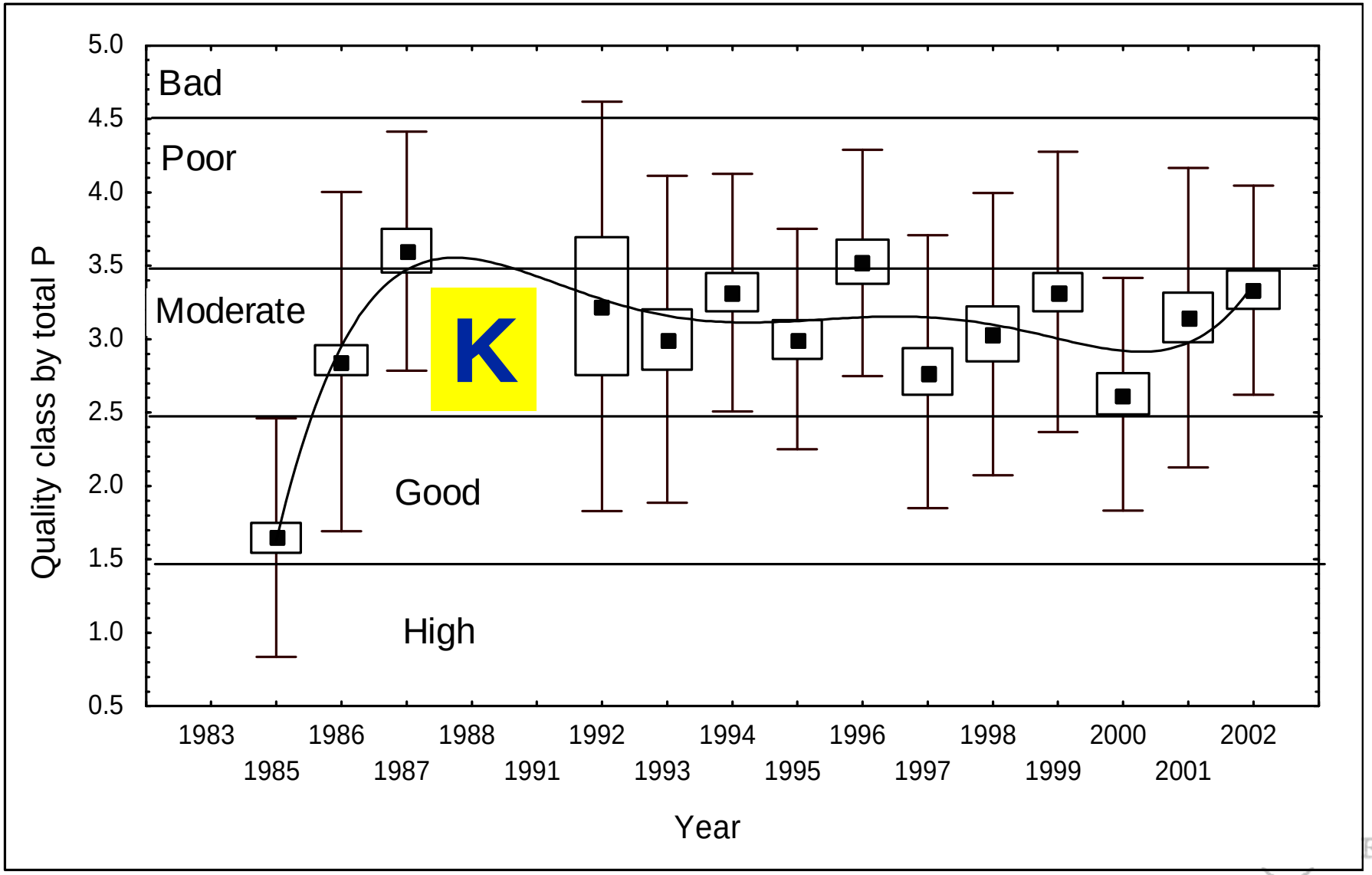
Peeter Nõges et al. (2003)



Present ecological quality of L. Peipsi

- **Chemistry** **‘moderate’**
- **phytoplankton** **‘moderate’**
- **Zooplankton** **‘good’ - ‘moderate’**
- **Macrophytes** **‘good’ - ‘moderate’**
- **Periphyton** **‘good’ - ‘moderate’**
- **Macroinveretebrates** **‘good’**
- **Fish** **‘good’**

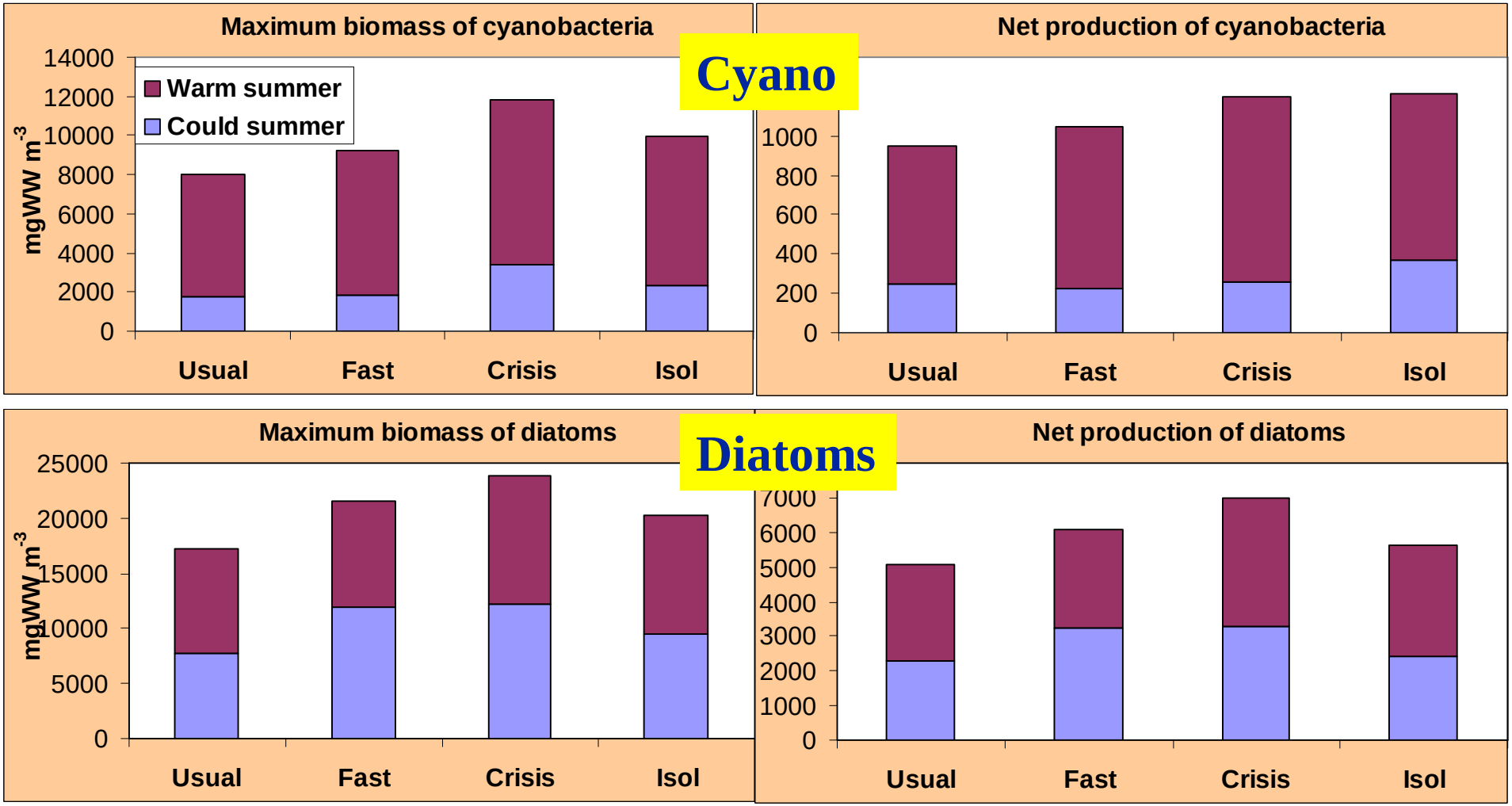
Present trends show a **deterioration of the status**

The overall score is ‘moderate’

Peeter Nõges et al. (2003)

Nõges et al. (2003)

Reaction of lake to different scenarios in 2015-2019



Worse water quality in case of CRISIS

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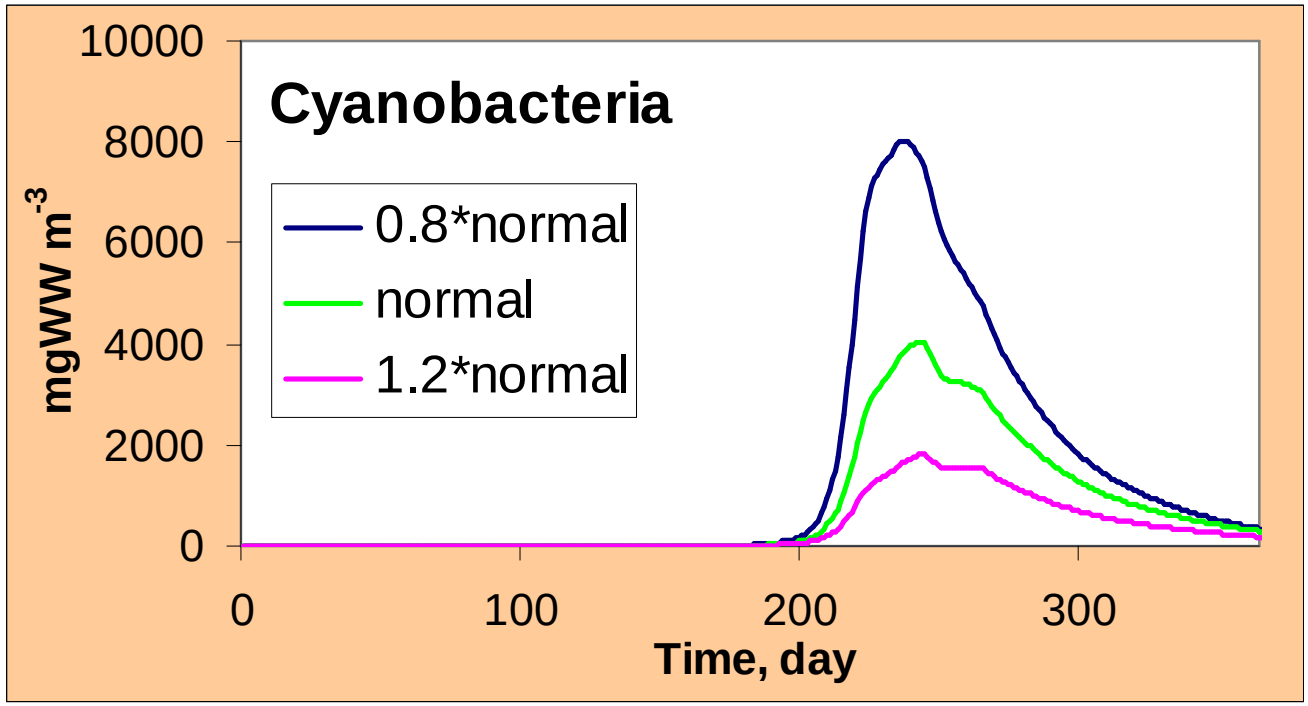
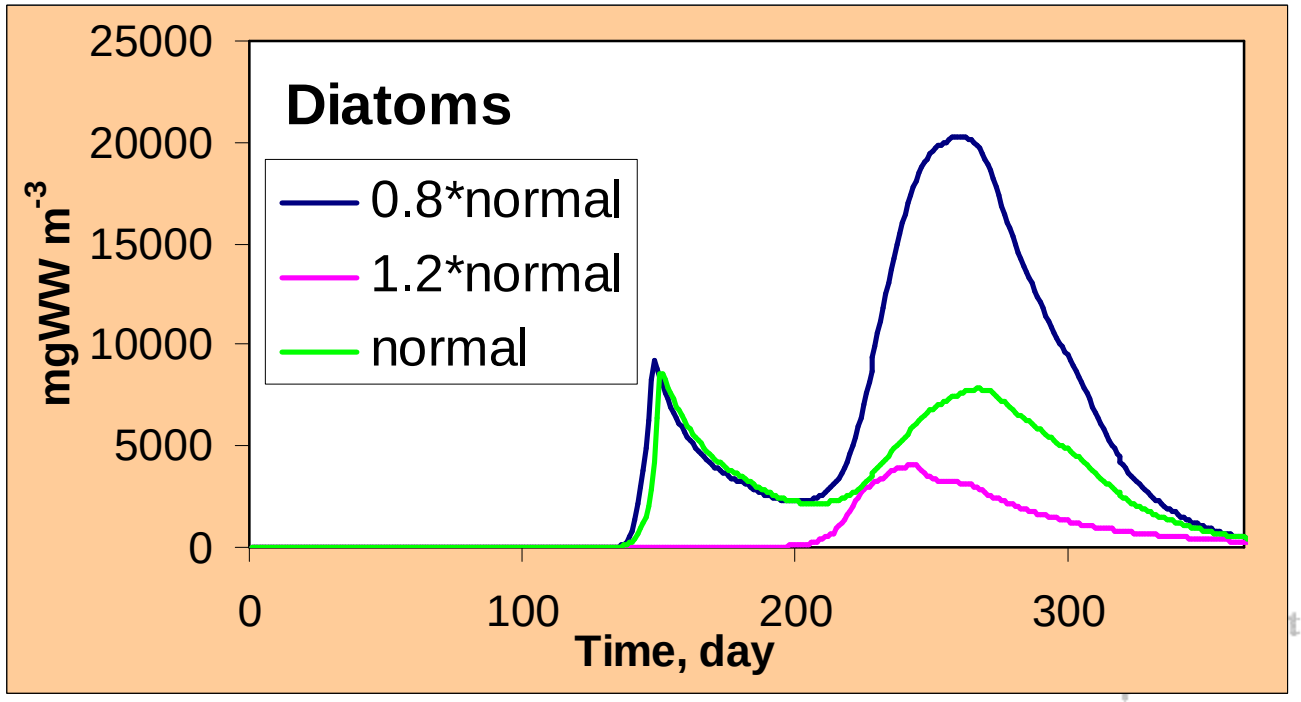


Higher biomass in low-water years

Sensitivity to hydrological conditions



Nõges et al. (2003)

Concluding remarks

- Scenarios stimulates to interdisciplinarity and integration
- Change of the amount of arable land is a major factor controlling nutrient loads to Lake Peipsi.
- Only very drastic changes in loads will improve the ecology of Lake Peipsi = Lake Peipsi will not be in ‘good status’ in 2015?
- Climate influence ecology in Lake Peipsi

MANTRA East

Website: www.mantraeast.org

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ИНТЕГРИРОВАННЫЕ СТРАТЕГИИ УПРАВЛЕНИЯ ТРАНСГРАНИЧНЫМИ ВОДАМИ НА ГРАНИЦЕ ЕВРОПЕЙСКОГО СОЮЗА – ПИЛОТНОЕ ИССЛЕДОВАНИЕ ЧУДСКОГО ОЗЕРА И ЕГО ВОДОСБОРА (MANTRA-EAST)".

Добро пожаловать в Mantra East

MANTRA-East (МАНТРА-Восток) – это международный научно-исследовательский проект в области охраны окружающей среды, нацеленный на анализ и развитие методов стратегического планирования и исследовательского инструментария для интегрированного управления трансграничными водными бассейнами, расположенными на сегодняшних и будущих внешних границах Европейского Союза.

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