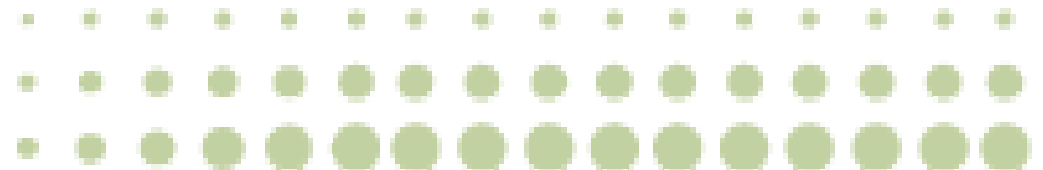




# Mitigation Measures in the Regulated River Suldalslågen

Steinar Sandøy

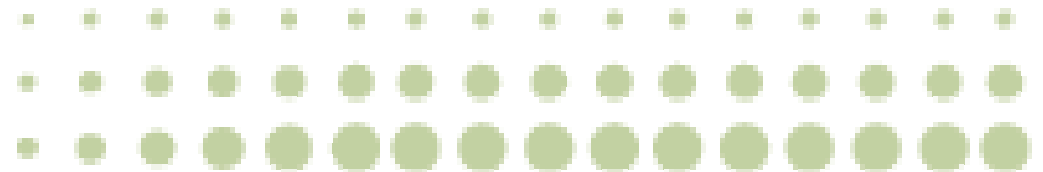
Directorate for Nature Management,  
Norway





# The River Suldalslågen

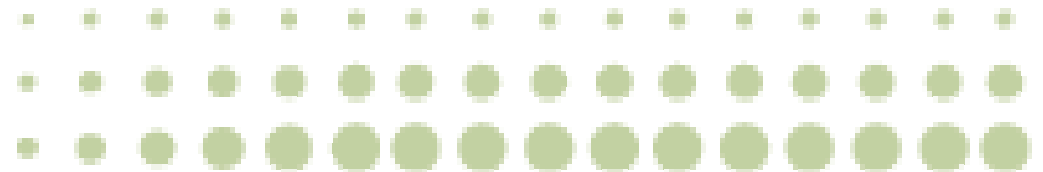
- Outlet of the Suldal river basin
- Heavily impacted by hydropower regulation
- Important for salmon fishing
- Salmon given special attention in licencing process
- Various mitigation measures undertaken
- Part of a pilot river basin (PRB)

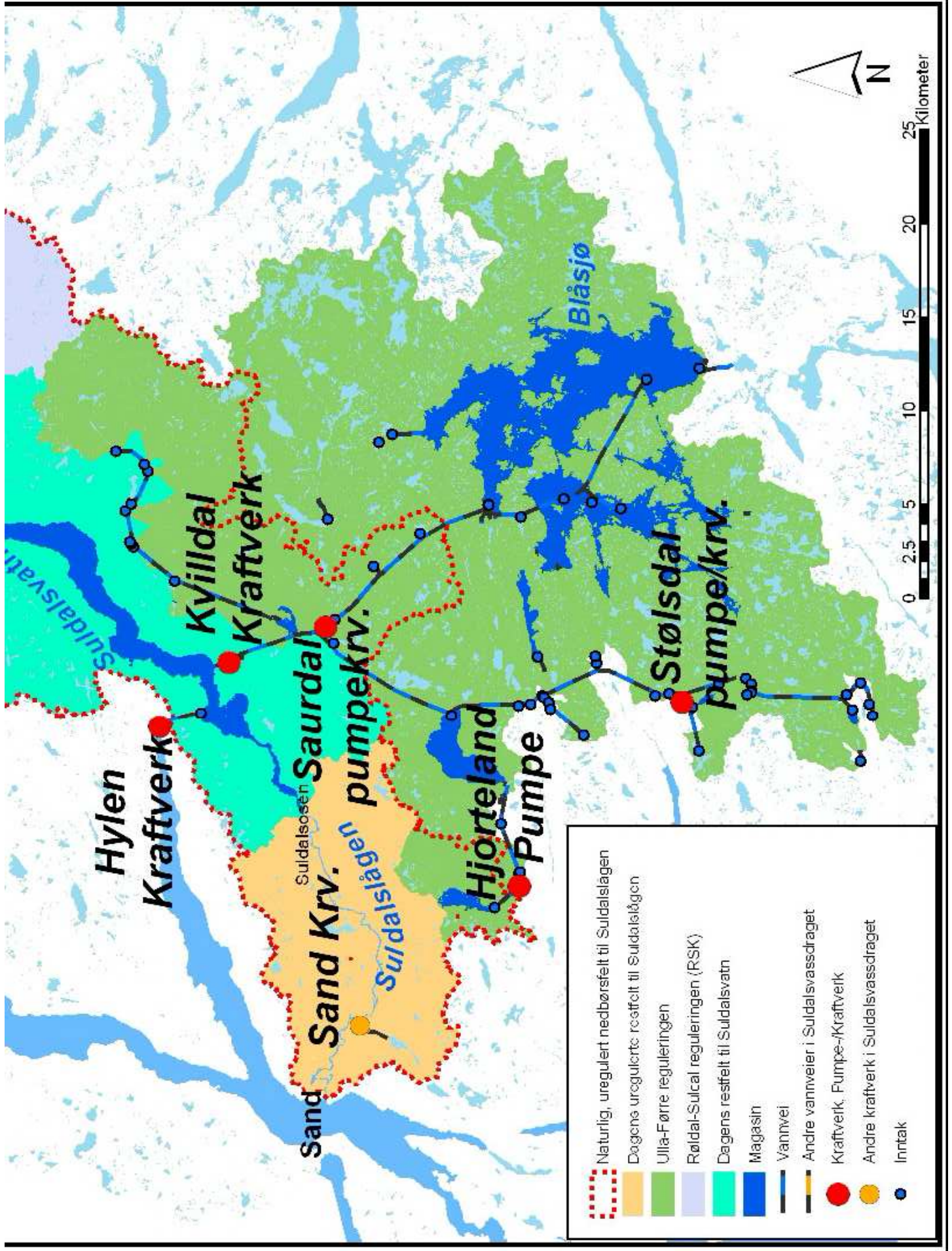




# Impact of regulation

- Average water flow reduced from 90 m<sup>3</sup>/s to 40 m<sup>3</sup>/s
- Large floods strongly reduced and less variations in water flow
- Increased sedimentation of fine particles
- Reduced quality of spawning and rearing grounds







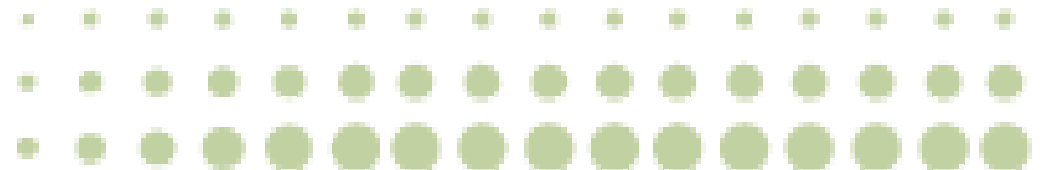
# Challenges in a regulated Salmon River

River management:

- Big river bed – low environmental flow means small wet area
  - Biology
  - Esthetics

Exemplifies conflicts in national politics:

- National interests vs local interests
- Production of renewable energy vs ecological consequences





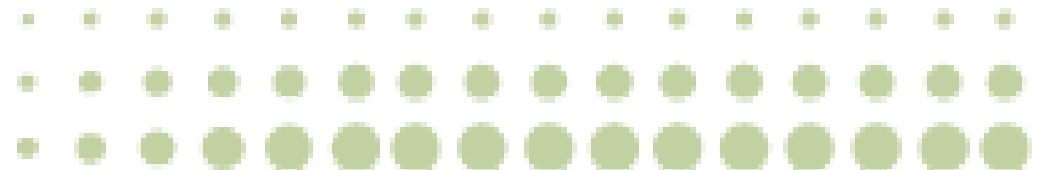
# Environmental Goals for River Suldalslågen

National goals:

- Maintain the original wild salmon stock – population size, genetics (big salmon)
- Maintain the possibilities of salmon fishing

Environm. objectives according to the WFD:

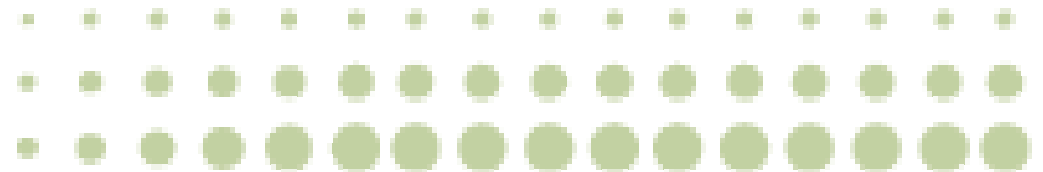
- Best approximation to Ecological continuum – migration to all parts of the river?





# Mitigation measures undertaken in R. Suldalslågen

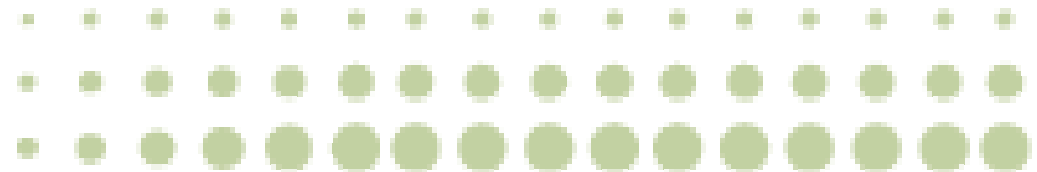
- **Water flow regime**
- Weirs
- Fish stocking
- Fish ladders





# Importance of water flow regime

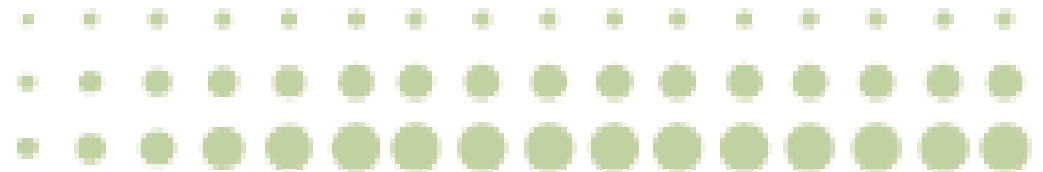
- Water flow affects water temperature and oxygen conditions
- Floods trigger essential events in life cycle of the fish – smolt- and spawning migration
- Floods are important for sediment transport, for armouring of the river bed and controlling distribution of vegetation
- Variable water flows - a way of preserving natural biodiversity





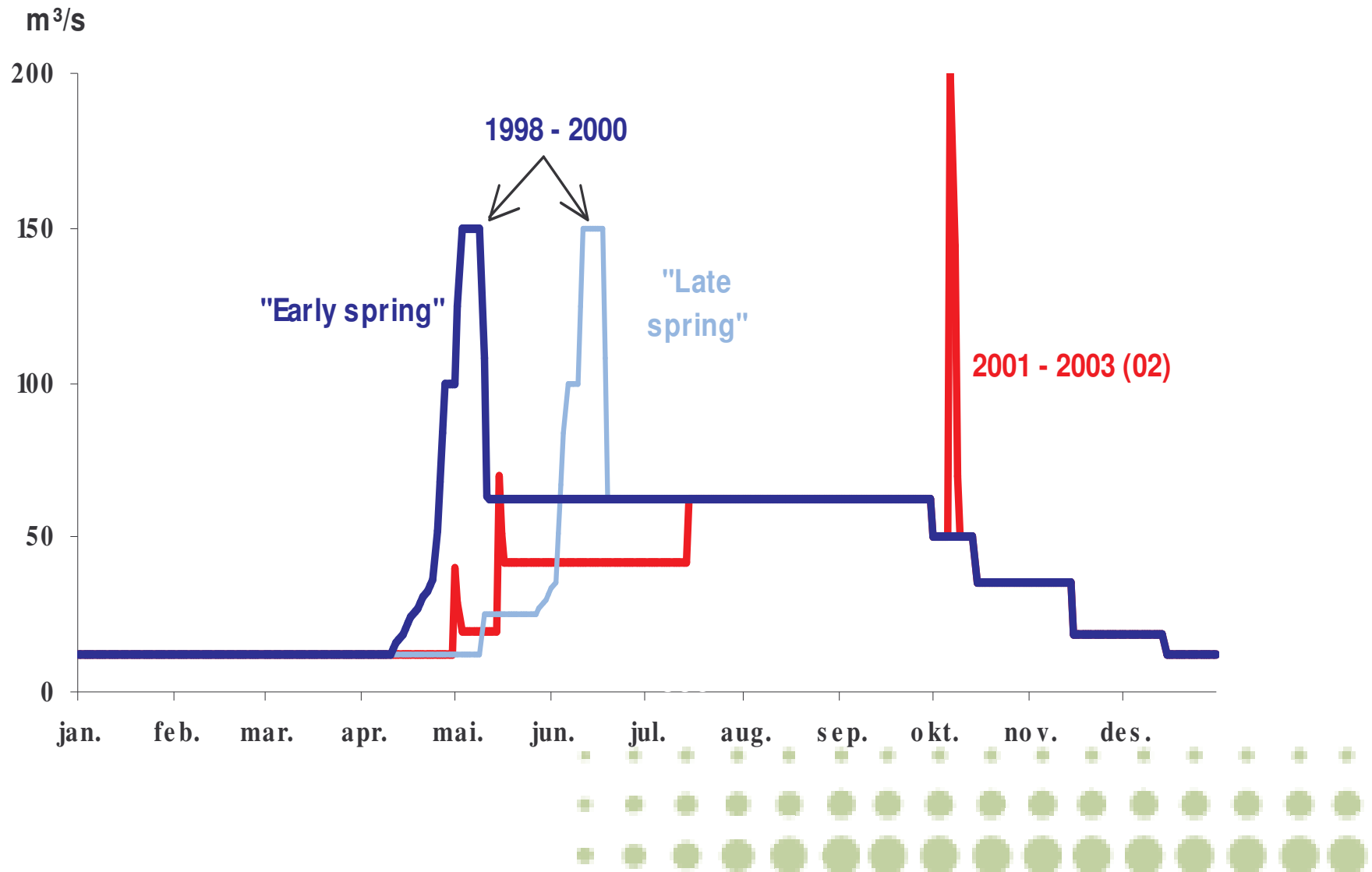
# Experimental changes in the water flow regime

- Two experimental periods
  - 1998-2000
  - 2001-2003
- Spring flood as a trigger for smolt migration
- Autumn floods to wash out accumulated fine particles from the river





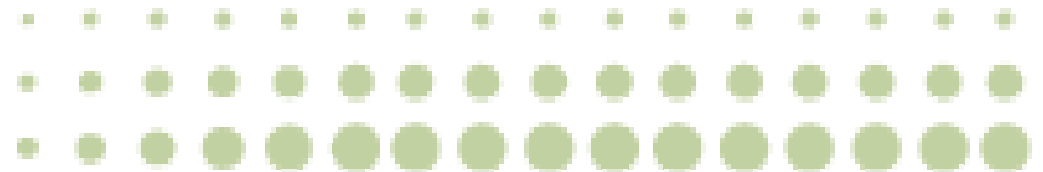
### Rule of operation, Suldalslågen 1998 - 2003





# Effects of increased springflood

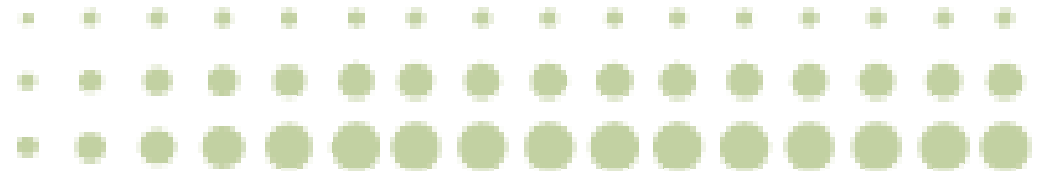
- More concentrated smolt migration
- Increased survival of smolt with a sizeable flood discharge of at least 100-150 m<sup>3</sup>/s during migration





# Effects of increased maximum (autumn) flood

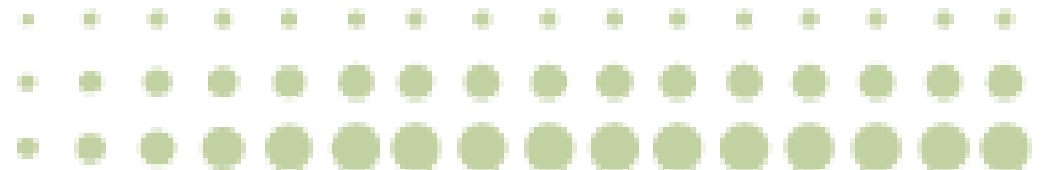
- Test floods of 250-300 m<sup>3</sup>/s gave the expected positive results:
  - Accumulated fine particles were transported out of the river
  - Gravel and stones were moved in the river bed
  - Vegetation cover of mosses decreased
- This positive effect could even be increased by a water flow during winter time designed to create more natural ice conditions





# Conclusion I

- There is a large potential for using water flow to improve the ecological conditions in regulated rivers
- A complex connection between water flow and biology – need for more knowledge





# Conclusion II

- Important to maintain natural variation - by imitating the water flow in an unregulated tributary
- Identify ecologically important hydrologic events which should be given special attention in the water flow regime
  - Spring flood – smolt migration
  - High (autumn) floods to preserve natural sediment conditions in the river bed

