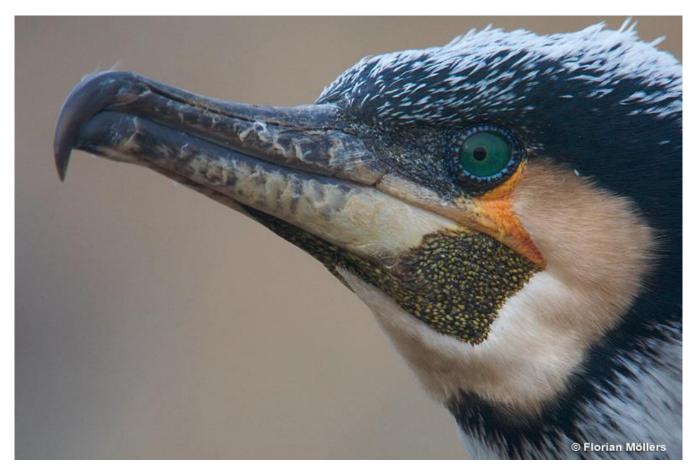


Cormorants and fish populations **DOCUMENTATION OF EFFECTS**

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Main points:

- 1. Short overview of the development of the cormorant conflict
- 2. Predation studies, coast, lakes, rivers what have we learned?
- 3. Briefly on Danish cormorant management plan

Documenting the impact of predation:

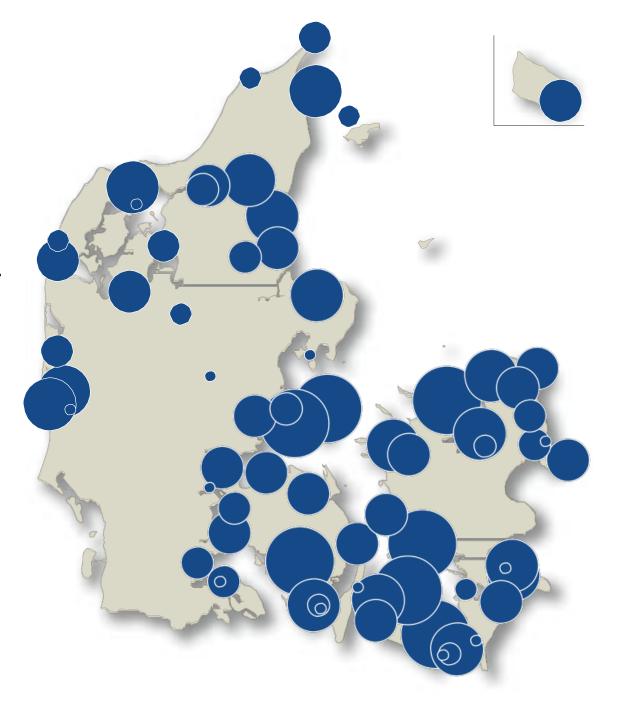
- Proving things that have happened
- Lack of fish to study
- High variation from year to year
- Effect of capture, handling and tagging
- Statistical confidence in estimates

Funding for studies ??

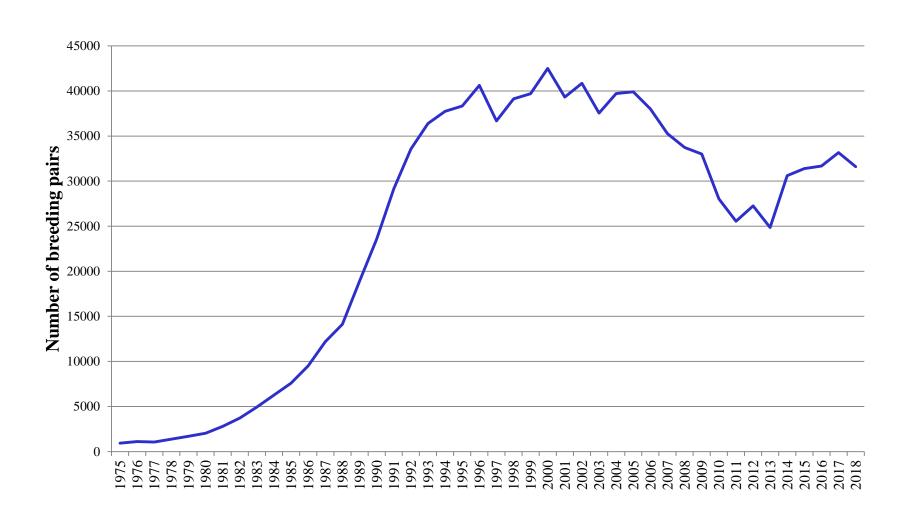
Colonies 2016

Current max number of birds: 250.000

Current min number of birds: 15.000

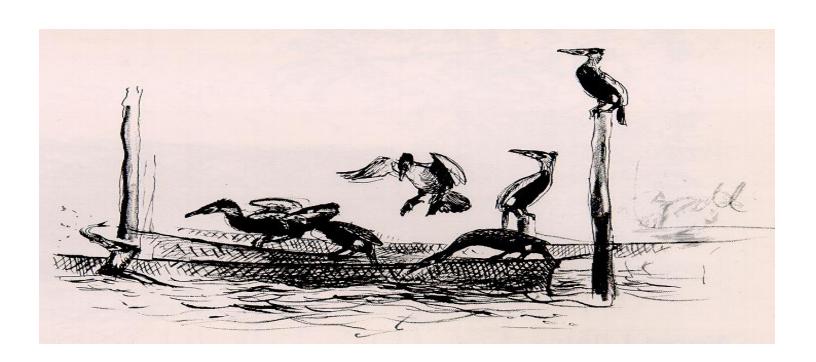


Development in breeding stock (pairs) in Denmark 1975-2018



Who has the problems?

- Pound-net fishers
- Recreational net fishers
- Anglers
- Biodiversity?



Coast:

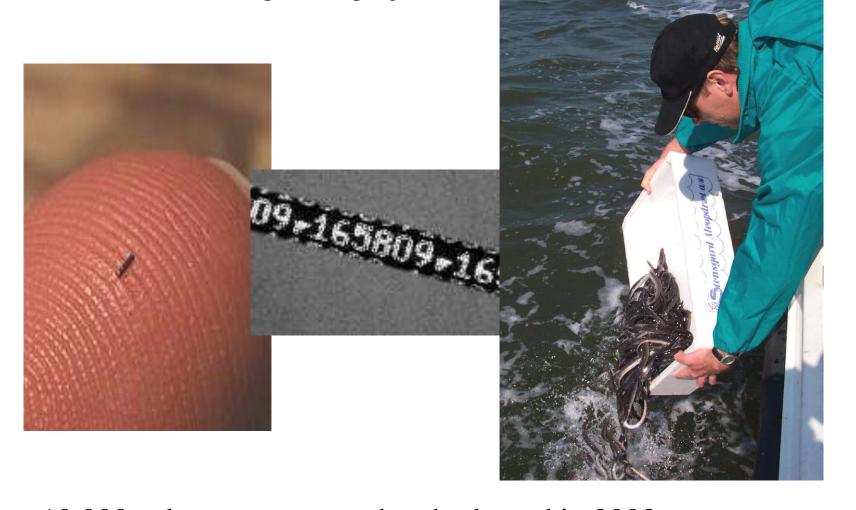
Eelpout and cod largely disappeared

Documented impact on flounders

Documented impact on eel

Documented impact on salmon

Ringkøbing Fjord



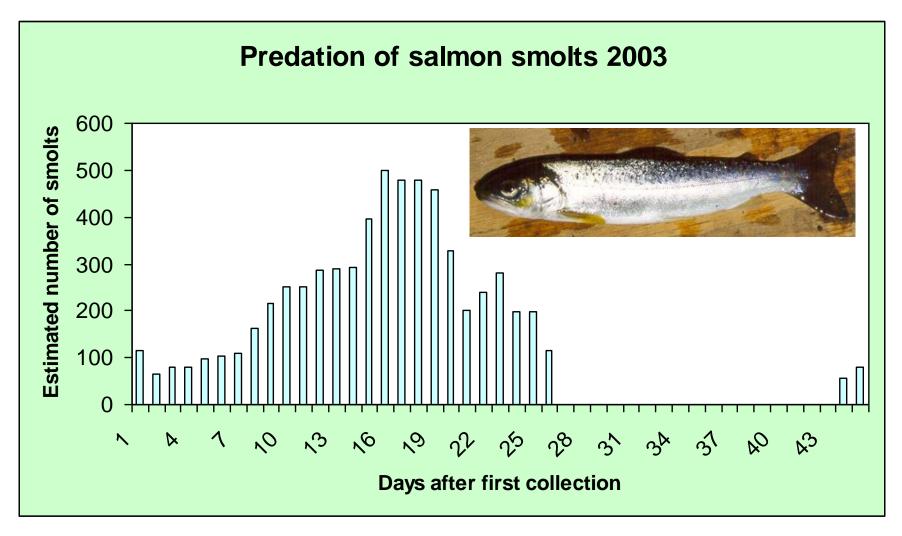
10,000 eel were cw-tagged and released in 2003 and 64.000 CW tagged 1-year salmon were released in Skjern River



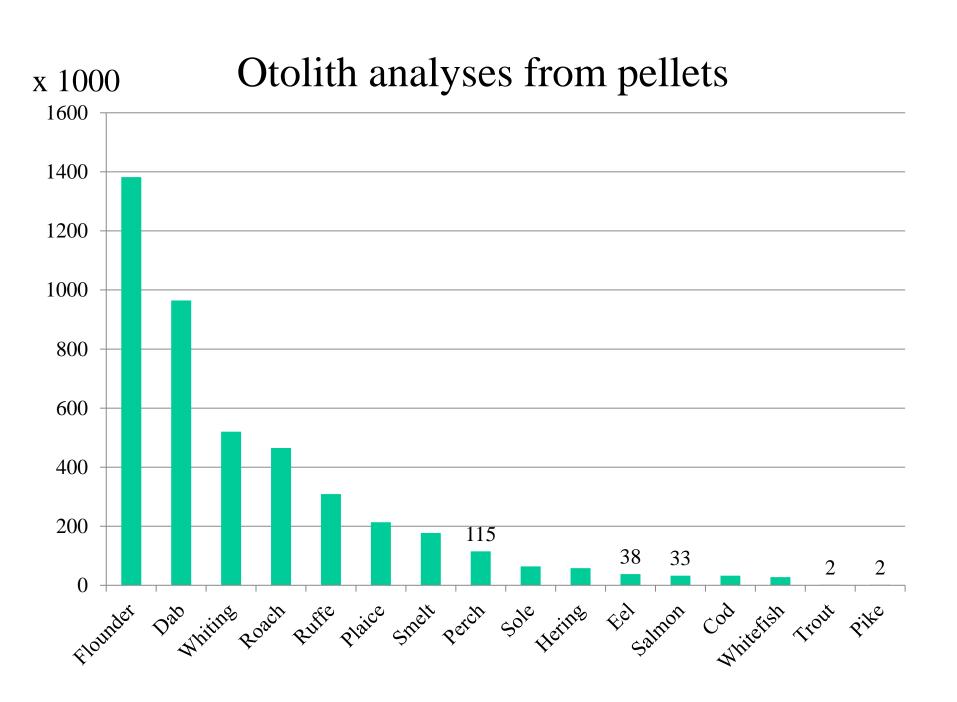
4,000 flounders (7 – 20 cm) were caught and cw-tagged in 2004



Pellet collection



Recovery of cw tags from salmon smolts from cormorant pellets collected April through June 2003



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 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)

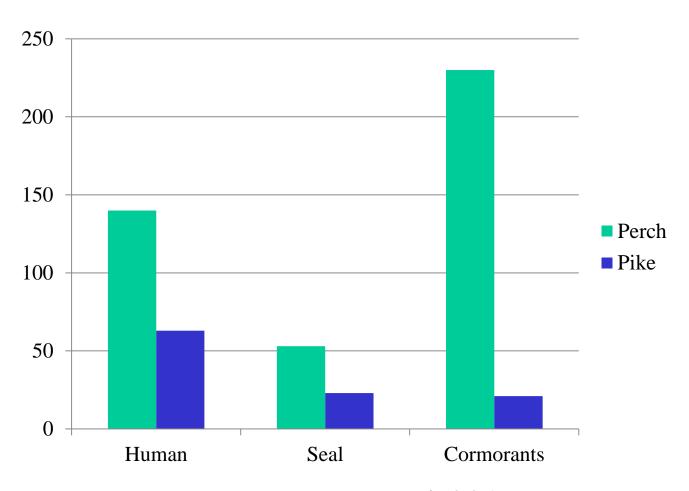
Year	Number tagged	Species	Mortality by cormorants (%)	Method	Source
1997	50	Wild trout	55	Radio-telemetry	Dieprink et al. 2001
1997	50	Hatchery trout	67	Radio-telemetry	Dieprink et al. 2001
2000	17	Wild trout	24	Radio-telemetry	Dieprink et al. 2002
2000	51	Wild salmon	48	Radio-telemetry	Dieprink et 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!

Not many salmon survive to this size!



Consumption of fish from the Baltic Sea – kg/km²/year



From Hansson et al. 2017

Cormorants in rivers – a new phenomenon in DK



Foto: Allan Guido Nielsen



Two cold winters 2009-10 2010-11



Foto: Michael Holm

Grayling



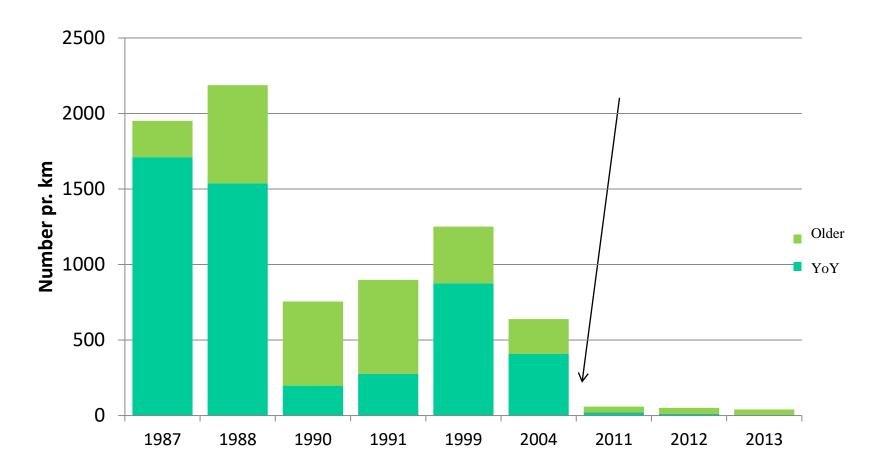




Grayling – Omme Å	2009	2010	
Number pr. km			
Fry	147	0	
1+	250	5	
Larger	15	1	
Total	412	6	

Catch of Grayling by electrofishing a 2 km stretch in 2009 og 2010 (Iversen 2010).

Grayling



Grayling density in 1,5 km stream.

25 grayling (32-36 cm) were radiotagged in October.

River with very few cormorants

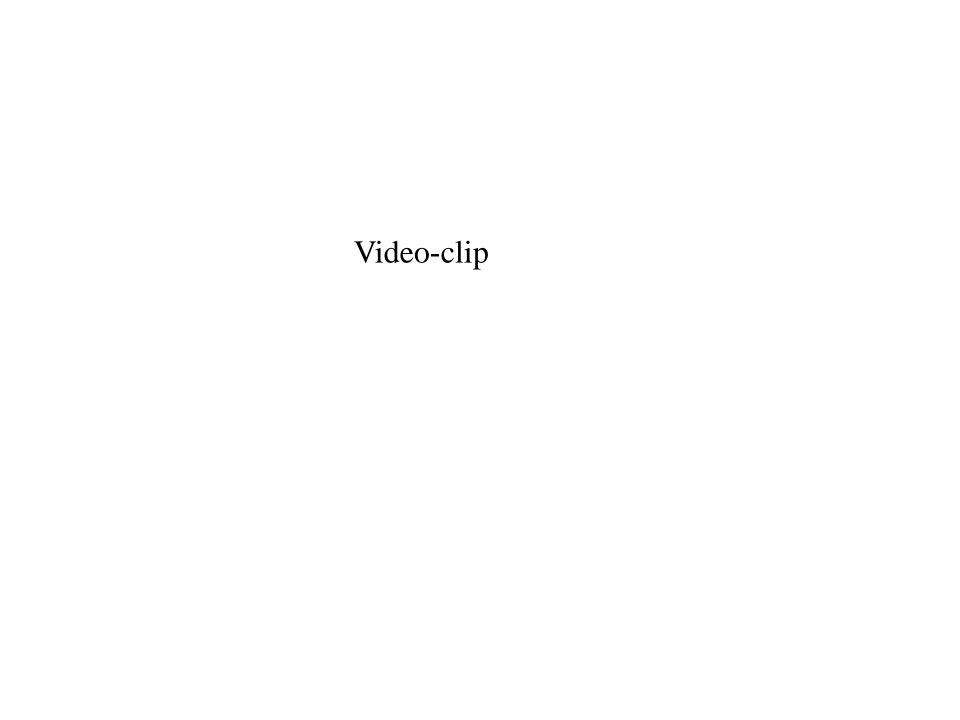
Only two tagged grayling survived

A loss of 80% of total fish biomass was estimated





Jepsen et al. 2018



Trout



Year	PIT-tagged (N)	Recovered (%)		
2010	650	8.5		
2011	1038	12.2		
2012	937	14.6		

PIT-tags from brown trout, recovered at a cormorant roosting site. *Jepsen et al.* 2018



Predation on lake fish?







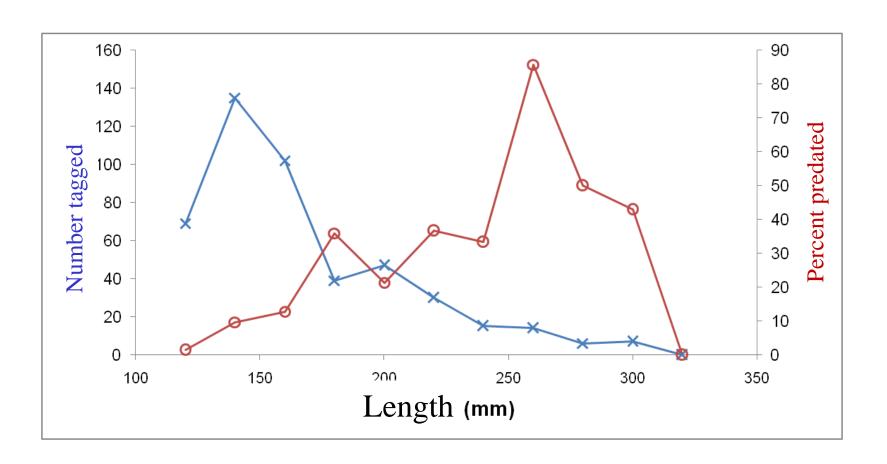
PIT studies of lake fish

More than 1000 PIT tags were found in one colony 13-20 km away

	Loldrup Lake			Vib	Viborg Lakes		
	2005	2007	2008	2009	2008	2009	
Roach	19%	32%		17%	30%	24%	
Bream	11%				33%	33%	
Perch	41%			46%	70%	45%	
Pike			33%	30%			

Minimum estimates (Skov et al. 2014)

Perch



Larger perch are more vulnerable







Conclusion:

Impact on fish populations in Rivers, Lakes and coast.

Documentation (by different methods) that predation from cormorants is now the *main regulating factor* for many fish stocks.

Effects include:

- Economic loss (commercial and recreational fishing)
- Cultural loss
- Biodiversity loss
- Problems in reaching WFD requirements

Management

Ministry of Environment

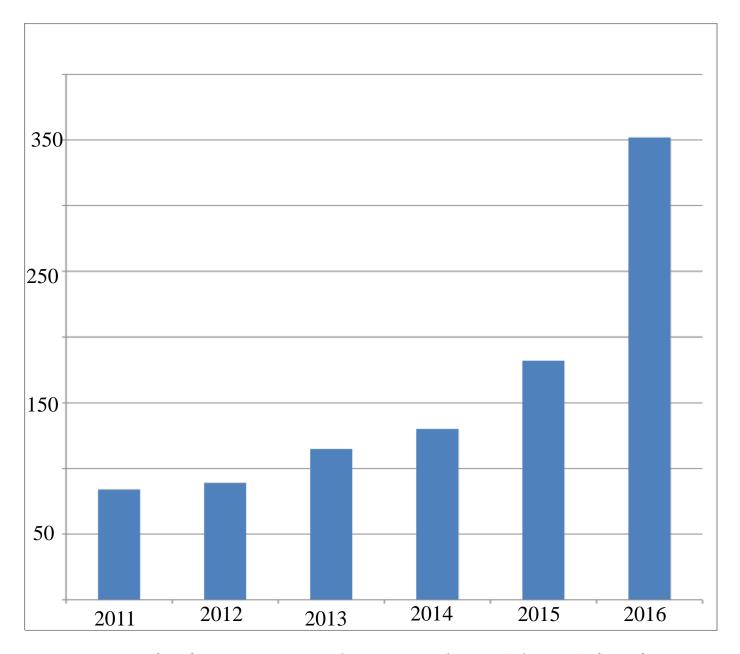
Cormorant-group: Stakeholders, managers, experts

National cormorant management-plan since 1997:

- •Egg oiling
- Prevention of new settlements
- •Protective Shooting (fishers and hunters)
- •Regulation outside breeding season in rivers

Adaptive management

- MP provides the framework
- Loss in poundnets fishermen were permitted to shoot cormorants at nets (1000 m)
- Loss of smolts anglers were permitted to shoot cormorants during smolt migration
- Cormorants foraging in the rivers protective shooting was initiated
- Continued problems in rivers permission to shoot at night roosting sites



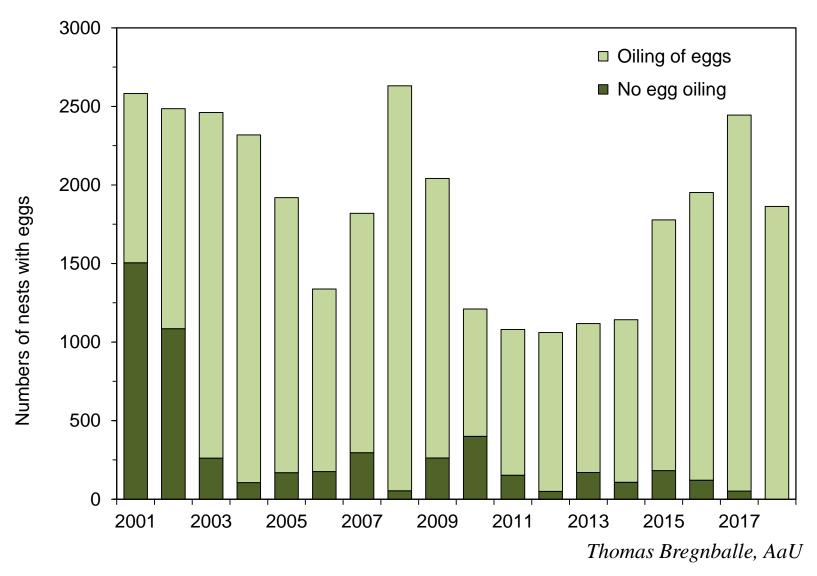
Permissions granted to regulate (shoot) in rivers











17 years after start, we have app. 2000 nests in 2018

- Despite much effort conflicts still remain high
- No clear effects of regulation
- High immigration rate
- A common EU plan would help management



Thank you

- 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, 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.
- 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*.

Human - Wildlife Conflicts in Europe

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Klenke, R.A.; Ring, I.; Kranz, A.; Jepsen, N.; Rauschmayer, F.;

Henle, K. (Eds.). 1st Edition., 2013, 50 illus.