

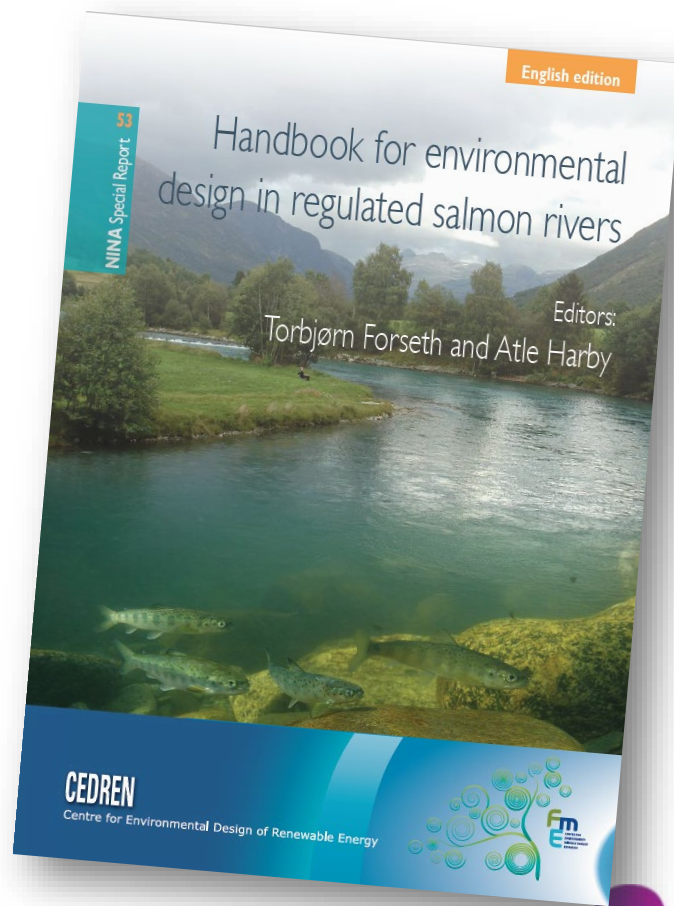
Expanding the concept of environmental design in Case Nea

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Environmental design in regulated salmon rivers

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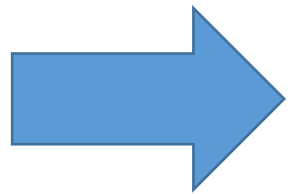


UiO : Naturhistorisk museum



Environmental design expanded

- Expanding the concept to new river systems
 - ▶ Inland rivers, other fish species
- Adding more ecological elements and people
 - ▶ biodiversity, recreational use, landscape perception



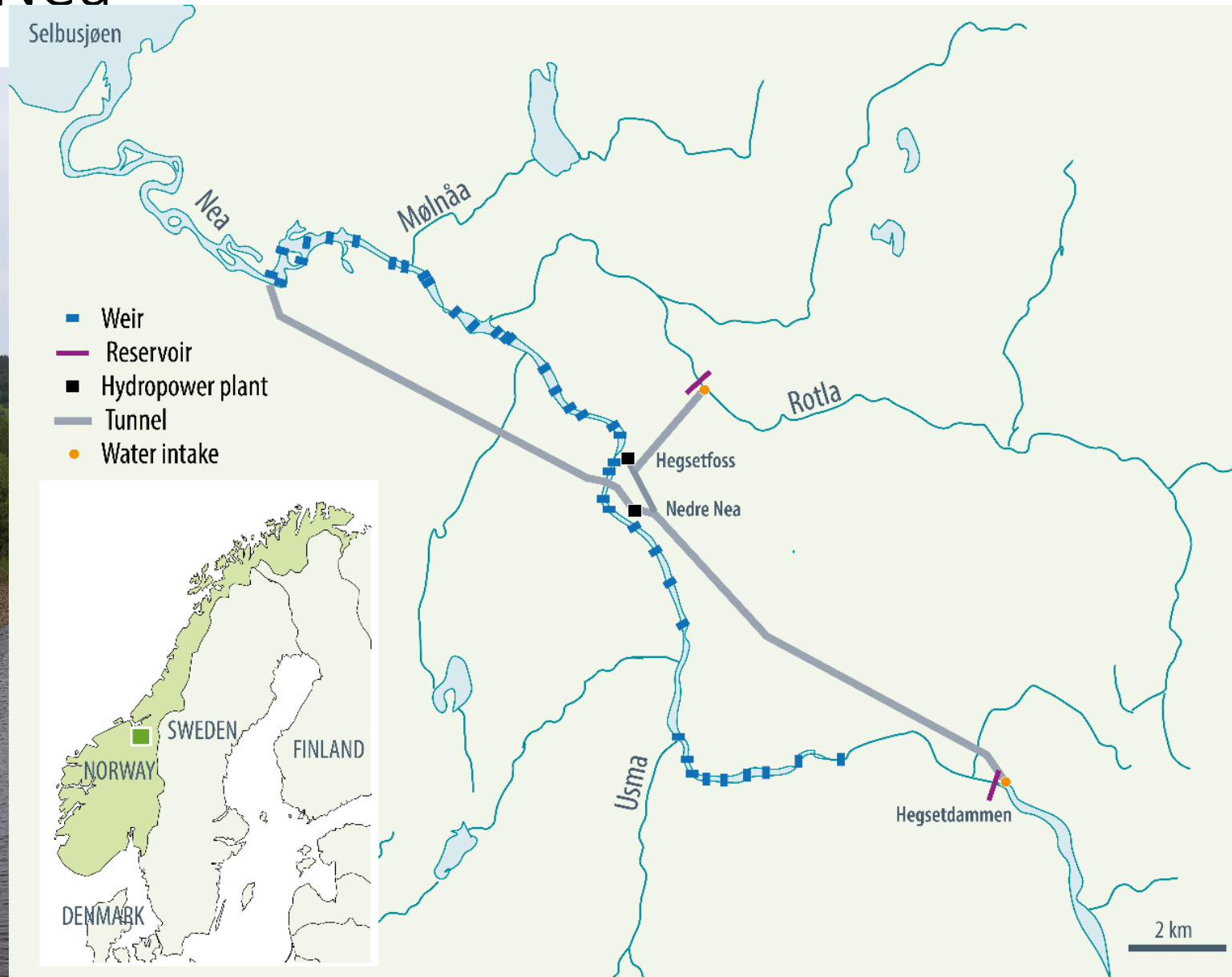
Test case: River Nea



HydroCen
NORWEGIAN RESEARCH CENTRE
FOR HYDROPOWER TECHNOLOGY



River Nea



Background River Nea

- Historically important spawning and recruitment river for large brown trout from Lake Selbusjøen

Challenges:

- Reduced discharge, water transferred to HP tunnel
- 32 weirs in 20 km
- Weirs may act as barriers for spawners

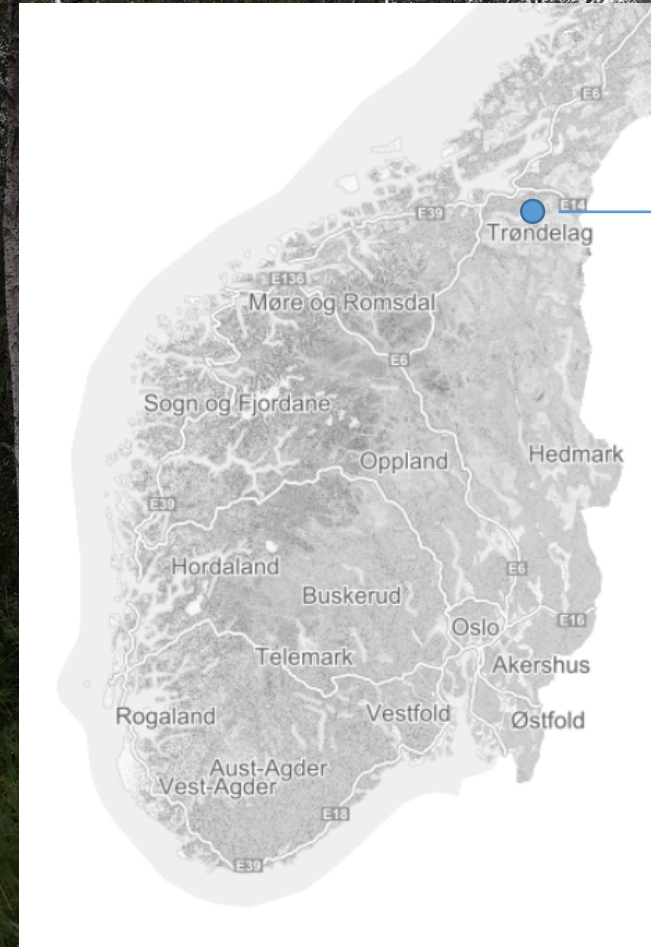
Non-native species introduced :

- European minnow (*Phoxinus phoxinus*)
- Pike (*Esox lucius*)



Case studies: River Nea 32 weirs (20 km stretch)

- Mapping of recreational use
- Green Lidar mapping and hydraulic modelling
- Survey (postal to locals and on site for tourists) of attitudes towards weirs, river-in-river and weir modification based on hydraulic modelling and visualisation (photos)
- Mapping of present and potential spawning areas (not used due to depth or velocities)
- Traditional sampling, e-DNA and barcoding of aquatic invertebrates to describe diversity and productivity (compared to regional expectations)
- Genetic kinship analyses of juvenile trout to estimate population size, genetic structuring and population fragmentation due to migration barriers

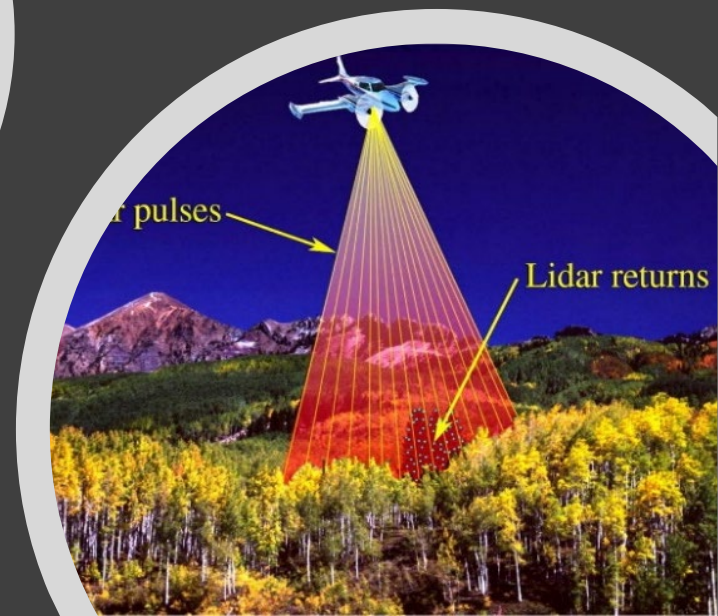


Nea river

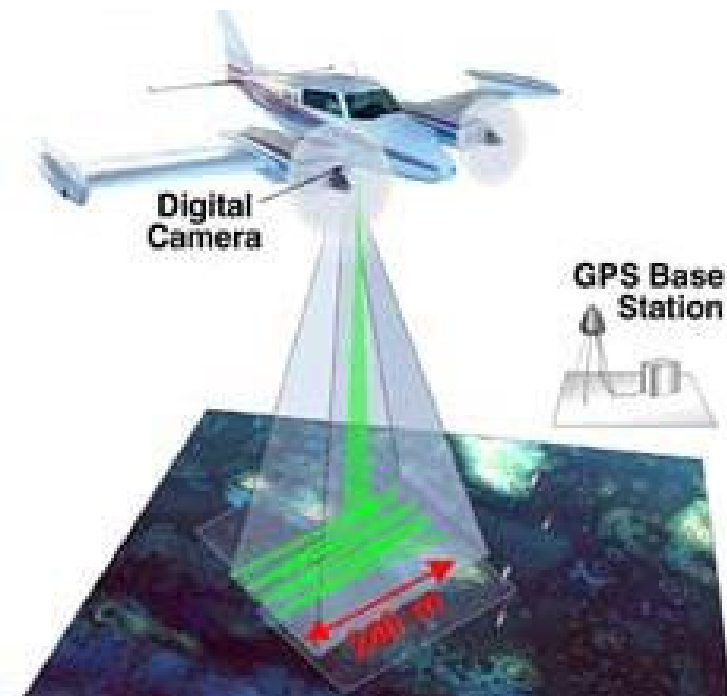
32 weirs på 20 km



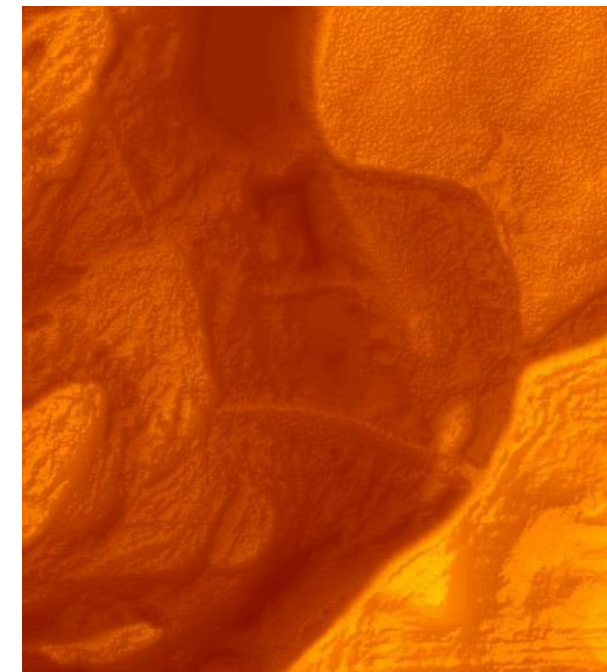
Methods



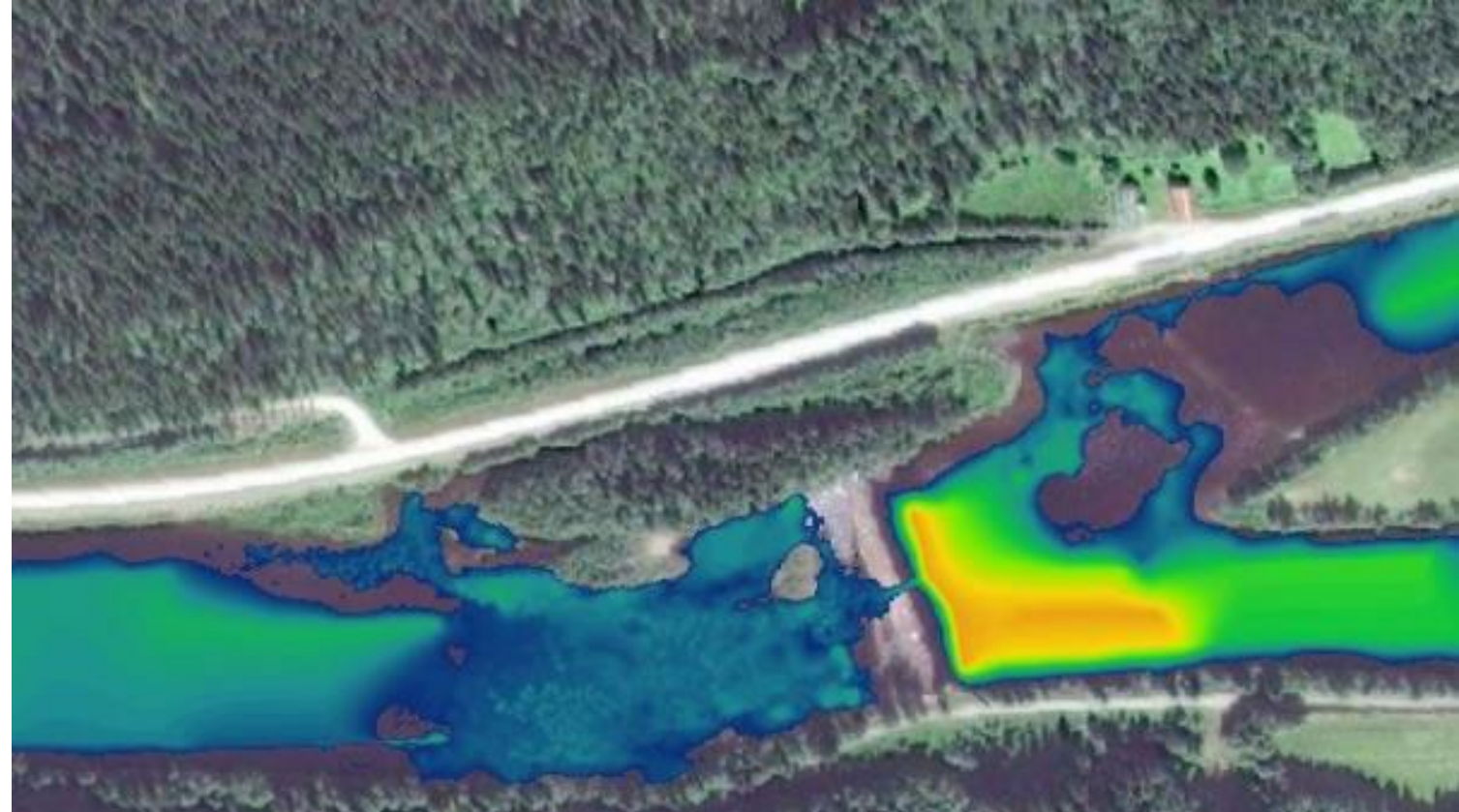
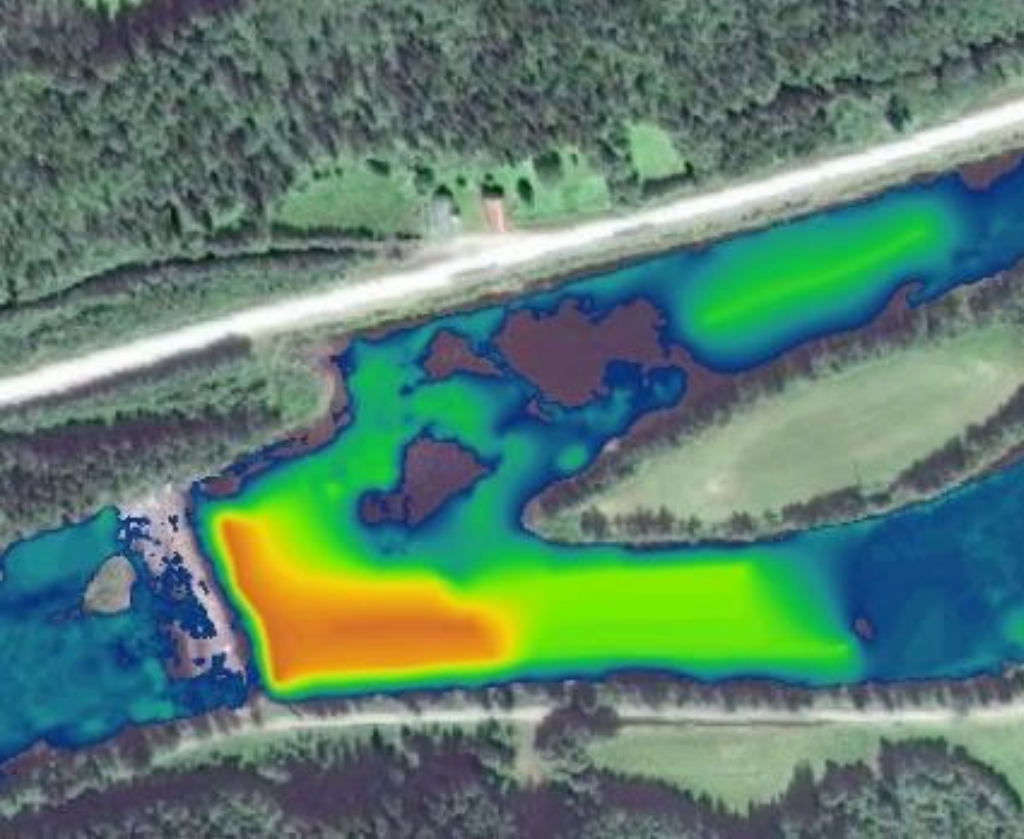
From a birds point of view



Green laser



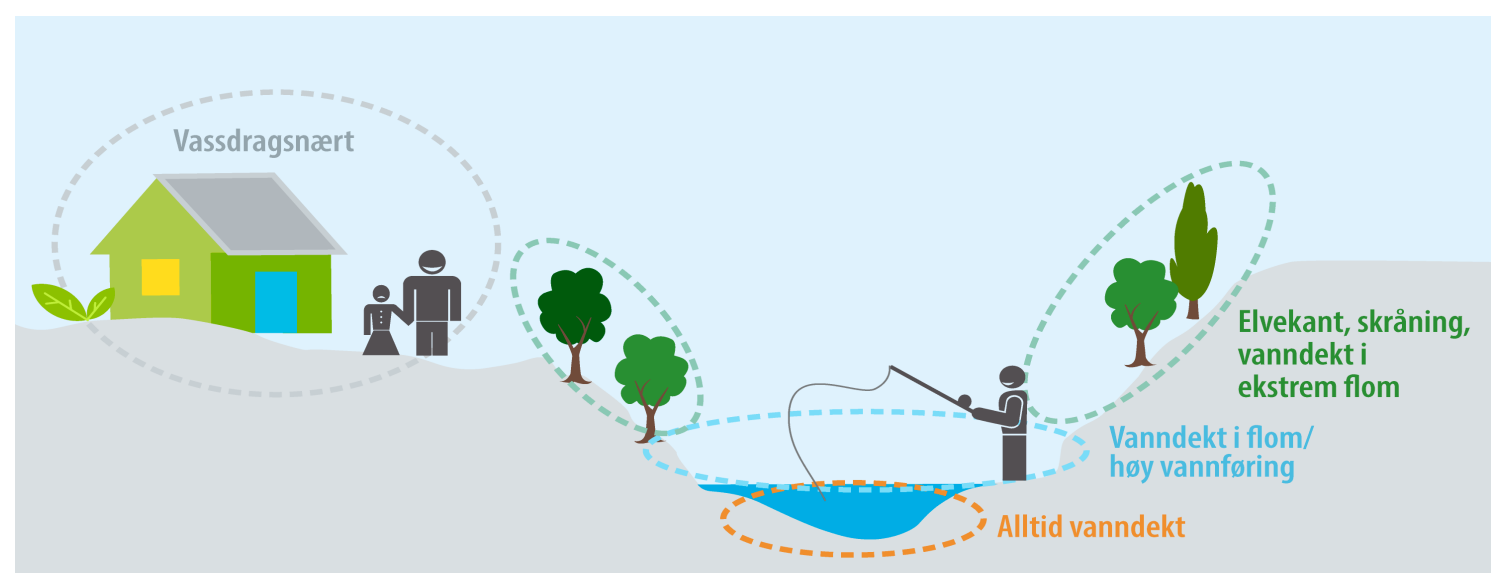
Digital elvemodell



Describe habitats and conditions for fish and other animals

Simulate different discharges and mitigation measures

River and landscape



Nea and weirs as landscape elements

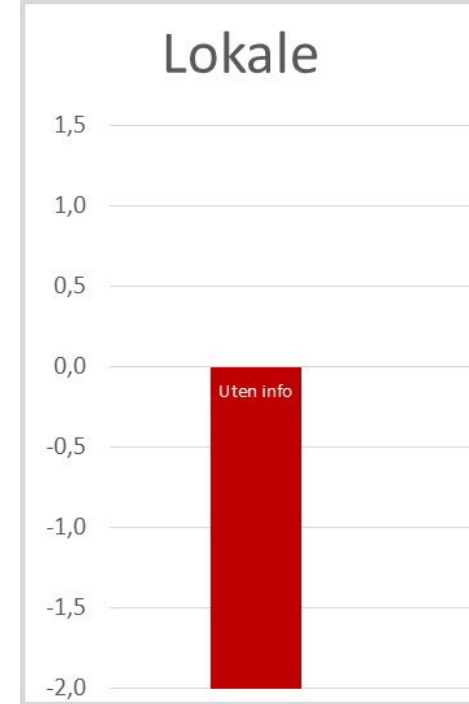


How do people like some mitigation measures?



-3	-2	-1	0	+1	+2	+3

Vet ikke



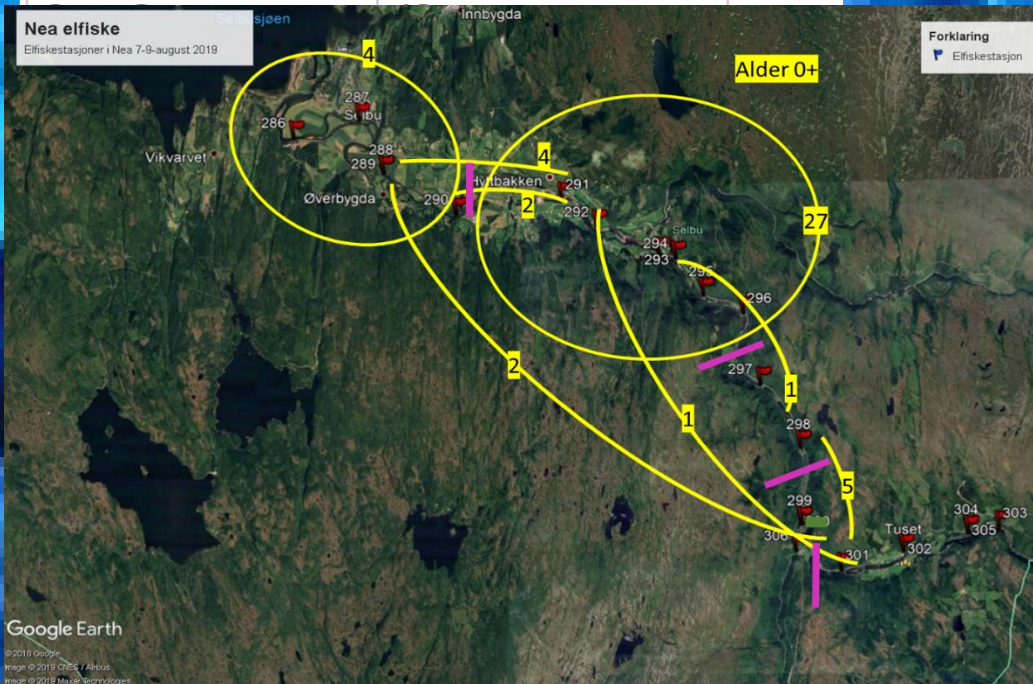
Fishing for answers...



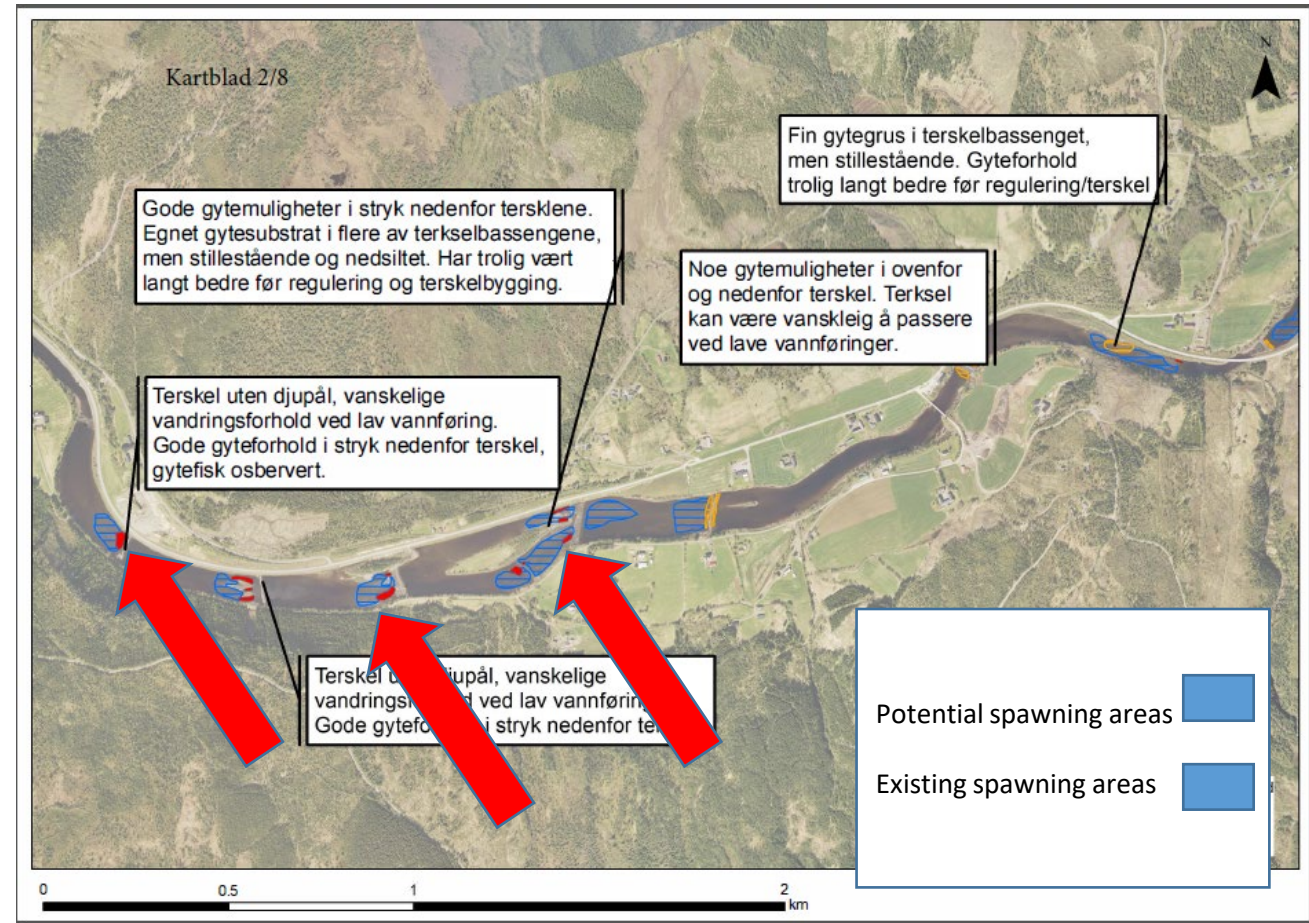
Brown trout in Nea: Siblings, halfsiblings and relatives

Age	No. of sibling pairs	N
0+	46	222
1+	35	213
2+	2	79
3+	0	7
0+ og 1+	42	

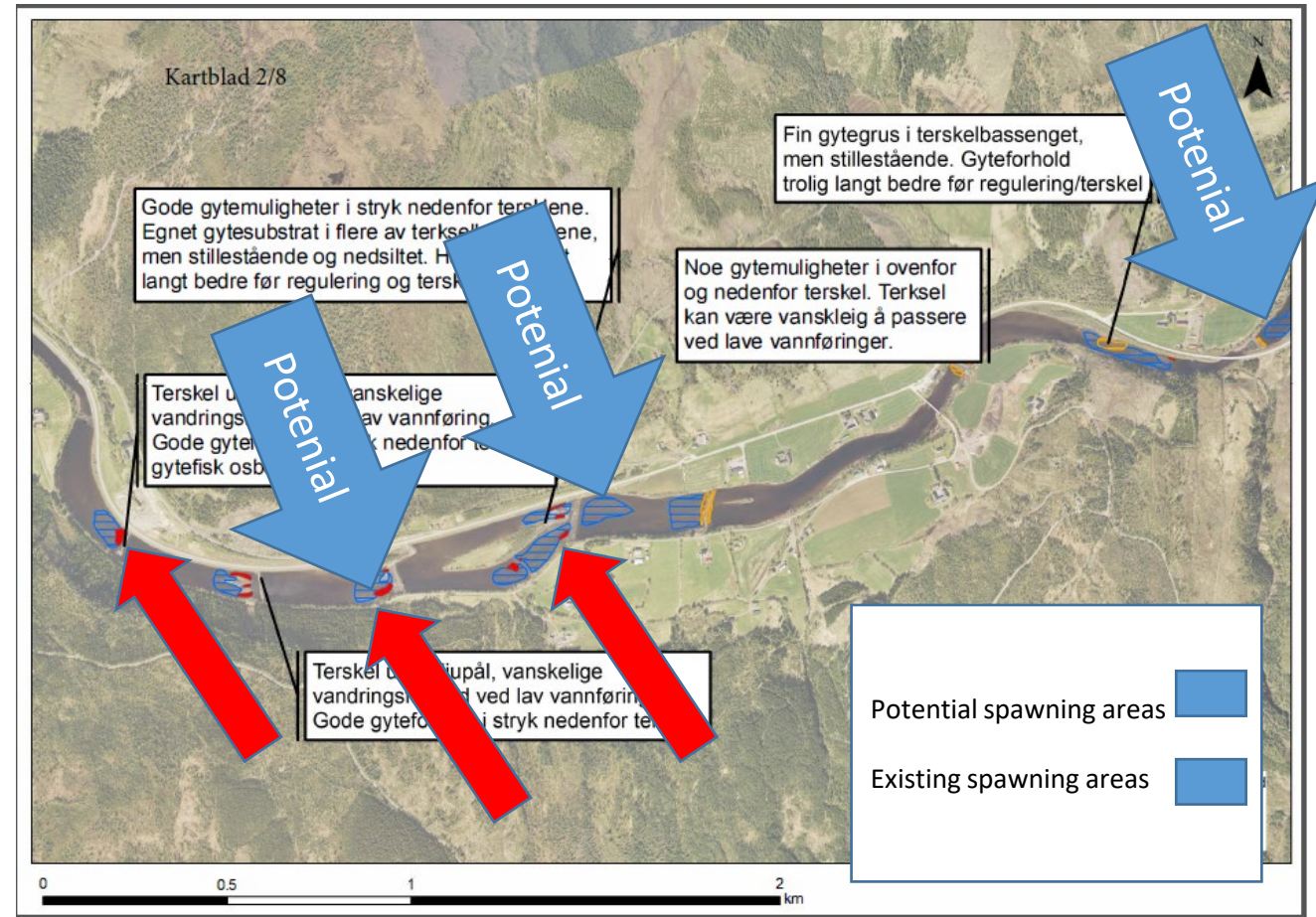
	N_e	Lower CI	Øvre KI
Age 0+	156	125	197
Age 1+	139	110	178



Mapping of spawning habitat



Mapping of spawning habitat

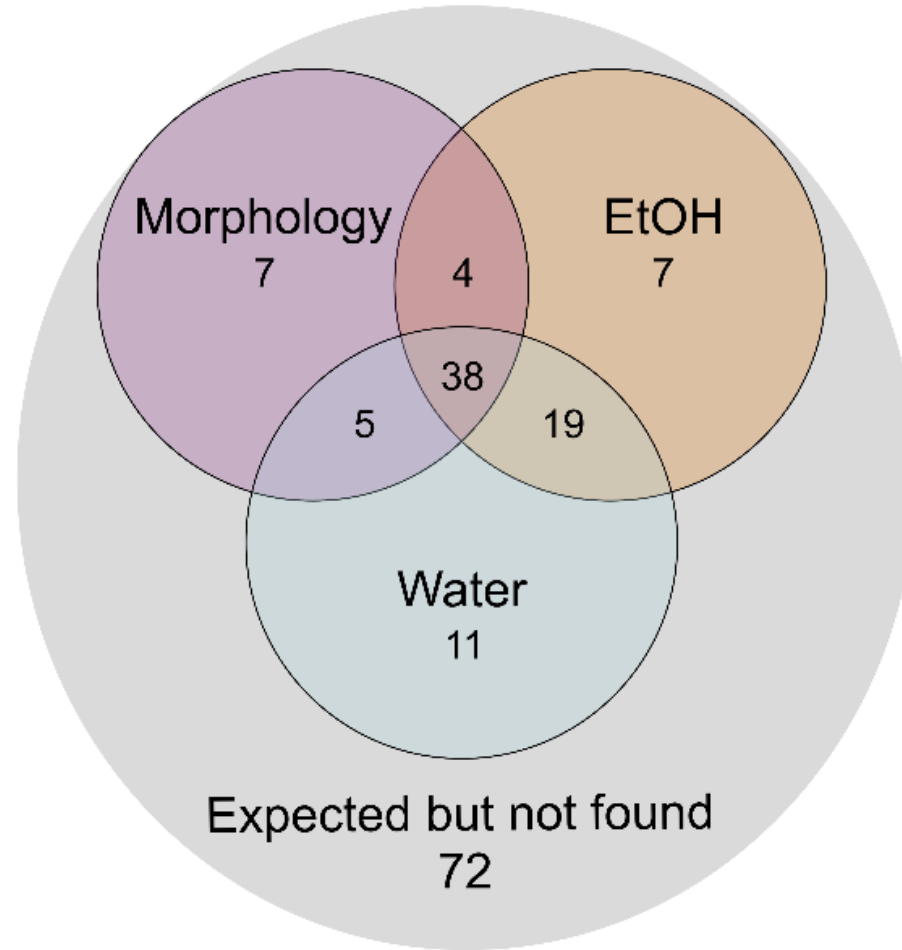


What about biodiversity?

- Kick samples (traditional method)
- DNA-barcoding from the ethanol which were stored on
- Environmental-DNA from watersamples kicksamples



Biodiversity



Diagnosis

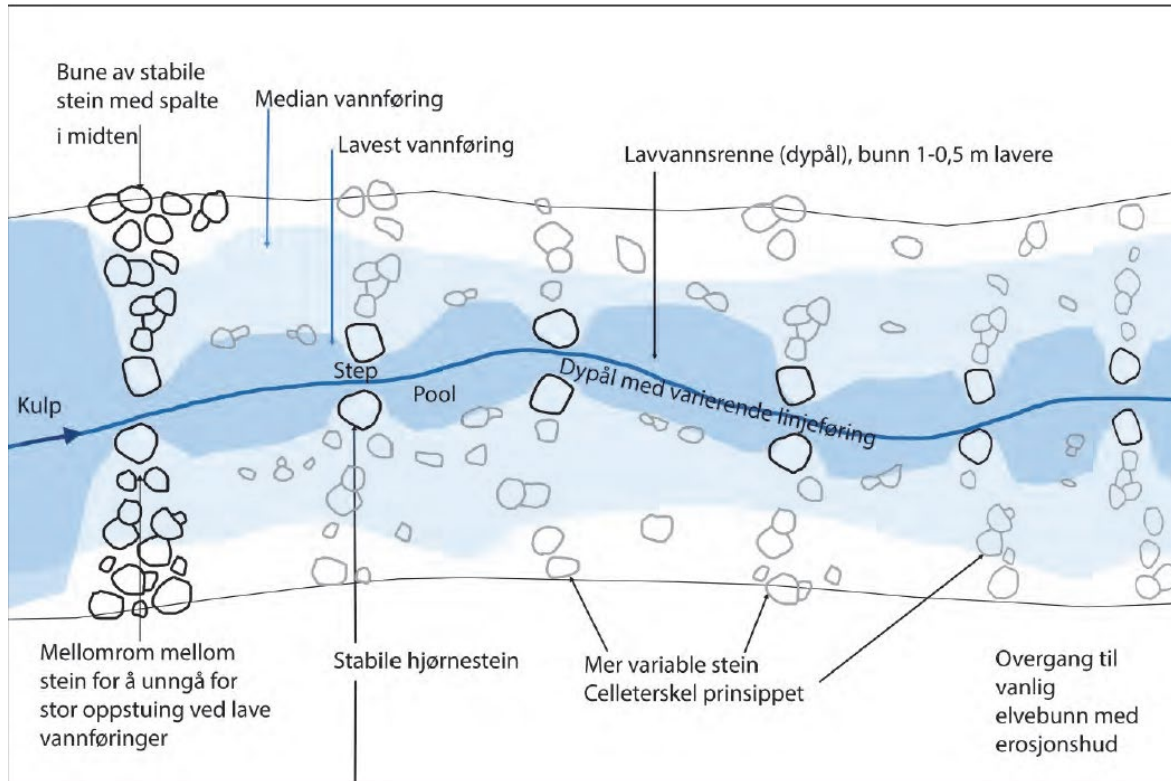


- Spawning stock of trout is very small, inbred and fragmented because weirs are stopping fish from moving upstream and downstream the river
- The weirpools are less productive and have lower biodiversity
- Weirs are however important for peoples perception of landscape, but there is acceptance for changing them to improve conditions for trout and invertebrates
- Without weirs the river would become a «rock desert» and the recreational value would be very much reduced
- Nea has several spawning areas which cannot be utilized as they are covered by still water
- Pools are important habitats in winter for survival of trout

How can conditions be improved?

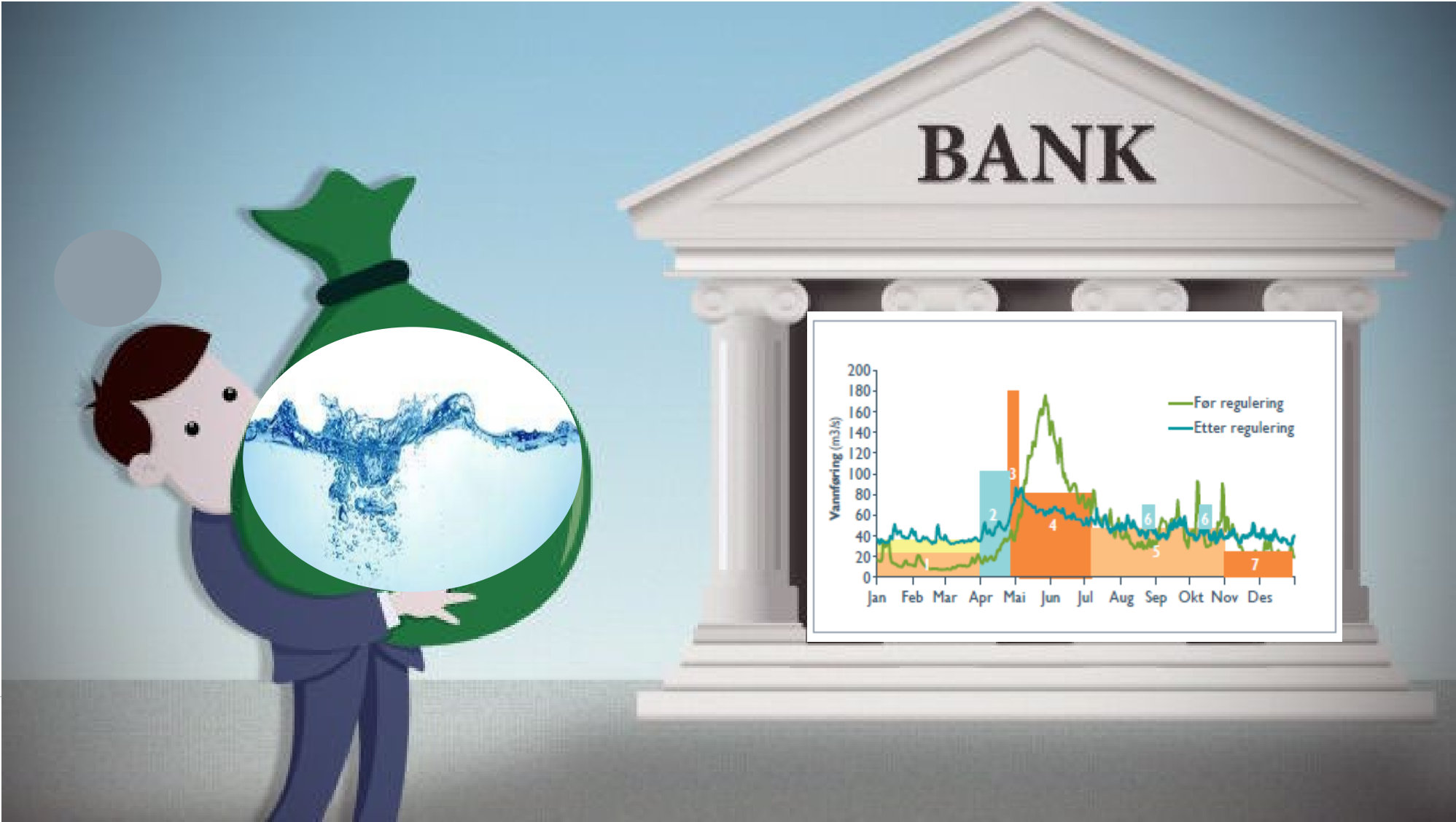


A good compromise solution which improves the ecological conditions



(Figure from "Tiltakshåndboka", NORCE)

Water bank



The suggested *modfications of weirs* in combination with the *water bank* will improve ecological conditions in the river

By removing bottlenecks for the trout population production will likely increase.

Statkraft is positive to the suggested measures

Thanks!