Reintroducing Atlantic salmon in the River Rhine for decades:

Why did it not result in the return of a viable population?

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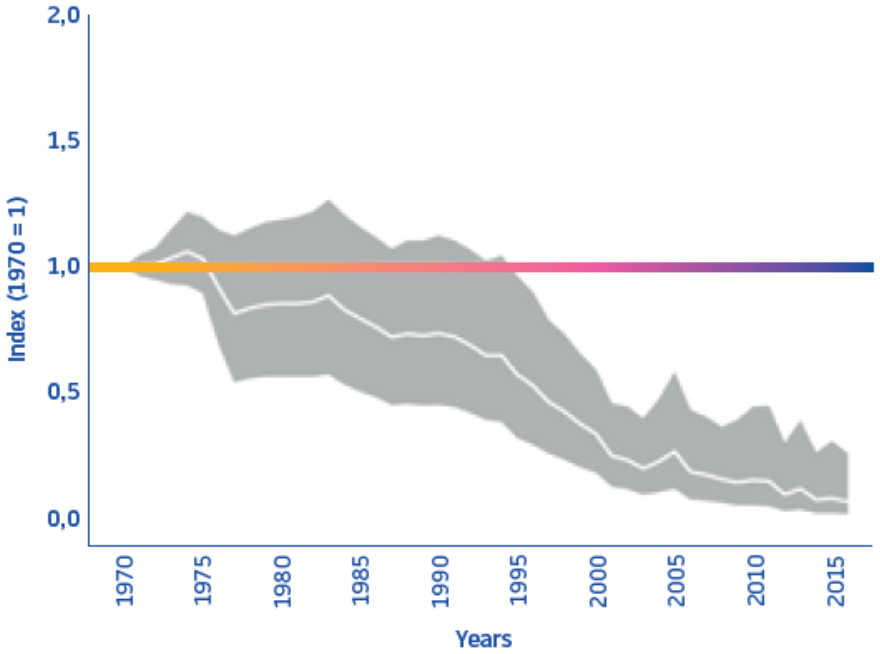
Migratory fish decline

Worldwide decline of migratory fish species: 76% since 1970

Europe: 93%!



Deinet et al. 2020

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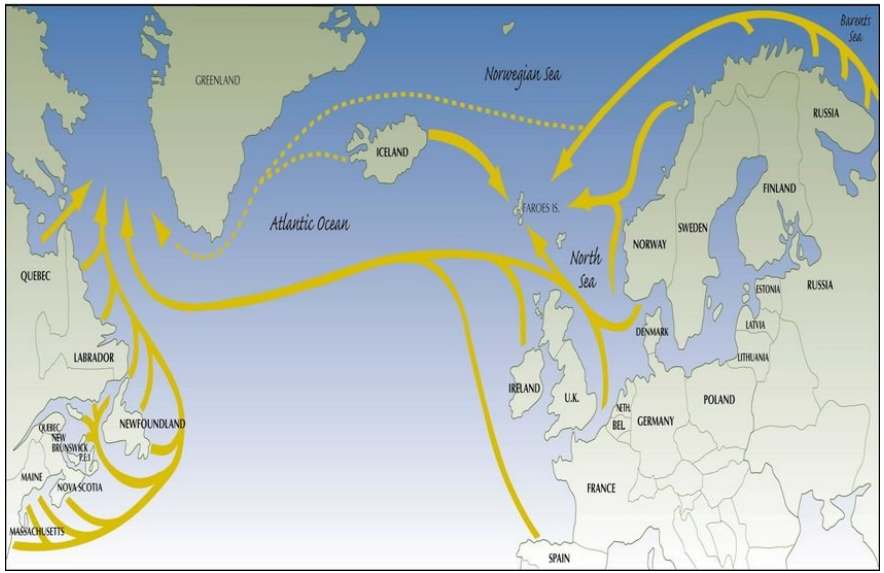
Atlantic salmon (Salmo salar)

- Declines between 50% (NE) - 70% (NA) – 90% (SE), since 1980s
- Anadromous
- Migrates to Greenland

and Faroe islands to feed

- "Rhine" salmon



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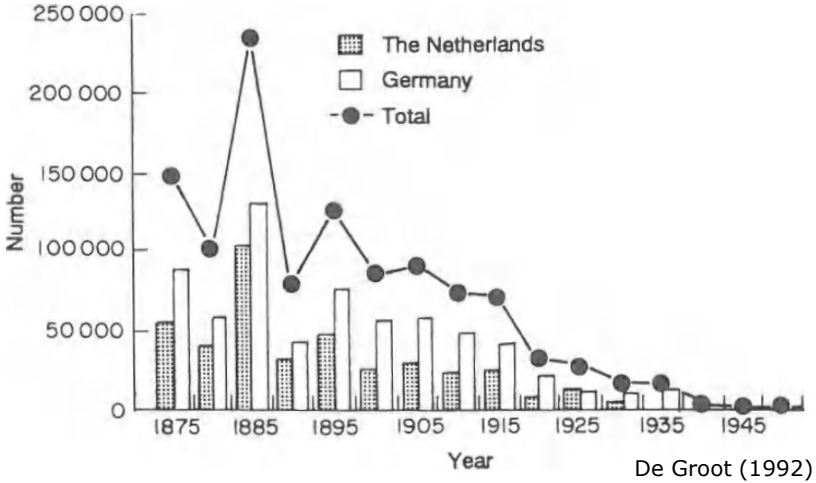
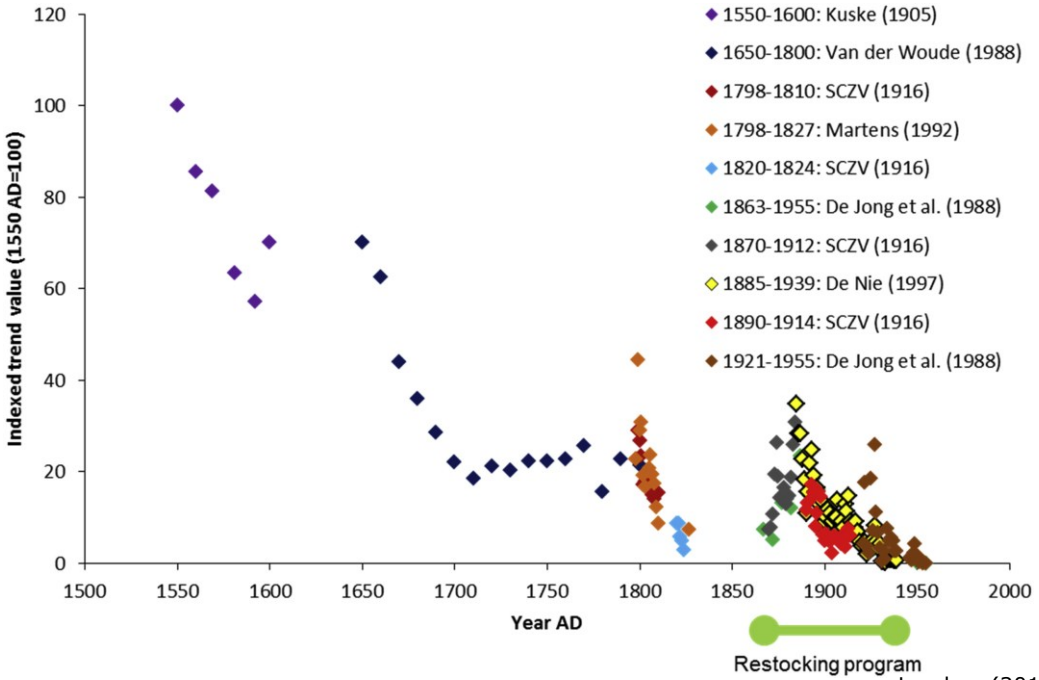
ICES (2021)

Rhine salmon extinct in the 1950s



De Groot (1992)



Lenders (2017)

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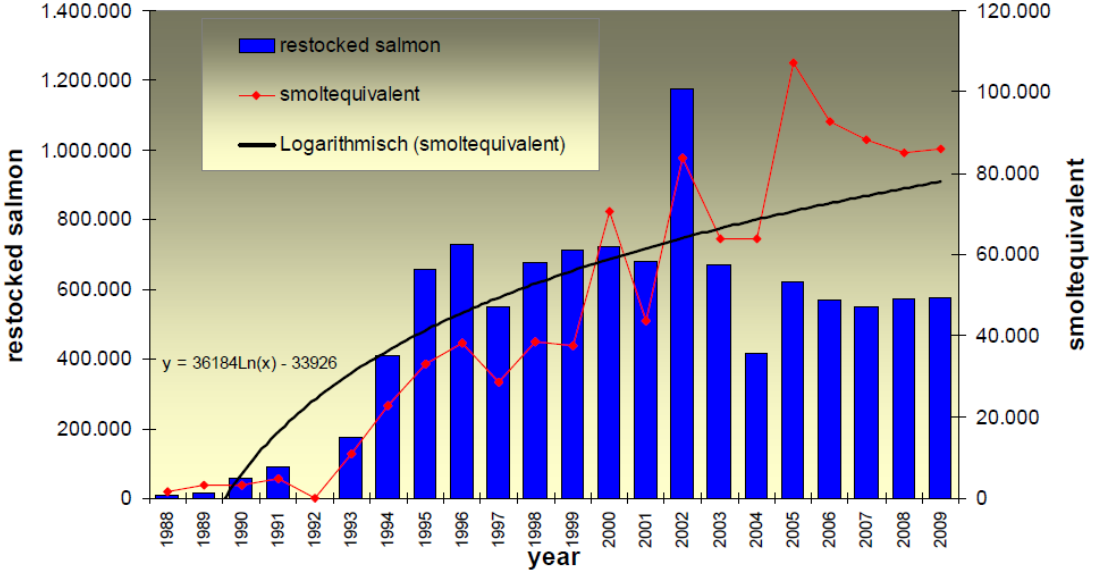
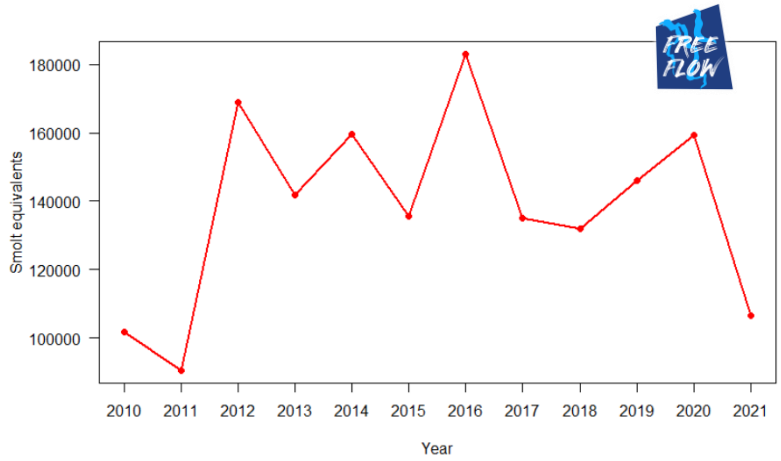
Reintroduction – 1980s



Data: LANUV (NRW, Germany), assembled by Armin Nemitz (Rhineland Fishery-Association)



Data: ICPR, smolt equivalents calculated based on ICPR (2009)

Photo:Armin Nemitz

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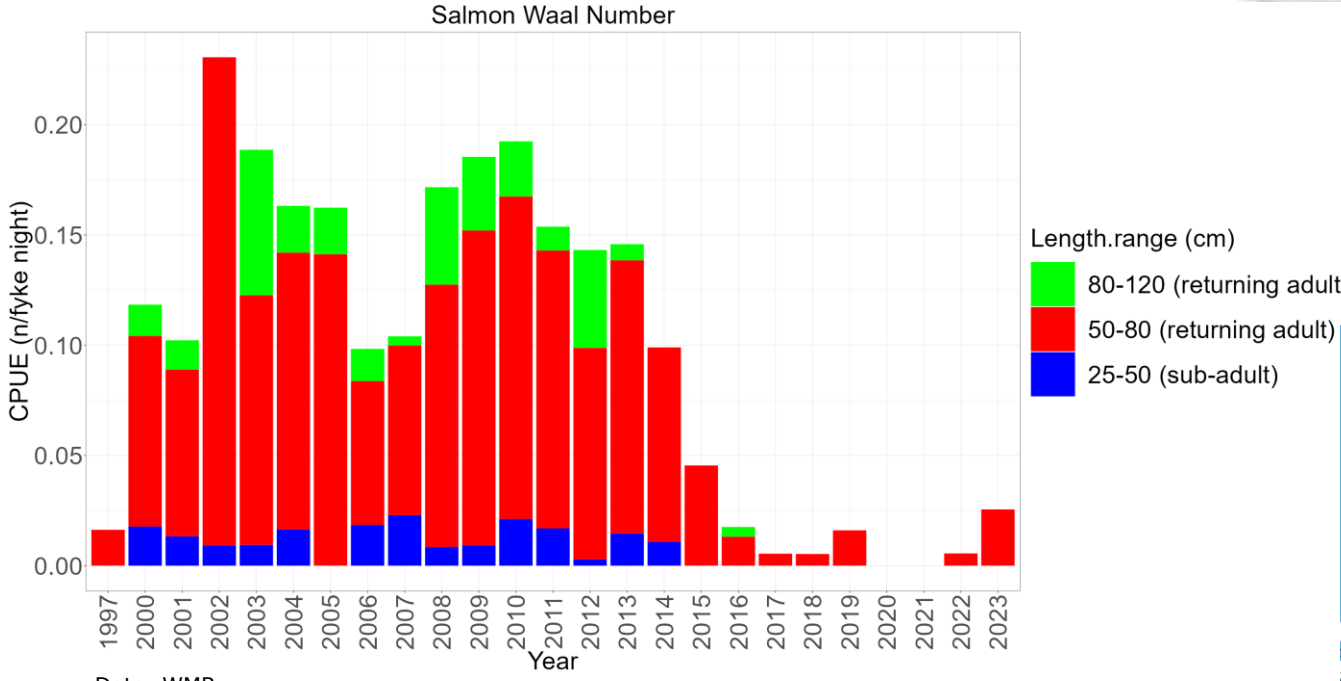
Salmon trend (river Waal)



Data: WMR

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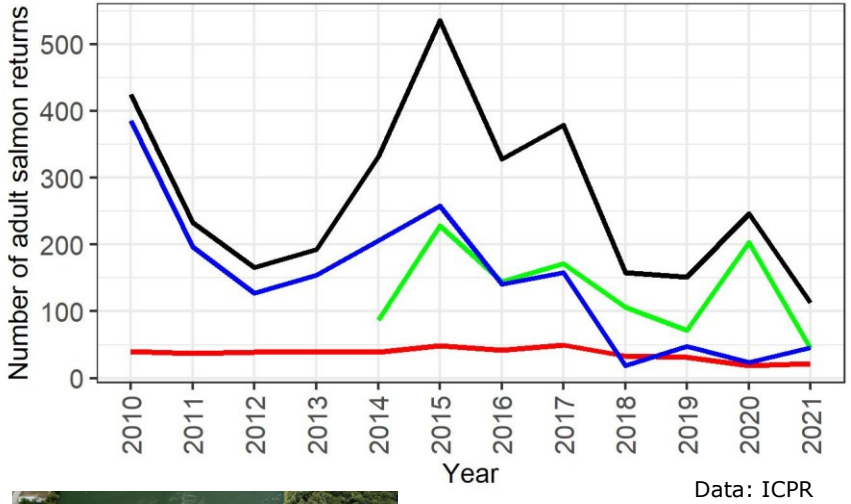
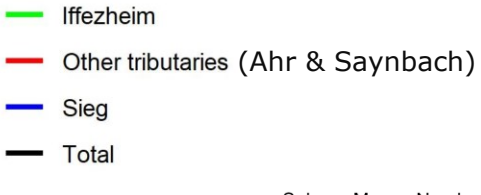
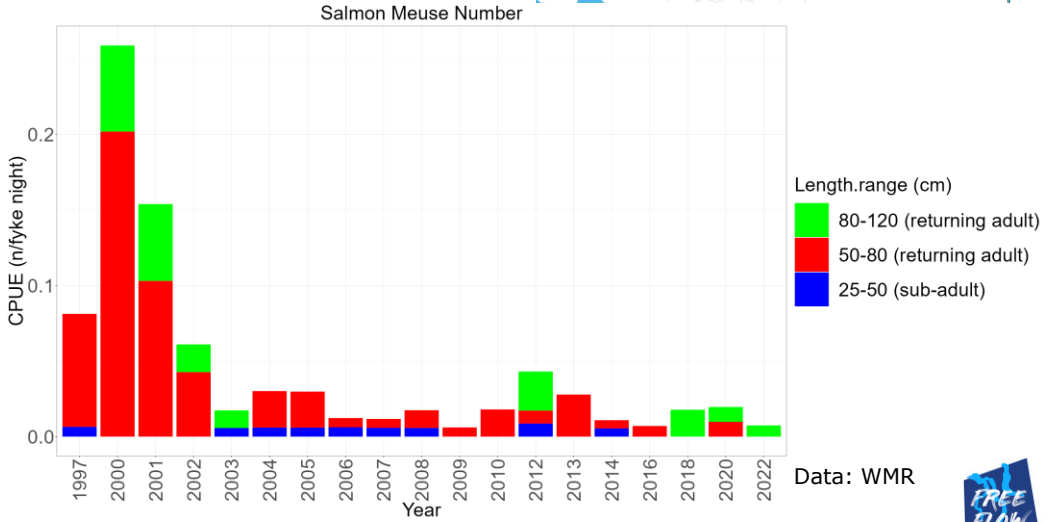
Salmon trend (German tributaries and Meuse)



Data: ICPR





Data: WMR

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Methods (fish tracking)

- Adults: 926 sea trout, 195 salmon (2001-2016)

@Haringvliet sluices

- Smolts: 1305 salmon (2006-2016)

@Sieg, Dhünn, and Wupper

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Results

Smolts

- Average number of reintroduced smolts ~138.000 (2010-2021)
- Average natural production ~2000 smolts (2010-2021) Data: Jörg Schneider
- Average total 140.000 smolts

Adults

- Average number of returning adults 279
- 35%-75% is estimated to be observed Armin Nemitz (personal communication)
- 373-798 returning adults per year

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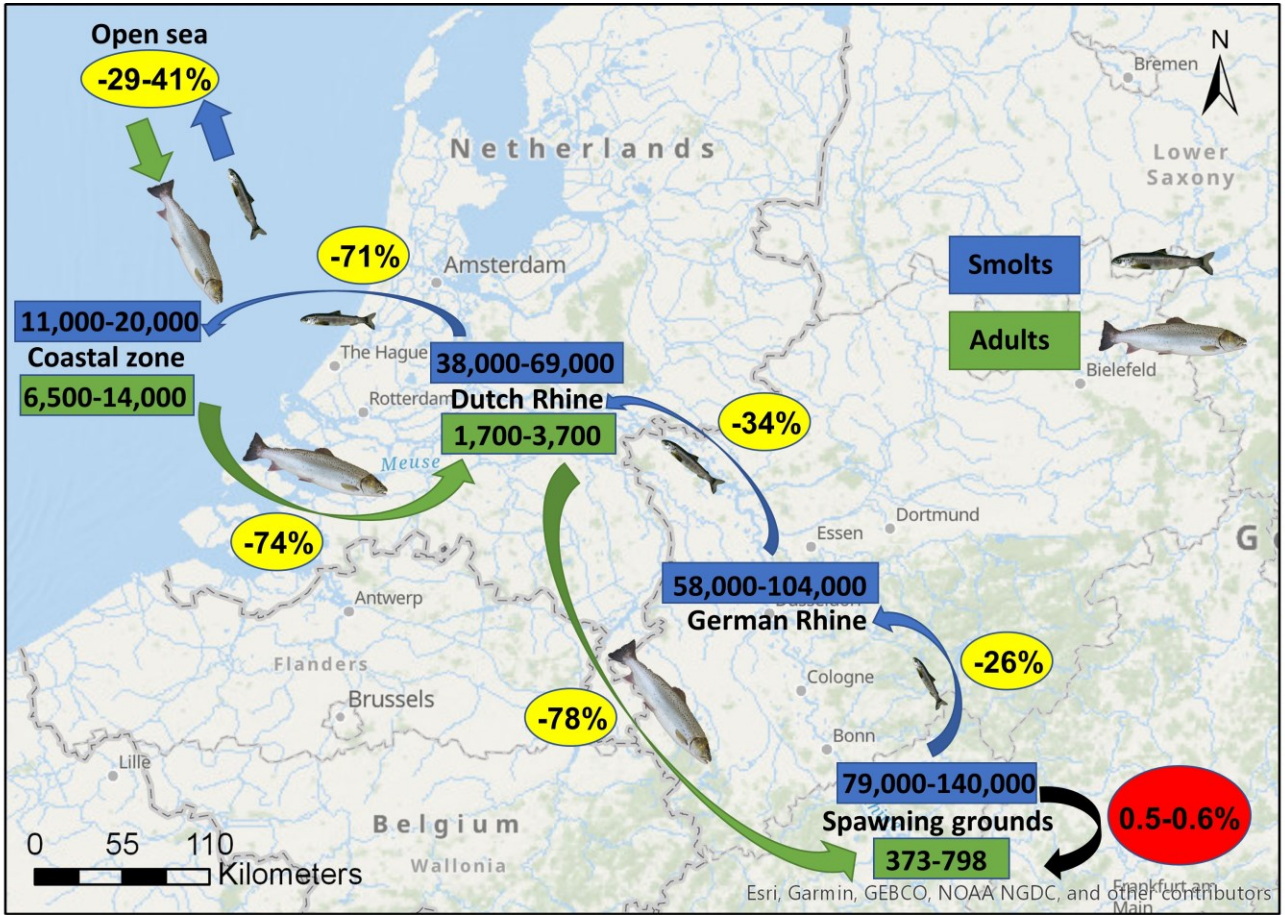
Results



56% of tagged smolts reach mouth of river Wupper, equals minimum estimate

Discussion

- Return rate of 0.5-0.6%, while ~3% is assumed to be needed for self-sustaining population Schneider (2009)
- Losses are very high in freshwater (26%-78%), marine “only” (29-41%)
- However, large (29 cm), 2+, hatchery reared smolts used

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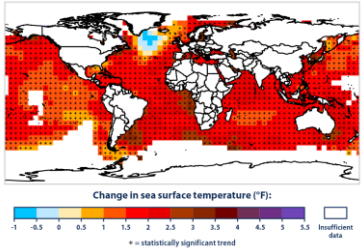
Discussion – probable causes

- Turbines, weirs
- Predation
- Ship navigation
- Reduced discharge
- Fisheries (oceanic)
- Reduced body condition
- Food availability (in the ocean)



- Warmer ocean and river temperatures
- Illegal, unreported & unregulated (IUU) fisheries
- Insufficient spawning/nursery habitat quality
- Pink salmon?
- Genetic (un)suitability?
- Overstocking same time/place?

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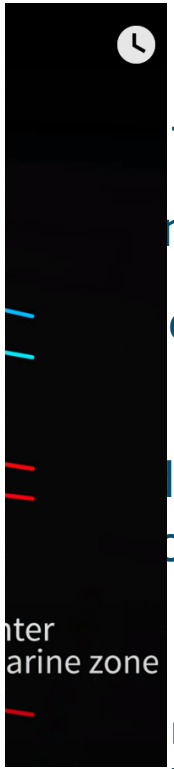
Conclusions



tive effects?

nvironment →

ers! Einum & Nislow (2010),

l discharge

o-called human

https://atlanticsalmontrust.org/our-work/morayfirthtrackingproject/

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Take home messages

- Too much focus on adult salmon ocean phase, smolt survival crucial for population!
- So....freshwater-part of lifecycle = crucial
- Restoring rivers should be primary focus
- Salmon can be used as an indicator of river restoration

  No salmon = no properly restored river

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Thank you!

Thanks to:

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Jörg Schneider (Büro für fisch- und gewässerökologische Studien)

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