

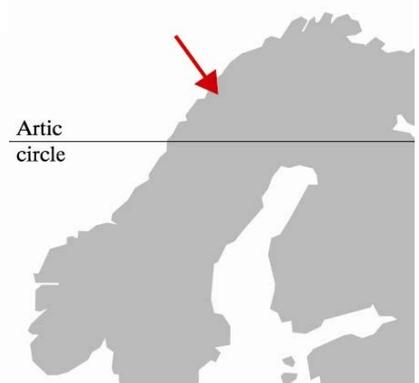
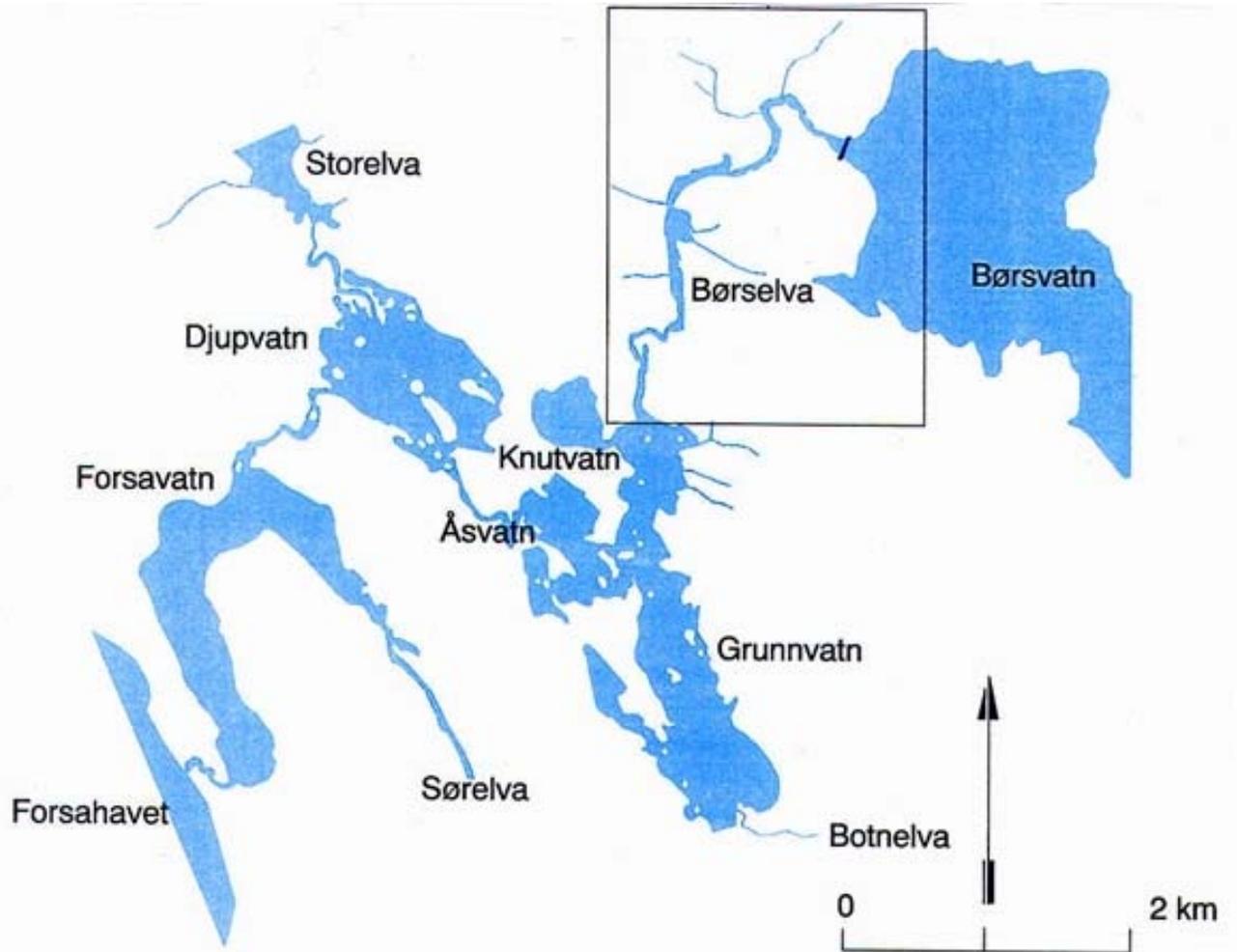
A Case Study on River restoration Børselva, 1997- 2007.



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Location of Børselva



Adapting a regulated river to a new flow regime.

Background

- Lake Børsvann was regulated in 1914 for generation of electricity
- The water was transferred to a power plant in another watercourse.
- The catchment area was reduced from 85 km² to 5.5 km²
- Up to 1970 there was no lower limit for water flow in the river
- Overflowing of water from the dam only happened in periods with extremely high water flow .
- During years of low flow, the river developed into an eutrophicated river overgrown with water plants

New owner - new regulation obligations

Background (cont.)

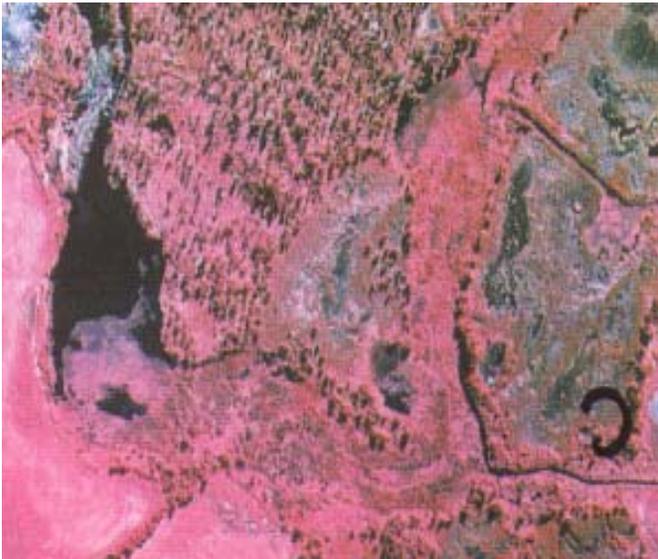
- The new licence forced the owner to **develop a new flow regime** for the river, with a minimum residual discharge, including some artificial floods to ensure satisfactory quality in the watercourse
- Together with the flow limitations there was an instruction **to conduct a clearing of the watercourse** to restore free passage and to improve the watercourse's self-purification properties
- A project running for 5 + 5 years was started in 1997/98 to fulfil these limitations set by the government.
- A new 5 year project starts in 2009 to monitor the system, develop a management plan and to define the best way to deliver the amount of water for the minimum flow

Preliminary studies

Three main reasons for the problems in Børselva

1. **E**rosion in a tributary created siltation problem
2. **T**he high input of nutrients and organic material from agricultural activities along the river created eutrophication problems
3. **T**he reduced water flow

Siltation



Eutrophication

The main reason for the eutrophic situation in Børselva is

- A** The high input of nutrients (P) over a long period. Together with
- B** Input of sediments, reduced water flow and reduced fluctuations/floods.

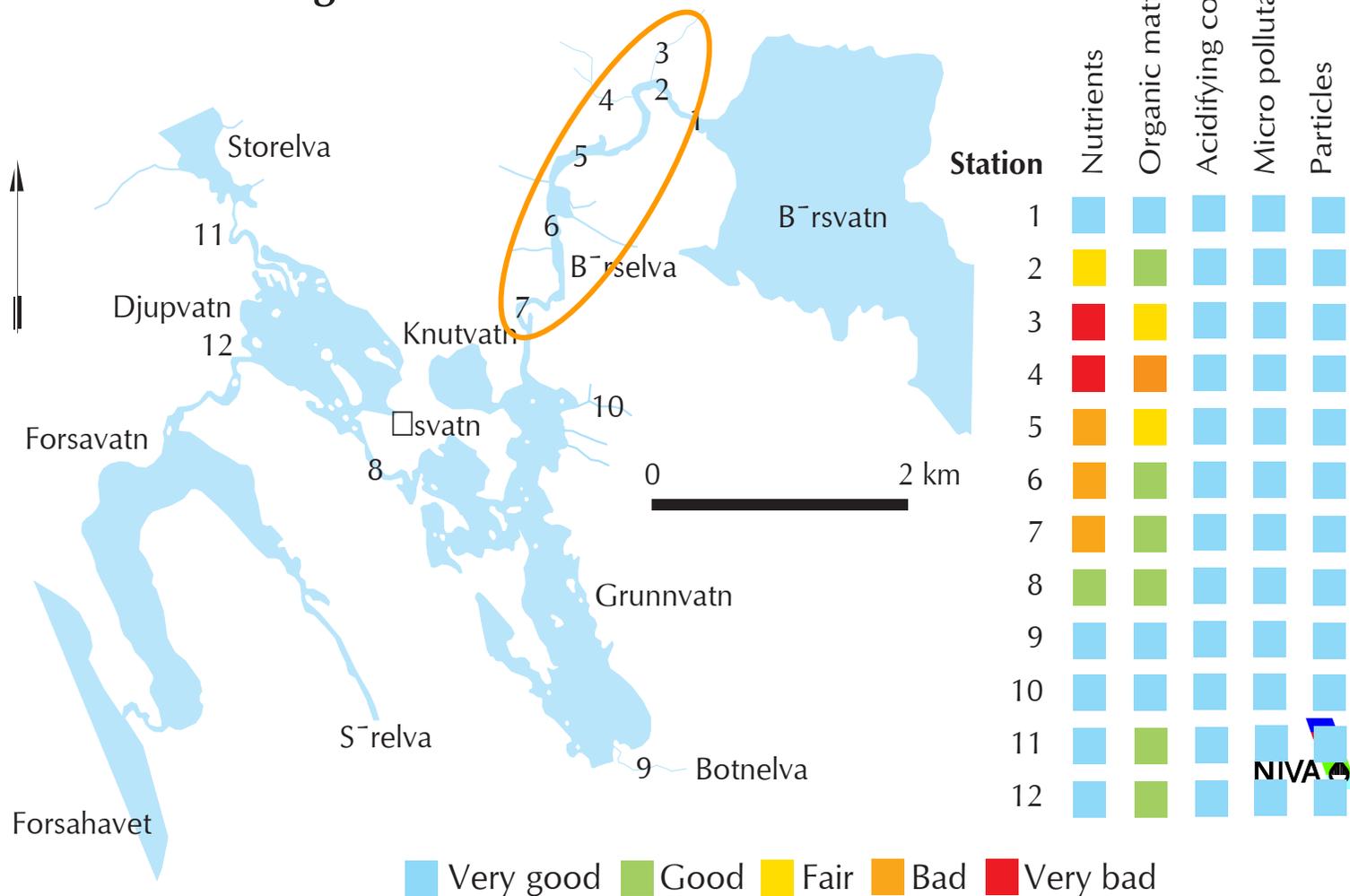
The river was drastically changed and nearly **70%** of the river bed was covered with water plants.



Water quality

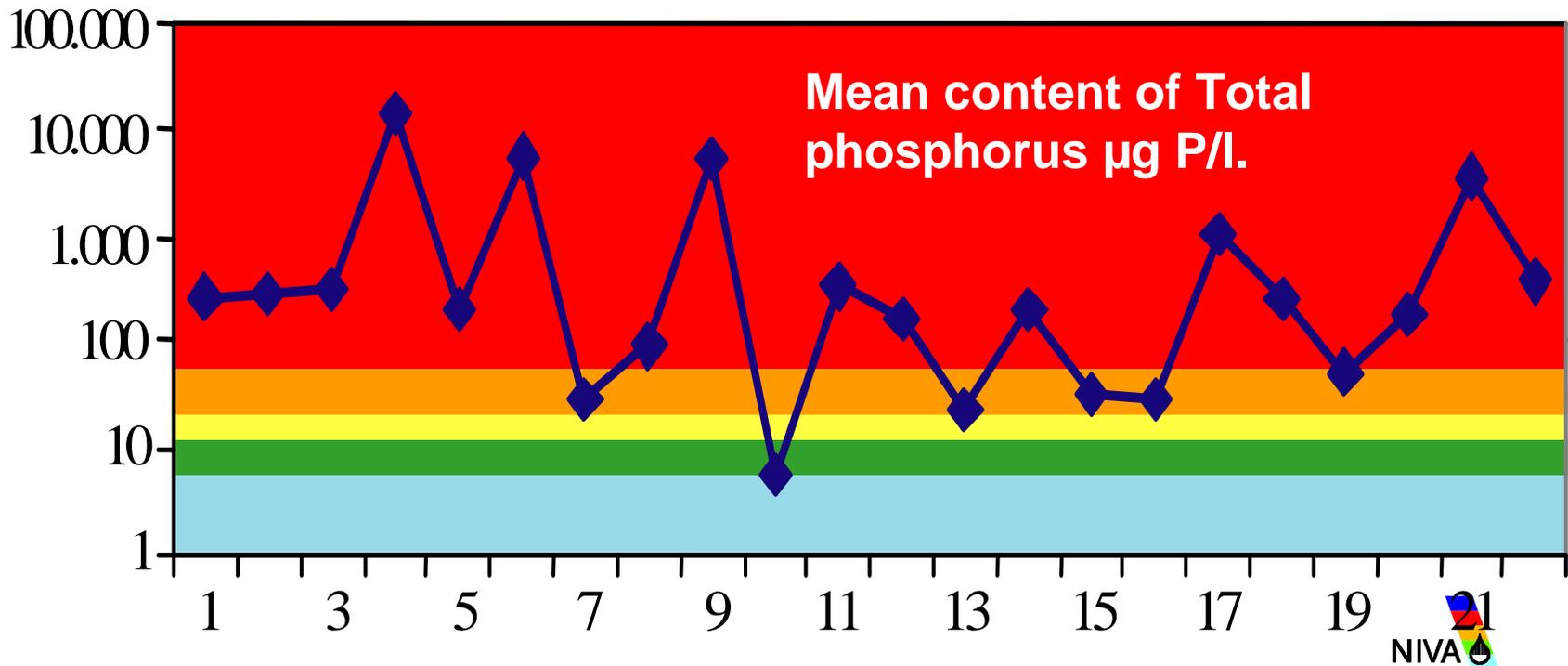
Results from a monitoring programme describes the water quality in the River
 - the system is heavily overloaded with nutrients and organic matter

B^rrselv-vassdraget.



Pollution

Results from a monitoring programme of all tributaries indicated that **80 %** of the nutrients and organic material were due to the farming activity.



Fish

- Børselva was earlier the main spawning and recruiting area for the lakes downstream and had a valuable population of arctic char and trout.
- Fishing with nets and electro fishing did not catch any fish in 1998 and 1999.



Wildlife reserve

- The water course was early in the project period protected as a nature reserve due to its importance as a feeding and resting area for migratory water birds,.
- A substantial number of different water birds used to nest in the river and lake system some of them were/are red listed species.
- During the most recent years there has been a drastic reduction in number and species present.



Rehabilitation – Restoration

- Along with the need for a physical changing of the river to
 - re-establish the continuum in the system
 - adapt the “new river” to the future water flow regime
 - develop new biotopes for fish and water birds
- **There was obviously a need for improving the water quality in the system for a successful restoration of the water course.**
- The goal was to reduce the load of nutrients and organic material to levels that will not in the future exceed the recipient capacity in the system.

Re-establish a good water quality

- Stop all discharges of nutrients from point sources, and create an awareness among the farmers for the problems seen
- By using capture dams, wetland fields and re-establishing the riparian vegetation along the river (as buffer zones) the run-off from arable land of nutrients will be reduced to an acceptable level.
- The efforts to stop the contamination of the river Børselva was done in parallel with the physical restoration of the river
- Some work have still to be done



Mechanical methods : I

A pre-study was carried out to suggest cost effective methods to re-open the water course.

Manual cutting

- Required considerable manpower and resources.
- The cutting had to be repeated regularly
- Disturbed birdlife.



Mechanical methods : II

Harvest and Cover

- Another method tested was to cover the opened stretches after the vegetation had been taken away with a geotextile, covered with a 10 cm layer of crushed stones.
- This way to create openings in the vegetation was very promising: We got a new substrate type, but there was still a need for much manpower and the method was by that very expensive.



Mechanical methods : III

- Method II was developed further and tested when the river was covered with ice
- The need for manpower was reduced and the method showed to be very cost effective
- When working on an ice covered river this method provided easy possibilities to create a river with curves, changeable width, side arms and new openings in the vegetation.
- By changing the thickness of the stone layer and support this with some bigger stones we created new habitats for fish and benthic fauna.





Mechanical methods : IV

- **Excavators**
- When pools and deeper parts of the river was developed an excavators with a long arm was used



Wetlands protection

- Heavy machinery would have had great difficulties to move along the river – and would have created wounds difficult to repair
- Carpets made for military use for safe and environmentally transport over wetlands was the solution and showed to function very well



Excavator on a fleet

Work late autumn on the lakes

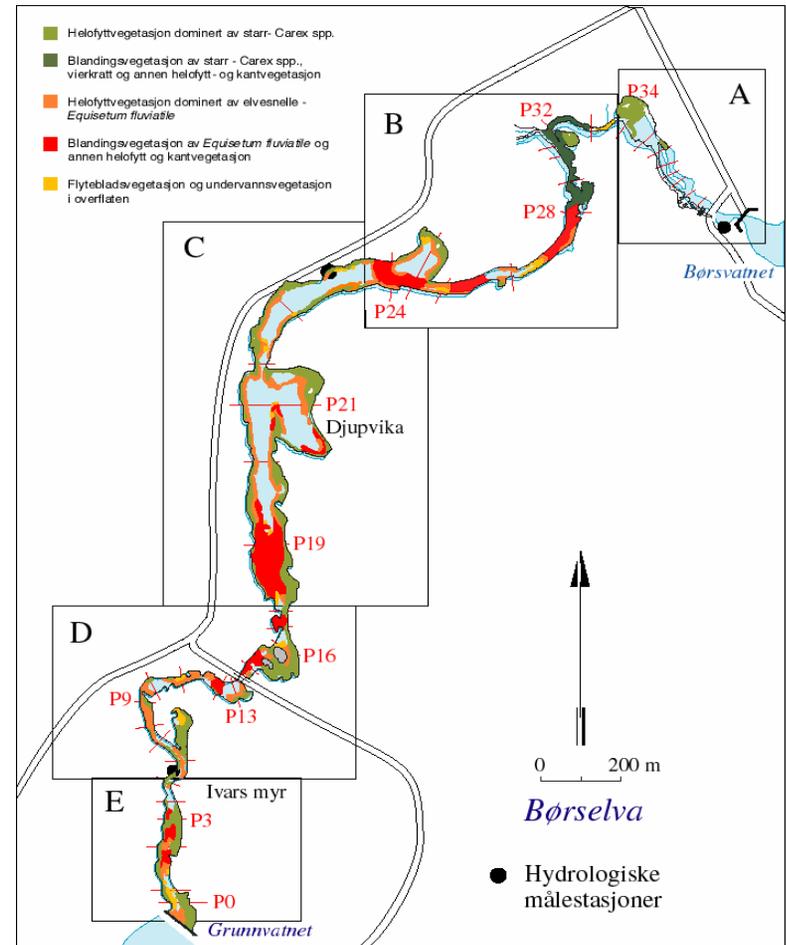
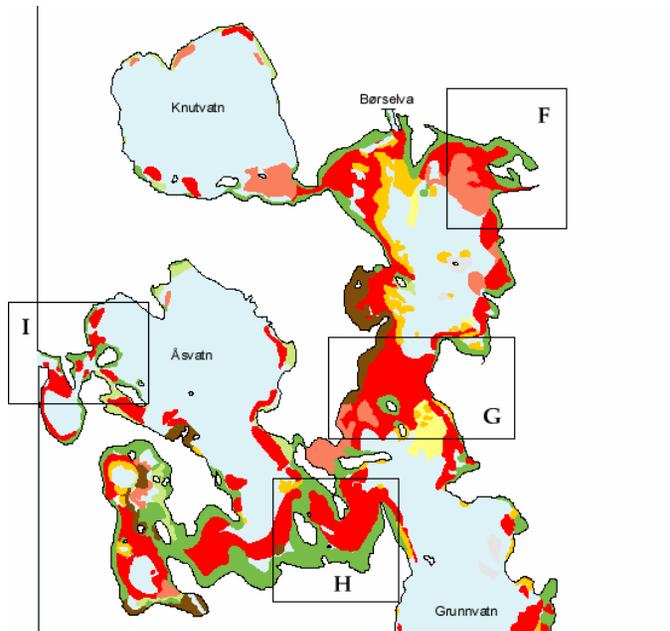


Restauration Plan

The watercourse was divided into separate compartments and a detailed plan for a new river was developed for each section.

Methods

Combinations of the textile (NIVA) - method and the use of excavators.



A new river in the old river bed



Results: Before and after



2005 → 2008

Results: Before and after



2005 → 2008



Results: After rehabilitation



Results: Downstream. Inlet to lake Djupvann



Summary

- The Børselva – project is a national pilot project and the first of its case in Norway
- Experiences gathered from this project will be very valuable for future restoration works in similar systems
- During the ten years period the project has been running, a thorough knowledge of all the elements in the Børselva river- and lake system have been gained
- This material will be very valuable in follow-up studies on how the system develops in the future
- A management plan will succeed the project to secure that the improved natural resources created will be taken care of in the future

More info can be seen at our home page including scientific reports written during the project period

www.borselva.no



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