From endangered towards sustainable: Atlantic Salmon populations in Denmark

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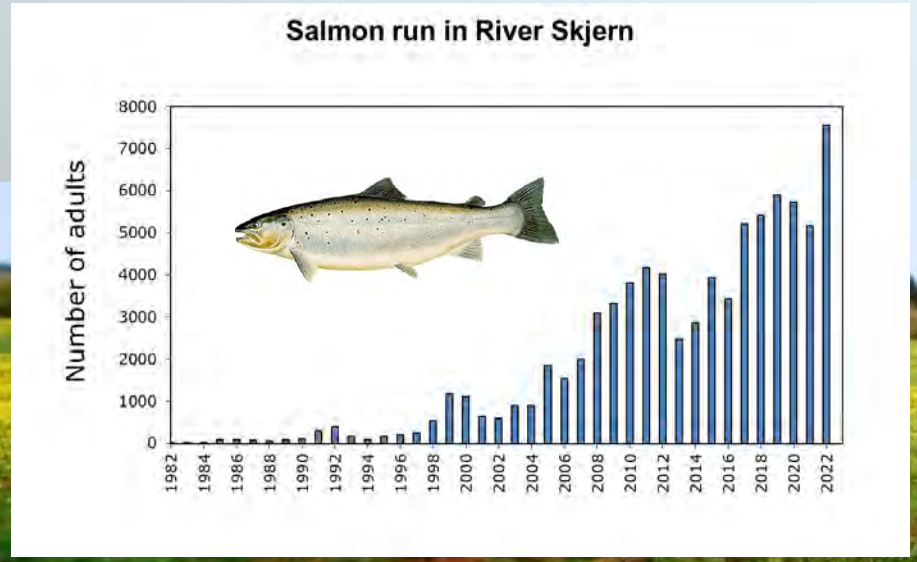
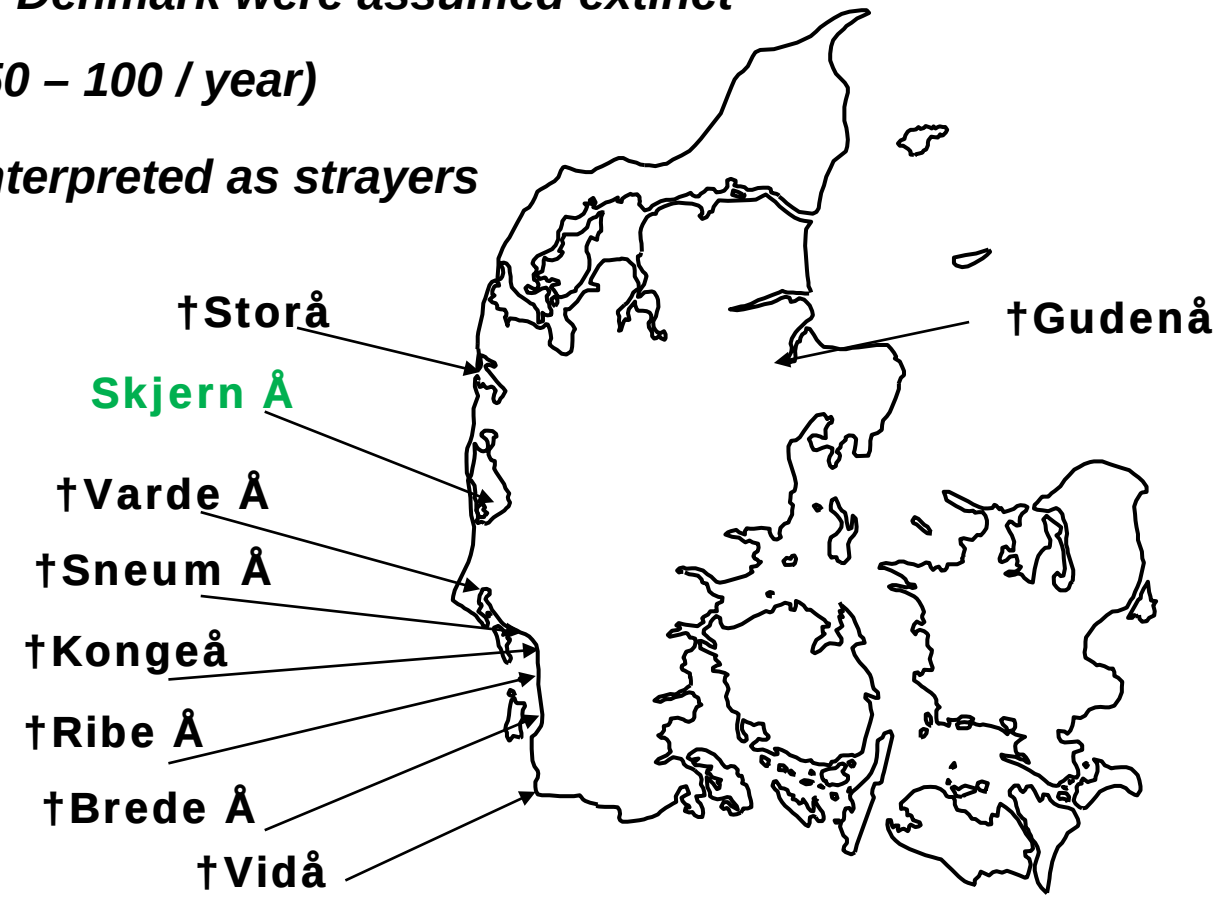


Status of the Danish salmon populations in the 1980'ies

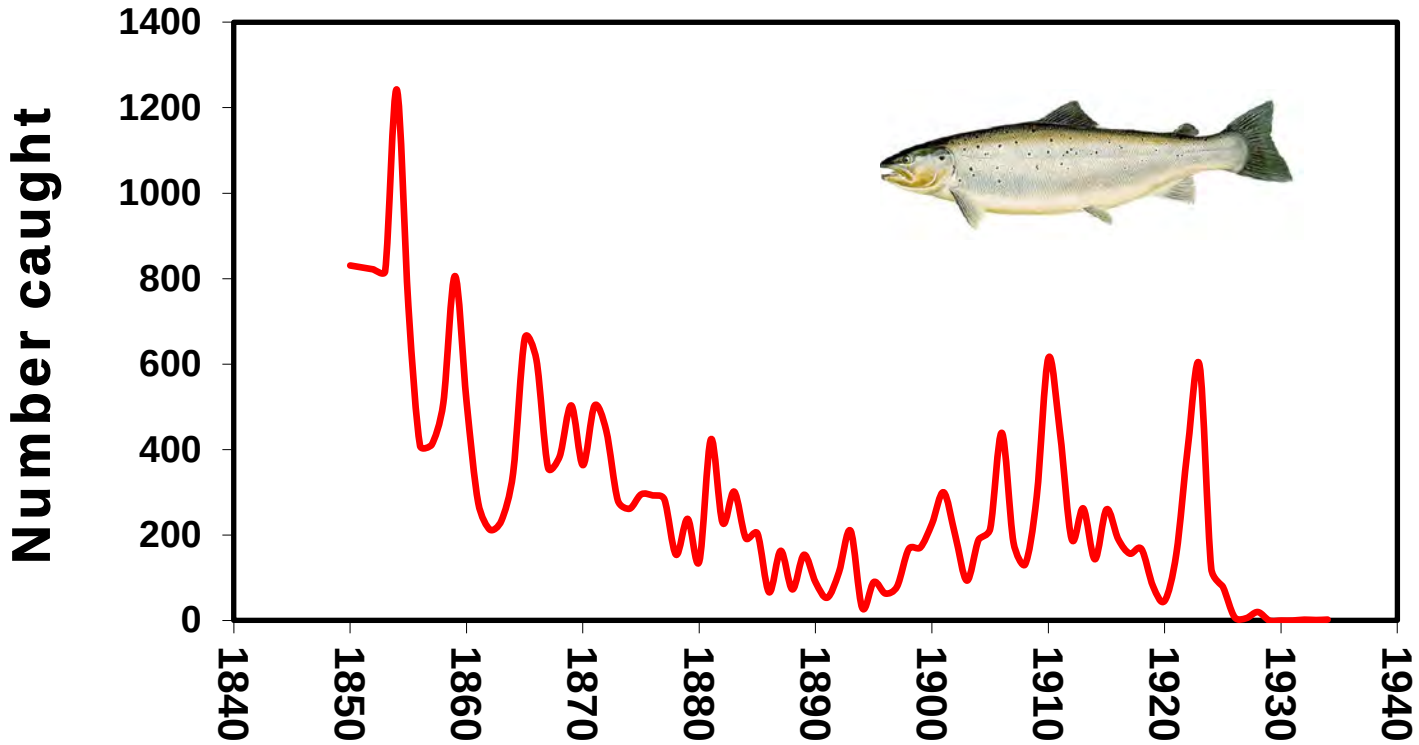
In the 1980'ies the salmon populations in Denmark were assumed extinct

- except for River Skjern (spawning-run 50 – 100 / year)

- Sporadic catches in other rivers were interpreted as strayers



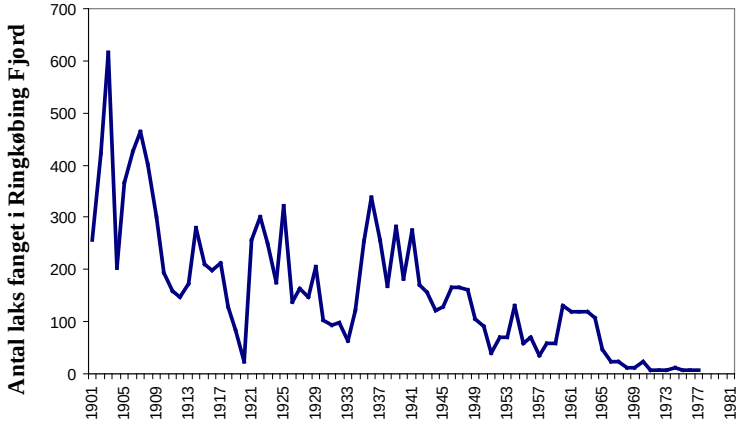
What went wrong?



Poulsen 1935

During 1940-1970 large land claim projects were carried out - destroying spawning and nursery areas, impairing migration.

Lots of small barriers – mills and fish farms



Fish farming, 1894 – 1975.

Caused habitat loss, habitat degradation and impaired migration.

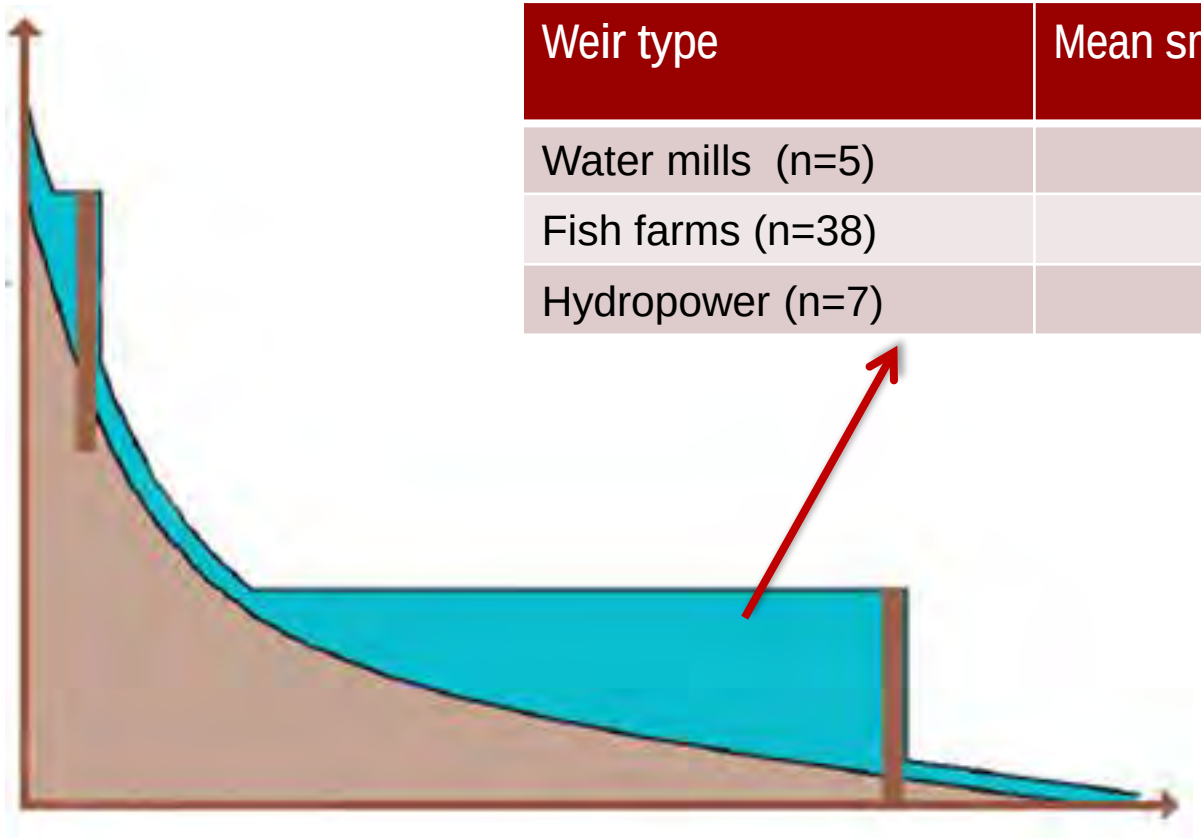
About 800 in 1970, 150 left today.

Hydropower development, 1920-1970

Hydropower development River Gudenå 1921

River blockage prevented the salmon in reaching the spawning areas - the River Gudenå salmon vent extinct

Problems for downstream smolt migration at weirs

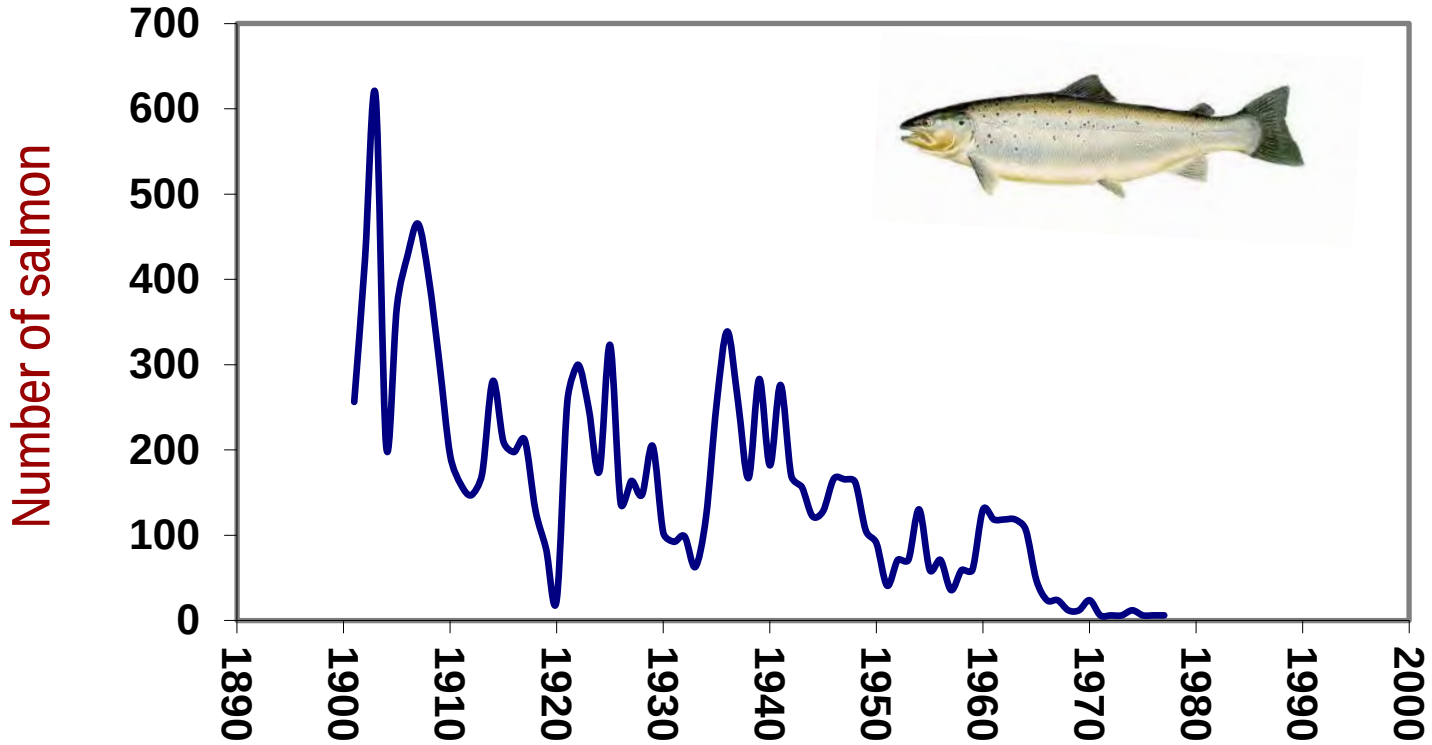


Weir type	Mean smolt loss (%)
Water mills (n=5)	30
Fish farms (n=38)	42
Hydropower (n=7)	82

Smolt loss when passing 3 fish farms in a river: $(1-(1-0.42)^3) = 80\ \%$

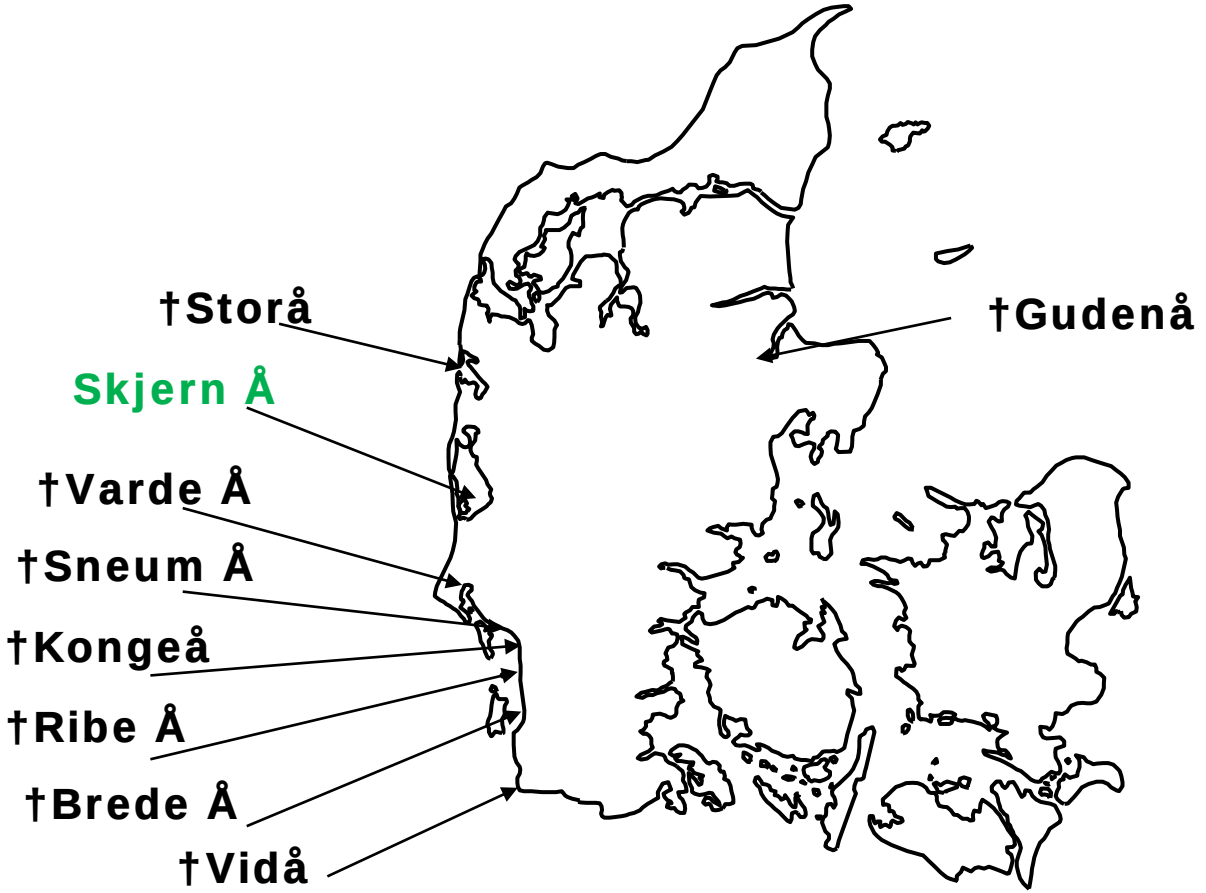
Salmon landings in the estuary of River Skjern Å

Landings in Ringkøbing Fjord 1900 - 1978



Otterstrøm (1938) og Statistisk Årbog, Fiskeriministeriet

In the late 1990'ies a review combined with surveys of the salmon rivers for YOY, suggested that salmon populations still existed not only in River Skjern Å



DNA from old scales compared with DNA collected during 1993-2003

DNA from old scales compared with DNA collected during 1993-2003

Old DNA (1910 - 1913)

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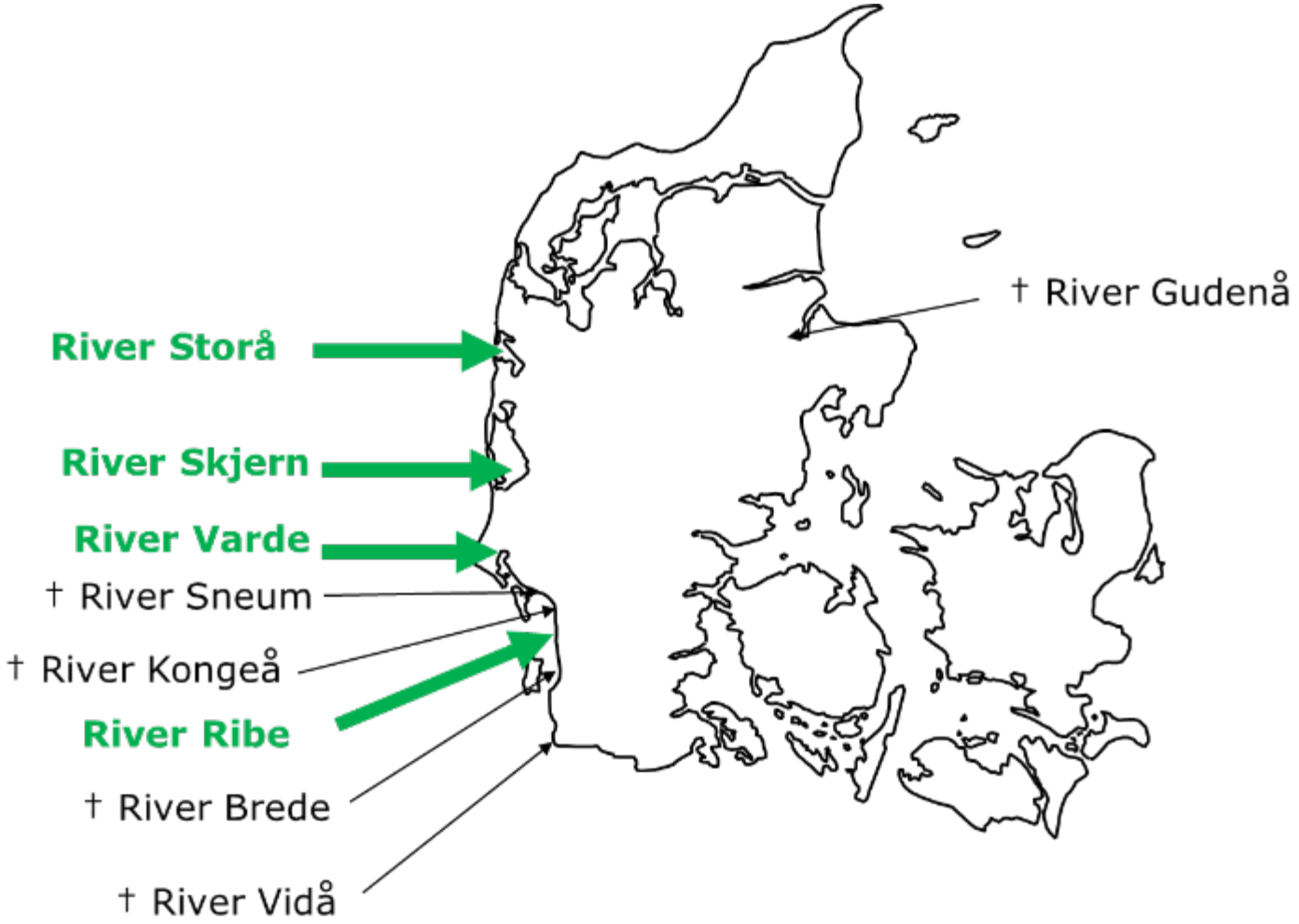
Present

New status 2003 - four indigenous populations left

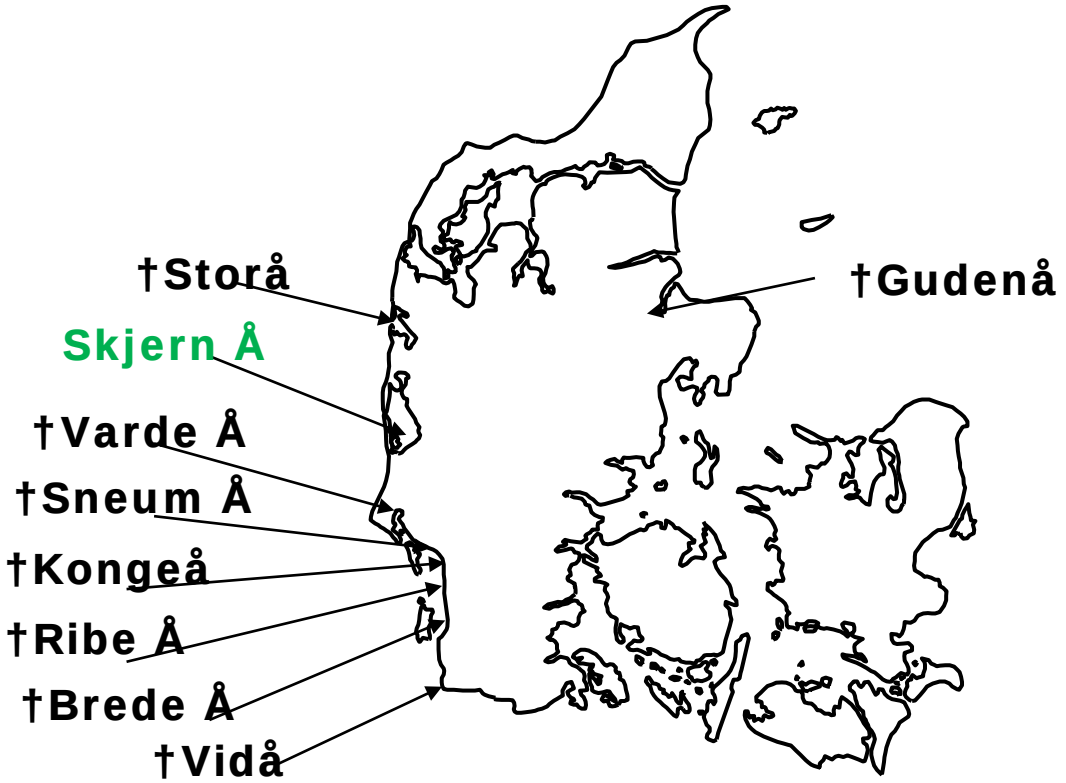


Nielsen, Hansen & Bach (2001)

Resurge of the salmon populations – multi-faceted management

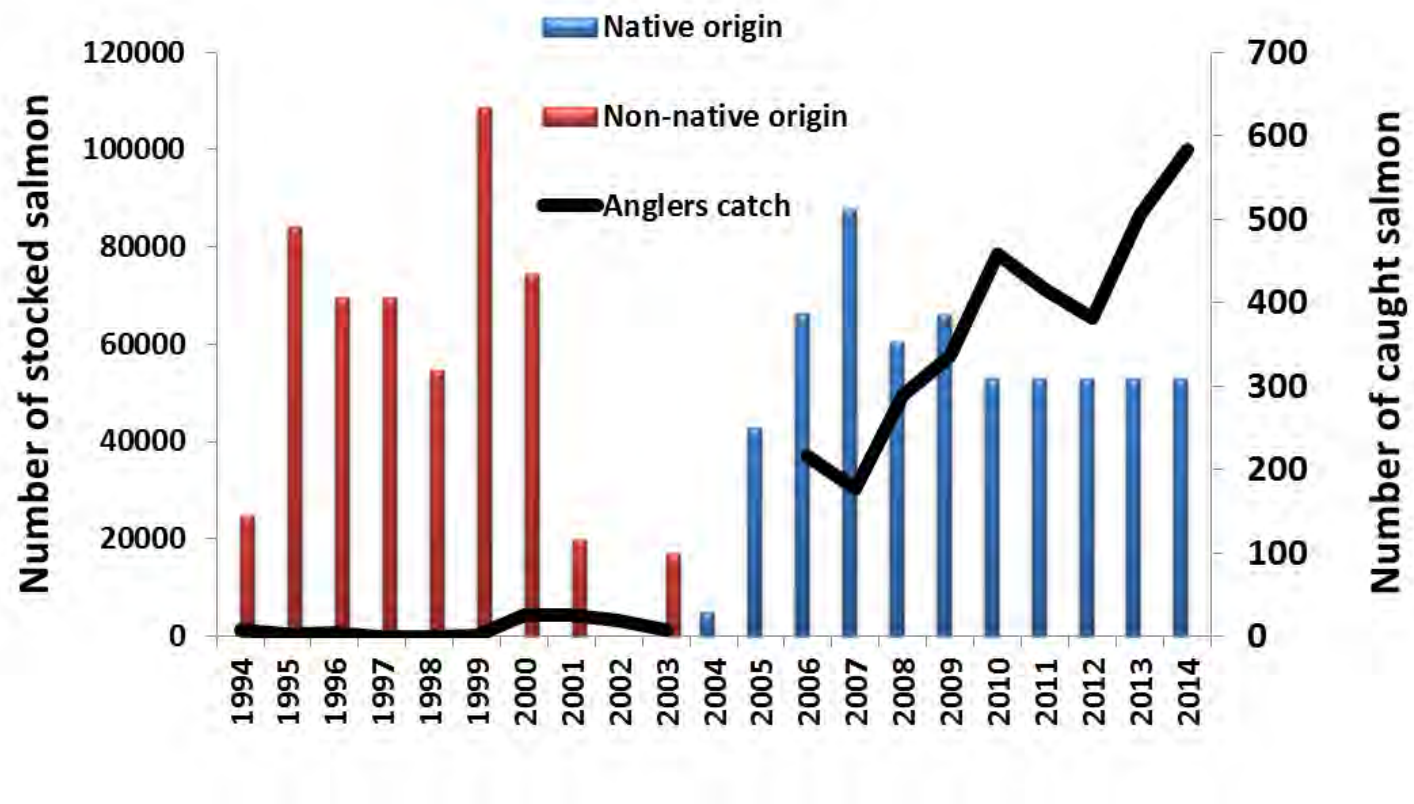
Management tools

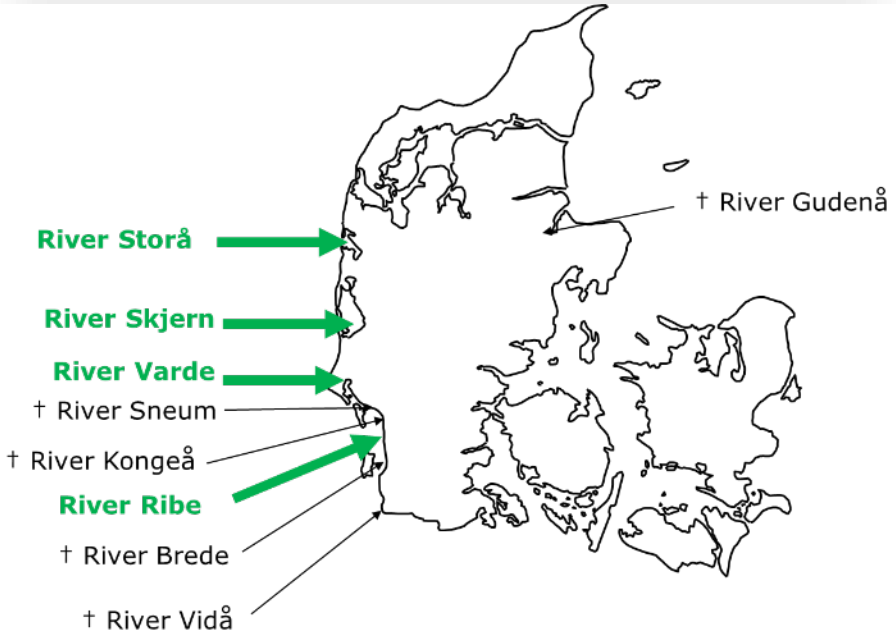
- Restoration of habitats
- Fishery regulations
- Stocking



The salmon stocking programme was optimised

River Storå – stocking of native *vs* non-native orgin



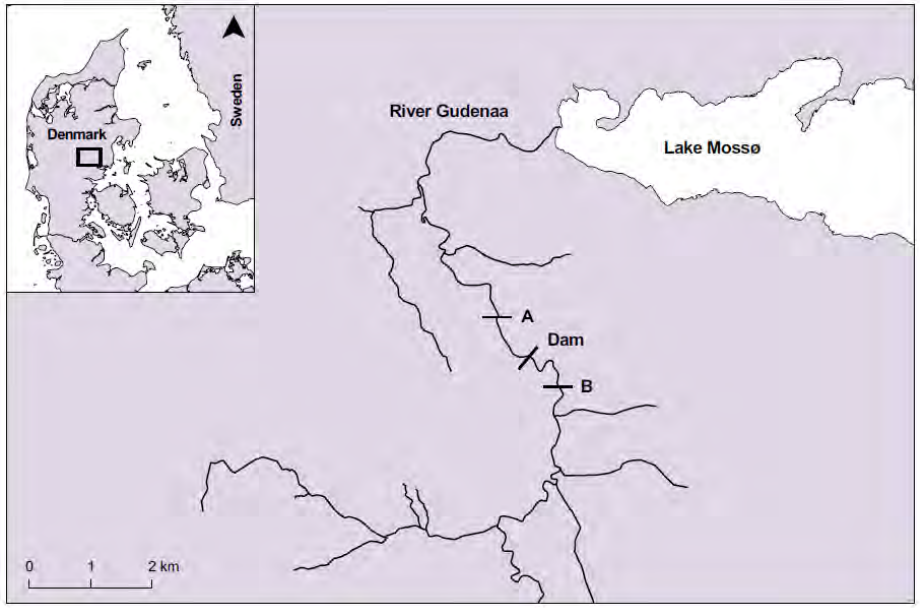


Nielsen, Hansen & Bach (2001)

Migration barriers have been removed and habitats restored

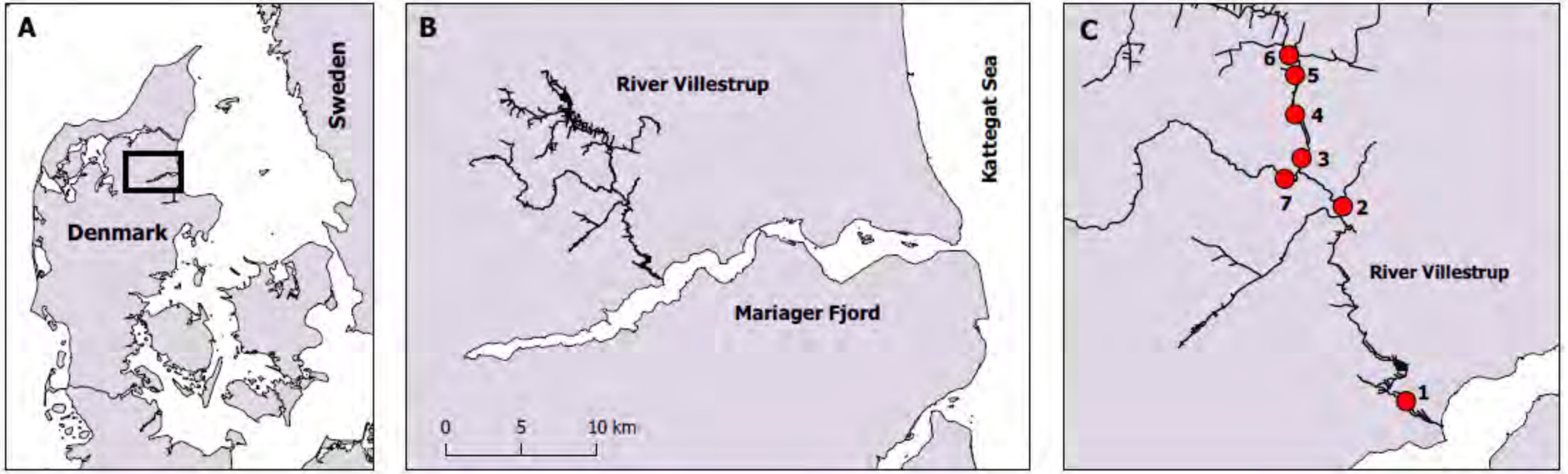
The weir and dam at Vilholt Mill was removed in 2008

What's the effect?



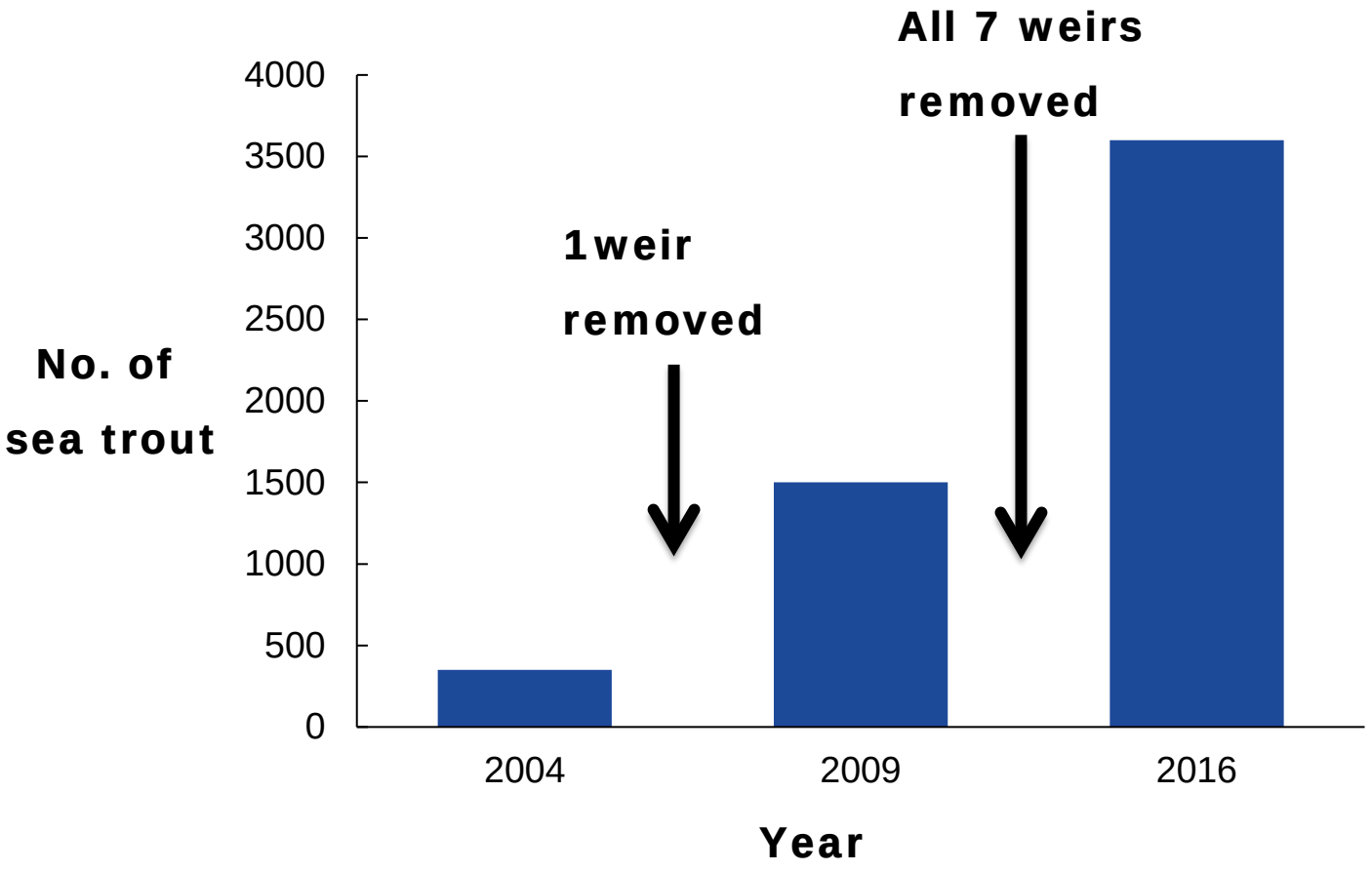
Effects of barrier removal at a whole-system scale

Full river restoration



Birnie-Gauvin et al. 2017; MS V

Spawning run of sea trout

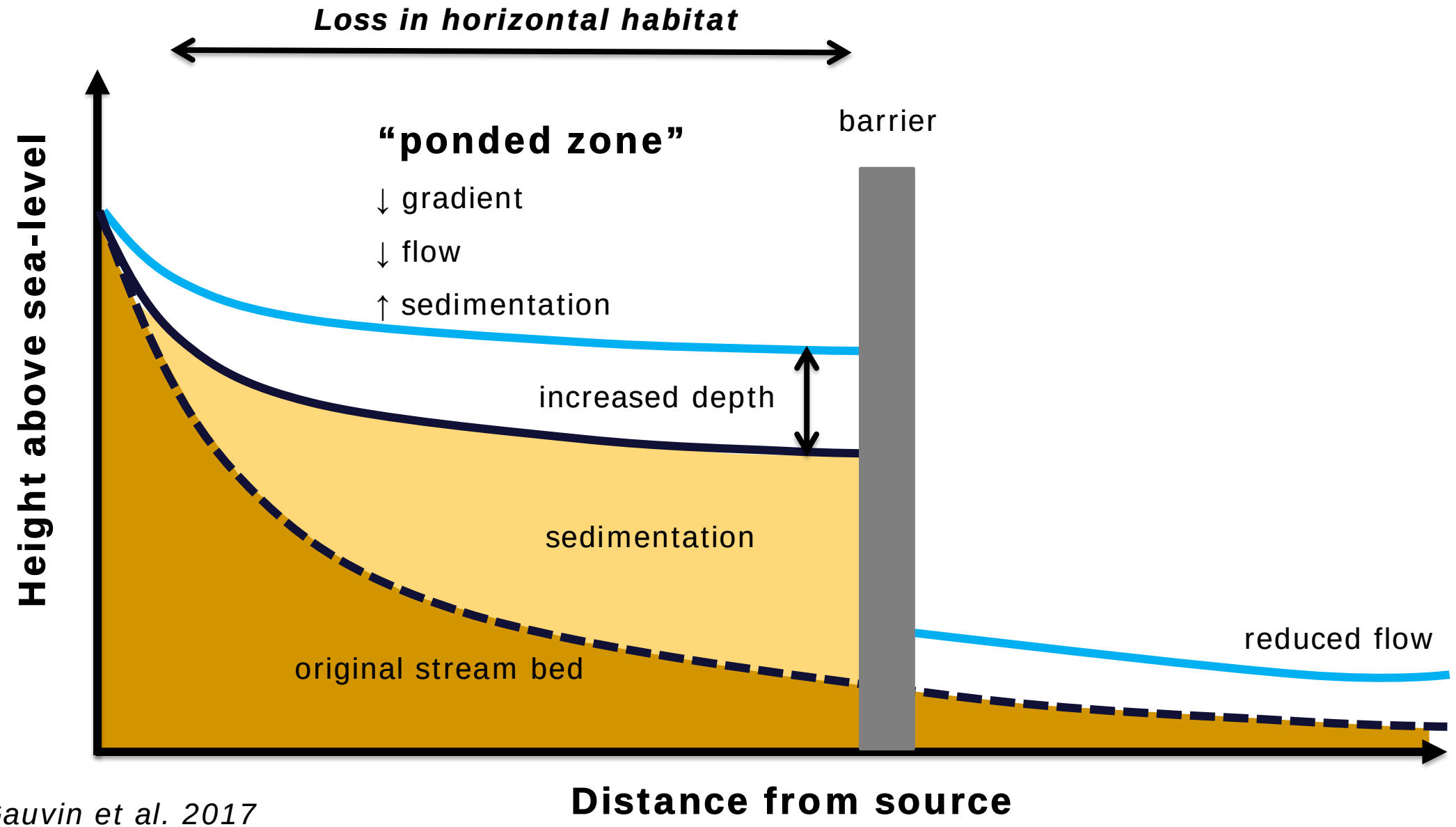


Restored habitat in the ponded zone

Ponded zone – before

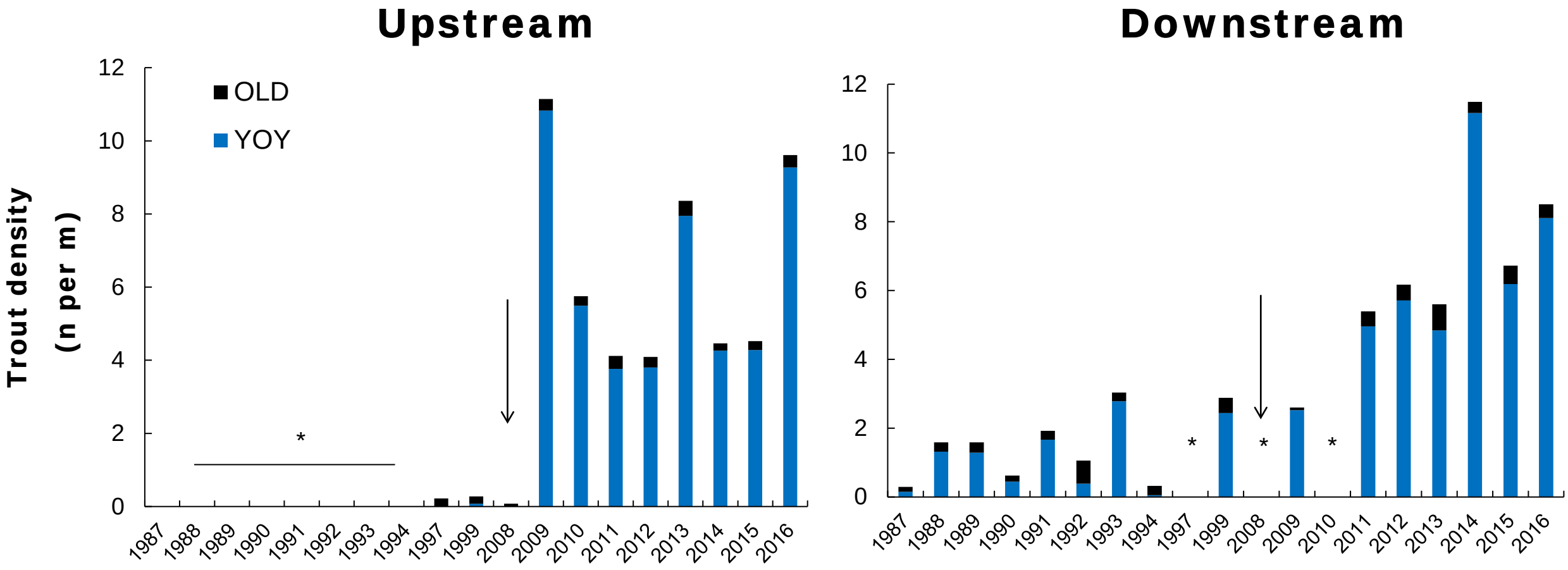
Ponded zone – after

Loss of habitat as a (overlooked) consequence



Birnie-Gauvin et al. 2017

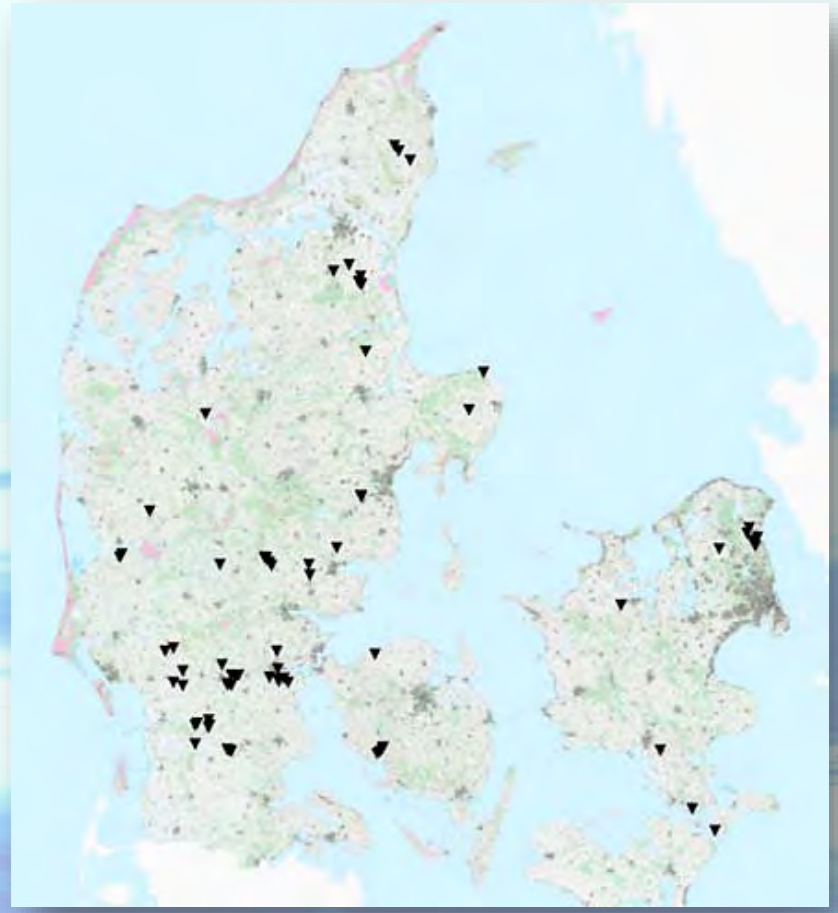
Trout density before and after removal



Birnie-Gauvin et al. 2017

Habitat restoration - data

Trout as model species



A total of 71 projects:

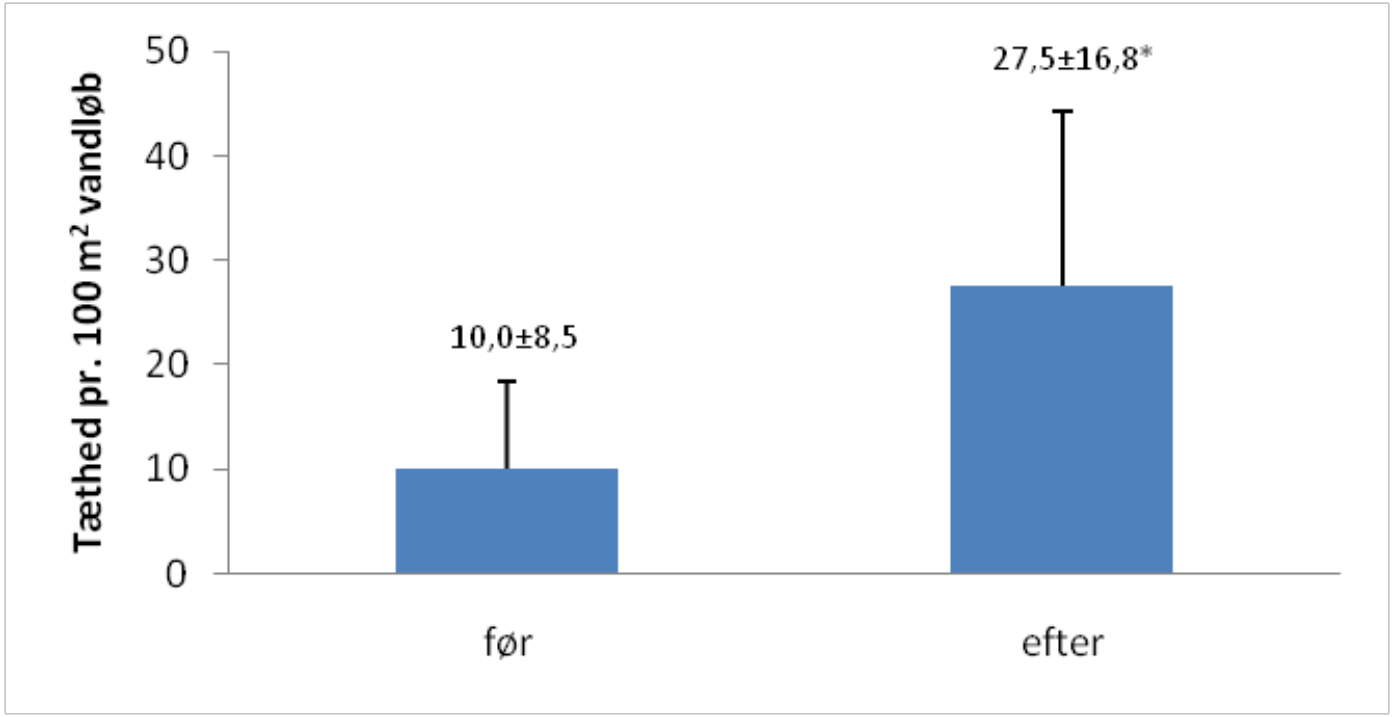
- 29 eastern Jutland
- 27 Western Jutland
- 15 on the Islands

Habitat restoration – data

Trout as model species

YOY trout

The density increased averagely 175 %



The River Skjern Nature Project 2002

- Largest river restoration project i Northern Europe

Foto: Povl Toft ©

Dam removal

Dam removal

Fishery regulations

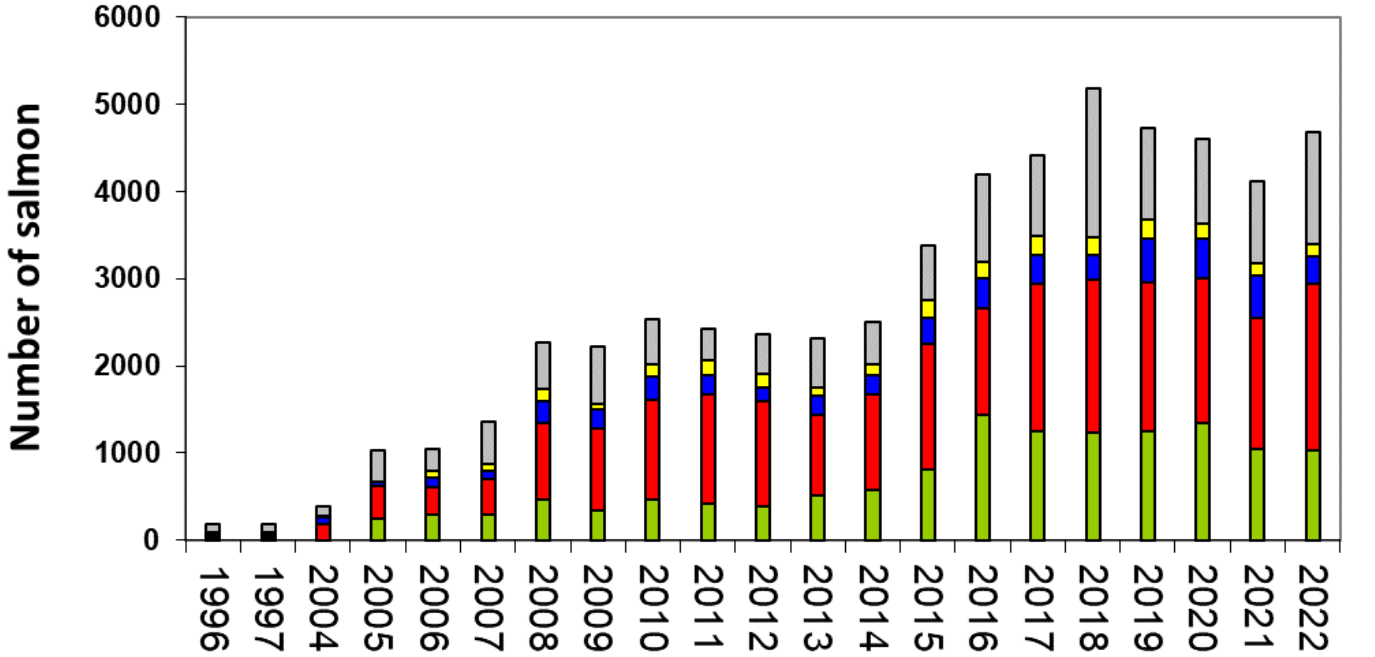
- *In the estuaries and in the Wadden Sea*
- *Quotas in the rivers, 1SW+MSW (10% of spawning run) > C&R*
- *Reduced period 16. April - 16. October*

Regulation of predators

Acoustic and radio tagged salmon smolts:
40 - 50 % tags recovered in one cormorant colony
(Koed et al. 2006, Jepsen et al. 2018).

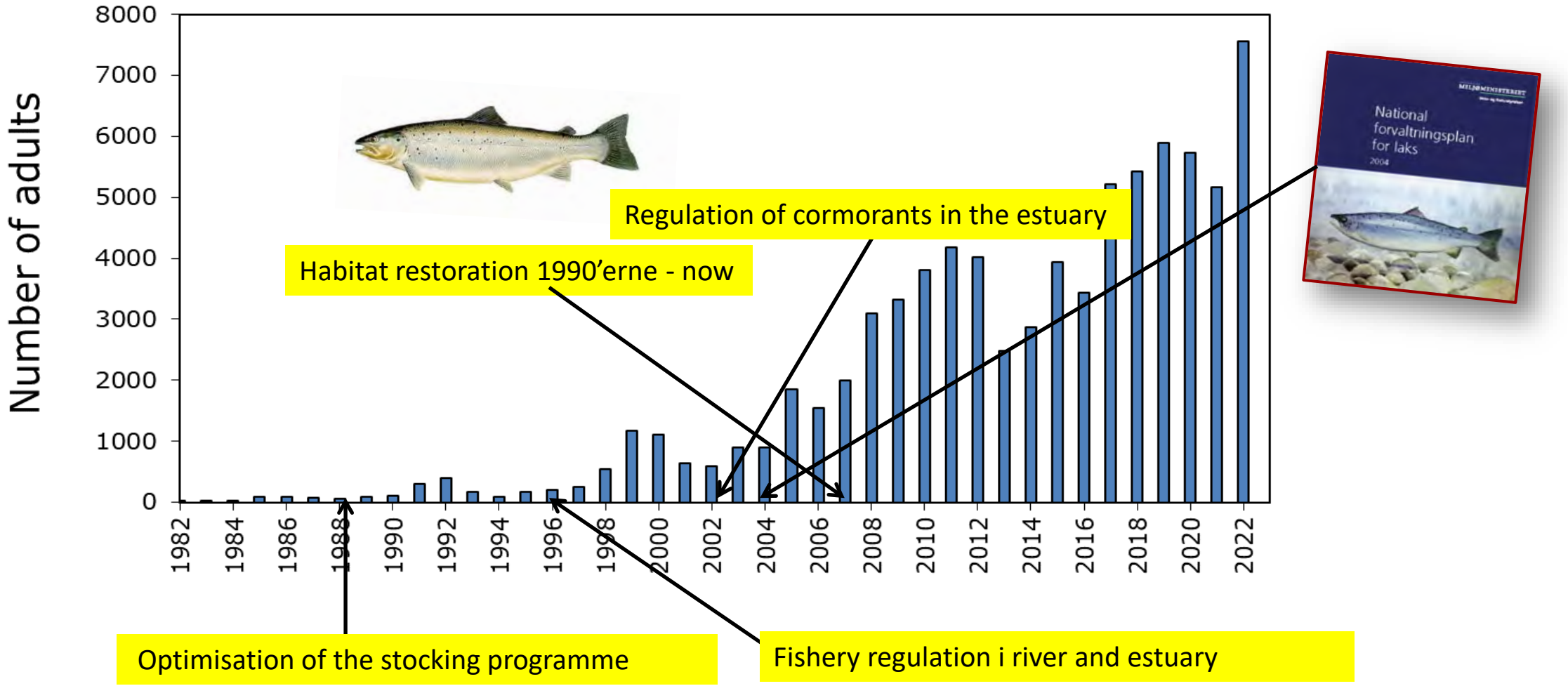
The Danish salmon populations - development

Angler-caught salmon 1996-1997 and 2004-2022



The Danish salmon populations – the River Skjern

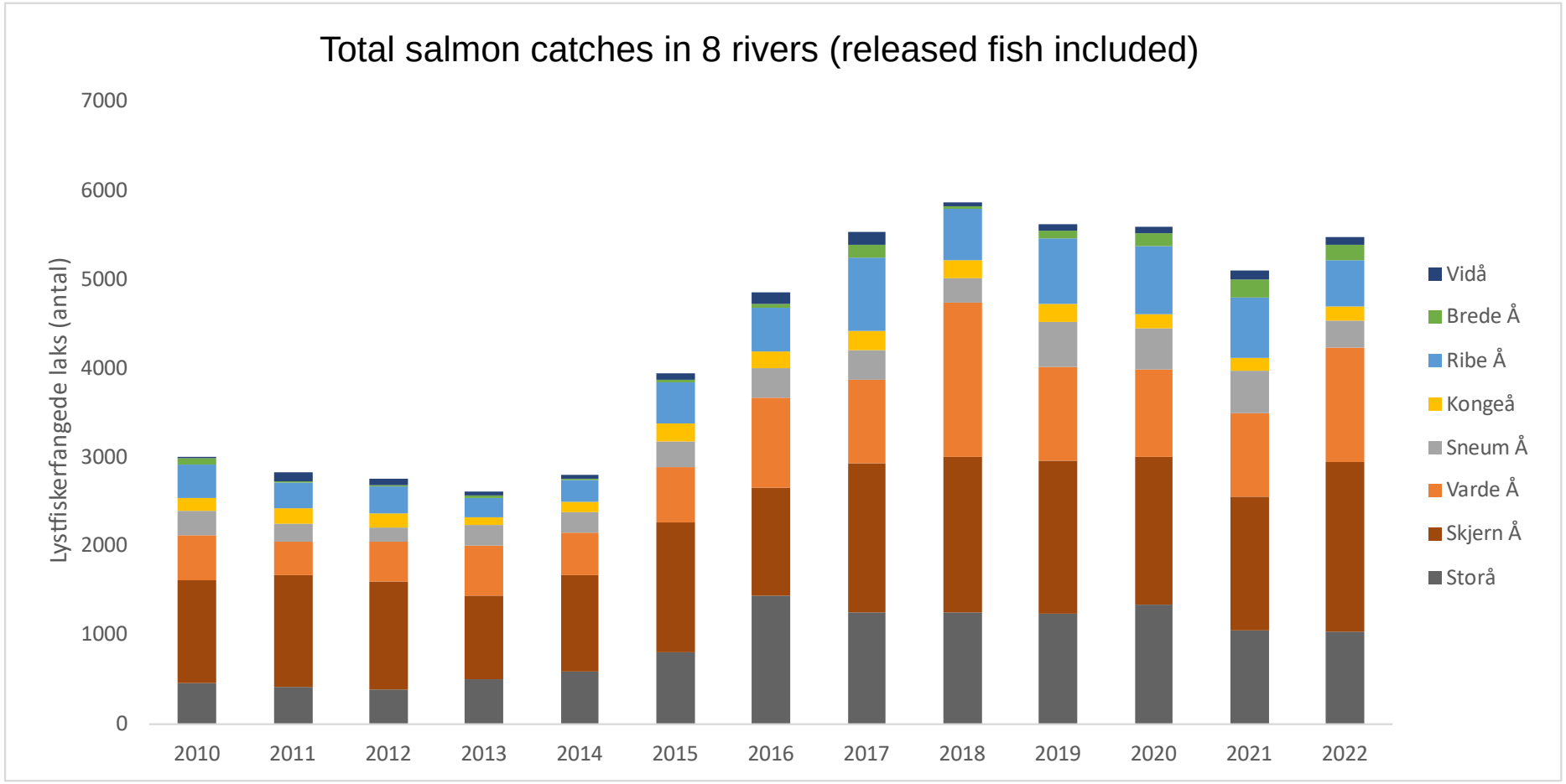
Result of an extensive, focused and knowledge-based effort



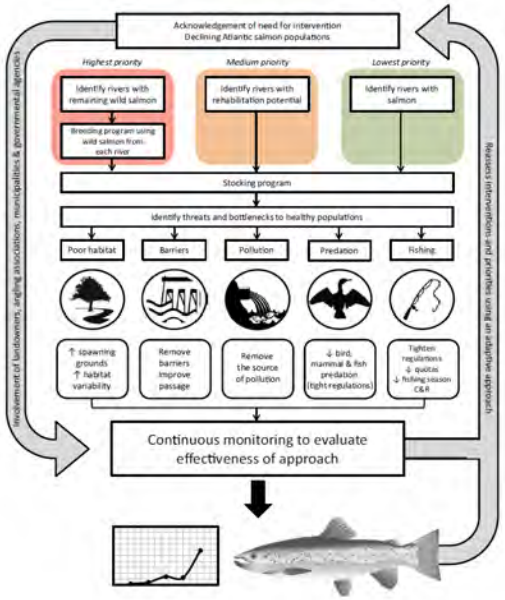
Status for River Storå 2017 and River Ribe Å 2023:

Self-sustaining salmon populations and no supportive stocking (TAC ~ 10 %)

Where to go from here?



Adaptive Management Approach



a) Identify the rivers of highest priority - production potential and potential for recovery

b) Identify local threats - poor habitat, predation pressures, barriers, pollution etc.

c) Restore habitats for spawning and growth.

d) Remove barriers to movement or efficient fish passage

e) Fishery regulations and reduce predation

f) Perform systematic stock assessments to evaluate

ORIGINAL ARTICLE

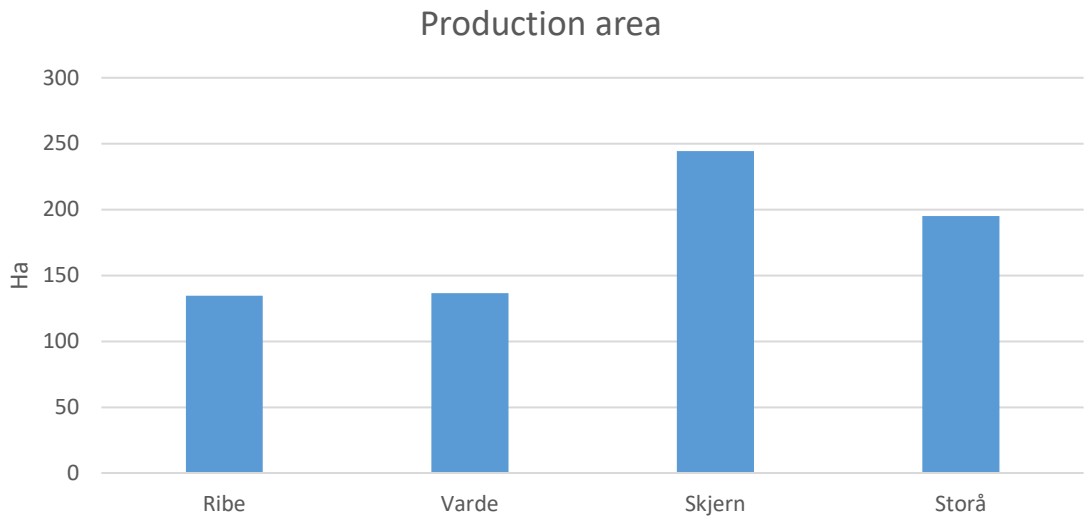
Fisheries Management and Ecology WILEY

From endangered to sustainable: Multi-faceted management in rivers and coasts improves Atlantic salmon (*Salmo salar*) populations in Denmark

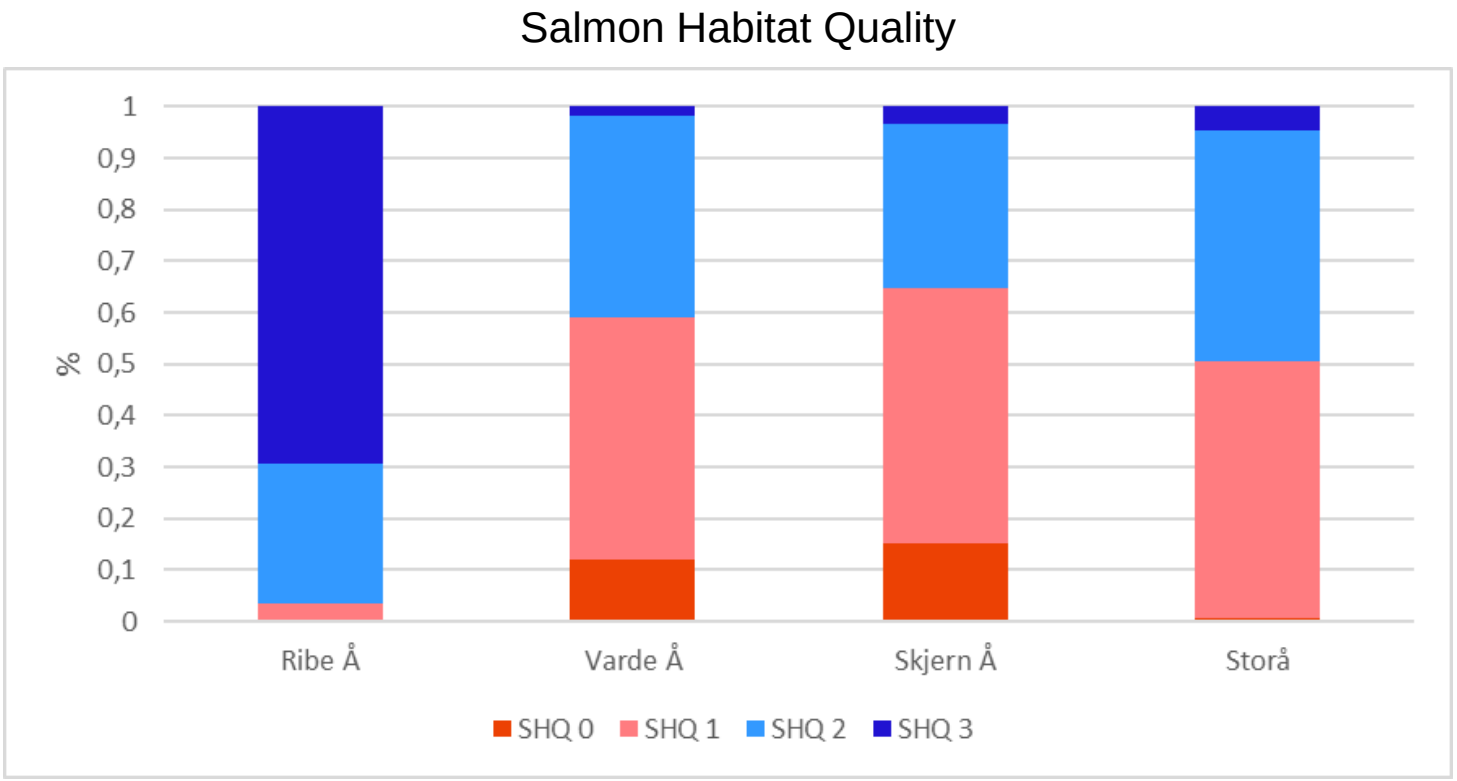
Anders Koed | Kim Birnie-Gauvin | Finn Sivebæk | Kim Aarestrup

More efficient regulation of predation?

Improving and expanding habitat



Improving and expanding habitat



Continued focus on removing barriers

Conclusions

- Adaptive management and close collaboration and engagement of stakeholders, decision makers and researchers has been central for the positive development of the salmon populations in Denmark.
- All management approaches were applied simultaneously. Focus is now on barrier removal and habitat restoration.
- Stronger focus on tourism and socio-economic may me a positive contributor.
- Prioritisation of which tools to focus on:

Management tools

a. River restoration
b. Fishery regulation(s)
c. Stocking

Thanks for your attention!

Questions?

Further information on: http://www.aqua.dtu.dk and http://www.fiskepleje.dk