# River specific management and restoration efforts in Norway

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NORCE
VITENSKAPELIG RÅD FOR LAKSEFORVALTNING
Norwegian Scientific Advisory Committee for Atlantic Salmon

## Norwegian Scientific Advisory Committee for Atlantic Salmon

Founded by the Environmental Directorate in 2009
Annual evaluation of the status of wild Atlantic salmon in Norway
Give independent advice to management



13 researchers from
7 research institutes/universities

www.vitenskapsradet.no

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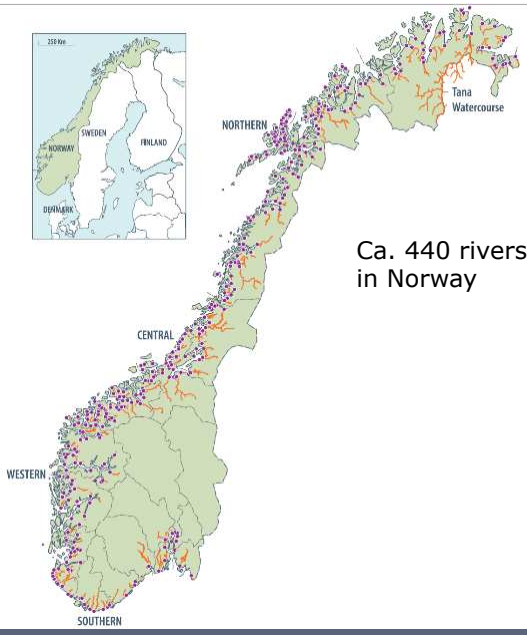
Spawners return to their natal river, so individuals are adapted to conditions in their natal river by natural selection. This knowledge is reflected in the river-specific management.










Ca. 440 rivers with Atlantic salmon in Norway

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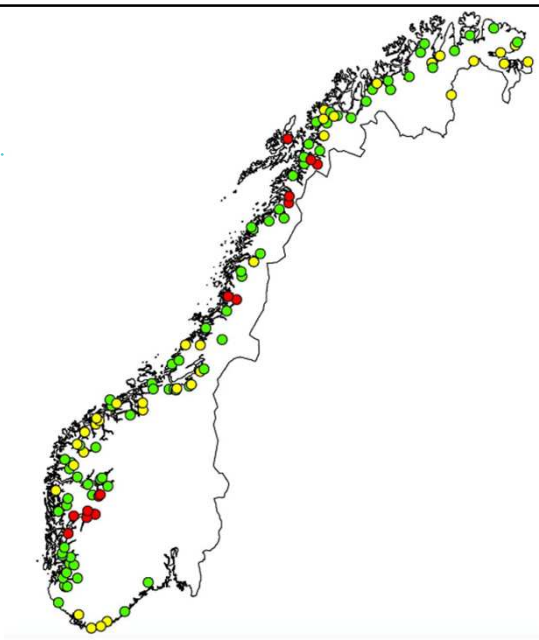
## Large national programme for counting of spawners and monitoring catch efficiency

- Scuba diving for counting of spawners
- Recording in fish passages/video
- In 2010 there was 54 rivers counted, in 2017 the number had increased to 123 rivers.

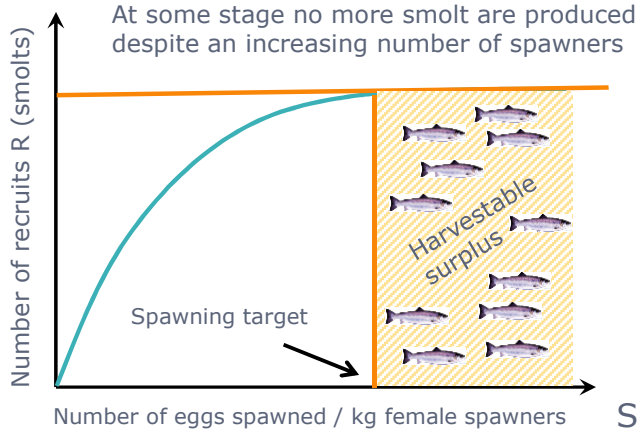




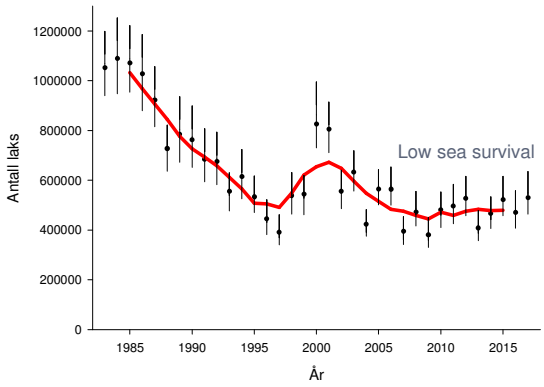
## Spawning targets are based on stock-recruitment (SR) relationships and developed for each salmon river. Very important step for management of Atlantic salmon in Norway.

SALMON STOCKS DO NOT GROW TO INFINITY

At some stage no more smolt are produced despite an increasing number of spawners



## Pre fishery abundance of salmon in Norway has been reduced by more than 50 % since 1983





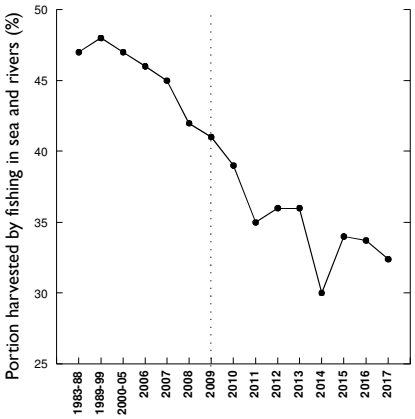

## The quality norm for Norwegian salmon populations

Quality norm

- A quality norm sanctioned by the Nature Diversity Act was adopted by the Norwegian government in 2013.
- It set a standard that all salmon populations should attain. The aim is to contribute to the conservation and rebuilding of salmon populations to a size and structure that will ensure diversity and productivity within the species, and that will ensure harvest opportunities.
- To attain the standard of the quality norm, the population must not be genetically impacted by escaped farmed salmon or other anthropogenic activities, it must have a large enough spawning population to reach the spawning target and it must provide a normal harvestable surplus.
- Hence, population status can only be classified as good when the spawning targets are attained after a normal exploitation of the population.

## The reduced abundance of salmon has led to a substantial reduction in fishing both at sea and in the rivers

- fishing is regulated by the management and reduced fishing secure that the spawning stocks are maintained

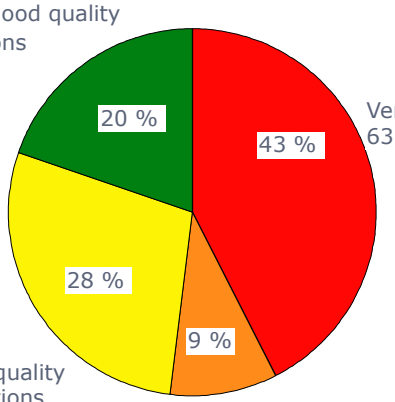





## Only 20 % of 148 populations achieved good or very good quality in 2017

Quality norm

Good/very good quality
29 populations




Very bad quality
63 populations

Moderate quality
42 populations

Bad quality
14 populations

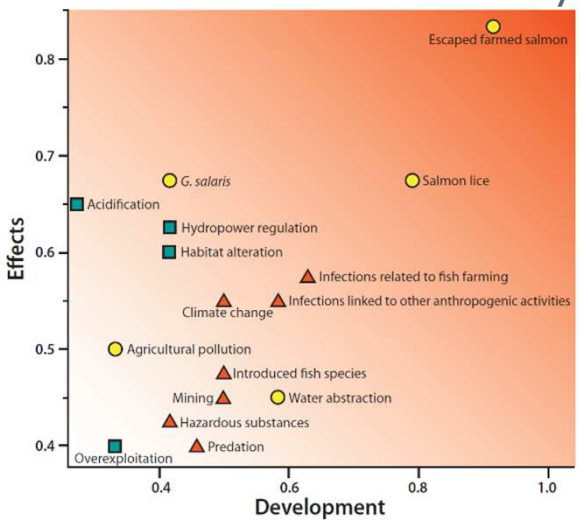
# The major threats to Atlantic salmon in Norway

- The largest threat is escaped farmed salmon followed by salmon lice


ICES Journal of Marine Science

Review article

The major threats to Atlantic salmon in Norway

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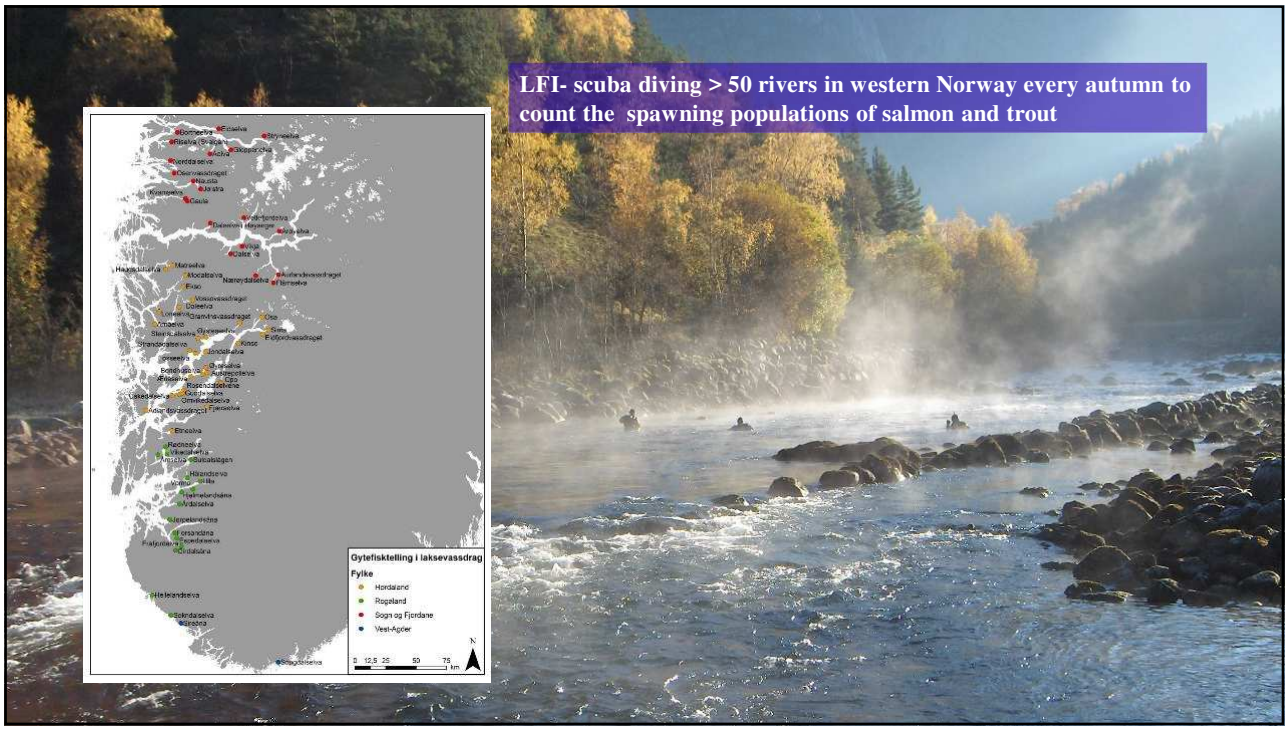
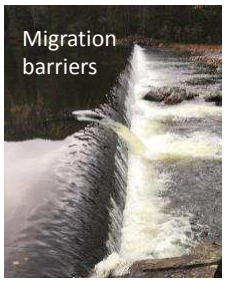
NORCE – A research institute owned by four universities. Research for a sustainable development.

Research group LFI –
field studies and direct observations are the foundation of our research. 20 employees plus ca 10 students. Financed from severeal sources: management, power companies, research council...

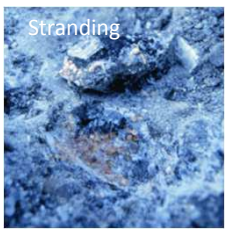


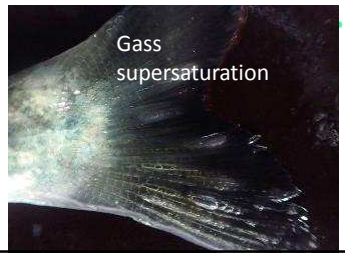

# Field observations used to detect negative impacts







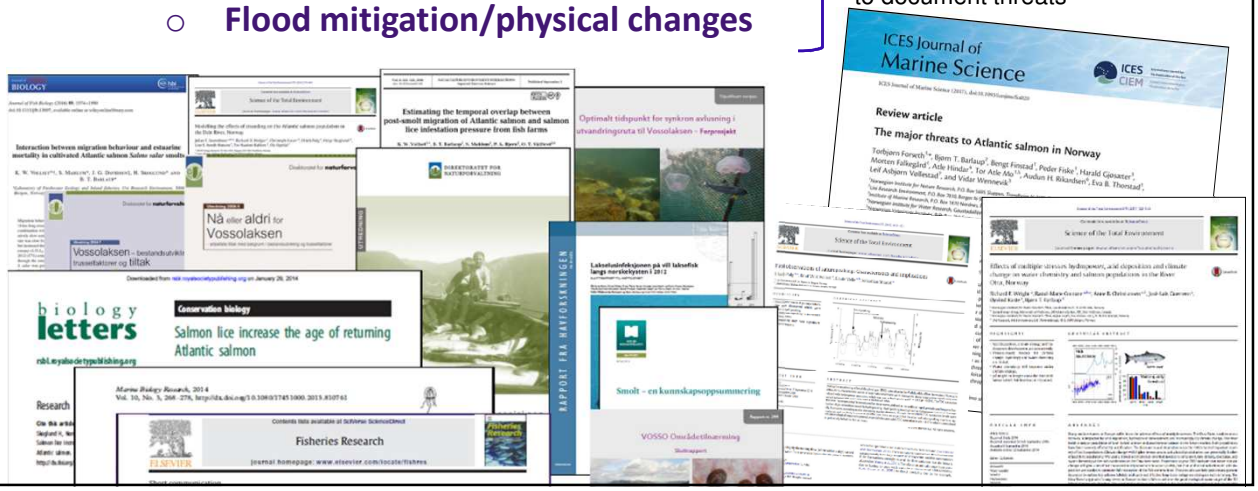



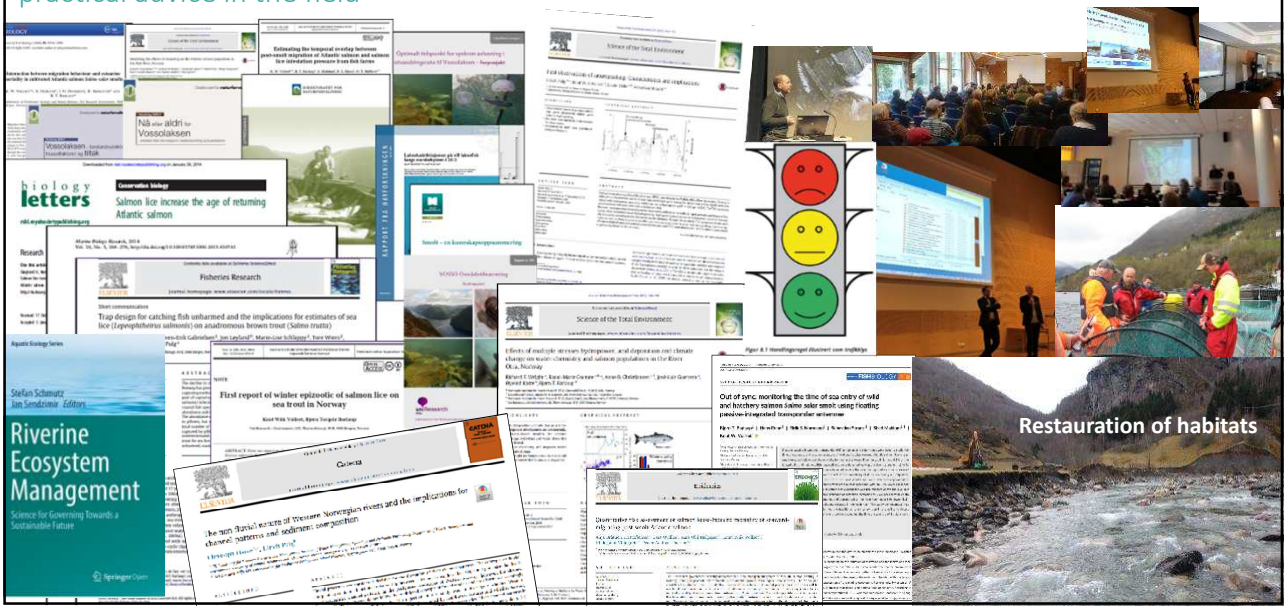

## Wild salmon populations are often exposed to multiple stressors

- **Effect of fish farming** (escaped salmon/sea lice)
- **Effects of hydro power development**
- **Flood mitigation/physical changes**

Very important to use scientific studies to document threats




…important to communicate the results through scientific papers, reports, talks, participitation in expert groups, teaching and by giving practical advice in the field



## Local perspective: access to healthy, harvestable salmon stocks = happy communities

1. Biodiversity, the salmon is an important indicator species
2. Natural and cultural heritage
3. Present and future opportunities for recreation and business development

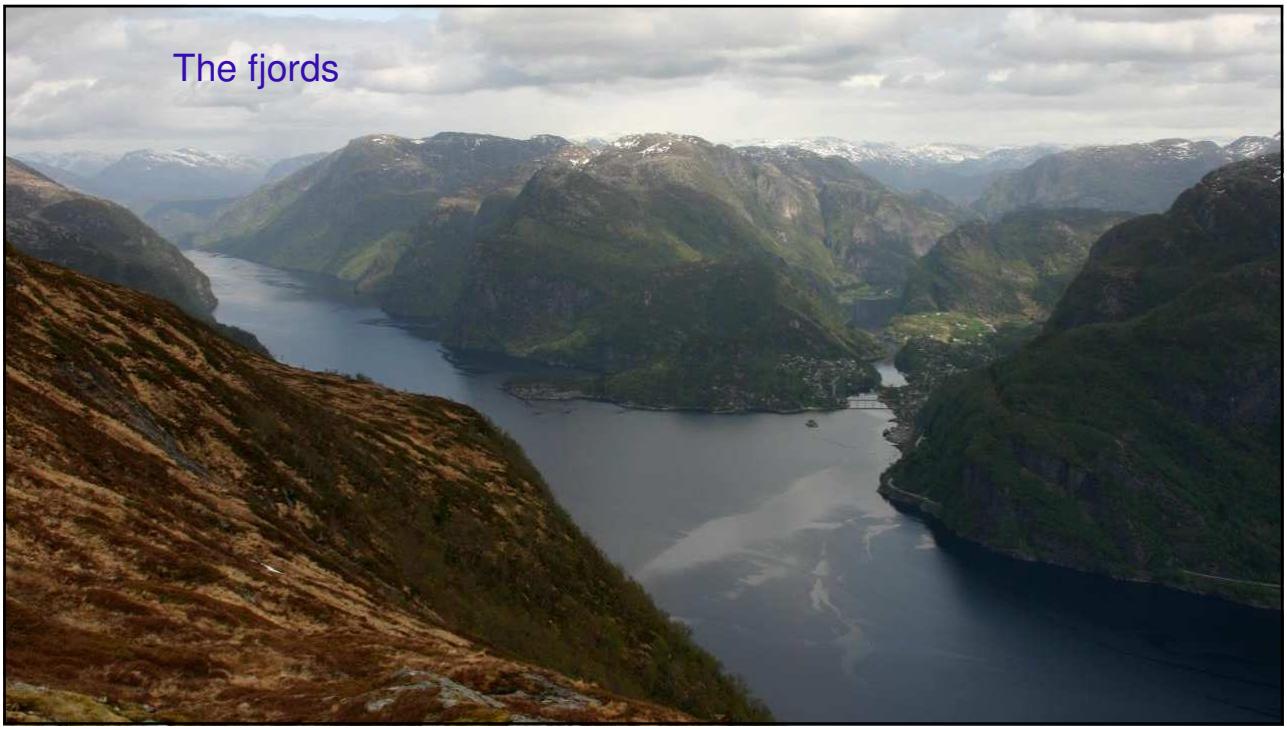
**Flott fiskestart**

*Esben Hesjedal, 07.07.11*

**Årets fiskesesong i Daleelva starta med godt fiske, og Øystein Sellevold tok årets første laks.**

*Øystein Sellevold jublar med årets første Dalelaks, medan fiskarlagsformann Inge Sandven inspiserer den flotte fisken.*

Fiskeentusiasten frå Dale var sjølvsagt på plass i Daleelva då det vart opna for fiske ved midnatt fredag sist veke.
– Eg fekk ein flott holaks på 5,9 kilo i Hagahølen i halv fire-tida om natta, fortalde Sellevold då VP trefte han ved elva morgonen etter første fiskenatt.




The Vosso salmon restoration project
- Population collapse in the late 1980s
- Ongoing plan to restore the population


Trap nets to catch returning salmon in the fjords

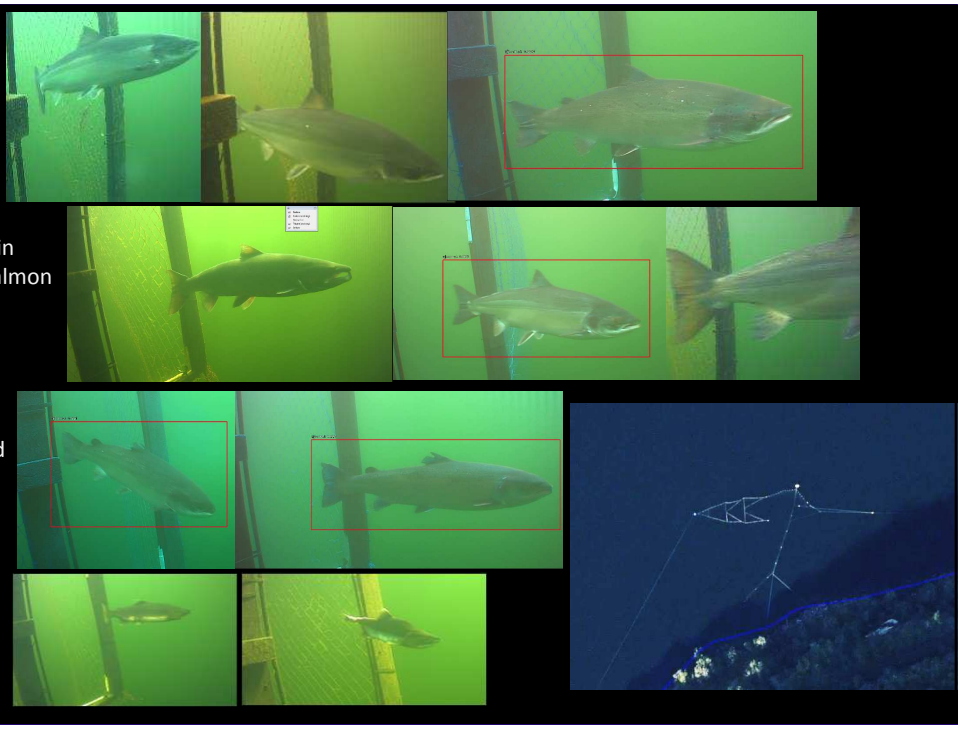
Open bagnet with camera

Wild salmon

Adipose fin clipped salmon

Escaped farmed salmon

Pink salmon



Special bag nets for catching the salmon


## A typical large–scale Norwegian fish farm

A total of 978 such farms were operated along the Norwegian coast in january 2017
(Source: Fisheries directorate)

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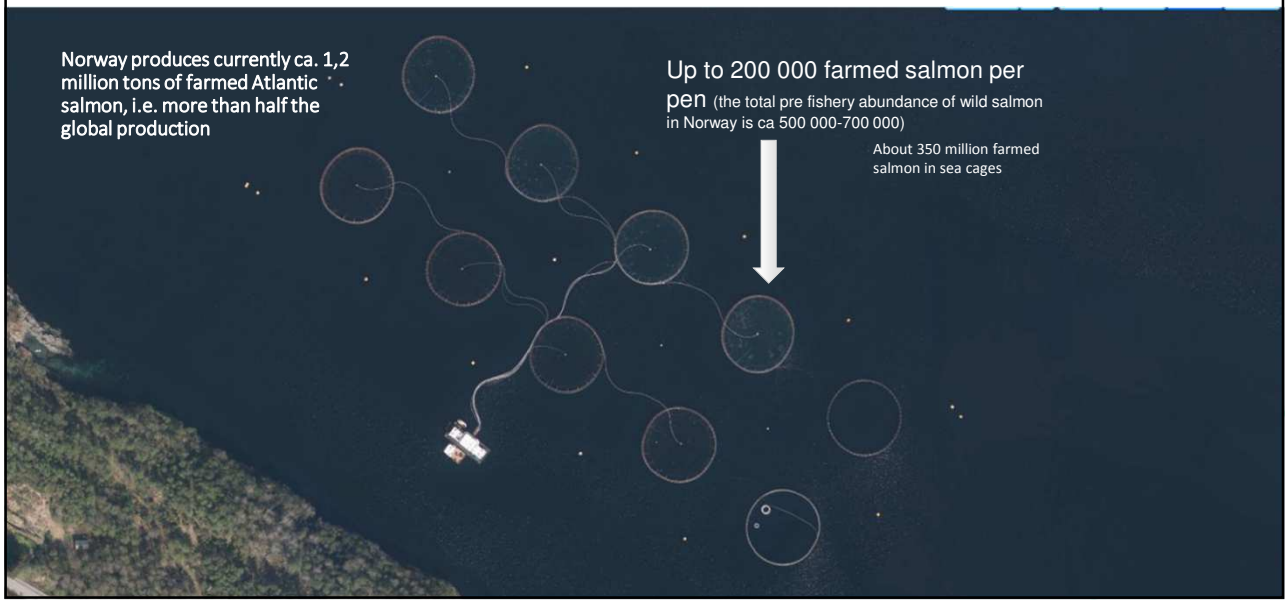
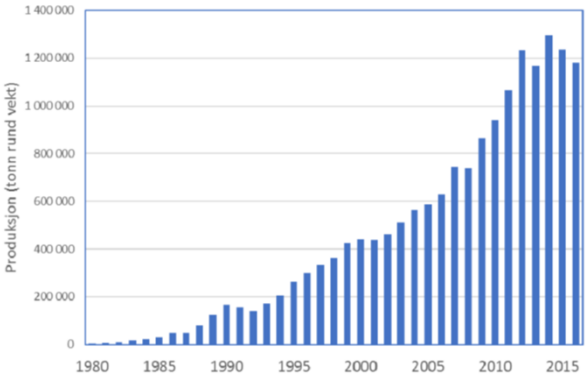
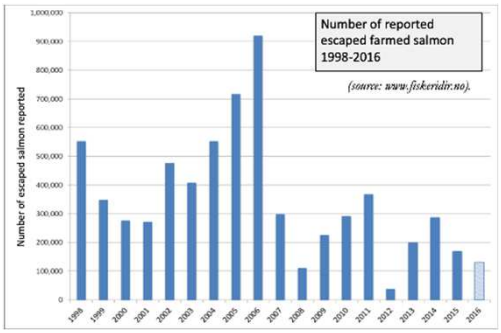
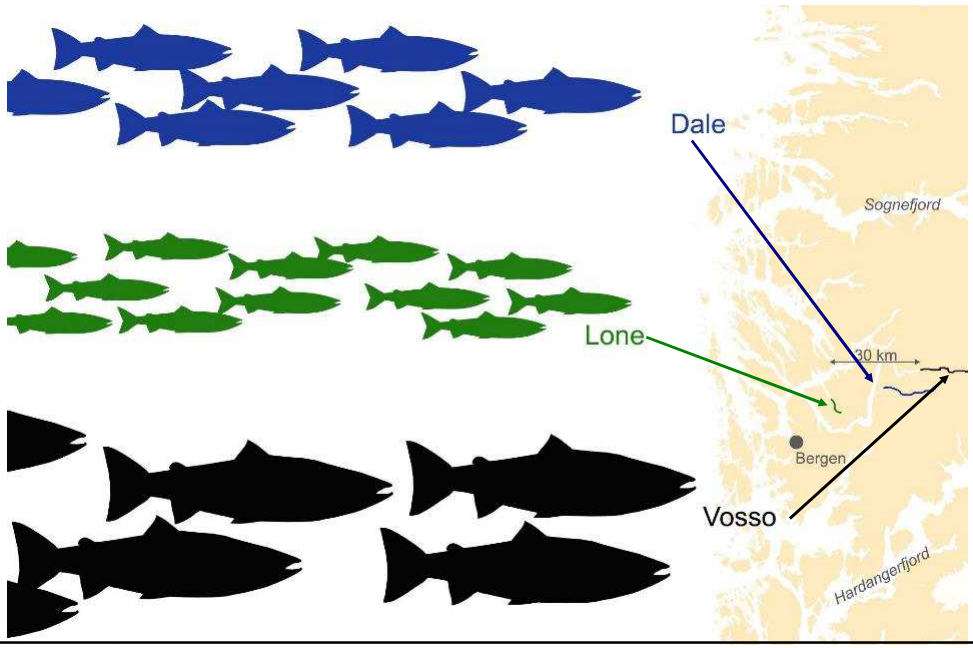


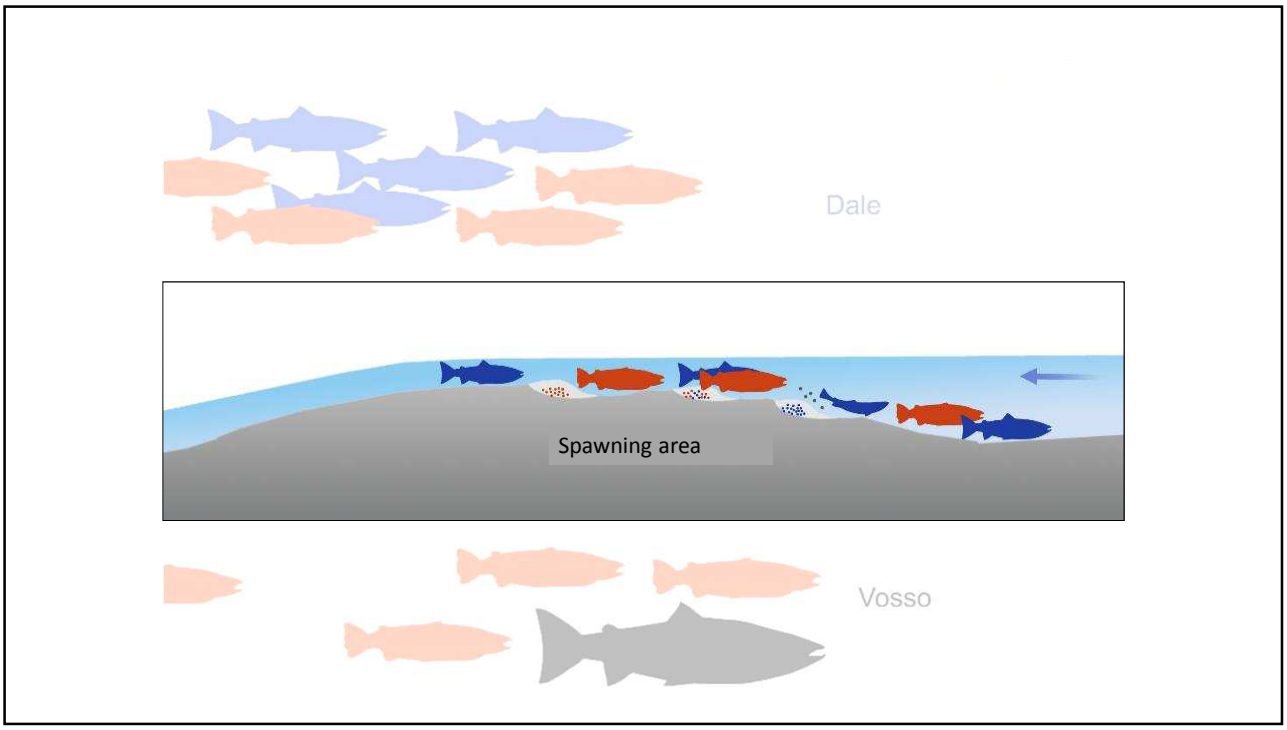



*Produksjon av oppdrettslaks i Norge i perioden 1980-2016 (tonn). Tallene for 2016 er foreløpige*
*(Kilde: www.fiskeridir.no).*

Every river has its own unique salmon stock adapted to the local, river-specific condition



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Article

# Gene flow from domesticated escapes alters the life history of wild Atlantic salmon

Geir H. Bolstad, Kjetil Hindar, Grethe Robertsen, Bror Jonsson, Harald Sægrov, Ola H. Diserud, Peder Fiske, Arne J. Jensen, Kurt Urdal, Tor F. Næsje, Bjørn T. Barlaup, Bjørn Florø-Larsen, Håvard Lo, Eero Niemelä & Sten Karlsson

*Nature Ecology & Evolution* **1**,
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Conservation biology

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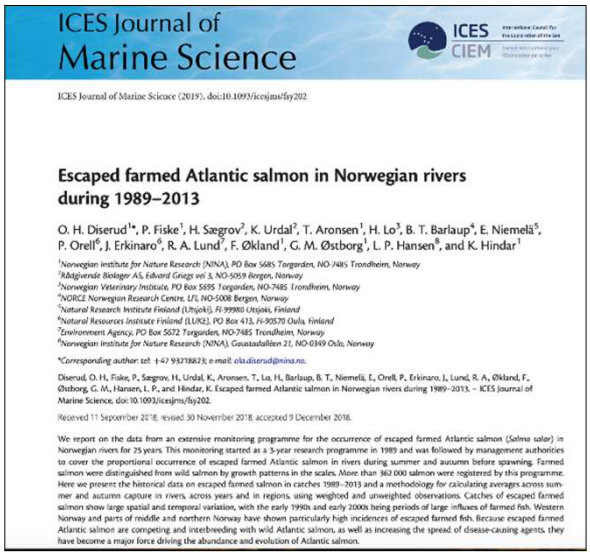
Norwegian monitoring programme for escaped farmed salmon in rivers has been operating since 1989



ICES Journal of Marine Science

ICES Journal of Marine Science (2019), doi:10.1093/icesjms/fsy202

**Escaped farmed Atlantic salmon in Norwegian rivers during 1989–2013**

O. H. Diserud[1]*, P. Fiske[1], H. Sægrov[2], K. Urdal[2], T. Aronsen[1], H. Lo[3], B. T. Barlaup[4], E. Niemelä[5], P. Orell[6], J. Erkinaro[6], R. A. Lund[7], F. Økland[1], G. M. Østborg[1], L. P. Hansen[8], and K. Hindar[1]

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Diserud, O. H., Fiske, P., Sægrov, H., Urdal, K., Aronsen, T., Lo, H., Barlaup, B. T., Niemelä, E., Orell, P., Erkinaro, J., Lund, R. A., Økland, F., Østborg, G. M., Hansen, L. P., and Hindar, K. Escaped farmed Atlantic salmon in Norwegian rivers during 1989–2013. – ICES Journal of Marine Science, doi:10.1093/icesjms/fsy202.

Received 11 September 2018; revised 30 November 2018; accepted 9 December 2018.

We report on the data from an extensive monitoring programme for the occurrence of escaped farmed Atlantic salmon (*Salmo salar*) in Norwegian rivers for 25 years. This monitoring started as a 3-year research programme in 1989 and was followed by management authorities to cover the proportional occurrence of escaped farmed Atlantic salmon in rivers during summer and autumn before spawning. Farmed salmon were distinguished from wild salmon by growth patterns in the scales. More than 362 000 salmon were registered by this programme. Here we present the historical data on escaped farmed salmon in catches 1989–2013 and a methodology for calculating averages across summer and autumn capture in rivers, across years and in regions, using weighted and unweighted observations. Catches of escaped farmed salmon show large spatial and temporal variation, with the early 1990s and early 2000s being periods of large influxes of farmed fish. Western Norway and parts of middle and northern Norway have shown particularly high incidences of escaped farmed fish. Because escaped farmed Atlantic salmon are competing and interbreeding with wild Atlantic salmon, as well as increasing the spread of disease-causing agents, they have become a major force driving the abundance and evolution of Atlantic salmon.

ICES Journal of Marine Science

ICES Journal of Marine Science (2019), doi:10.1093/icesjms/fsy207

**Domesticated escapees on the run: the second-generation monitoring programme reports the numbers and proportions of farmed Atlantic salmon in >200 Norwegian rivers annually**

K. A. Glover[1,2]*, K. Urdal[3], T. Næsje[4], H. Skoglund[5], B. Florø-Larsen[6], H. Otterå[1], P. Fiske[4], M. Heino[1,2,7], T. Aronsen[4], H. Sægrov[3], O. Diserud[4], B. T. Barlaup[5], K. Hindar[4], G. Bakke[1], I. Solberg[8], H. Lo[6], M. F. Solberg[1], S. Karlsson[4], Ø. Skaala[1], A. Lamberg[8], Ø. Kanstad-Hanssen[9], R. Muladal[10], O. T. Skilbrei[11] and V. Wennevik[1]

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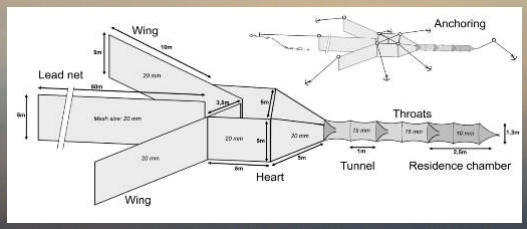
†Deceased.

Glover, K. A., Urdal, K., Næsje, T., Skoglund, H., Florø-arsen, B., Otterå, H., Fiske, P., Heino, M., Aronsen, T., Sægrov, H., Diserud, O., Barlaup, B. T., Hindar, K., Bakke, G., Solberg, I., Lo, H., Solberg, M. F., Karlsson, S., Skaala, Ø., Lamberg, A., Kanstad-ansen, Ø., Muladal, R., Skilbrei, O. T., and Wennevik, V. Domesticated escapees on the run: the second-generation monitoring programme reports the numbers and proportions of farmed Atlantic salmon in >200 Norwegian rivers annually. – ICES Journal of Marine Science, doi:10.1093/icesjms/fsy207.

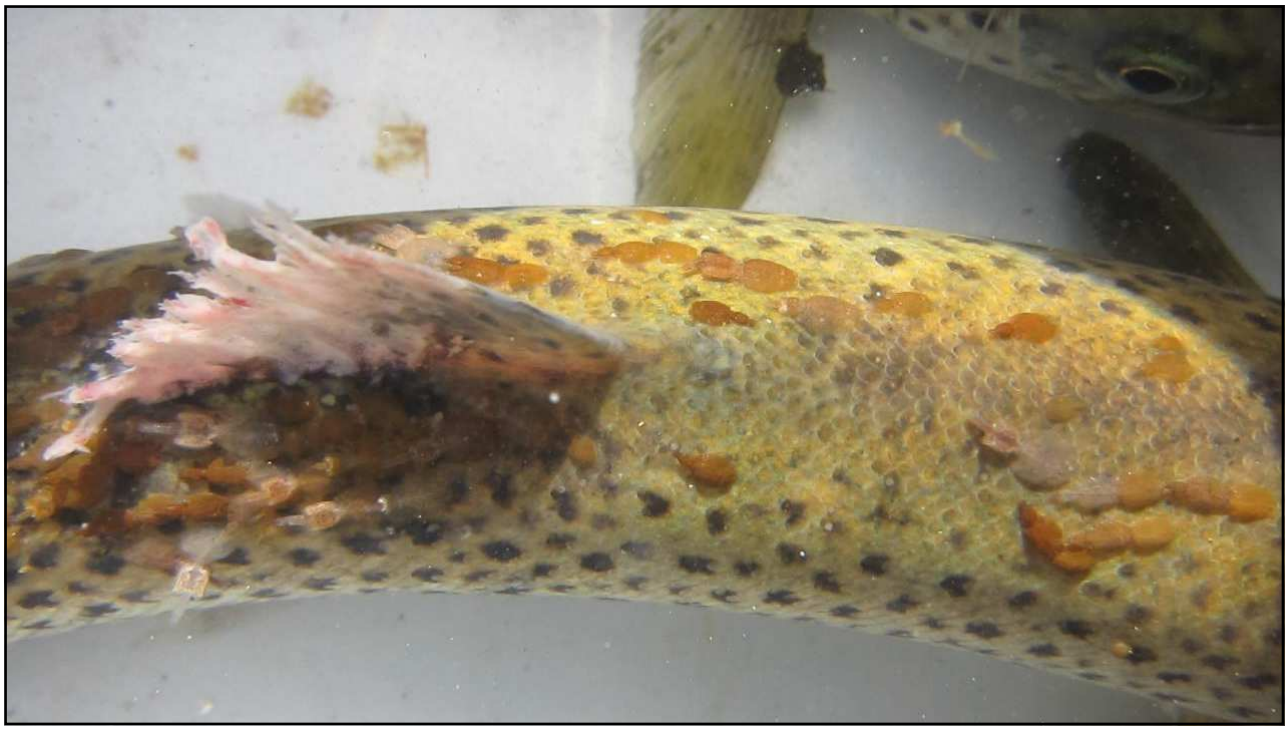
Received 11 September 2018; revised 11 December 2018; accepted 12 December 2018.

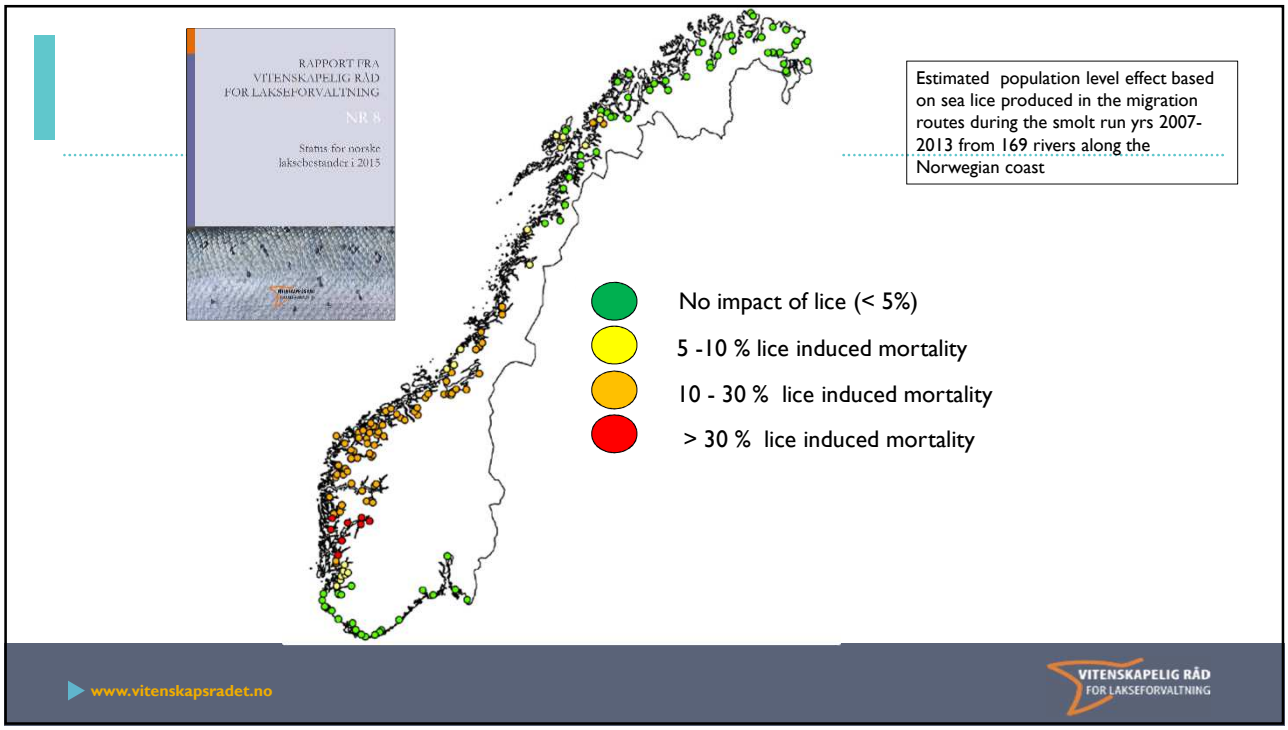
Restoration efforts are based on reintroduction of salmon from original stocks kept in a national gene bank


Trapnet to record salmon lice on seatrout and salmon smolts in coastal waters




**Barlaup *et al.* (2012)** Novel giant trap net design for catching fishes unharmed and implications for estimates of sea lice (*Lepeophtheirus salmonis*) on anadromous brown trout (*Salmo trutta*). Fisheries Research




RAPPORT FRA
VITENSKAPELIG RÅD
FOR LAKSEFORVALTNING
NR 8
Status for norske laksebestander i 2015
Estimated population level effect based on sea lice produced in the migration routes during the smolt run yrs 2007-2013 from 169 rivers along the Norwegian coast
No impact of lice (< 5%)
5 -10 % lice induced mortality
10 - 30 % lice induced mortality
> 30 % lice induced mortality
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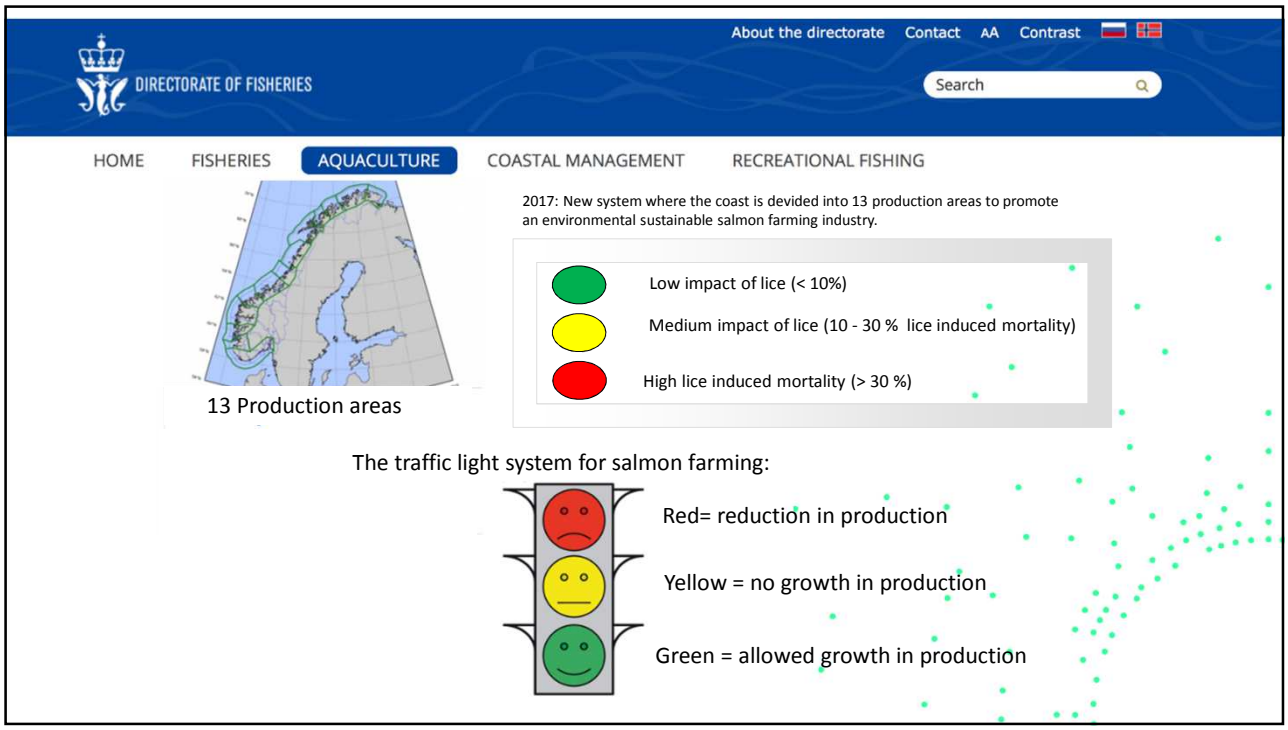
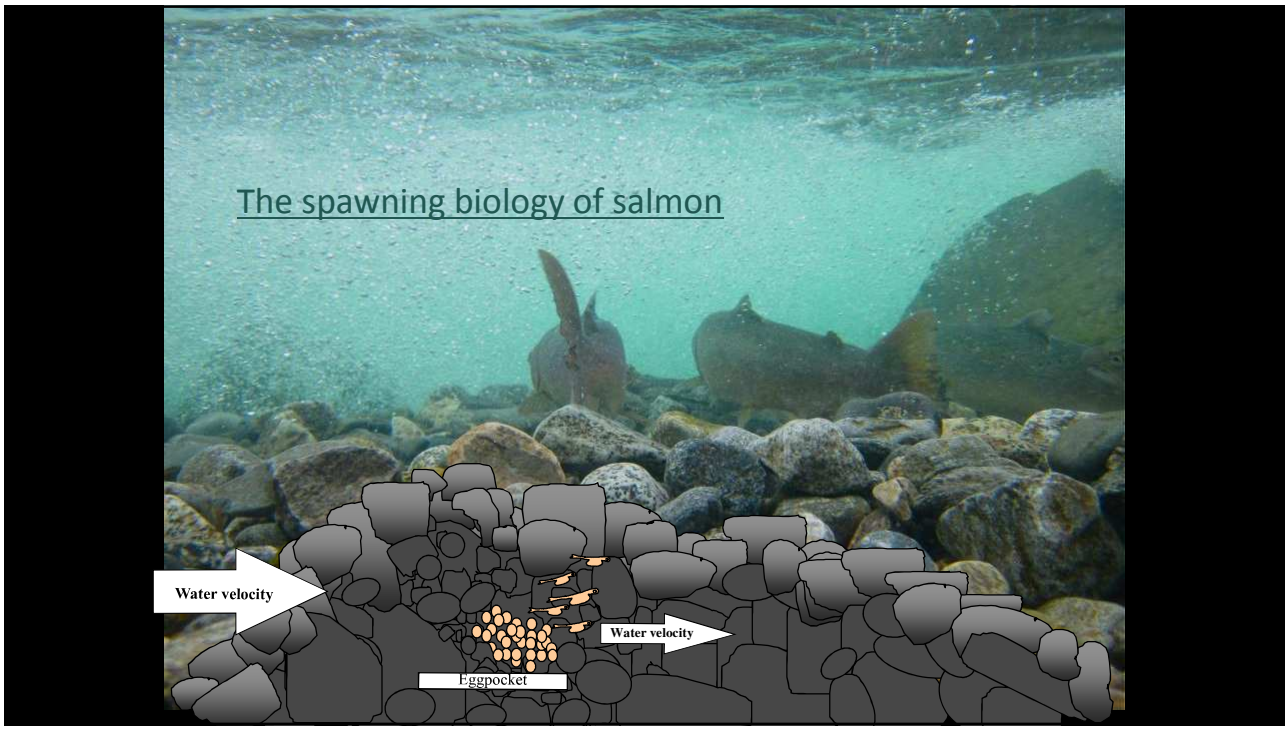



The solution to many environmental problems seems to be use of closed containment systems which prevent spread of salmon lice, diseases and escapes

Photo: Marine rådgivningstjeneste

The traffic light system is meant to promote development and use of closed containment systems to handle the salmon lice problem


Habitat destructions and restoration efforts in the rivers



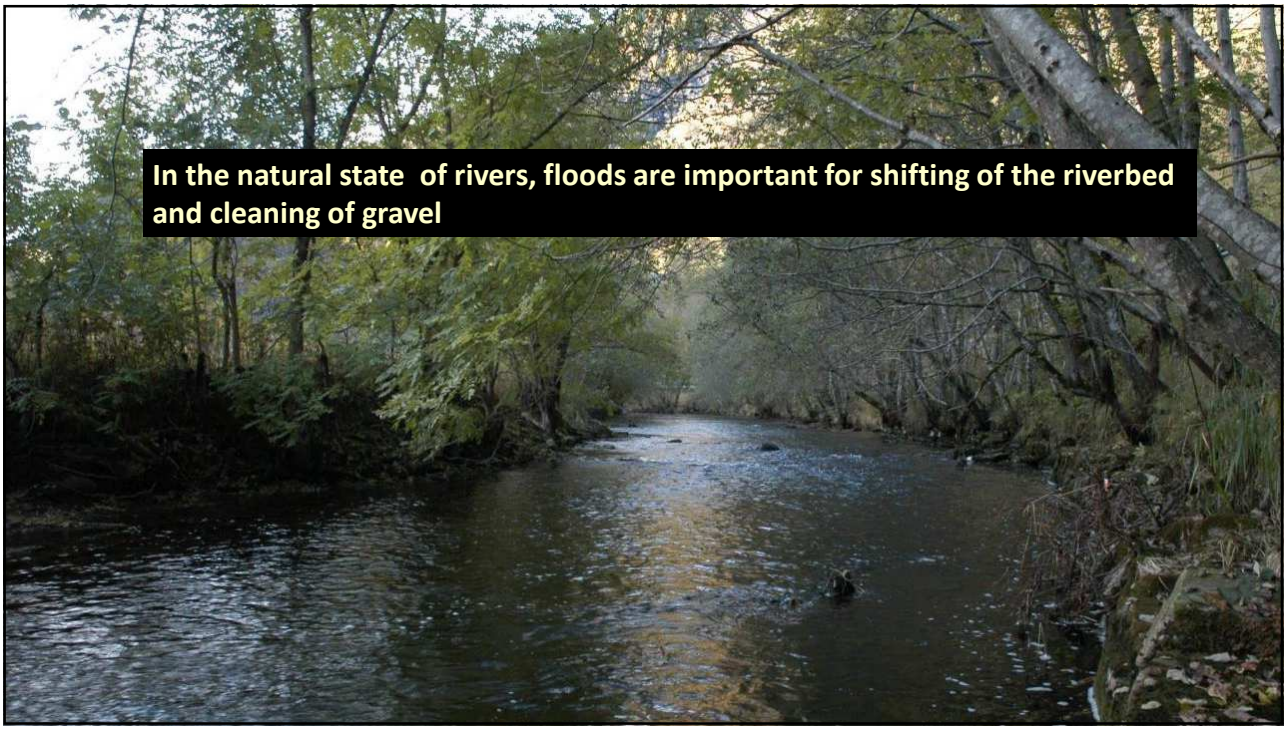

Stranded redd made by Atlantic salmon (110 cm):

- Dominating gravel > 64 mm
- Burial depth 25-30 cm

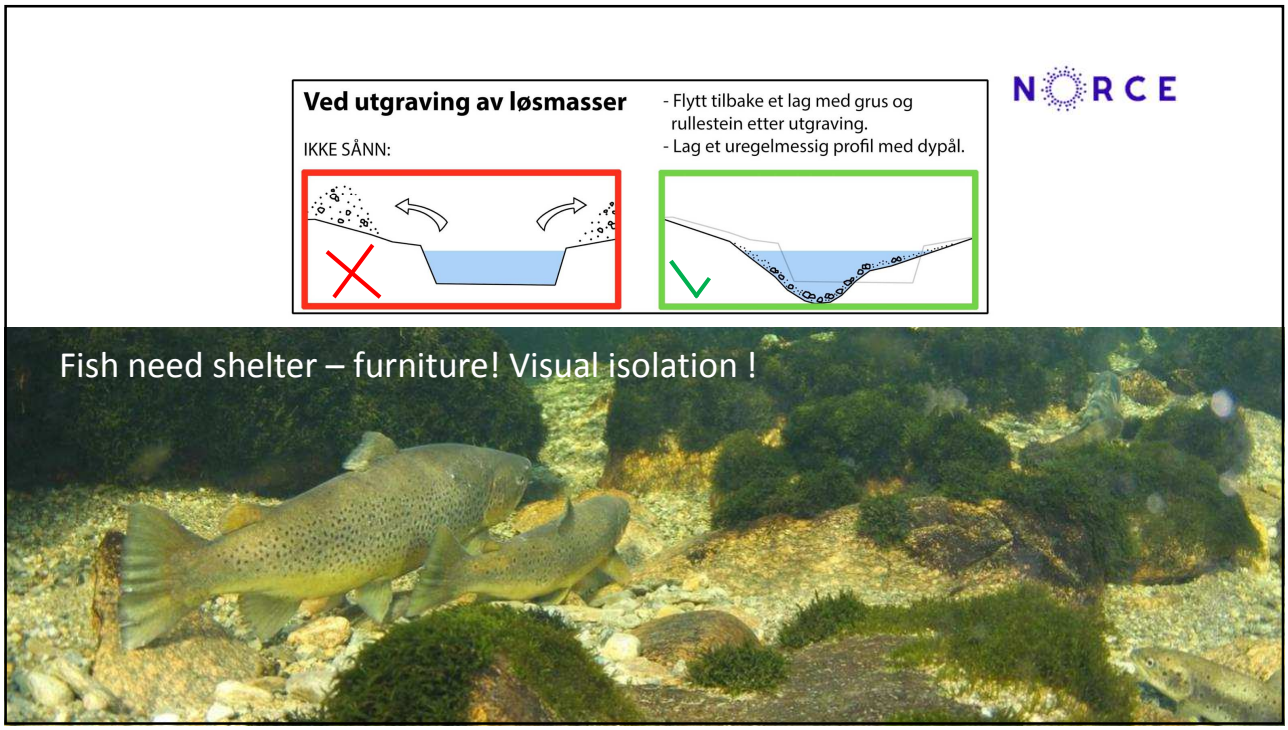
## Stranding of eggs during low winter discharge

Spawning period in autumn

Following winter

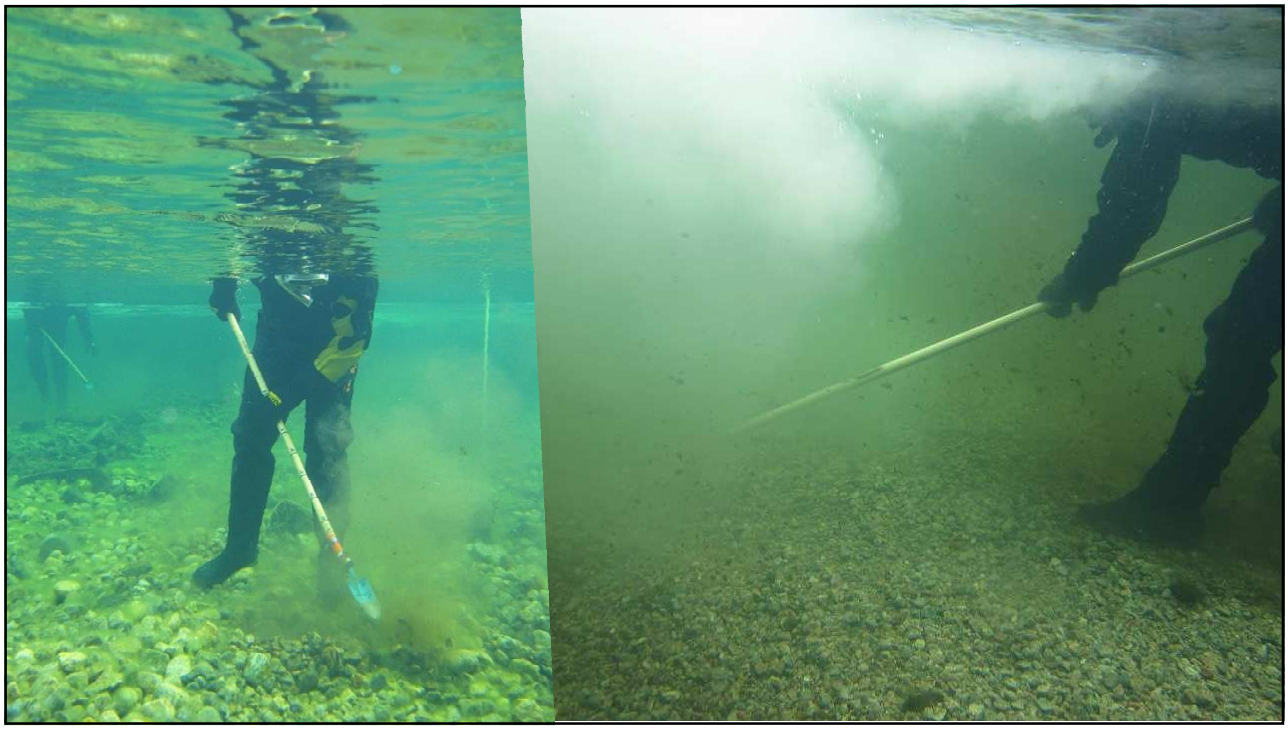


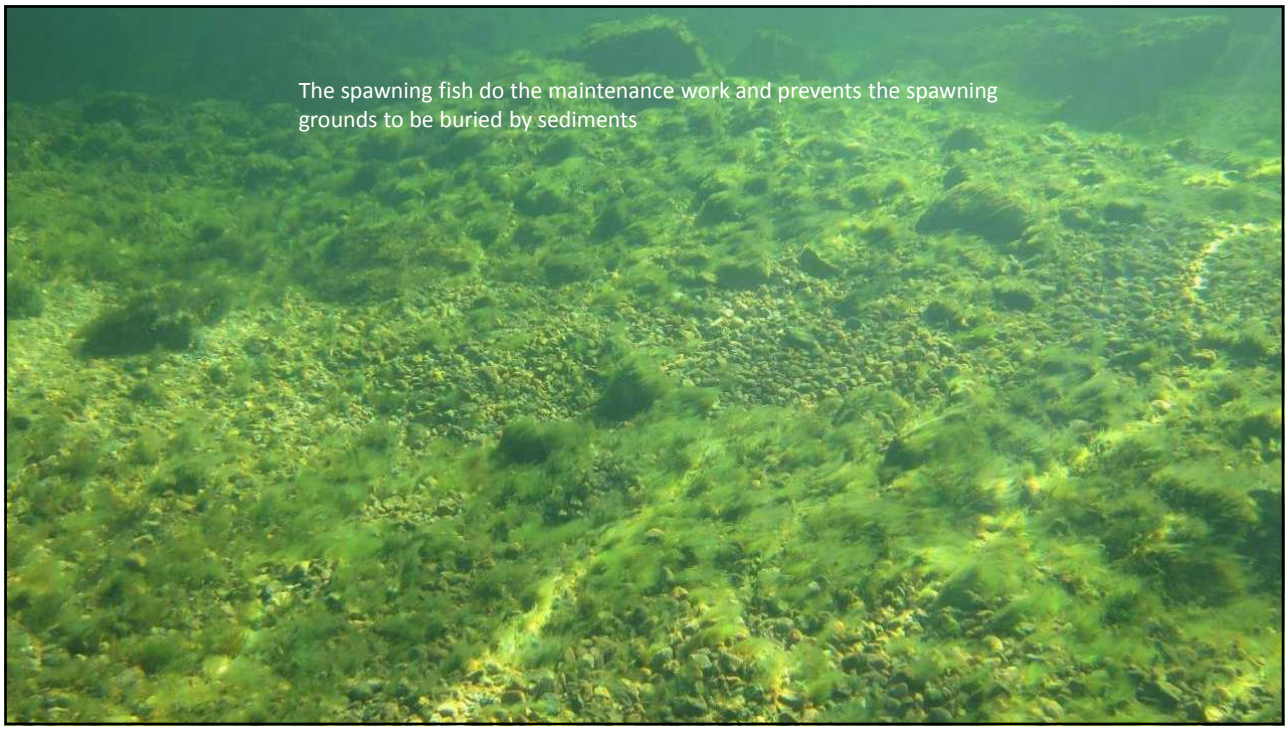

Canalization and dredging


Ved utgraving av løsmasser
IKKE SÅNN:
- Flytt tilbake et lag med grus og rullestein etter utgraving.
- Lag et uregelmessig profil med dypål.
NORCE
Fish need shelter – furniture! Visual isolation !


Canalization changes the physical conditions


Restoration of spawning areas
Håndbok for miljødesign i regulerte laksevassdrag
Redaktører:
Torbjørn Forseth og Atle Harby
NINA Temahefte
CEDREN






## Summary

- In Norway, there are both a political goal and legislation to maintain self reproducing, harvestable salmon populations, not genetically impacted by escaped farmed salmon.
- Annual monitoring of the salmon runs in combination with reference point based management is likely of key importance to maintain the spawning targets and thereby the wild salmon stocks.
- Escaped farmed salmon and salmon lice from the salmon farming industry are considered the most serious threats to the wild salmon stocks in Norway, but there are also challenges related to human impacts in the rivers
- There are known restoration and mitigation efforts to handle most of the threats, but restoration efforts may oppose businesses such as fish farming, hydropower development, road construction etc.
- Our experience is that direct field observation is an efficient method to detect threats and identify needs for restoration efforts


Thank you for your attention!