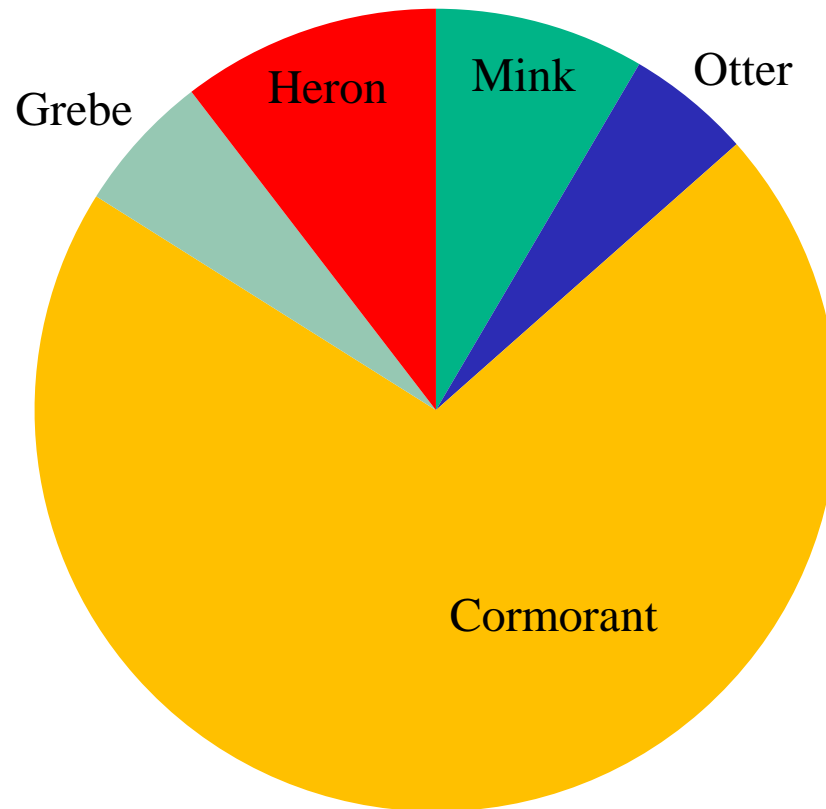


What did we learn from 20 years of predation studies?



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Fish predators



Estimated fish-consumption (Total 12595 t)

Documenting the impact of predation

Methods

PIT- Tags (Passive Integrated Transponder)



Acoustic tags



Radio-tags



Smolts

Salmon/trout, wild/hatchery

Pre-smolt/parr in-river predation

Predation on migrating smolts

Predation on post-smolts



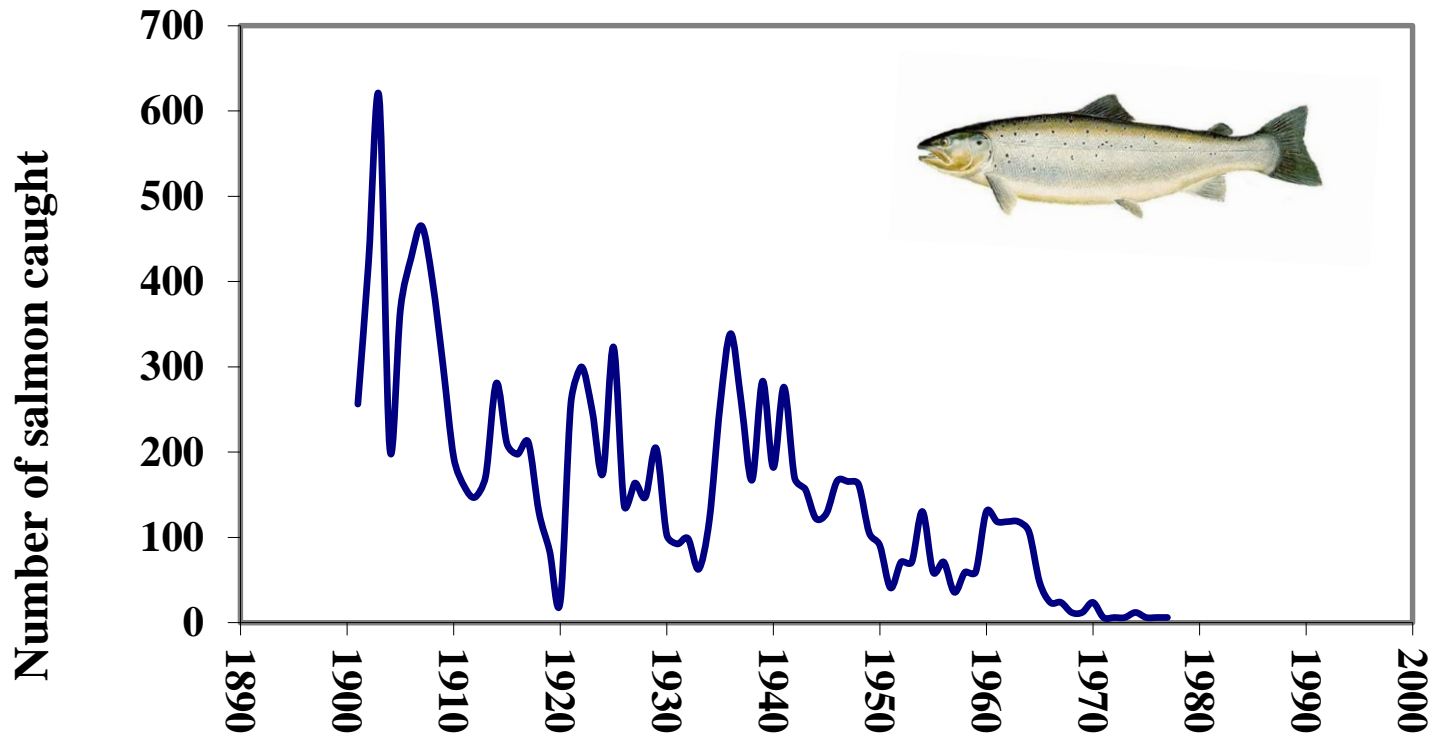
Do they really have wild Atlantic salmon in Denmark?

Yes we do!



River restoration, removal of barriers and stop for coastal fishing have increased the populations hundredfold

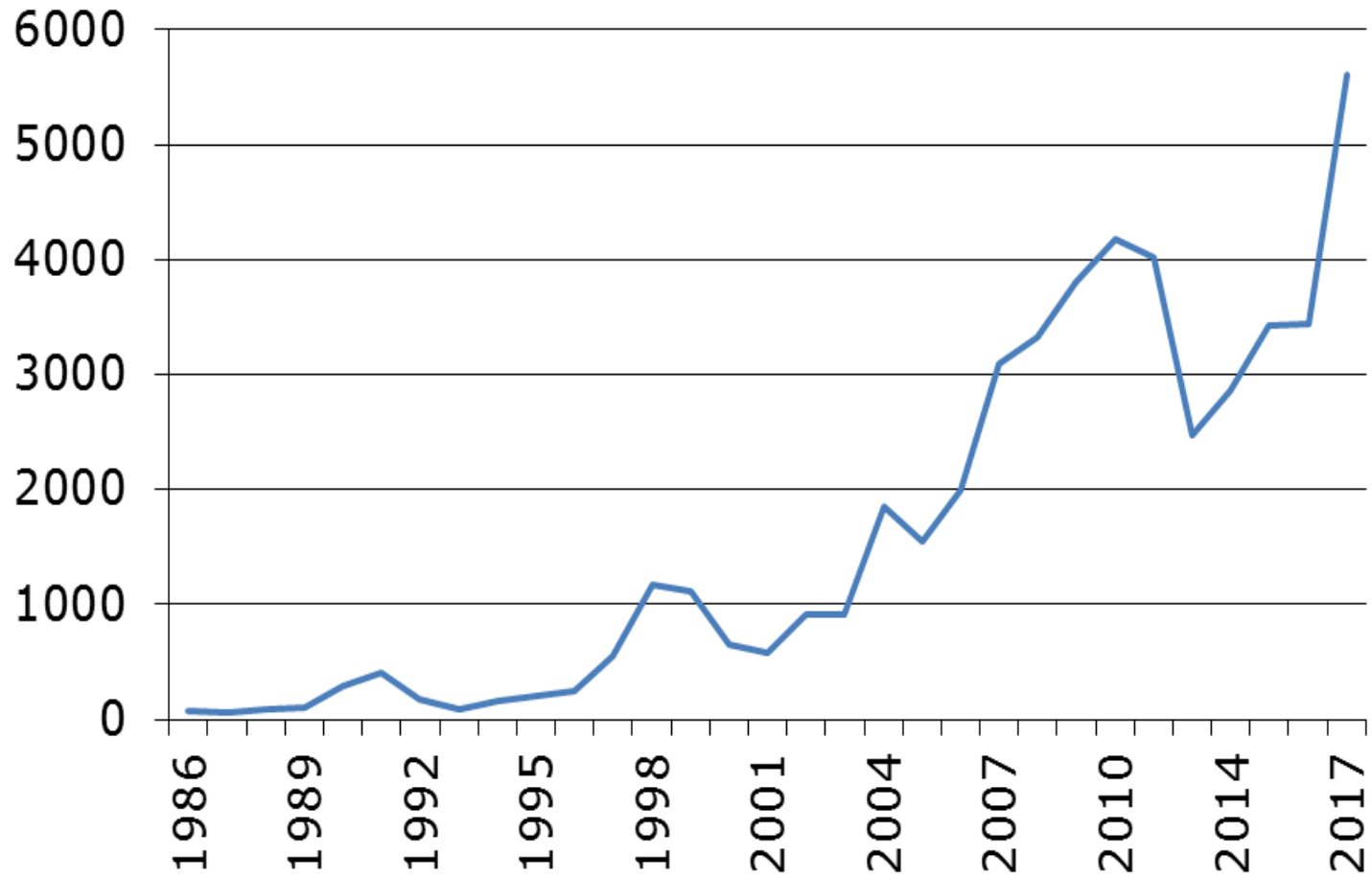
Annual catches of Salmon in the estuary of River Skjern, 1900 - 1978



Pollution, dams, fishing

Number of
adults

Salmon run in Skjern Å





Danish salmon 141 cm, caught by a young angler in 2016

Why do the Danish salmon fare so well?

No salmon lice (no salmon farms)

No dams (wind energy, not HP)

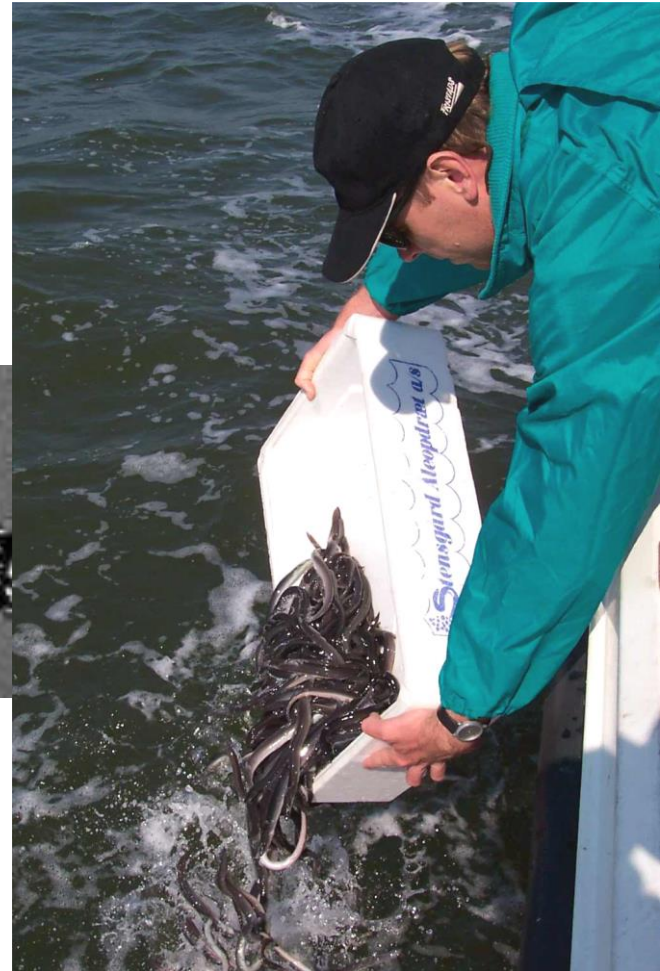
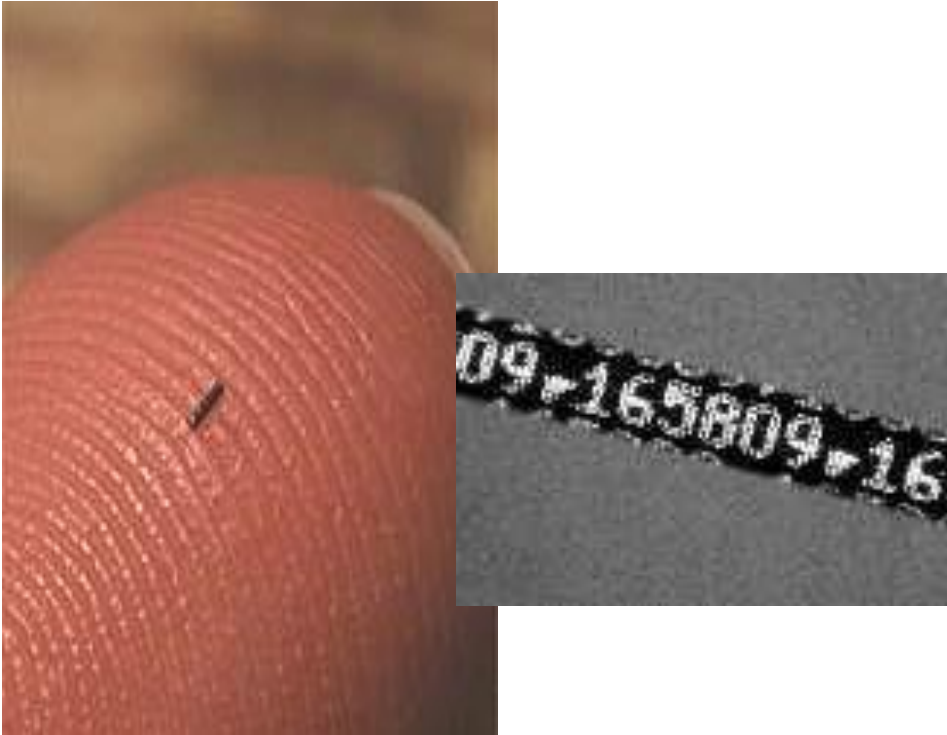
No harvest on coast or in estuaries

No Gyrodactulus

Good management ?

But we do have predation

Old cormorant stories



Eels, salmon smolts and flounders were cw-tagged and released in Skjern River and the estuary 2003 and 2004



Pellet collection

Results from Ringkøbing Fjord 2000 – 2004

Telemetry (2000, 2002): Salmon **smolts** 40 – 50 % of tags were recovered from one colony.

CW-tagging (2003, 2004): 25 % of the available tagged salmon **smolts** were eaten during the 3-weeks smolt migration period.
40 – 50 % of tagged eel were eaten in one year.
All (100%) of tagged flounders eaten in 15 days

Pellet analyses: 30,000 salmon **smolts**, 1.4 million flounders, 38,000 eel were eaten.

Smolt predation by cormorants *from Jepsen et al. (in press)*

Year	Number tagged	Species	Mortality by cormorants (%)	Method	Source
1997	50	Wild trout	55	Radio-telemetry	Dieprink et al. 2001
1997	50	Hatchery trout	67	Radio-telemetry	Dieprink et al. 2001
2000	17	Wild trout	24	Radio-telemetry	Dieprink et al. 2002
2000	51	Wild salmon	48	Radio-telemetry	Dieprink et al. 2002
2002	51	Salmon (mix)	40	Radio-telemetry	Baktoft 2003
2001					
2003	64,500	Hatchery salmon	23	CW-tagging	Jepsen et al 2010
2003	-	Salmon (mix)	> 60*	Pellet analyses	Sonnesen 2007
2005	10,000	Hatchery salmon	31	CW-tagging	Jepsen et al 2010
2005	58	Salmon (mix)	53**	Acoustic telemetry	Koed 2006
2005	42	Trout (mix)	88**	Acoustic telemetry	Koed 2006
2008	4363	Wild trout	45***	PIT-tagging	Jepsen et al. 2014
2008	5009	Wild trout	42***	PIT-tagging	Jepsen et al. 2014
2010	5900	Hatchery trout	72***	PIT-tagging	Thomsen 2013
2014	1400	Wild trout	22***	PIT-tagging	Jepsen et al. 2014
2016	74	Salmon (mix)	42	Radio-telemetry	Unpublished
Mean			47		

47% fewer smolts = 47% fewer salmon coming back!

Cormorants in our streams – a new phenomenon



Change of behaviour

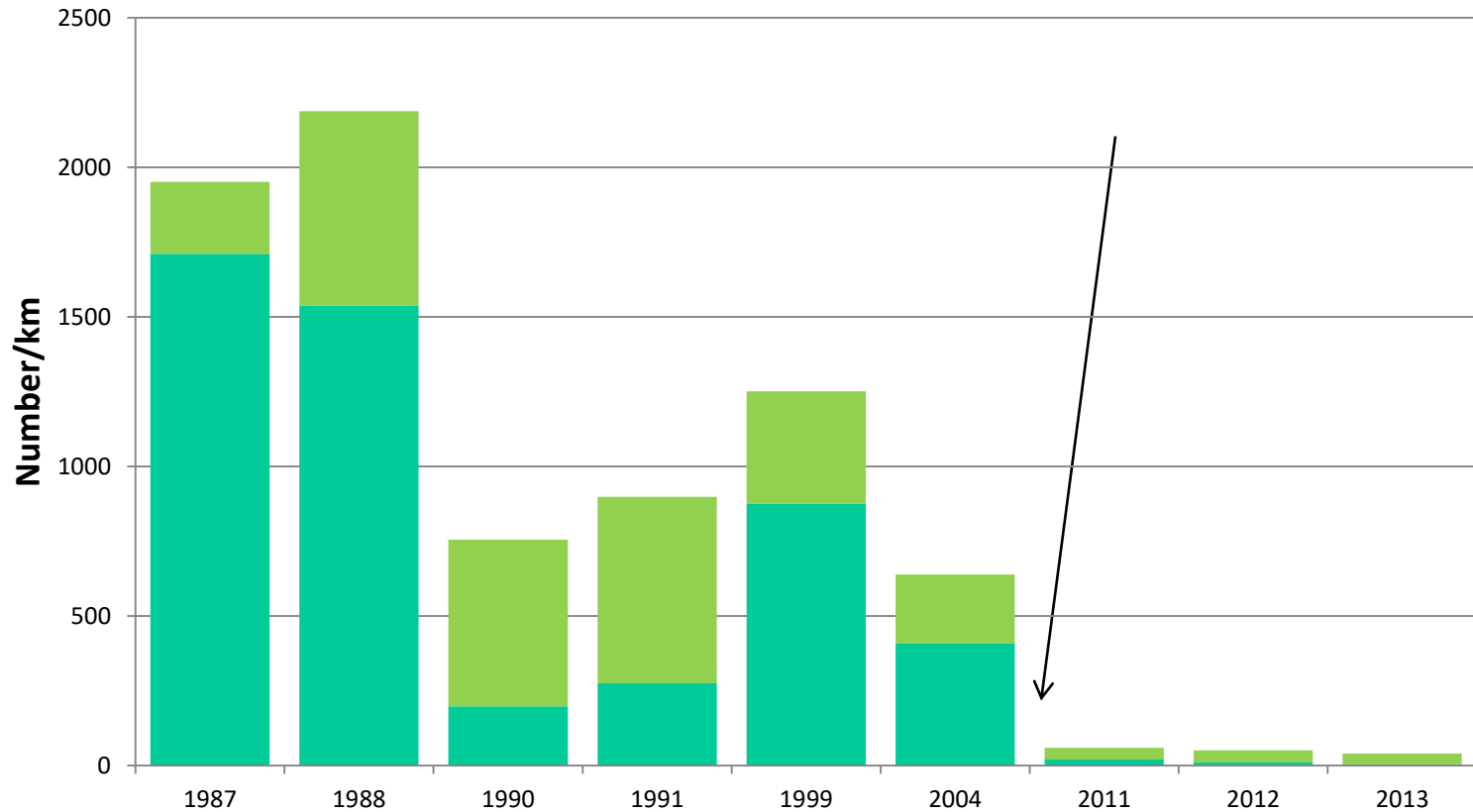


Silkeborg Centrum 2017

Grayling



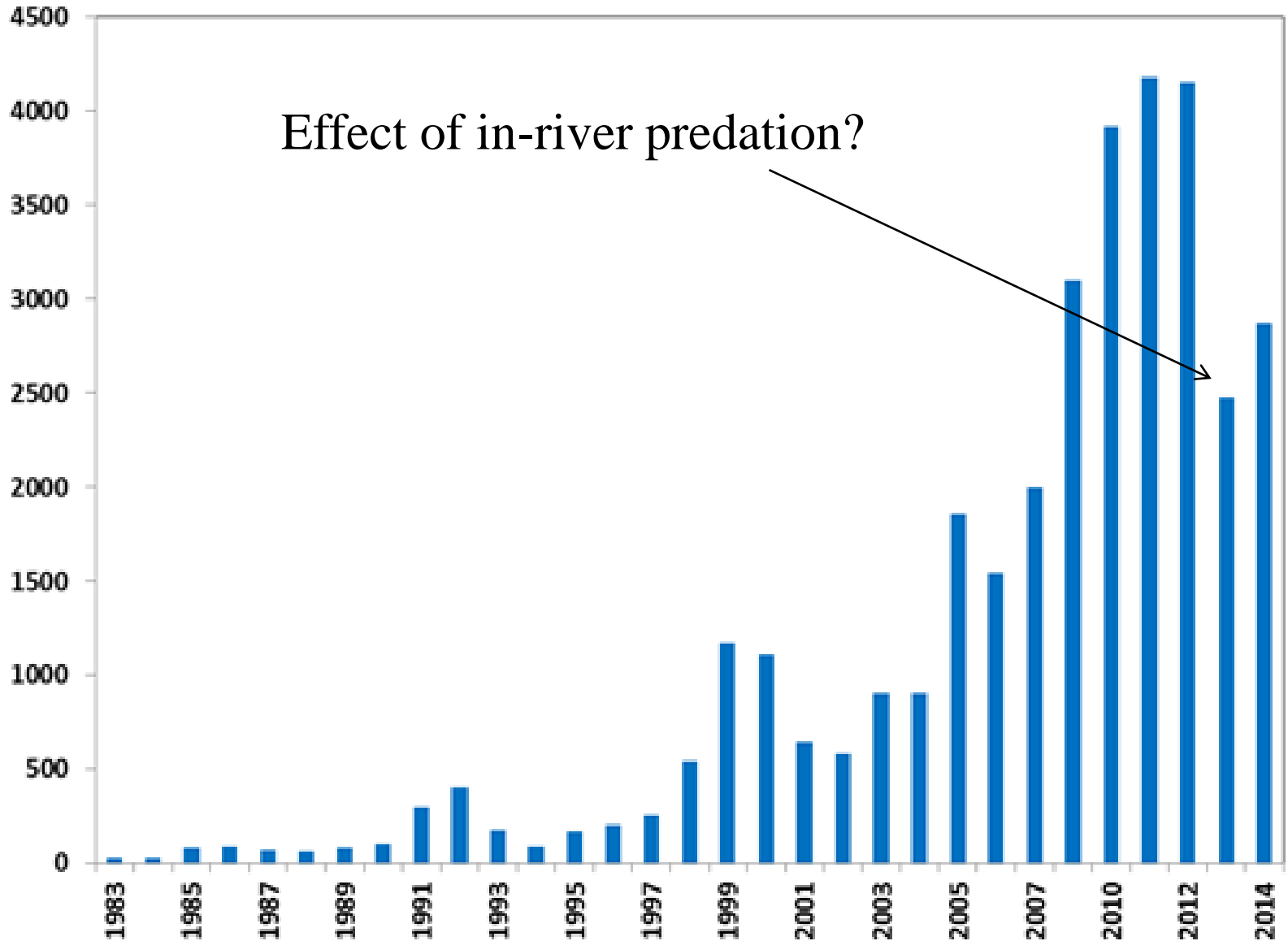
Grayling



Grayling density in 1,5 km stream. Cormorants were first seen in 09/10.

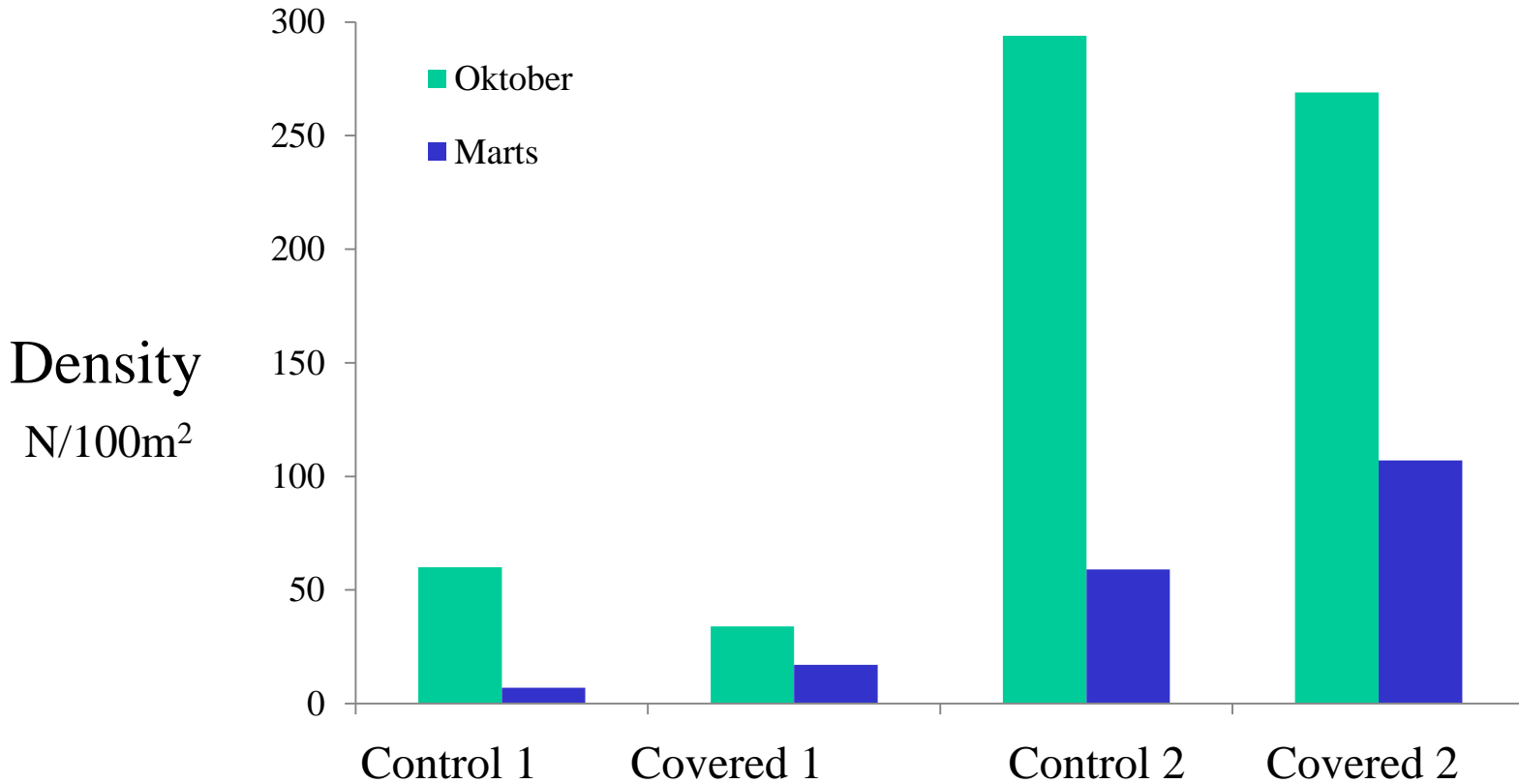
Predation in river on juvenile salmonids??

Salmon spawning-run - River Skjern





Salmon and trout juveniles



Three - four times better survival in the covered area



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Conclusion:

Significant impact on fish populations in Rivers, Lakes and coast.
Documentation that predation from cormorants is now the *main regulating factor* for many fish stocks, including salmon.

Is this only a problem in DK?

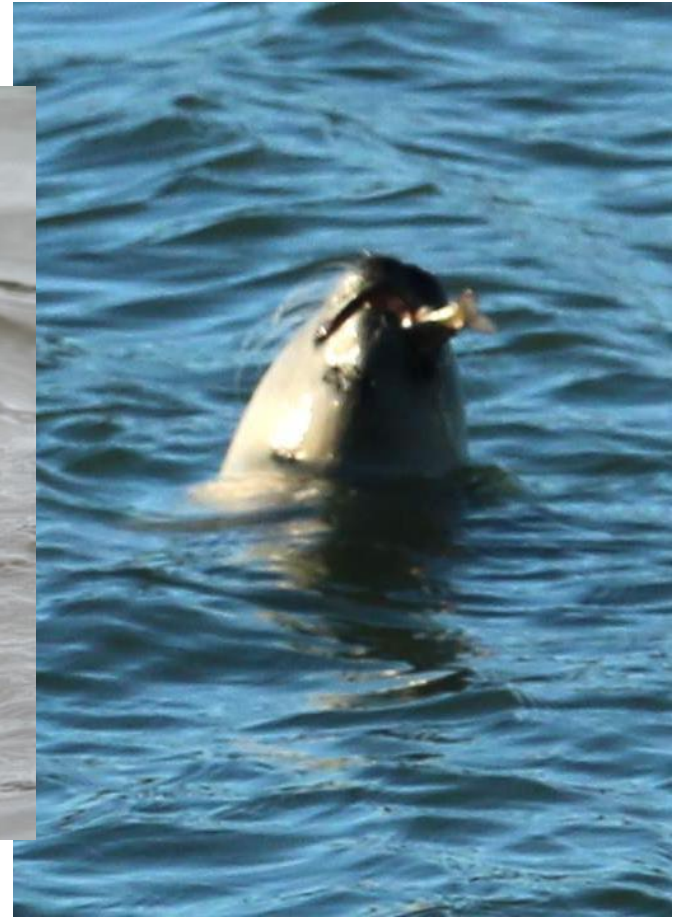
Results from the NASCO/EU funded SMOLTRACK project suggests otherwise. Very high predation seems to be the rule.

Documentation

- Dieperink, C., Pedersen, S. & Pedersen, M.I. (2001). Estuarine predation on radiotagged wild and domesticated sea trout (*Salmo trutta* L.) smolts. *Ecology of Freshwater Fish* 10, 177–183.
- Dieperink, C., Bak, B.D., Pedersen, L., Pedersen, S. & Pedersen, M.I. (2002). Predation on Atlantic salmon and sea trout during their first days as postsmolts. *Journal of Fish Biology* 61, 848–852.
- Koed, A., Baktoft, H. & Bak, B. D. (2006). Causes of mortality of Atlantic salmon (*Salmo salar*) and sea trout (*Salmo trutta*) smolts in a restored river and its estuary. *River Research and Applications* 22, 69–78.
- Jepsen, N., Holthe, E. & Økland, F. (2006). Observations of predation on salmon and trout smolts in a river mouth. *Fisheries Management and Ecology*, 13, 341–343.
- Jepsen, N, Sonnesen, P., Klenke, R. & Bregnballe, T. (2010). The use of coded wire tags to estimate cormorant predation on fish stocks in an estuary. *Marine and freshwater Biology* 61, 320-329.
- Boel, M. (2012). Life history types and strategies. Case studies on brown trout and alewives, involving physiological differences and interspecific interactions. PhD-thesis, DTU Aqua, pp 133.
- Hansson, S. et al. (2017). Competition for the fish - fish extraction from the Baltic Sea by humans, aquatic mammals and birds. *ICES Journal of Marine Science*, 75, 999-1008.
- Skov, C., Jepsen, N., Baktoft, H., Jansen, T., Pedersen, S. & Koed, A. (2014). Cormorant predation on PIT-tagged lake fish. *Journal of Limnology*.
- Jepsen, N, Ravn, H.D. & Pedersen, S. (2018). Change of foraging behavior of cormorants and the effect on river fish. *Hydrobiologia*, 820, 189-199.
- Jepsen, N., Flavio, H. & Koed, A. (in press). The impact of Cormorant predation on Atlantic salmon and Sea trout smolt survival. *Fisheries management and ecology*.

Seals are increasingly visiting our salmon and sea trout rivers





Seals eat smolts and adult salmon and trout



Salmon with bite marks, likely from seals



Thank you