# BARRIER REMOVAL:
## *THE DANISH PERSPECTIVE*


KIM BIRNIE-GAUVIN

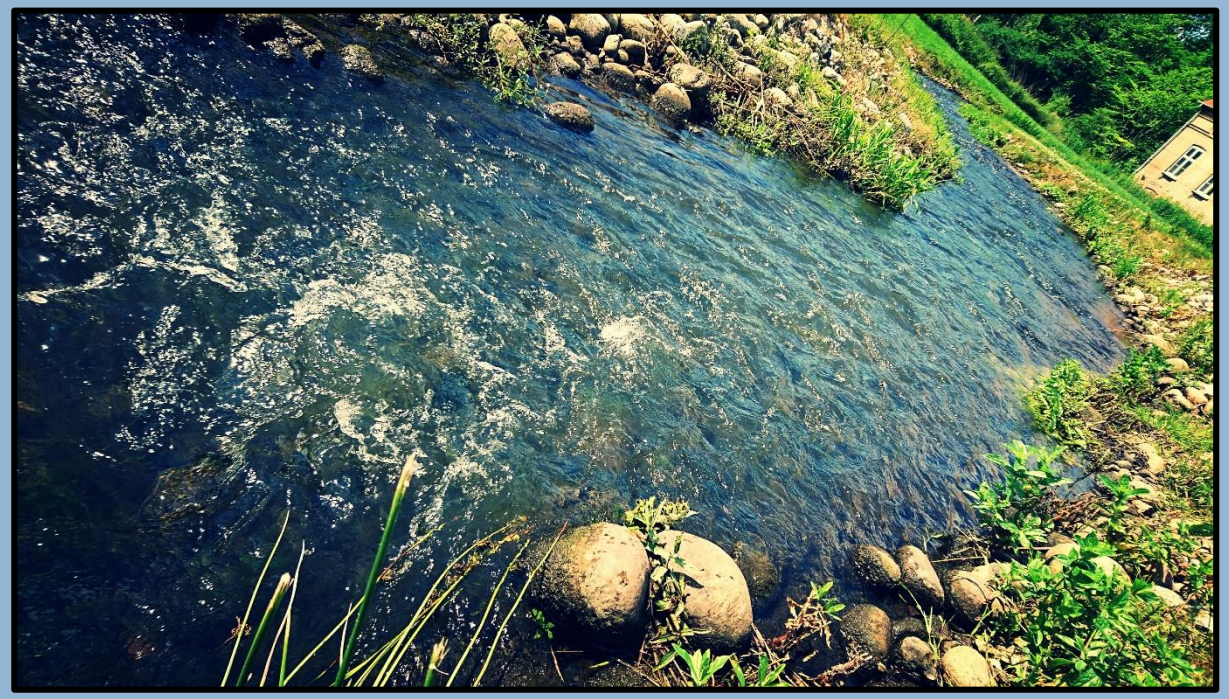
KBIR@AQUA.DTU.DK | @KBG_CONSERV

DTU Technical University of Denmark

AMBER


# THE DANISH CONTEXT

- Highest point: **171 m** above sea level
- No natural barriers in the streams
- More than 90-98% of the streams are regulated



# THE DANISH CONTEXT

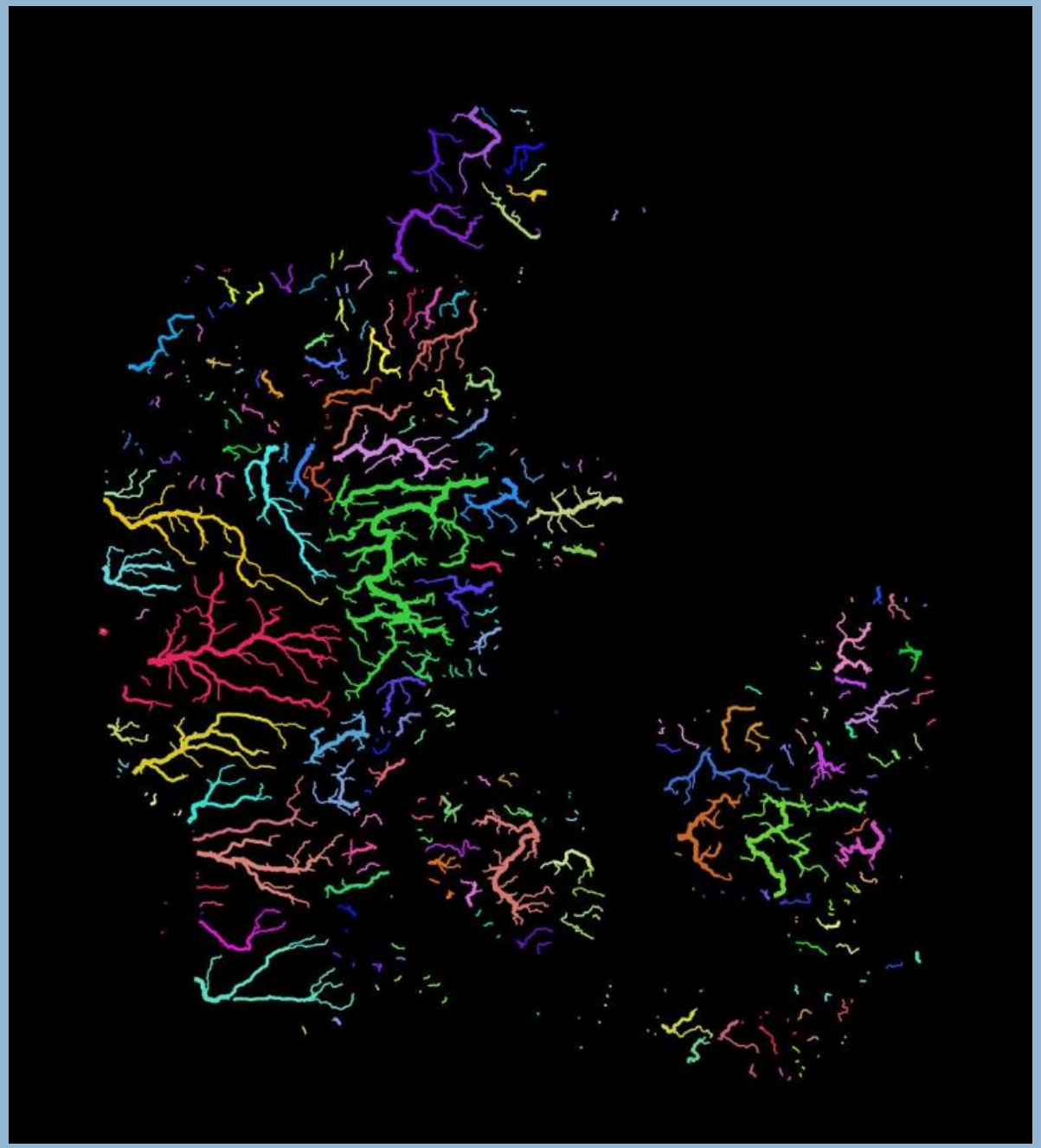
- Our rivers are **small** and have **low gradient**

- Rheophilic habitats are limited

- The gradient we do have is destroyed by barriers

# BARRIERS IN DENMARK

- Many in association with fish farms



*Robert Szucs*

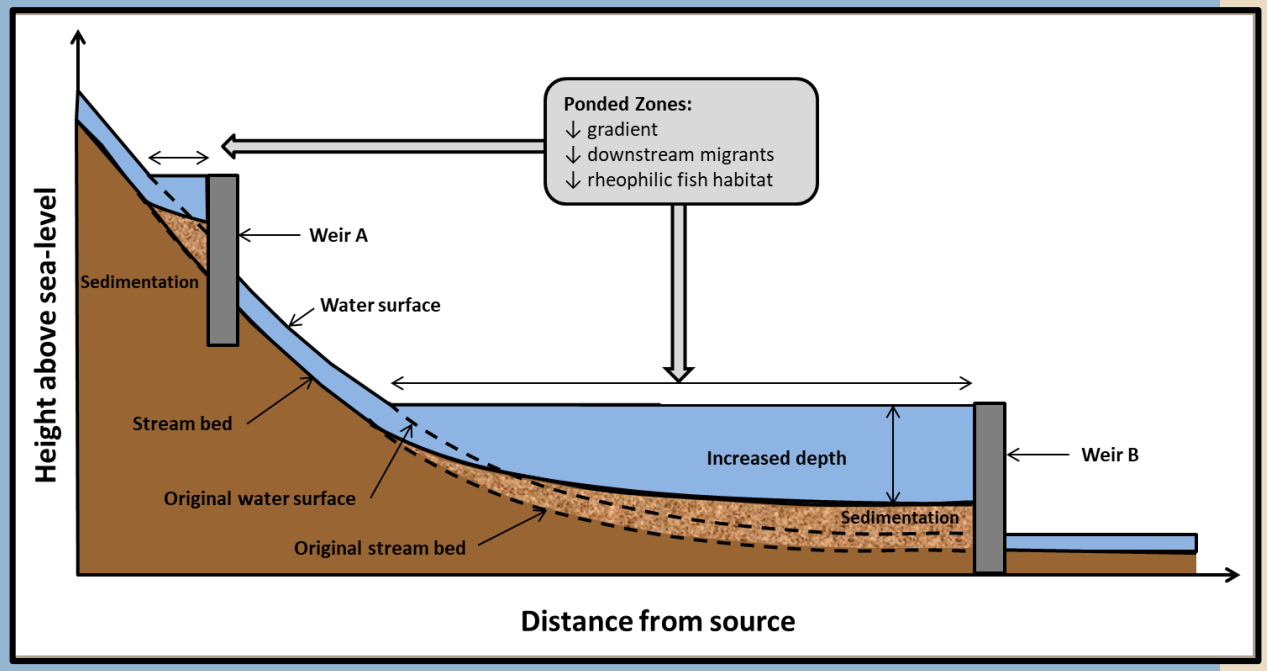
# BARRIERS IN DENMARK

Still the **same** negative consequences

- Poor habitat
- Passage issues
- Migration delays
- Predation

# 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 | -* | -* |

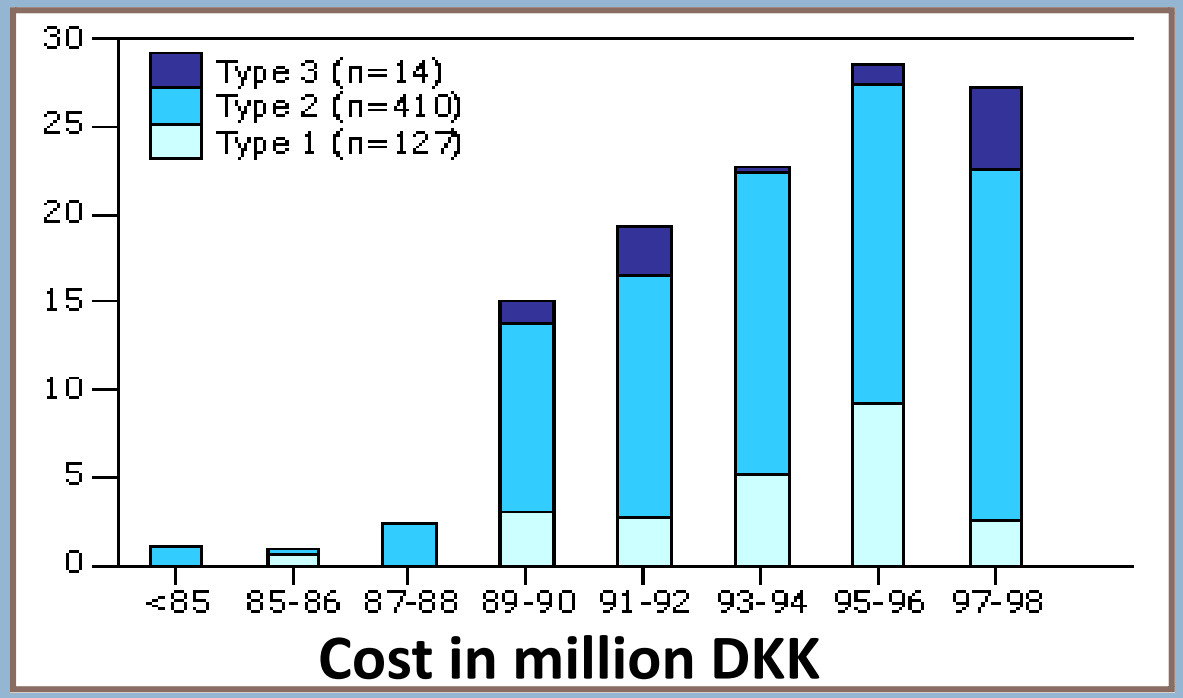
Birnie-Gauvin *et al*. 2017 *Aquatic Conservation*

# PASSAGE ISSUES

- 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*




# THE DANISH WAY

- Over the past decade or two, we have considered removal as the **most viable option**

- We (typically) fight for removal every time

# THE VILHOLT DAM *(ESTABLISHED 1866)*

# THE VILHOLT DAM

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


# THE VILHOLT DAM

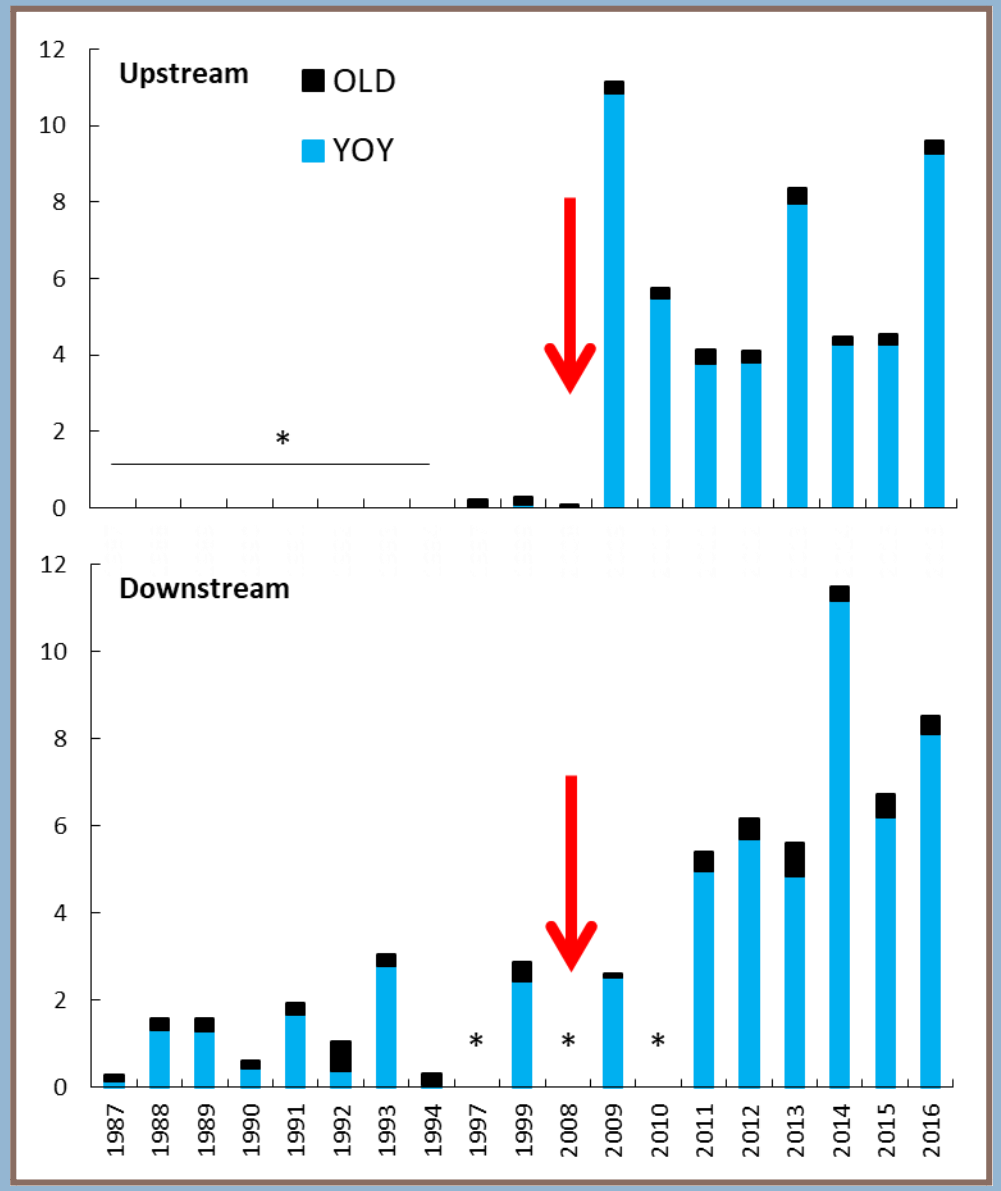
*Ponded zone – before*

*Ponded zone – after*

# THE VILHOLT DAM

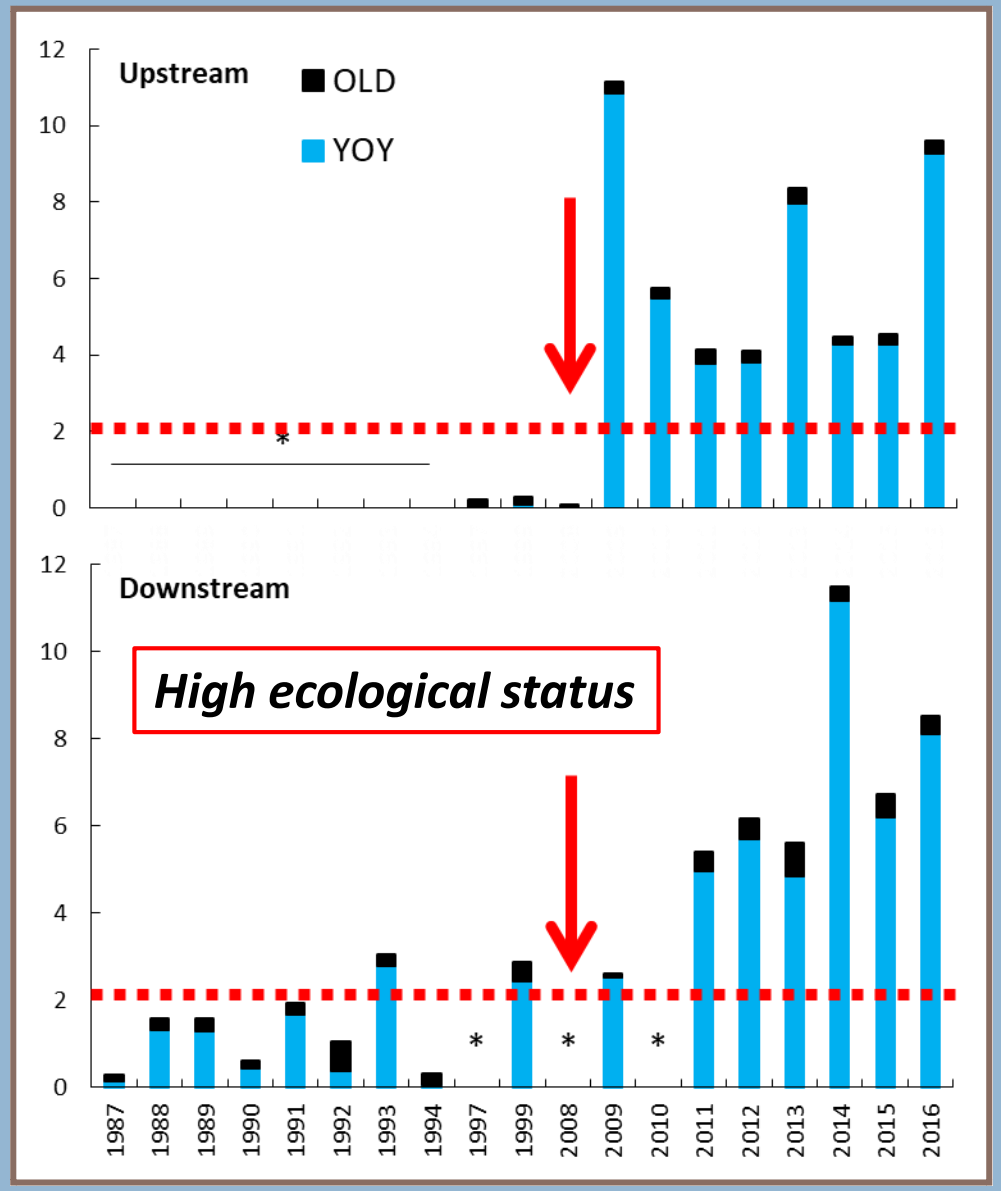
- Brown trout (*Salmo trutta*) density measured annually since 1987

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




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

# THE VILHOLT DAM




- Removal led to density far above what is considered a **'high ecological status'**

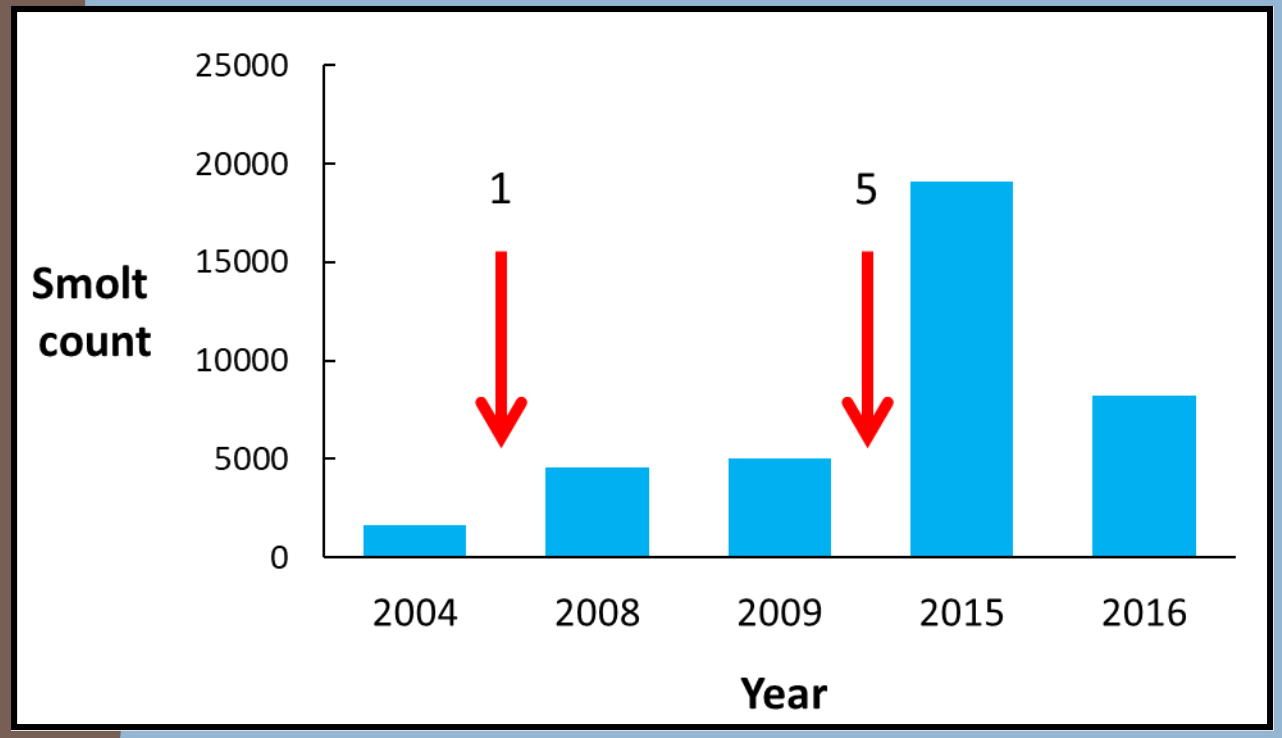
- Suggests we can aim for much higher index; and **we should**

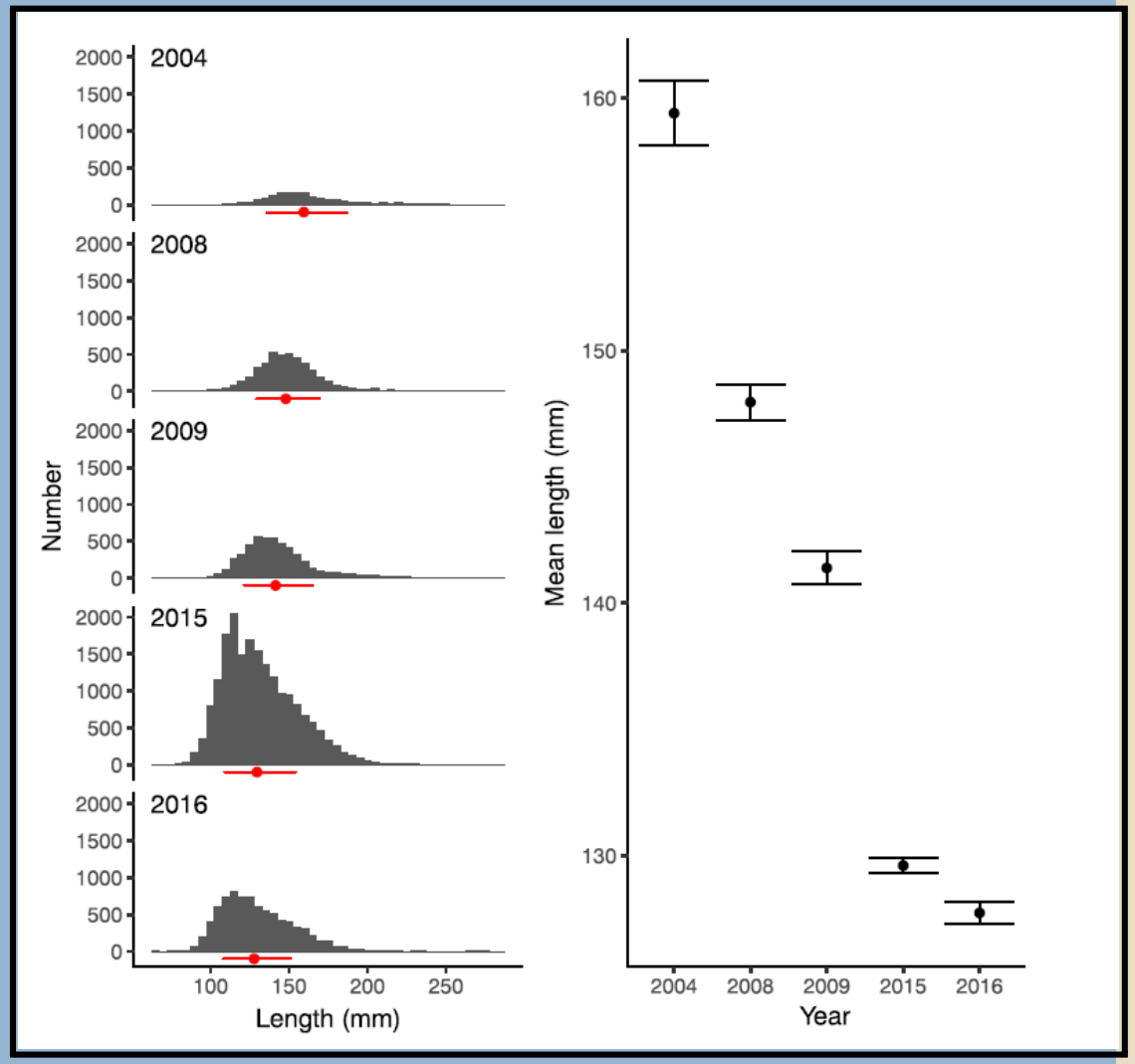
Birnie-Gauvin *et al*. 2017 *J. Environ. Manag.*

# RIVER VILLESTRUP

- 7 weirs total
- 6 removed

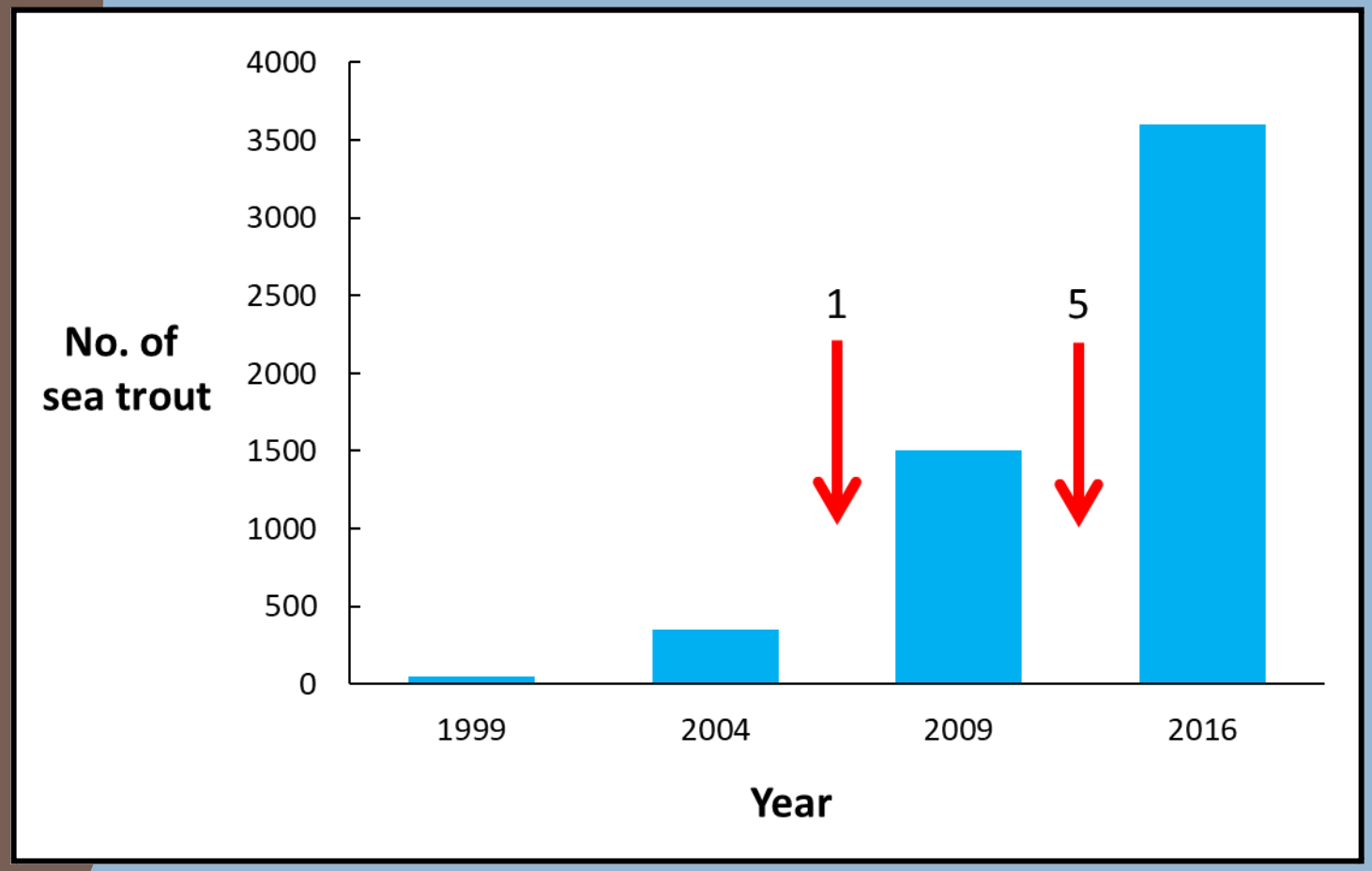

# RESTORATION OF RIVER VILLESTRUP



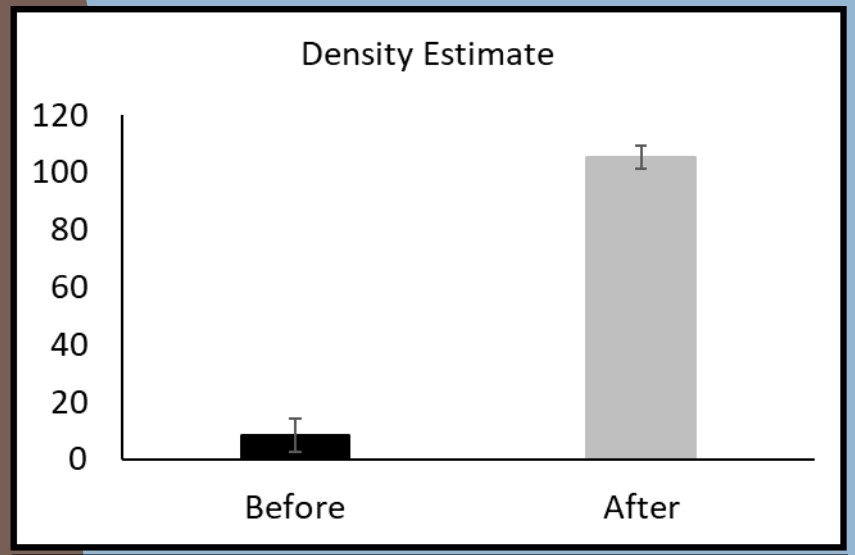



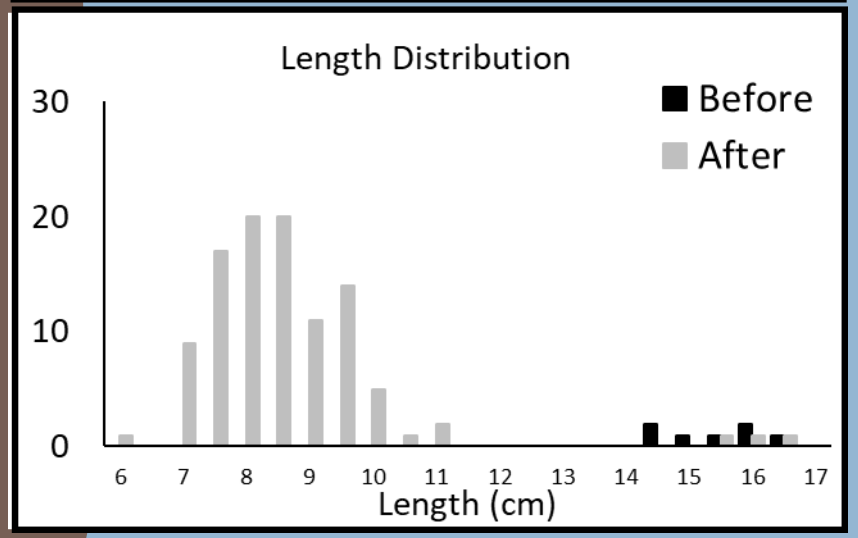

Birnie-Gauvin *et al*. 2018 *River Res. Appl*.

# RESTORATION OF RIVER VILLESTRUP




# DENMARK AS WORLD CHAMPIONS IN RESTORATION?

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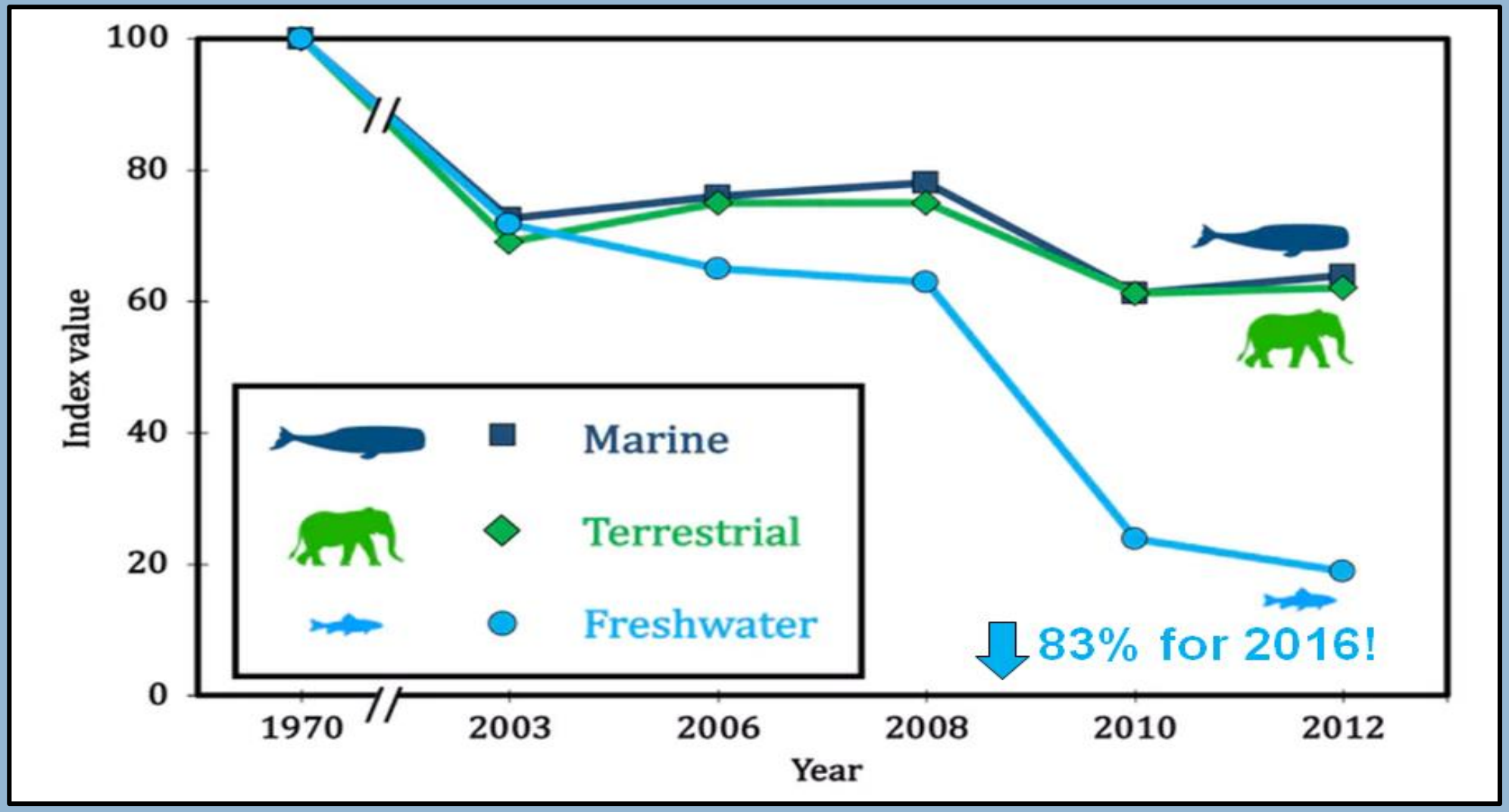
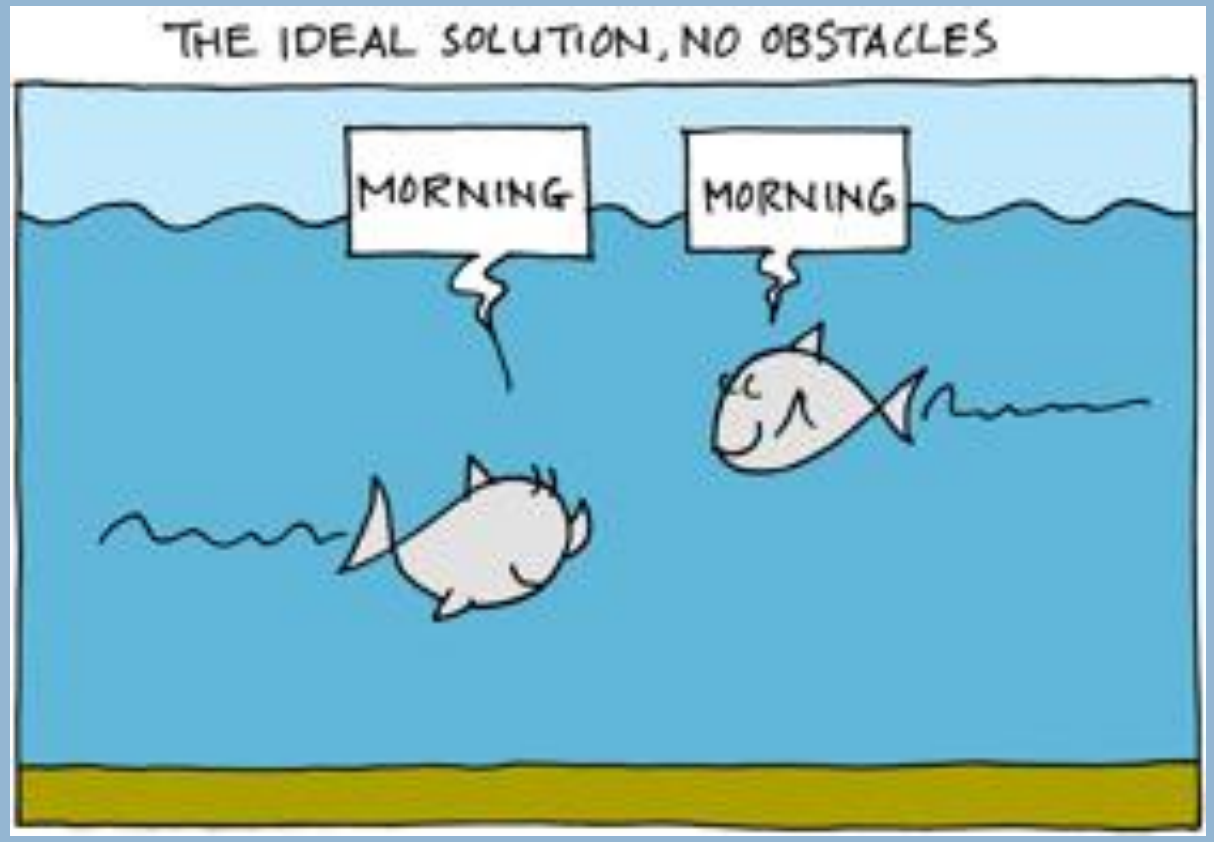
# TANGE HYDROPOWER

- Denmark's **biggest failure** for freshwater ecosystems
- Lead to the **extinction** of the Gudenå salmon population
- Produces energy that a **single** windmill can produce

# FRESHWATER ECOSYSTEMS NEED HELP




Reid et al. 2018 *Biol. Cons.*




✉ kbir@aqua.dtu.dk | @kbg_conserv

#letitflow
#freshwaterneedslovetoo

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# OUR RIVERS NEED US

- We must aim higher and do better
- We need better legislation
- We must be louder; it's our responsibility
- **Let's show our rivers some love!!**