

# Opportunities for common approaches in heavily modified water bodies

- Experiences from the joint study of Austria, Finland, Norway, Scotland and Sweden

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# Content

- Background
- Objectives and realization of the project
- Comparison of water course regulations
- Obstacles for harmonization
- Conclusions

# Background

- EU CIS working group for the identification and designation of Heavily Modified Water Bodies (2.2).
  - Guidance document as final outcome
  - Subgroup Hydropower led by Austria
- Work continued as a non-official grass root level working forum.
- Workgroup led by Scottish SEPA and Austrian Umweltbundesamt.
- Finnish part was financed by Ministry of Forestry and Agriculture in the framework of project Norsdemo (2003-2004).
- Close co-operation with EU CIS pilot river basin Oulujoki (FIN).

# Working group

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# Starting points and objectives

- Hydro power is a major pressure in many Fennoscandian water courses.
- Similarities in climatic and hydrological conditions:
  - Ice-cover period
  - Spring flood
- In addition, in Scotland and Austria there are regulated water courses which may have many similarities with Fennoscandinavian ones.
- Objectives
  - To analyse and compare water level fluctuation in regulated lakes in different countries.
  - To compare practices regarding assessment of the HyMo-pressures and provisional designation.
  - To find out opportunities to comparable or common practices.

# Realization of the project

- Small scale workshops and excursions
  - Edinburgh –11/03, Pelkosenniemi –5/04, Vienna –11/04, Stavanger –8/05
- Questionnaire
  - Number of water course regulation projects and their purposes
  - Quality of biological data
  - Hydrological and morphological criteria used for pHMWBs
- Water level analysis
  - 8 lakes in Finland, Norway, Scotland, Sweden
  - REGCEL water level analysis tool
- Common article
  - Main results of the study
  - Possible publication forum EWater (manuscript available)

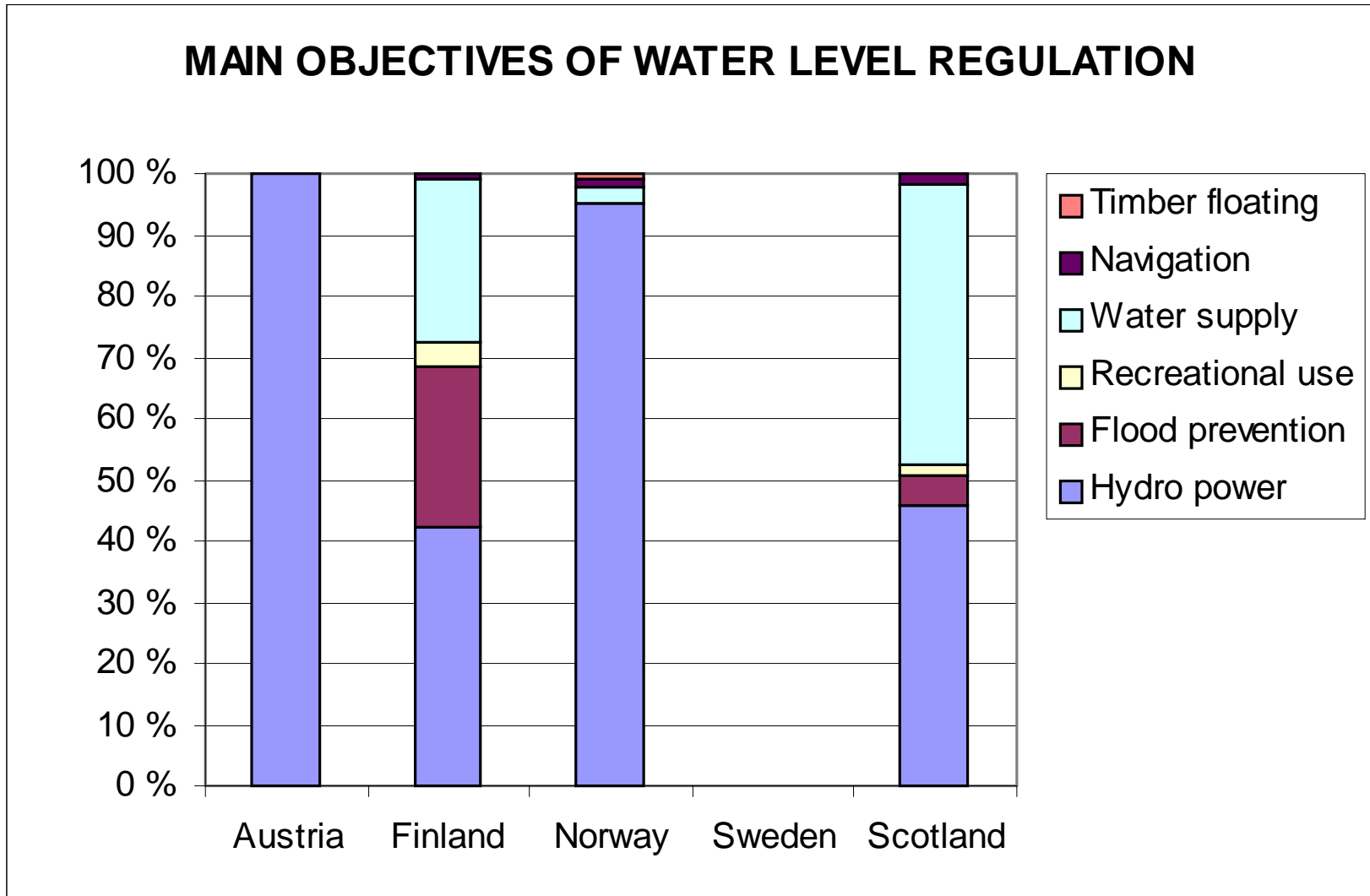
# GENERAL COMPARISON (1/3)

- The importance of the hydro power production varies remarkably:
  - Norway 99 % of the electricity is produced by hydro power
  - Austria ca 70 %
  - Sweden ca 50 %
  - Finland ca 15 %
  - Scotland ca 5 %

# General comparison (2/3)

	Number of lakes (>50 ha)	Number of reservoirs	Main purposes of regulation
<b>Austria</b>	62	13	Hydro power
<b>Finland</b>	4500	ca 350	Hydro power and flood prevention
<b>Norway</b>	4491	>900	Hydro power and flood prevention
<b>Scotland</b>	324	118	Hydro power
<b>Sweden</b>	7260	?	Hydro power and flood prevention

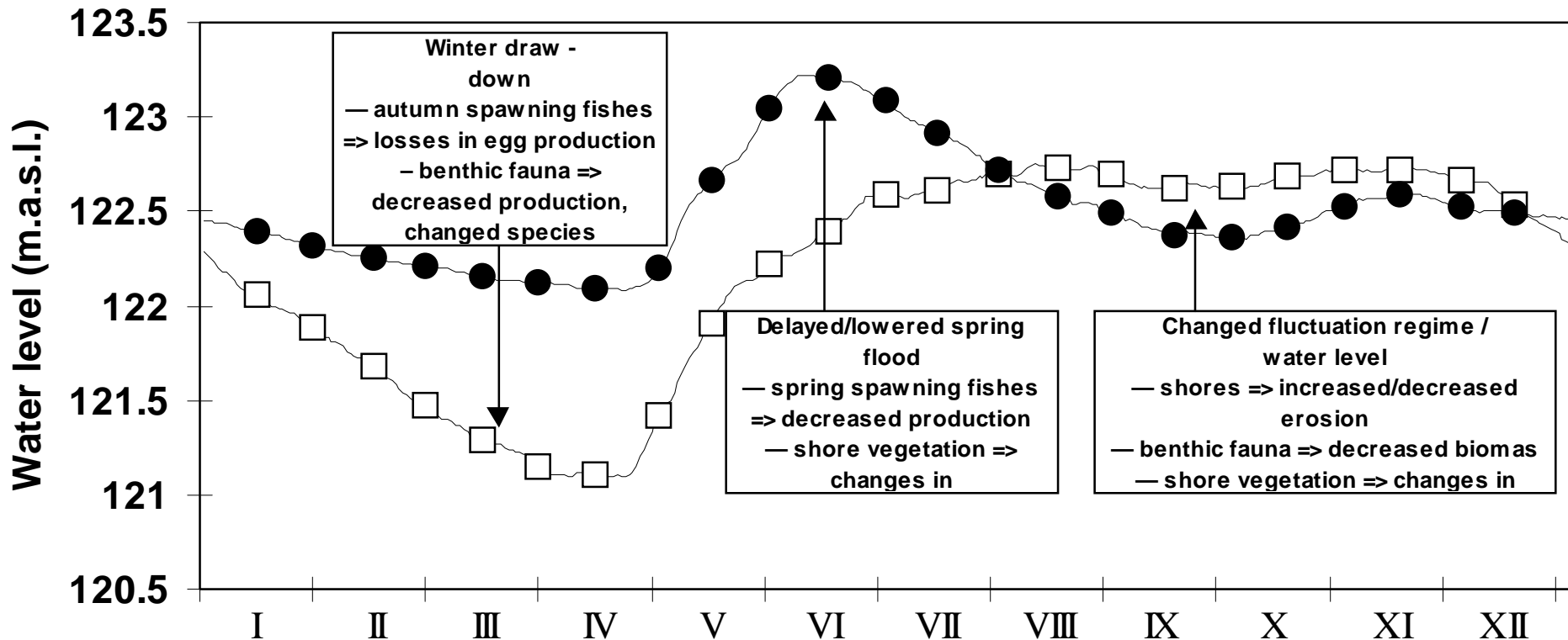
# General comparison (3/3)



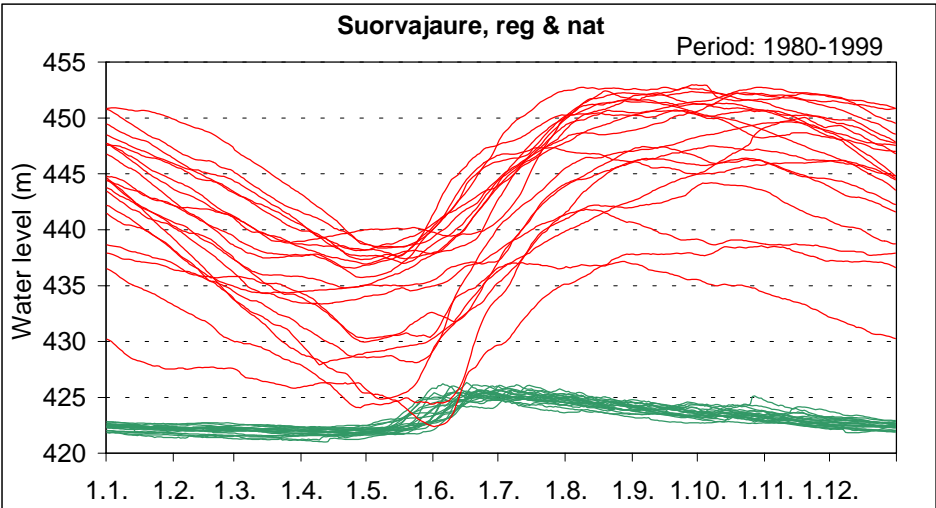
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!!! In Norway flood prevention is also an important objective in many water courses

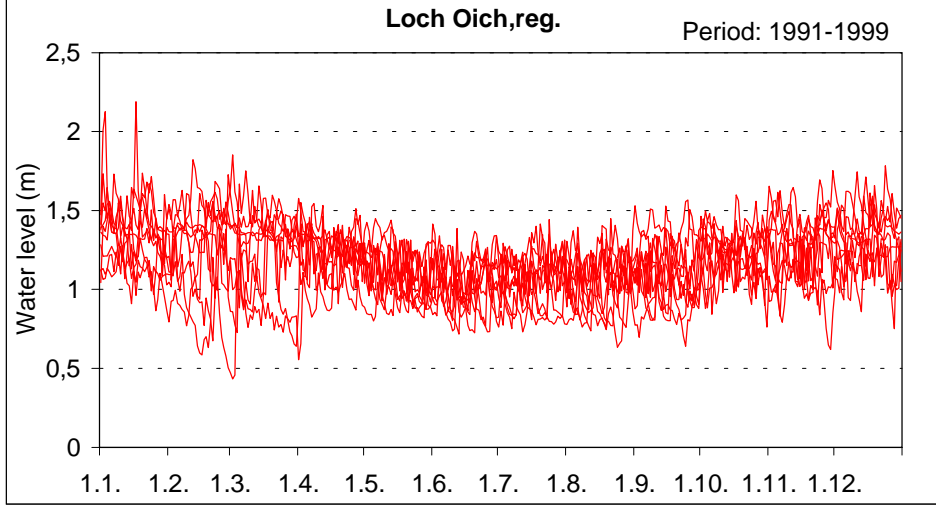
# Typical lake regulation in Finland



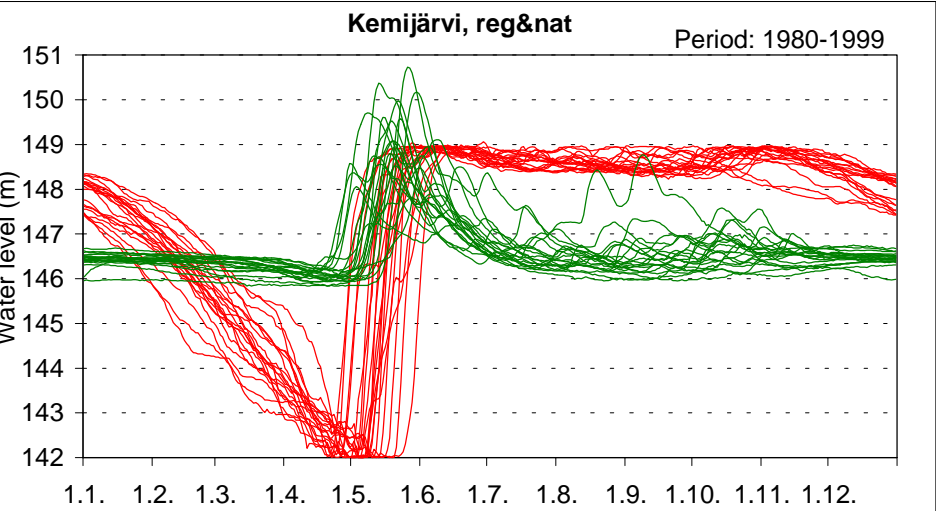
# Sweden, Suorvajaure



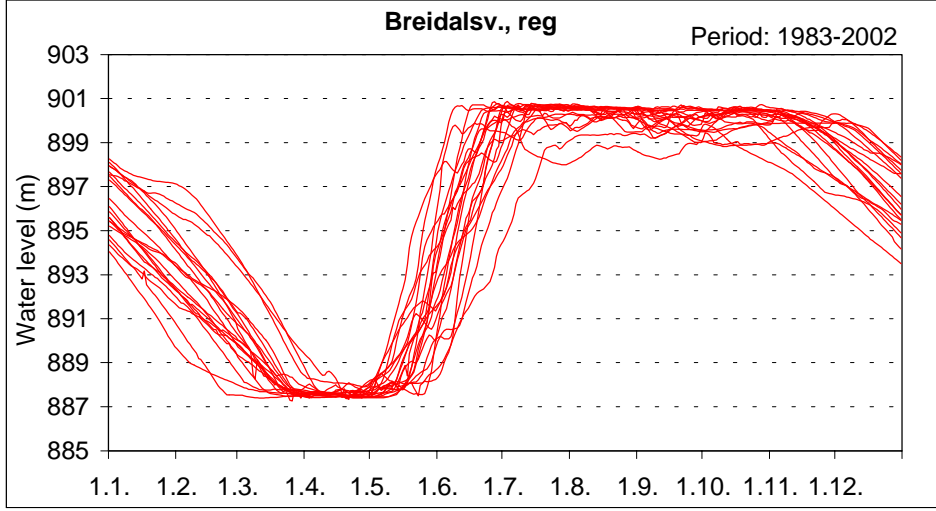
# Scotland, Loch Oich



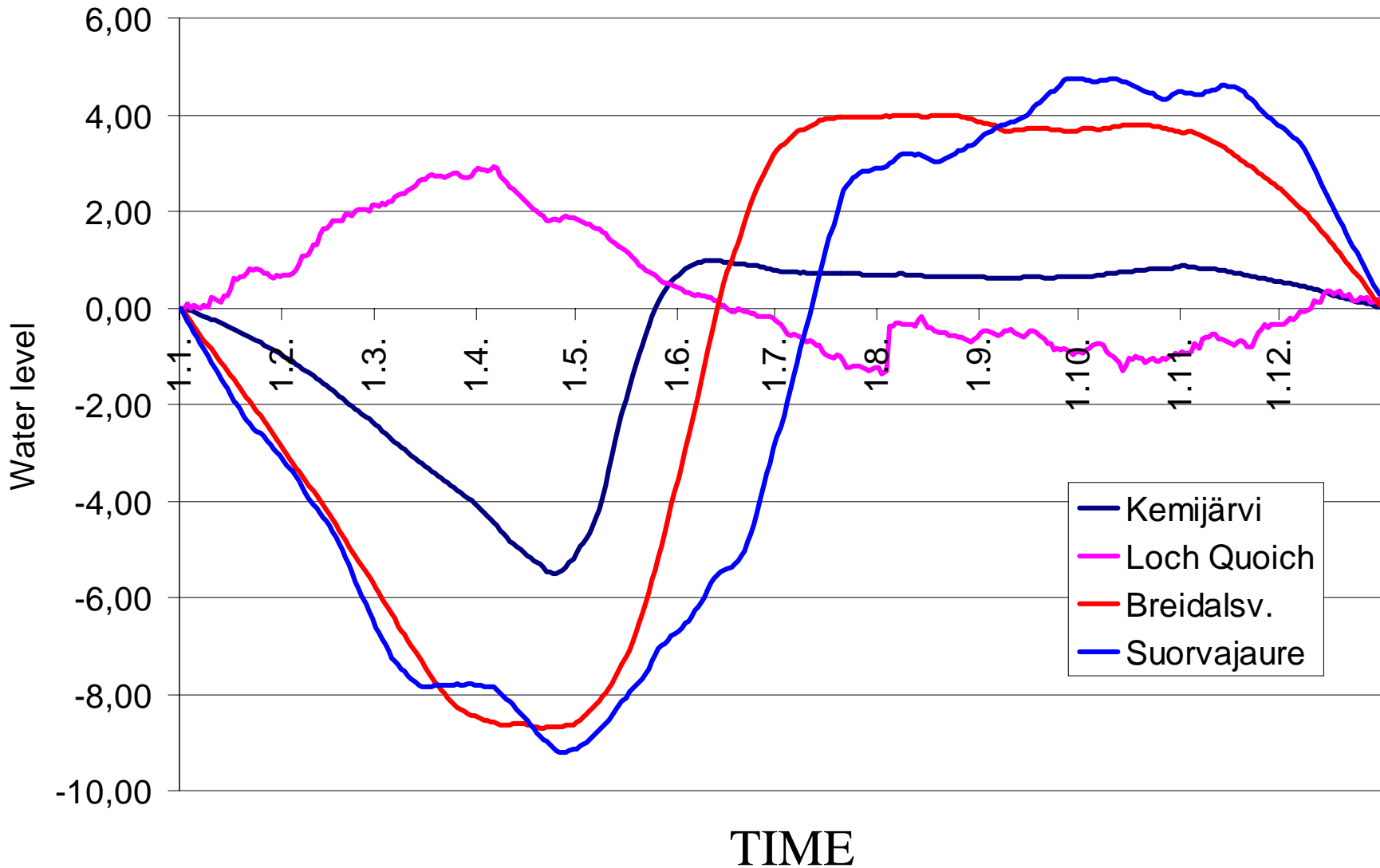
# Finland, Kemijärvi



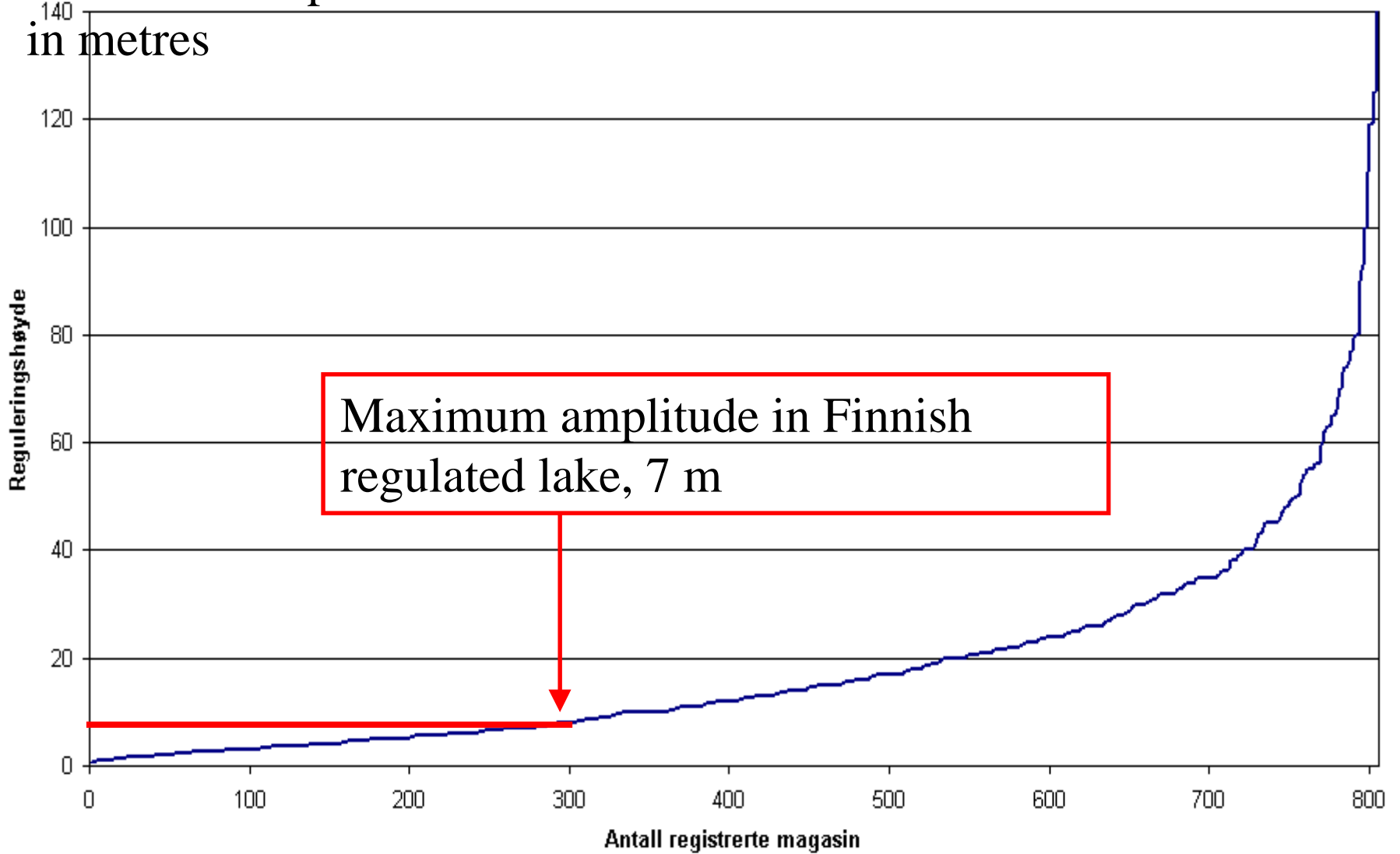
# Norway, Breidalsv.



# Comparison of mean water level fluctuation



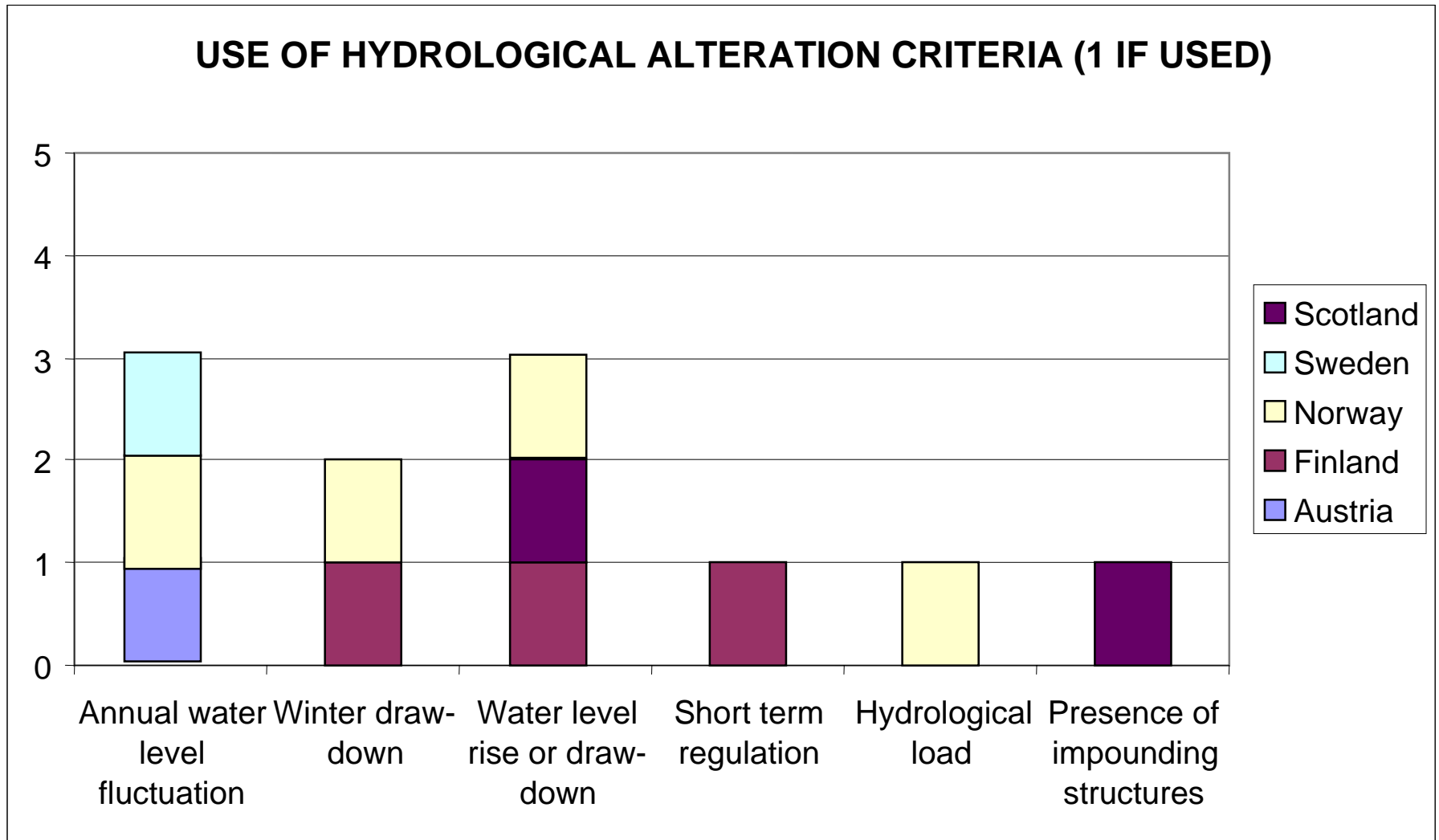
Maximum amplitude  
in metres



No of reservoirs registered

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# Provisional identification of lakes – hydrological criteria



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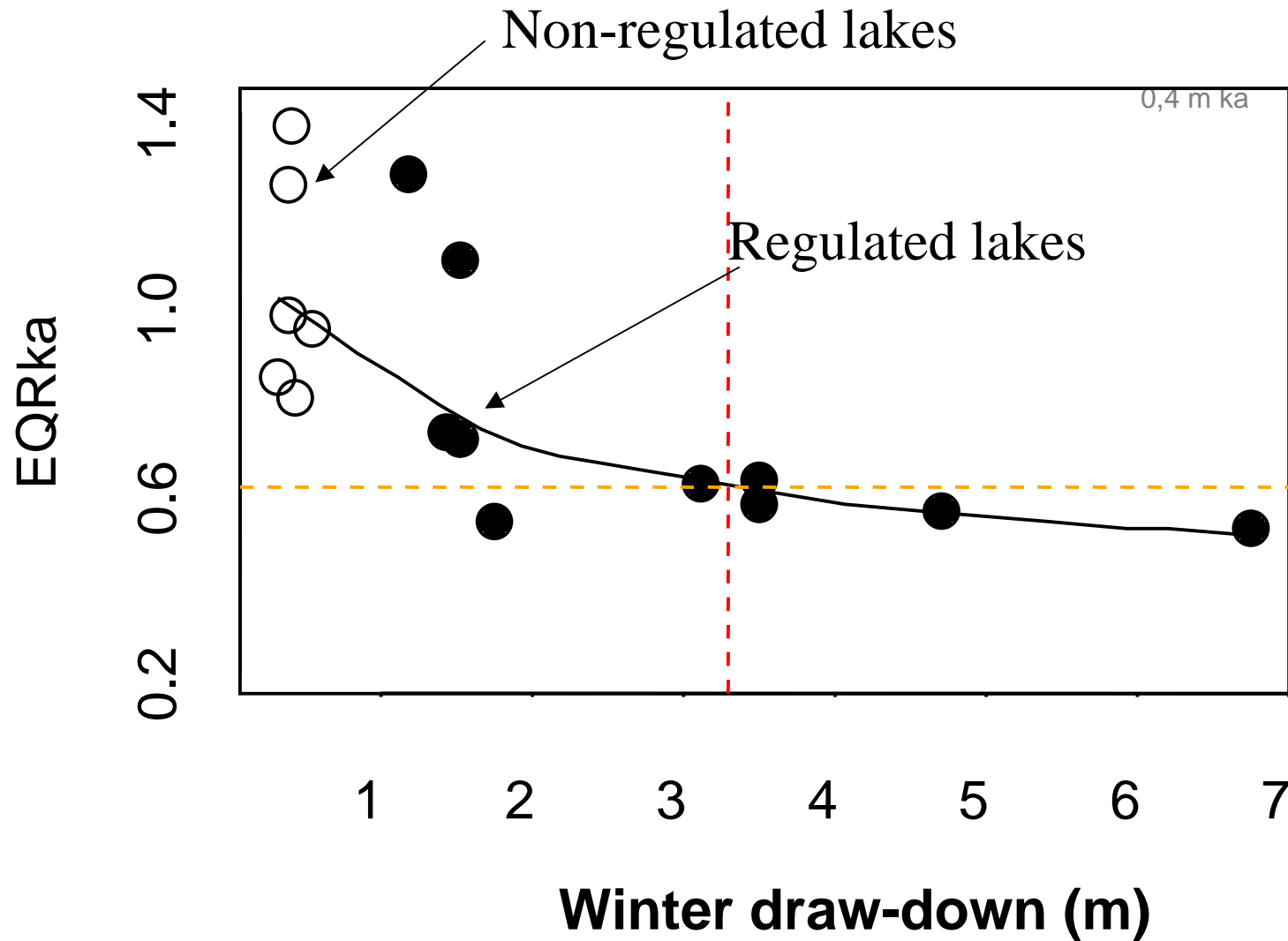
# Conclusions from the comparison

- Target countries have arrived at very different threshold values for water level rise criterion.
  - Finland: 1 m
  - Scotland: 5 m
  - Norway 10 m
- Annual water level fluctuation/winter draw-down is taken into account in 4 of 5 countries.
  - 3 m annual fluctuation or winter draw-down lead to pHMWBs in Finland, Norway and Sweden.
- Biological data has not been widely applied in the provisional designation phase. However, in Finland threshold value for 3 m winter draw-down is based on biological data.

# What does biological data suggest?

- Systematic data from aquatic macrophytes, littoral zoobenthos and littoral fish has been gathered from ca 20 regulated and ca 10 non-regulated large lakes in Northern Finland in 2003-2005.
- Winter draw-down more than 3 metres causes significant adverse impacts on littoral zone fauna.
  - Criteria: Ecological quality ratio (EQR) in regulated lakes is 60 % from the values of reference lakes (=threshold between good and moderate status).
    - Aquatic macrophytes: winter draw-down ca 3-5 m
    - Macroinvertebrates: winter draw-down ca 3-4 m
    - Littoral fish fauna: lake regulation affects but there is no clear response to the magnitude of water course regulation (preliminary result).
- Biological data supports the choice of the 3 metres winter draw-down criteria.

# Zoobenthos (depth 0.4 m, stony habitat)



# Why harmonization is difficult? (1/2)

## ■ Because there are many differences in

- Number of reservoirs (13, Austria => more than 900, Norway)
- Elevation from the sea level (all reservoirs in Finland locate less than 250 m asl)
- Characteristics of water courses (=vulnerability to the regulation)
  - Mean depth (from less than 5 m to more than 50 m)
  - Secchi depth (from 1m to more than 10 m)
  - Quality of the shoreline (stony ↔ muddy)
- Biology
  - E.g. number of fish species varies (Finland ca 15-20, mountain lakes in Sweden and Norway 0-3)
- Quality and quantity of hydrological and morphological data
  - Finland: good data available from hydrology but morphological alterations have been poorly documented.
- Water uses
  - Remote areas/intensively used water courses

# Why harmonization is difficult? (2/2)

- Water course regulation systems and policies vary remarkably
  - Maximum regulation amplitude varies from 7 m (in Finland) to > 100 m (Norway).
  - In Norway many water courses are heavily constructed (diversions, pumpstations)
- Differences in research and planning traditions and used methodologies
  - The use of existing expertise and methods
- Tight time schedule
  - National implementation process was carried out to strict deadlines at the same time as this study.
- Differences in the provisional identification strategies
  - Water bodies which are at risk were identified as pHMWBs
  - Water bodies which definitely will be HMWBs were identified as pHMWBs

# Conclusions

- The use of same indicators proved to be problematic as there are big differences in availability of required data and lake specific hydromorphological conditions vary a lot in different countries.
- 3 m regulation amplitude or winter draw-down was used in Finland, Norway and Sweden. This was the consequence of the information exchange and frequent discussions.
- Provisional designation is only one phase in the designation process and subsequent phases finally determine the number of HMWBs and required mitigation measures.
- Need for harmonization increases in the future. The definition of ecological objectives for HMWBs defines the required mitigation measures.
  - Need for same principles and criteria when defining MEP and GEP.

# THANK YOU!



## Table 3. Estimation scale for significance of hydrological pressures.

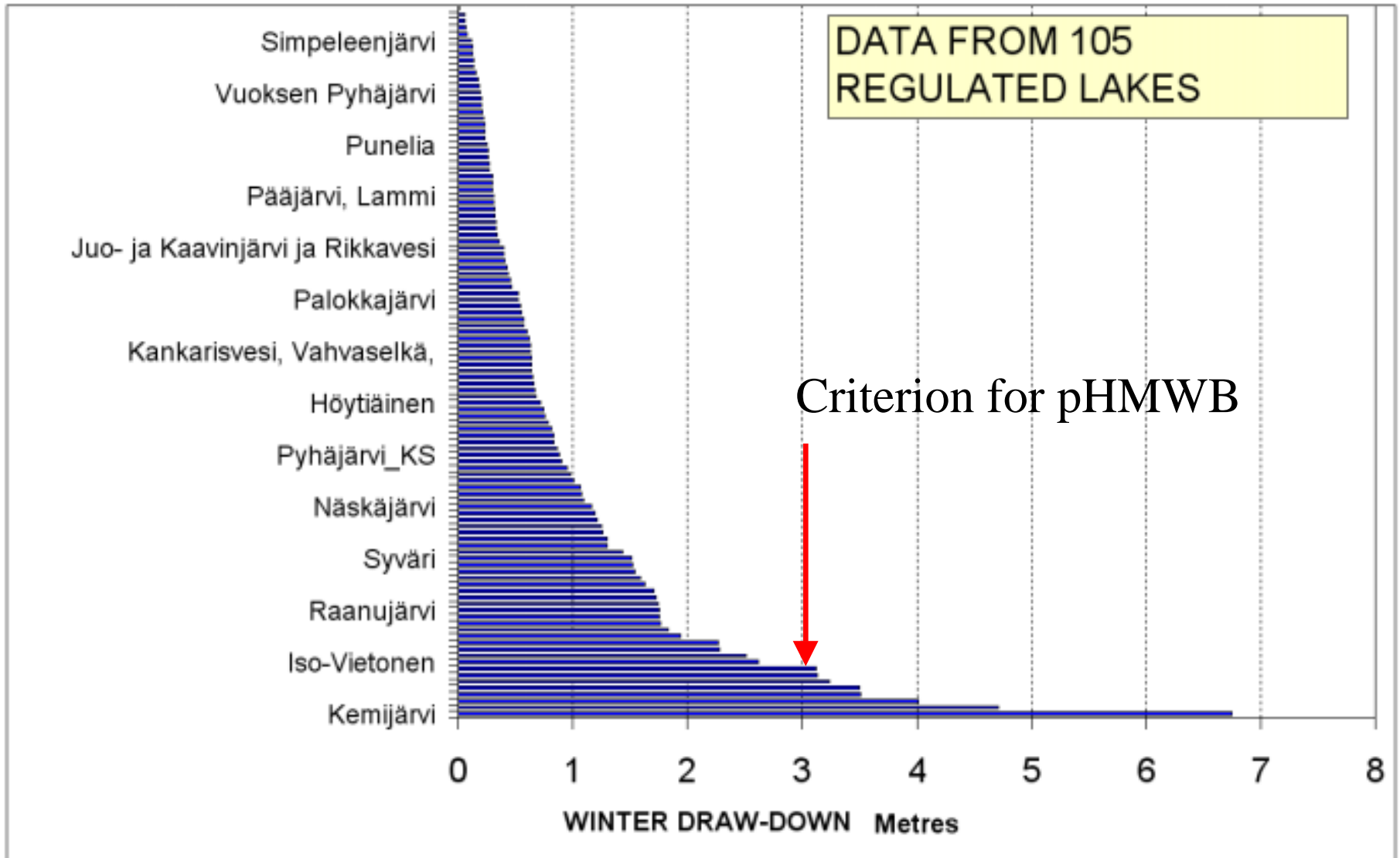
	Winter draw-down <sup>1)</sup> (m)	Winter draw-down compared to mean depth (%)	Water level rise <sup>2)</sup> (m)	Lowering the mean water level(m) <sup>2)</sup> based on mean depth < 1 m > 1 m		Short term regulation <sup>3)</sup> (m)	Abstraction of water (% lakes MNQ)
Great (***)	> 1,5	> 25	> 1	> 0,5	> 1	<sup>3)</sup>	>20
Moderate (**)	1,0-1,5	10-25	0,4 –1	0,1 – 0,5	0,5-1	<sup>3)</sup>	10-20
Minor (*)	0,5- <1,0	< 10	0,1-0,4	< 0,1	<0,5	< 0,1	<10
None (0)	< 0,5	0	< 0,1	0	0	0	0

<sup>1)</sup> The decrease of water level during ice period

<sup>2)</sup> Change in open water period mean water level

<sup>3)</sup> Expert judgement. Takes into account the magnitude and frequency of the water level fluctuation

# Winter draw-down in 105 Finnish regulated lakes



# CONCLUSIONS

- The study provided a good arena for discussions and information exchange with experts of different countries.
- However, in practice the national implementation in each country was done independently of this study and there was limited opportunity for arriving at a common approach.
- This was partly because of the limited time as the national implementation process was carried out to strict deadlines at the same time as this study.

# LAKE ONTOJÄRVI IN MAY

Littoral zone is dry and prone for erosion caused by ice and snow melting waters



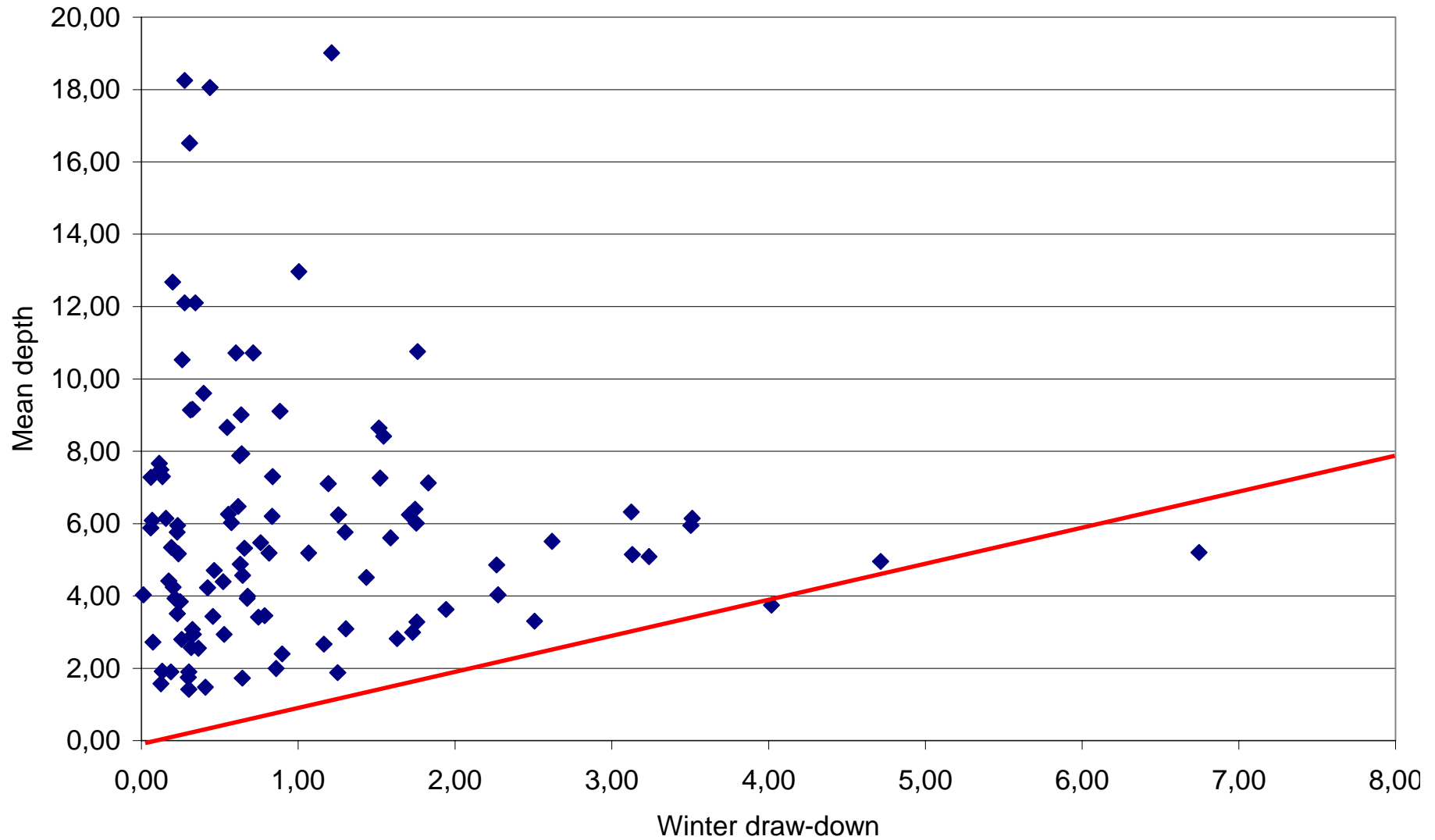
*Table 1. Use of morphological alteration criteria in target countries. \*) Lake taps refer to specific reservoirs where lake outlet is transformed to tube situated at the bottom of lake. \*\*) Term refers to cases where due to river diversion natural retention time has been significantly changed.*

	<b>Austria</b>	<b>Finland</b>	<b>Norway</b>	<b>Sweden</b>	<b>Scotland</b>
<b>Morphology</b>					
Embankments	X	X			X
Dredging		X			X
Canalisation					X
Bridges and terraces		X			X
Dam and weir structures	X	X	X	X	X
Lake taps <sup>*)</sup>			X		
Significant change in depth and surface area	X	X	X		

# Water level analysis tool (REGCEL)

- Model was applied in order to analyse and compare the water level fluctuation of regulated lakes in target countries.
- EXCEL spreadsheet model, developed in SYKE in 2000.
- Calculates values for water level dependent indicators which can be applied when assessing the impacts on aquatic ecosystem (e.g. macrophytes, fish, birdlife) and recreational use.
- Input data required
  - Daily water levels, Secchi depth, dates for ice melting and freeze-up
- Has been used in many Finnish R&D projects
  - To identify significant and non-significant impacts of regulation.
  - To compare regulation policy alternatives.

# Finnish lakes are relatively shallow (data 105 large regulated lakes)



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