Dam removal is the Holy Grail of river restoration

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Trickle to floodplain

Fundamental to life

Running waters matter

Rivers are intimately connected to the surroundings, so rivers are what we make of them.

General a vast increasing knowledge on freshwater biology and yet…

Article

More than one million barriers fragment Europe's rivers

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Rivers support some of Earth's richest biodiversity[1] and provide essential ecosystem services to society[2], but they are often fragmented by barriers to free flow[3]. In Europe, attempts to quantify river connectivity have been hampered by the absence of a harmonized barrier database. Here we show that there are at least 1.2 million instream barriers in 36 European countries (with a mean density of 0.74 barriers per kilometre), 68 per cent of which are structures less than two metres in height that are often overlooked. Standardized walkover surveys along 2,715 kilometres of stream length

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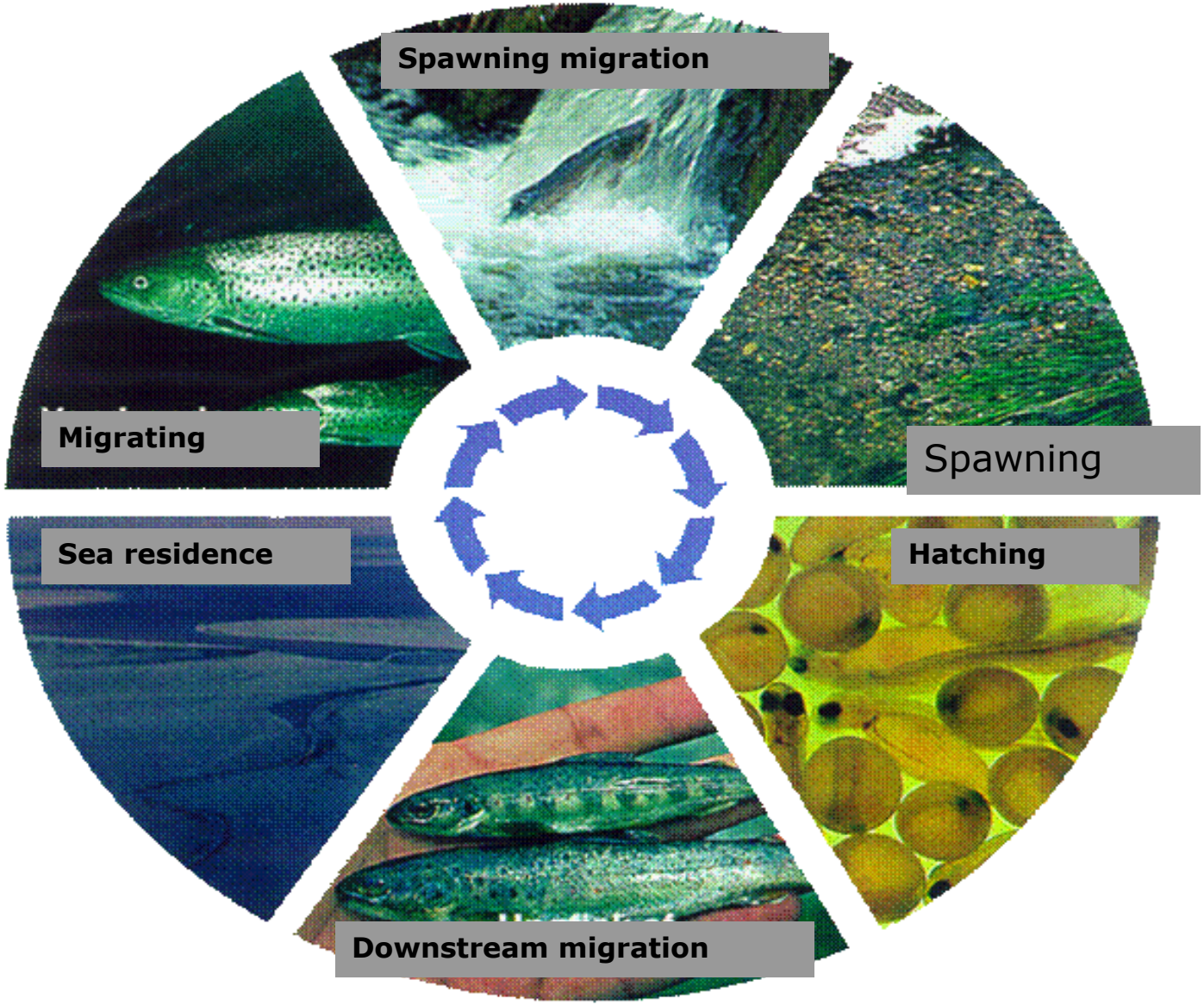
SUSTAINABLE DEVELOPMENT GOALS

Damremoval - Denmark

- - Highest point: **171 m** above sea level
- - No natural barriers in the streams
- - More than 90-98% of the streams are regulated
- Small, low gradient, but still loads of dams and weirs – same consequences

How do we measure status - indicator species



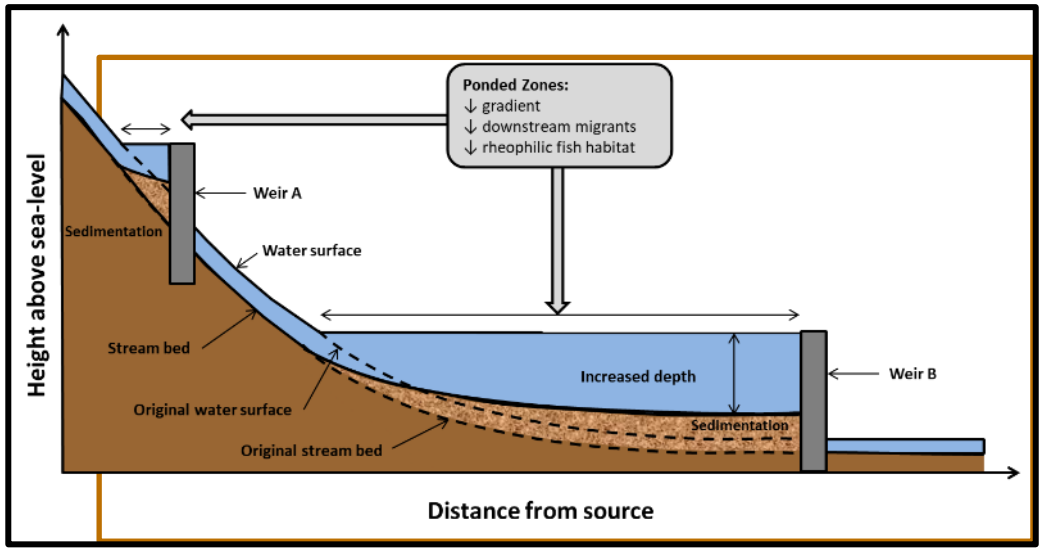
- Passage is both an **upstream** and **downstream** issue
- Smolts *and* adults must migrate downstream

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

Aarestrup *et al*. 2006 *DFU report*

Loss of GOOD habitat

- Loss of both **vertical** and **horizontal** habitat
- Can **only** be resinstated by removal



River (# of dams)	Total drop from source to outlet (m)	Summed drop from barriers (m)	Vertical habitat loss (%)	Total river length (km)	Summed ponded zones (km)	Horizontal habitat loss (%)
Villestrup (6)	22	8.8	40	20.0	5.8	29
Omme (14)	75	17.7	24	55.0	11.35	21
Gudenaa (7)	69	24.9	36	149.0	-*	-*

Birnie-Gauvin *et al*. 2017 *Aquatic Conservation*

Case 1: Vilholt Dam (1866)

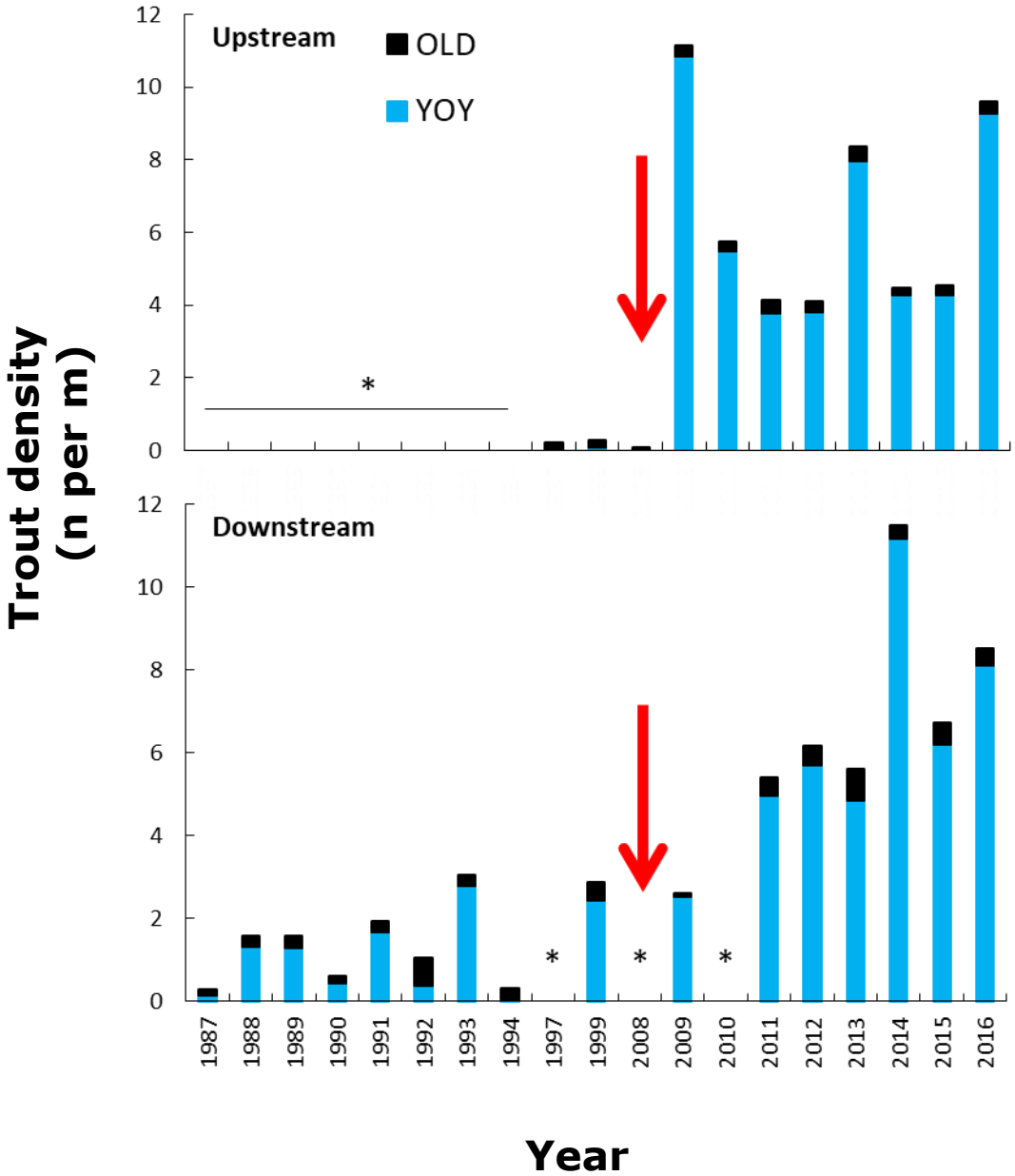
- Conflict since 1987
- Every argument was used to cancel/delay removal
- Removal almost 2 decades later, in 2008

Case 1: Vilholt Dam, local scale

Ponded zone – before

Ponded zone – after

Case 1: Vilholt Dam



- Brown trout (*Salmo trutta*) density measured annually since 1987

- Overwhelming increase in density **both upstream and downstream** of the dam

Birnie-Gauvin *et al*. 2017 *J. Environ. Manag.*

Case 2: River Kolding, river scale

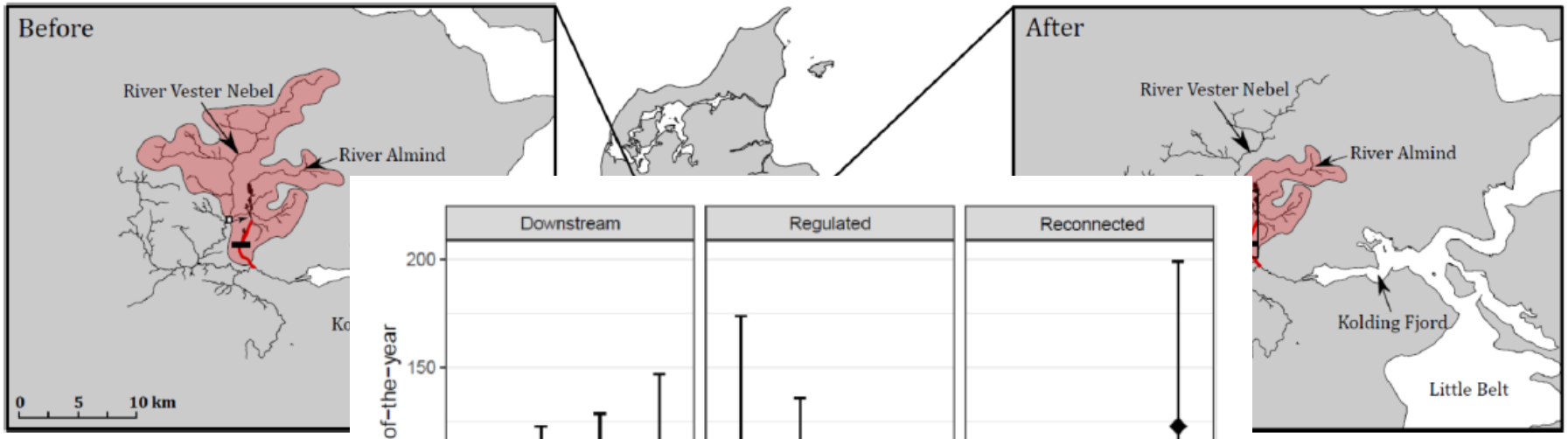


Fig. 1. Kolding watershed. The dam represented by the white square. The represented by the blue line. The rec

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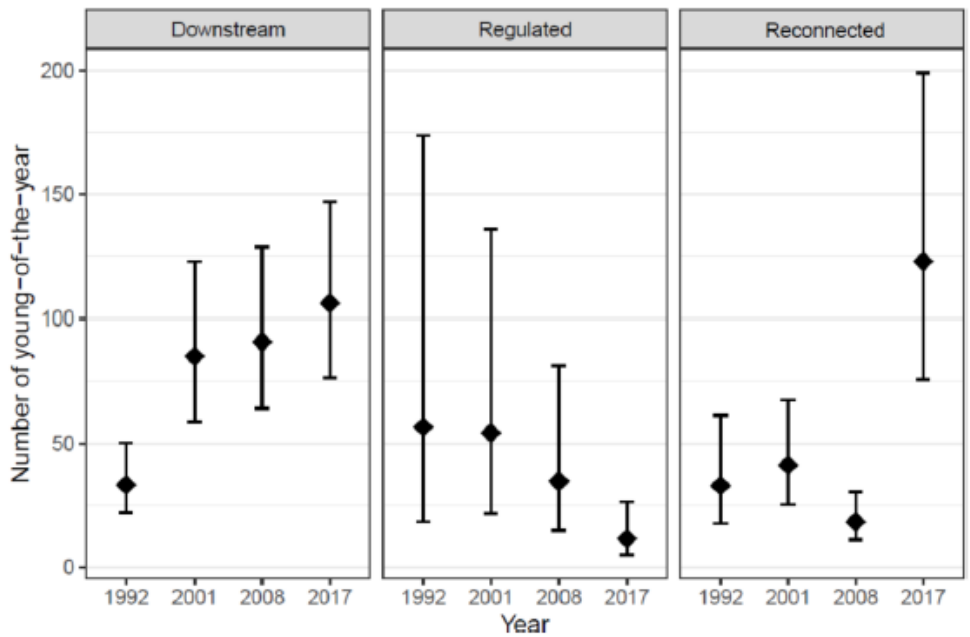
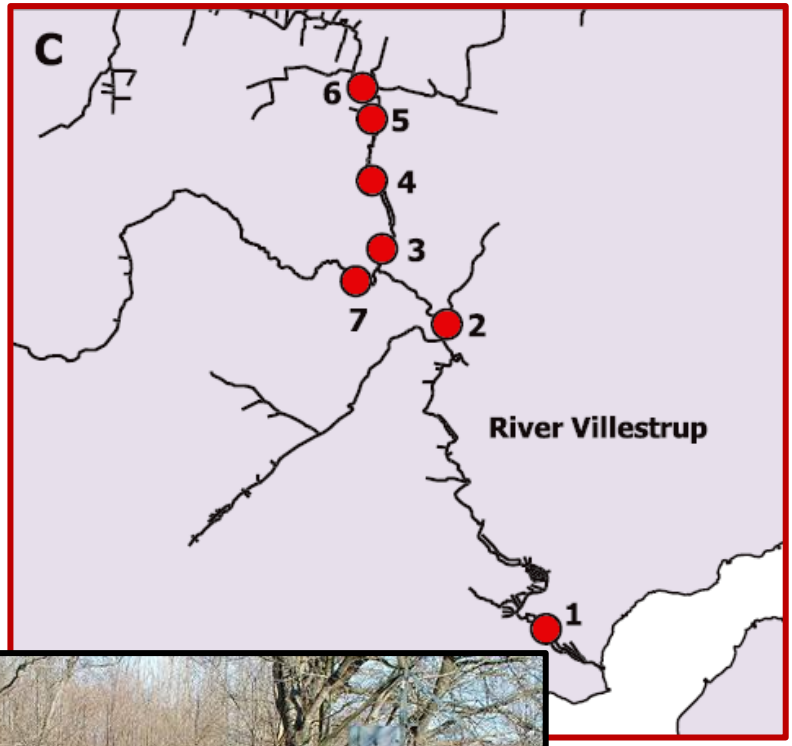


Fig. 3. Modelled density of brown trout (*Salmo trutta*) young-of-the-year (YOY) per 100 m^2 of river before the small bypass (1992), before the pseudo-removal (2001, 2008) and after the pseudo-removal (2017) at downstream, regulated and reconnected sites (with 95% confidence intervals). A significant year × type interaction is present ($p < 0.0001$).

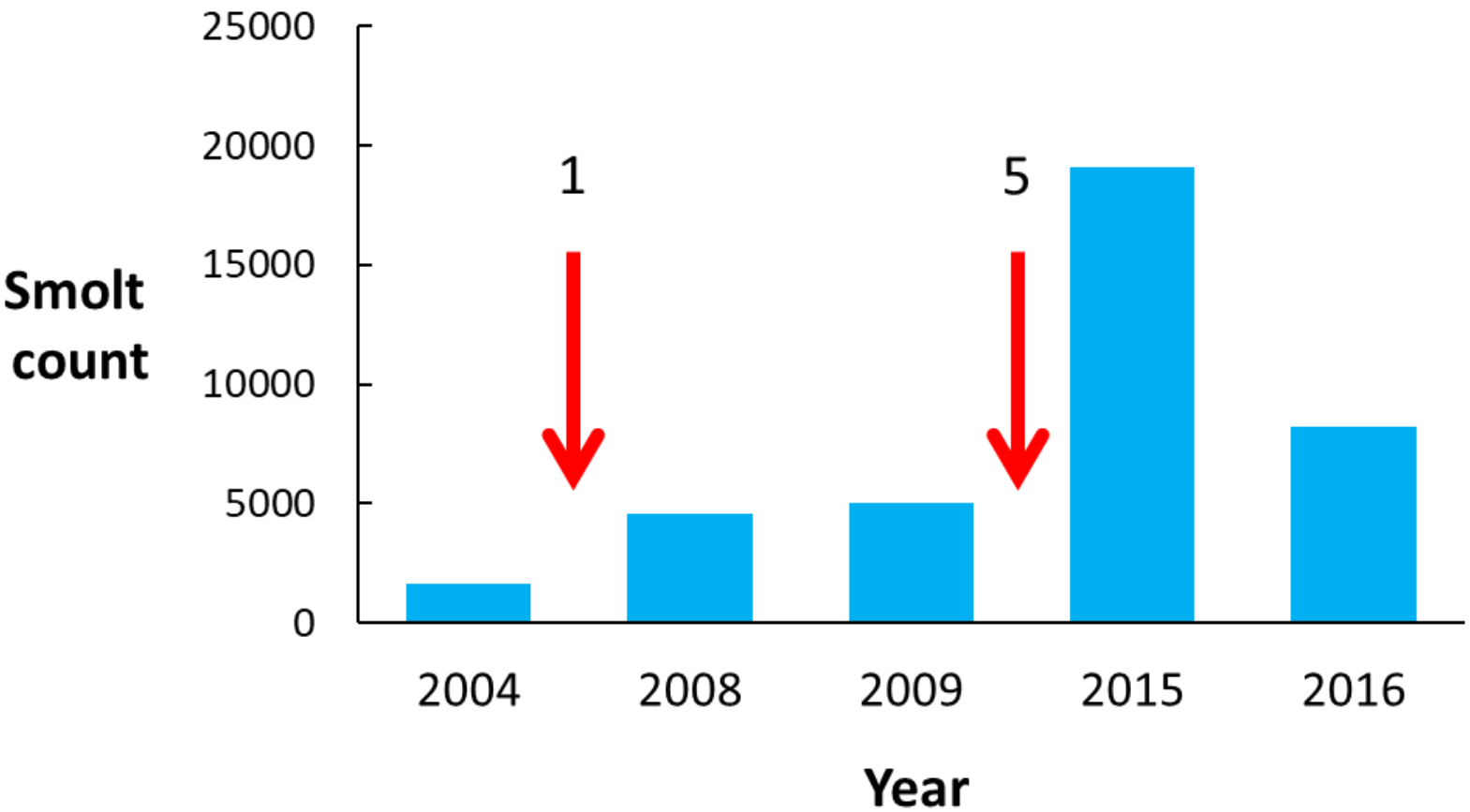
Birnie-Gauvin *et al*. 2020 *J. Environ. Manag.*

Case 3: River Villestrup, output

- 7 weirs total
- 6 removed

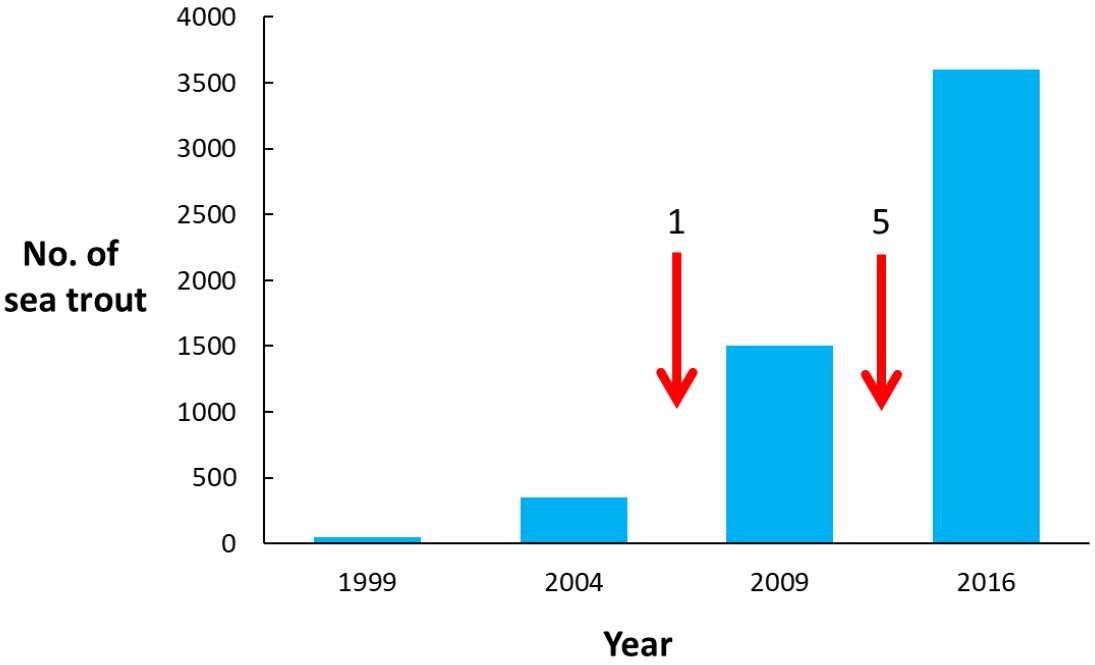


Case 3: River Villestrup



Birnie-Gauvin *et al*. 2018 *River Res. Appl*.

Case 3: River Villestrup



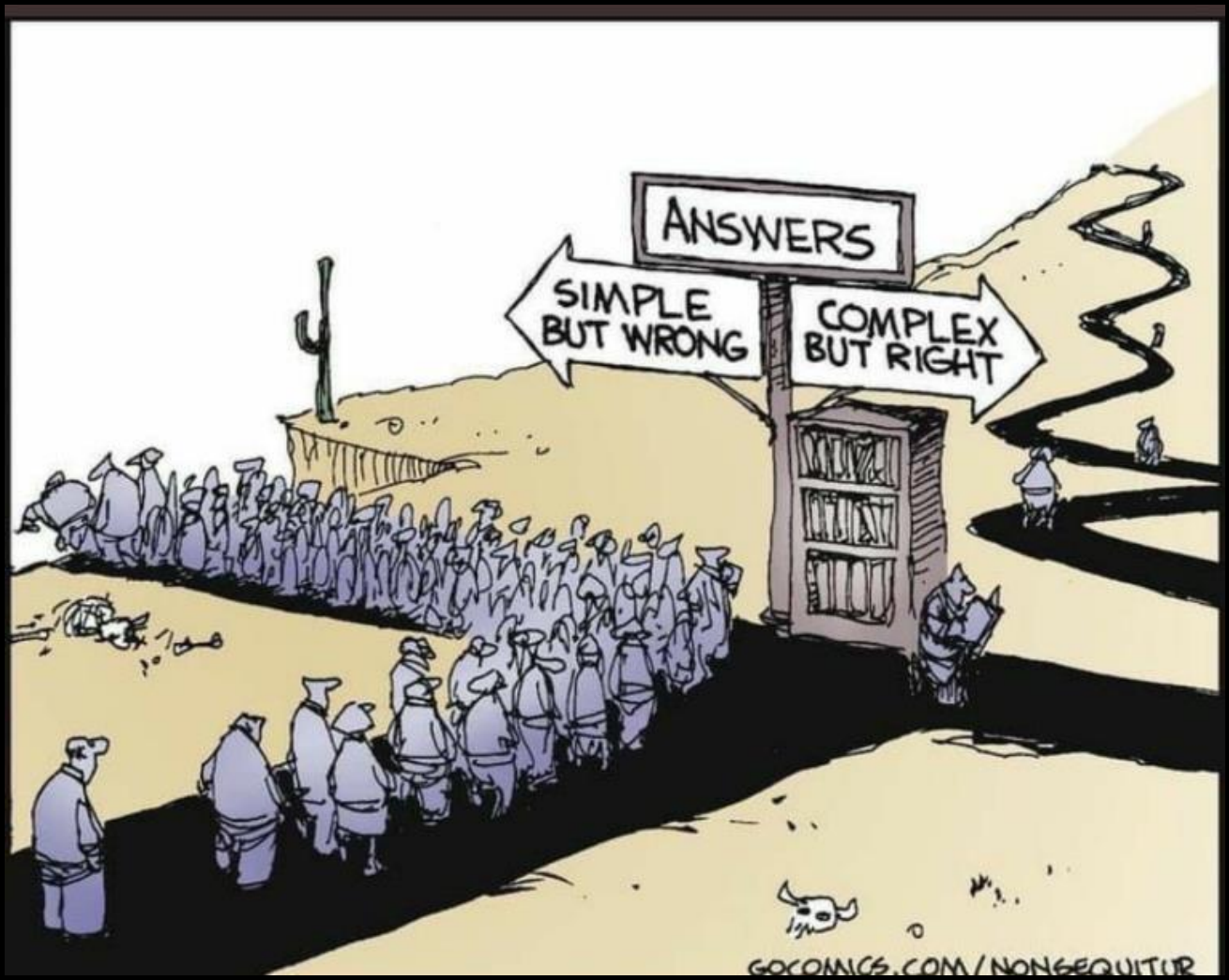
Conclusion

Prioritize Rivers – do better

Barrier removal has a direct benefit on over all river health

- Reaches far beyond the local site
- Can restore massive runs of fish

Barrier Removal is the Holy Grail of River management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