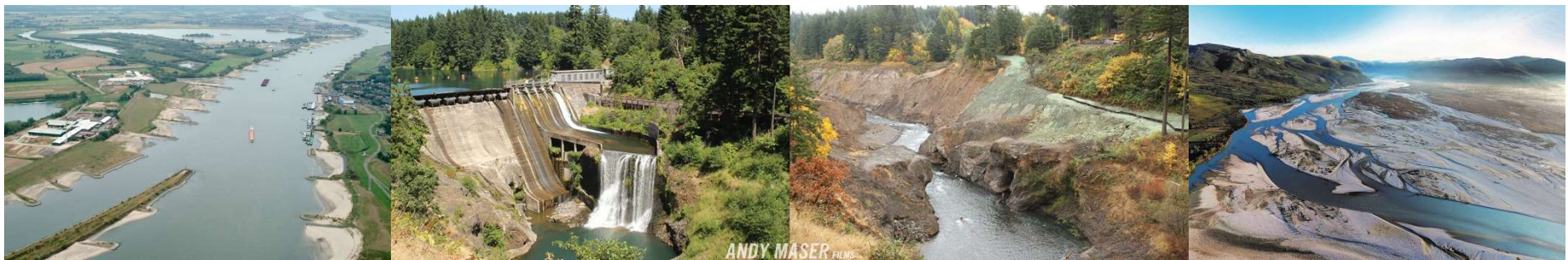


# Importance and threats to river ecosystems – with a focus on Europe and the Alps

**Klement Tockner**

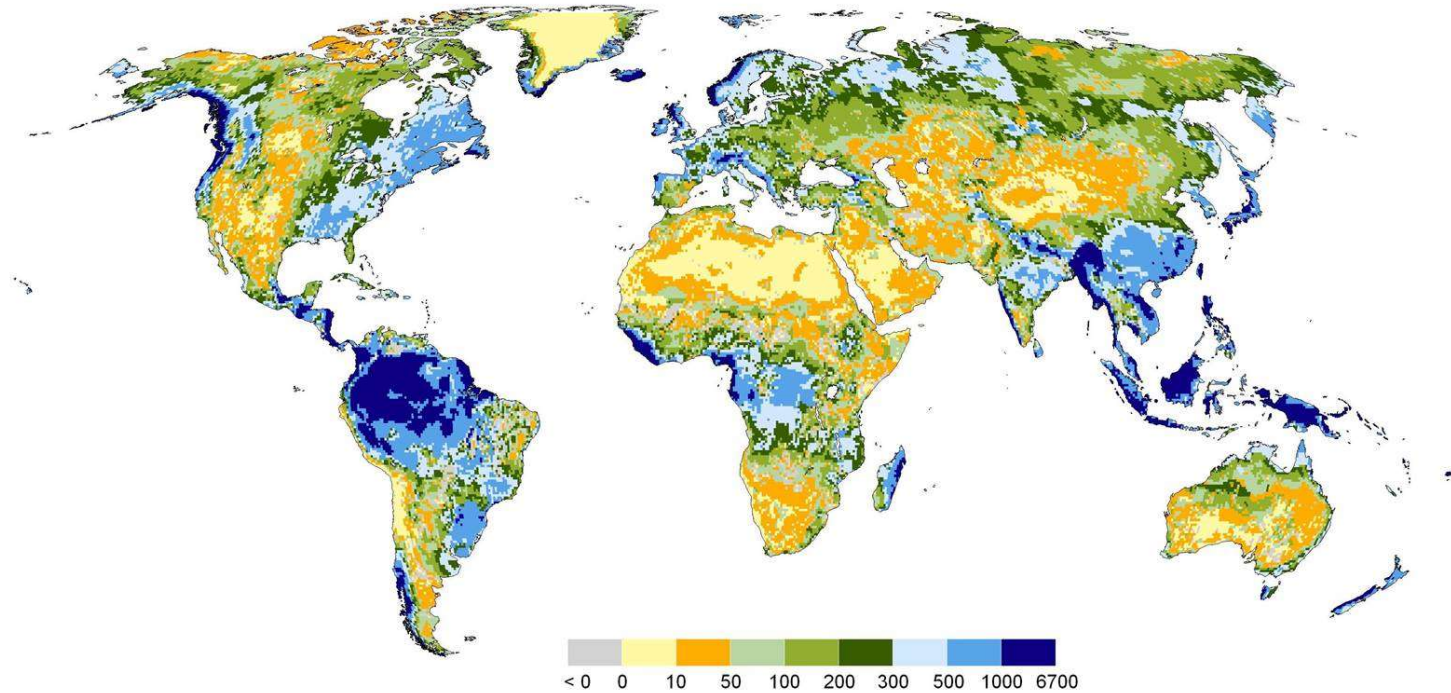
[www.senckenberg.de](http://www.senckenberg.de)

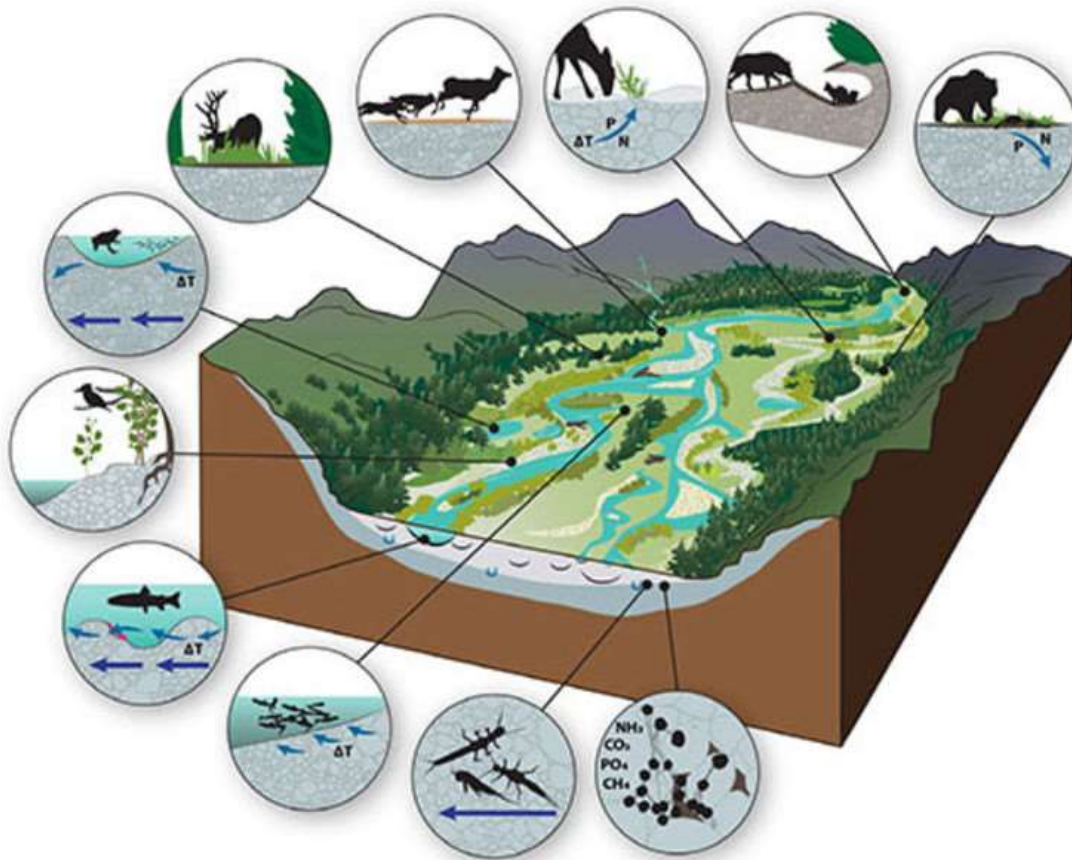
[klement.tockner@senckenberg.de](mailto:klement.tockner@senckenberg.de)



# Global distribution of freshwater resources

(in mm; WaterGap Model; [www.watergap.de](http://www.watergap.de))





**Aquatic, amphibic,  
terrestrial diversity**

**Ecosystem functions  
(e.g. refugia, carbon and  
nutrient cycling)**

**Ecosystem services  
(e.g. recreation, biomass)**

Courtesy: Emily Harrington



## Domesticated ecosystems (e.g. Rhine River)

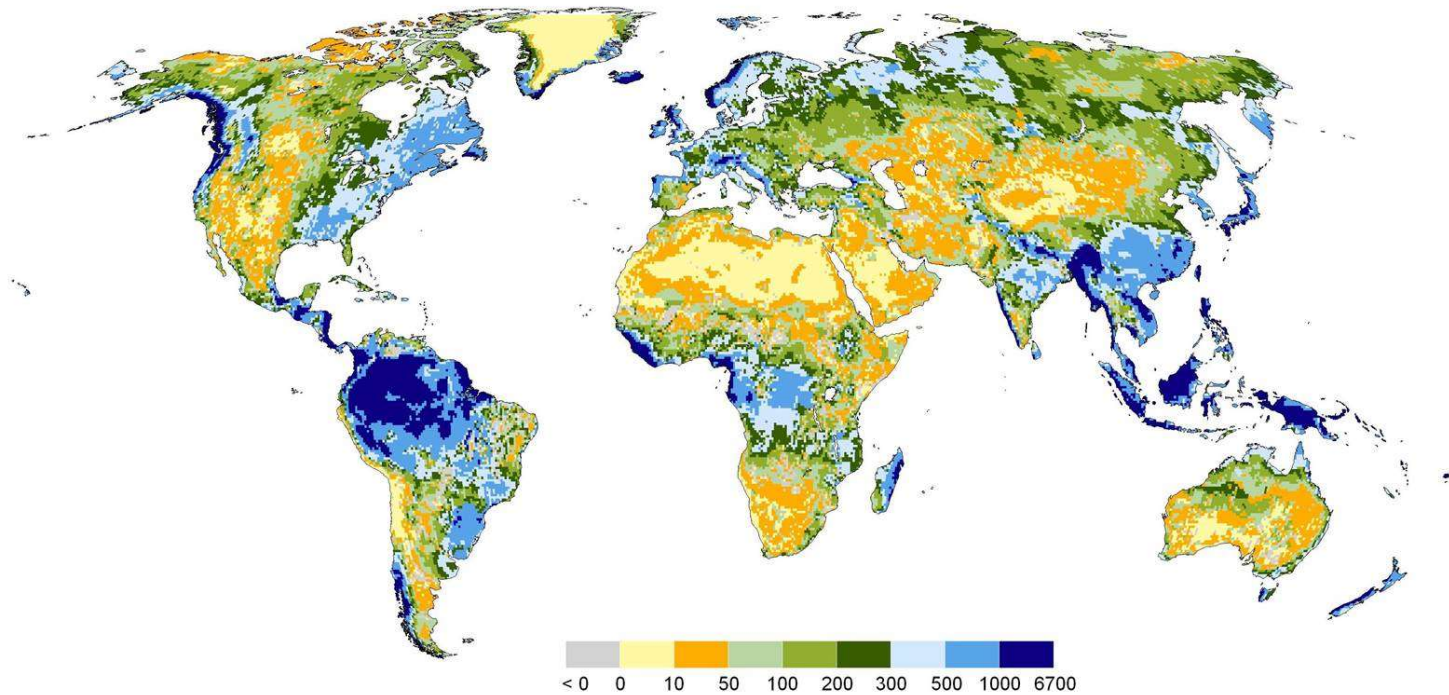
Floodplains:	11,900 km <sup>2</sup>
People:	9.1 million
BIP p.a.:	335 billion US \$



(Photo: Rijkswaterstaat, The Netherlands).

# Global distribution of freshwater resources

(in mm; WaterGap Model; [www.watergap.de](http://www.watergap.de))





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## Engineering solutions

[www.forumforthefuture.org](http://www.forumforthefuture.org)

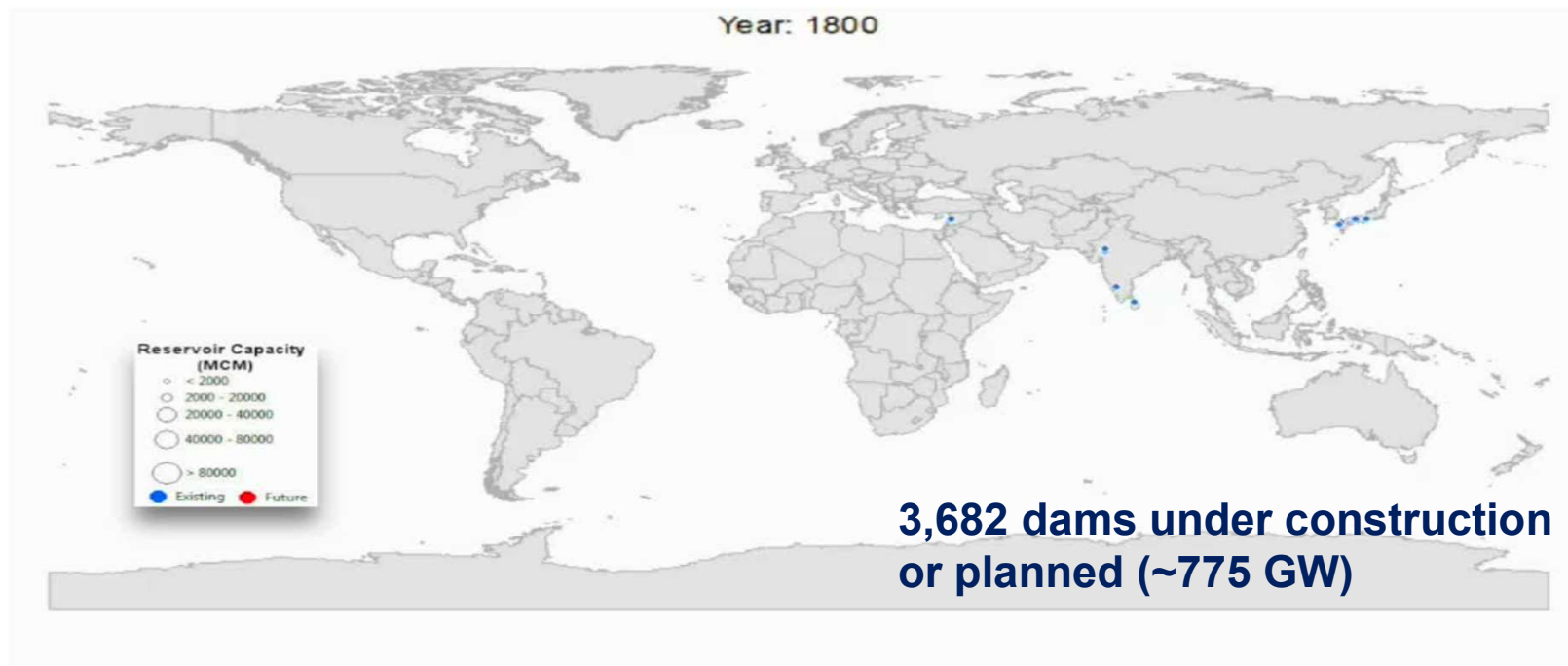


[www.symbiont.ansp.org](http://www.symbiont.ansp.org)



[www.smartwatermagazine.com](http://www.smartwatermagazine.com)

## Global development of hydropower dam construction – doubling current hydropower capacity



(Animation by Fabio Corso; data: Lehner et al. 2011, Zarfl et al. 2015)

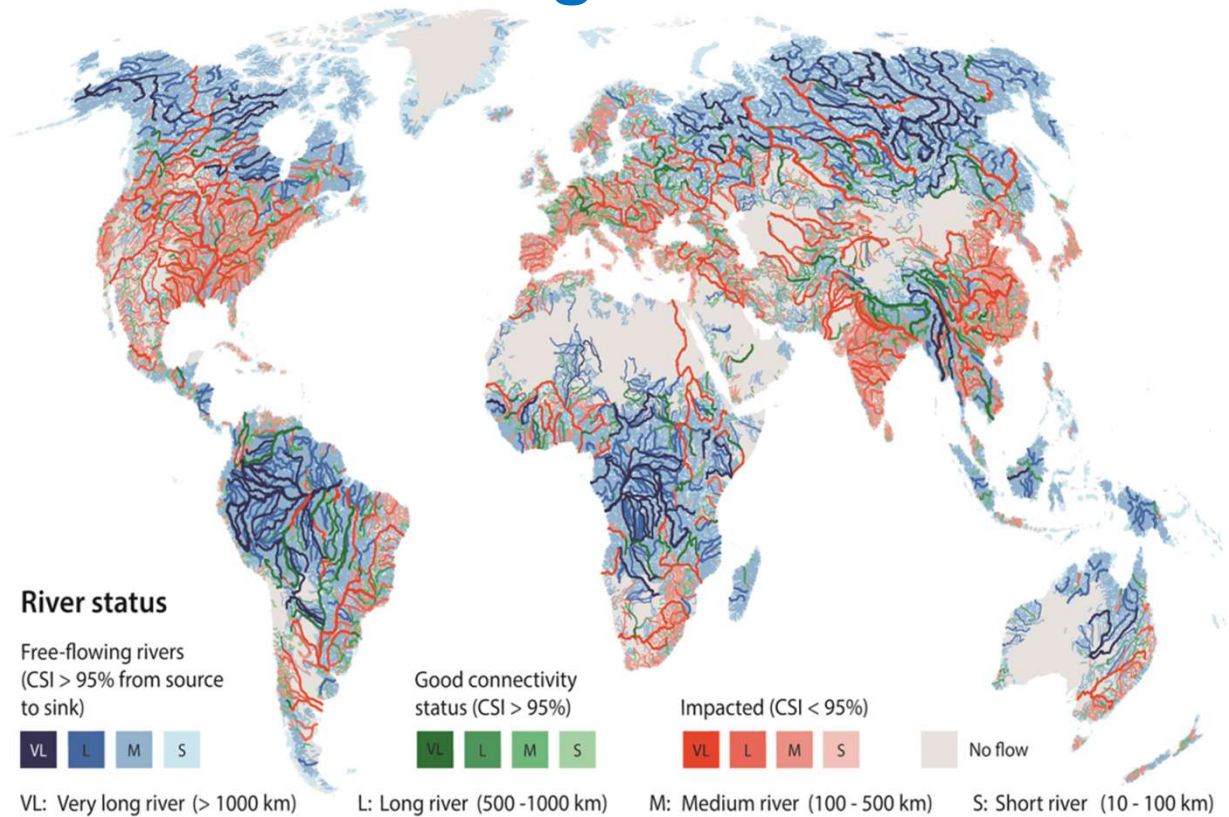
## Hydropower development is a global business

- average global investment in hydropower has increased more than **sixfold** within the past decade
- total expected investment within coming decade(s): more than **two trillion US \$** in dam construction
- Africa: **Hydromine** (USA) and **Sinohydro** (China) main investors (e.g. > 1 billion US \$ in Cameroon and Zambia, respectively)
- **no correlation** between future hydropower dam construction and the economic condition of a country

(Zarfl *et al.* 2015. Aquatic Sciences)

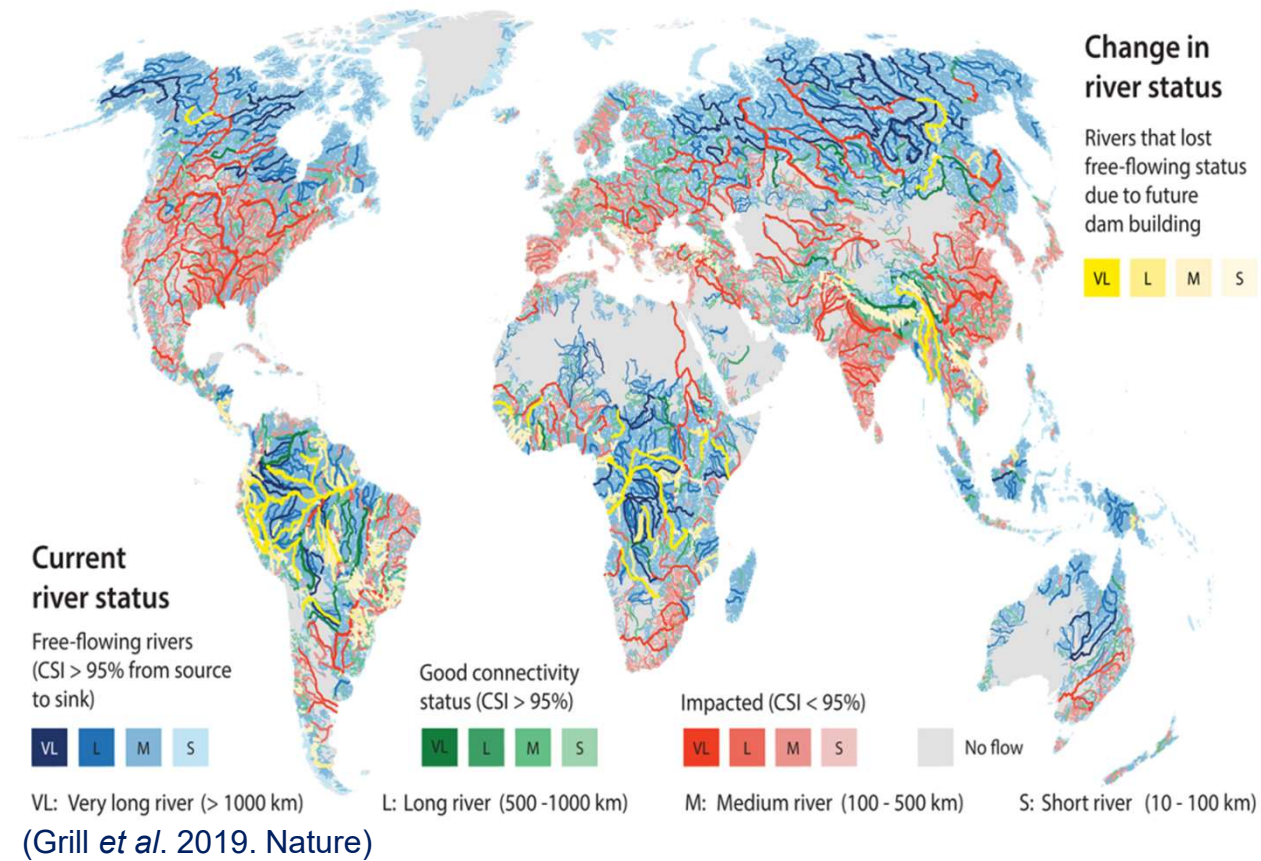


## Free flowing rivers are rare

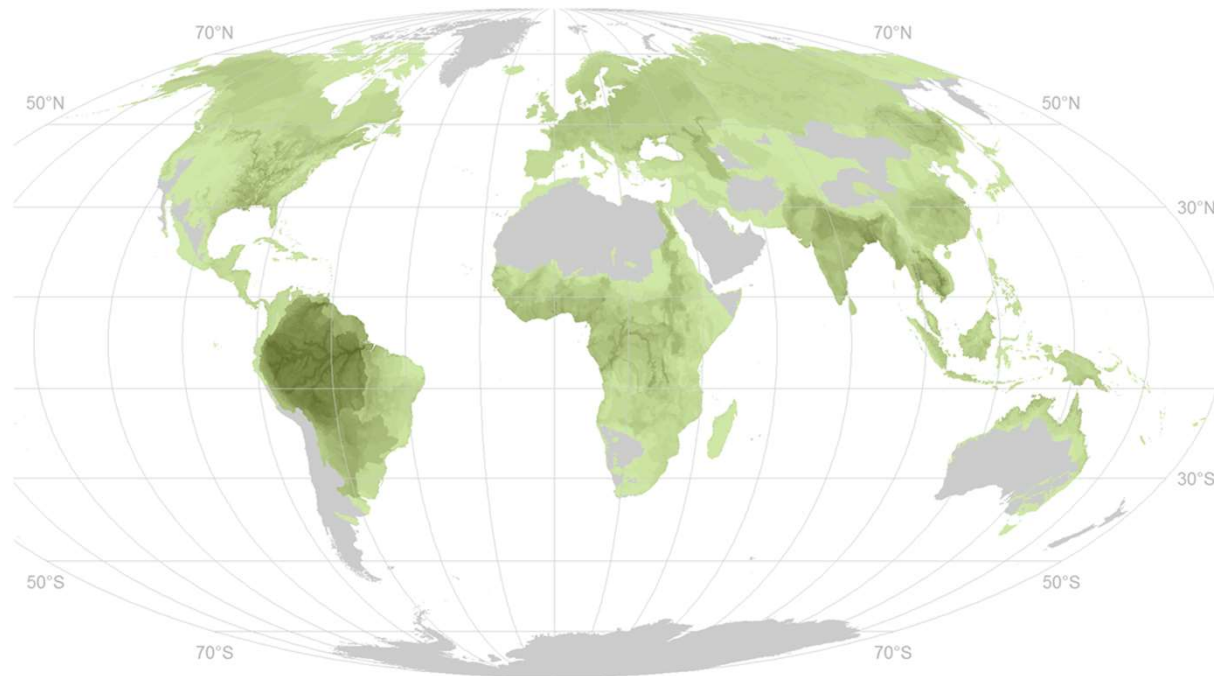


(Grill *et al.* 2019. Nature)

# Free flowing rivers are becoming more rare

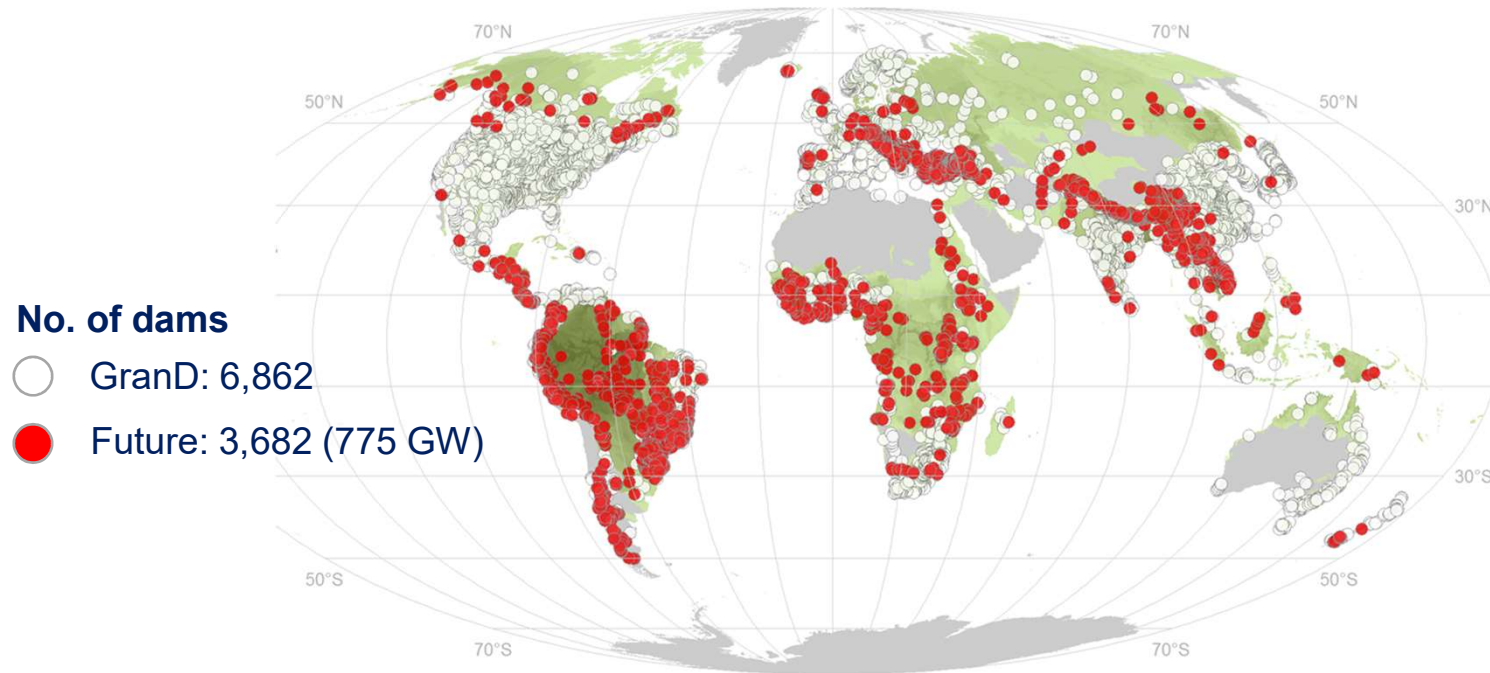


## Freshwater megafauna species richness



(Data: IUCN, IGB, BioFresh; Cavrizo *et al.* BioScience. 2017; He *et al.* 2018)

## Overlap of megafauna species richness and dams





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**Conservation**

## Giant river animals on verge of extinction, report warns

(10 August 2019)

*Populations of great freshwater species, from catfish to stingrays, have plunged by 97% since 1970* (He *et al.* 2019. Global Change Biology)

## Pandemic array of transformations in the water cycle

- Megaprojects build on self-confidence about technological progress. They are considered as a way to stimulate economic development and to demonstrate power.
- Underestimation of risks and overestimation of benefits (“survival of the unfittest”)
- Megaprojects constrain the development of alternative options for future generations.
- A reference-based forecasting required (e.g., outside view, benchmarking against similar projects)
- Ecological engineering: A potential solution?

**„Impair – then repair water“ is the dominant  
approach to human water security**

(Vörosmary *et al.* 2010. Nature)

## Environmentally harmful subsidies (Germany, EPA, 2017)

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Traffic:	28.6 billion Euro p.a.
Energy:	20.3 billion Euro p.a.
Agriculture:	5.8 billion Euro p.a.
Construction:	2.3 Billion Euro p.a.

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<b>Total:</b>	<b>57.0 billion Euro p.a.</b>
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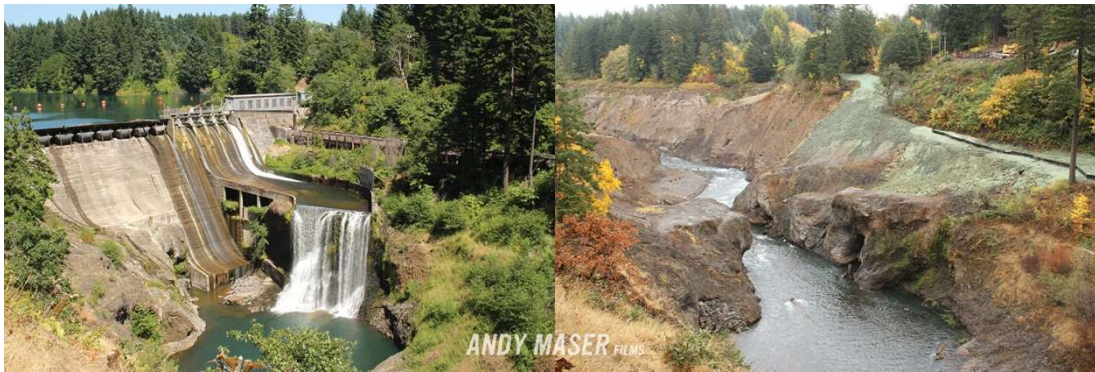
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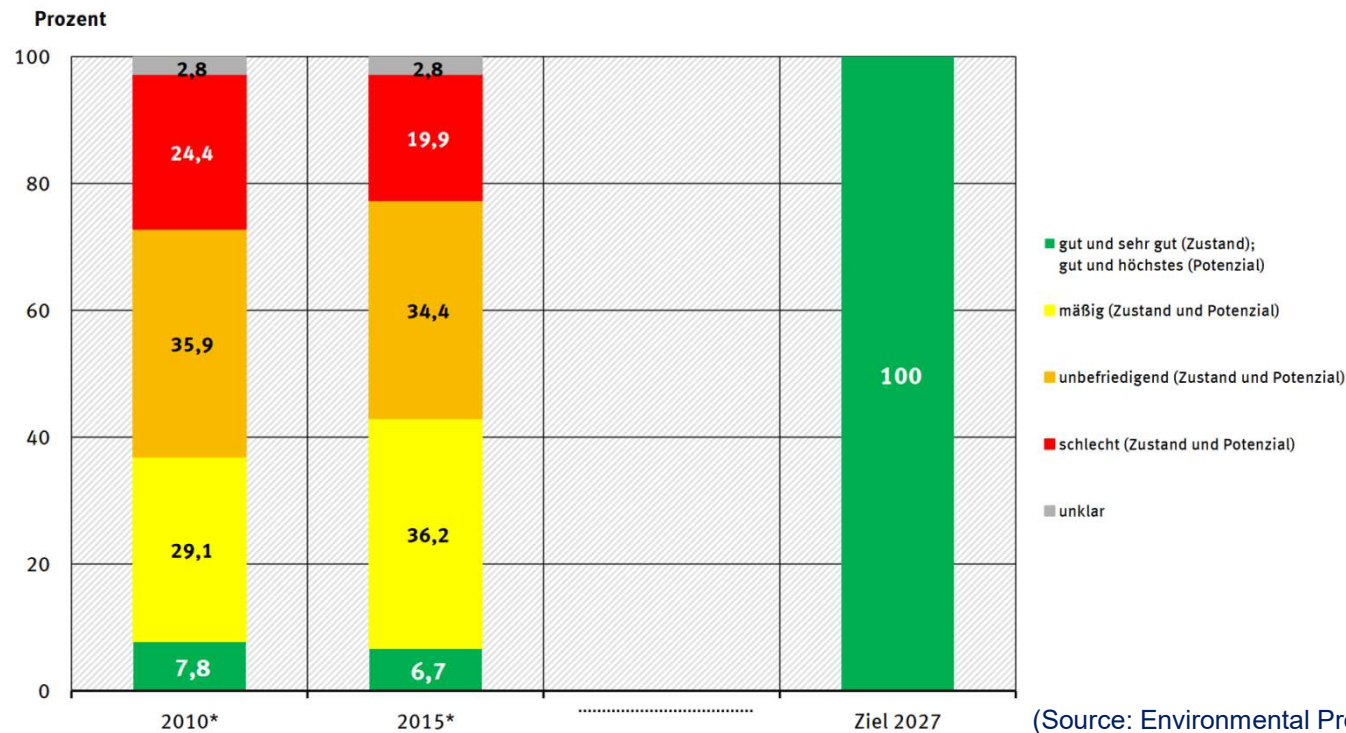
UNITED NATIONS DECADE ON  
**ECOSYSTEM  
RESTORATION**  
2021-2030



Condit Dam



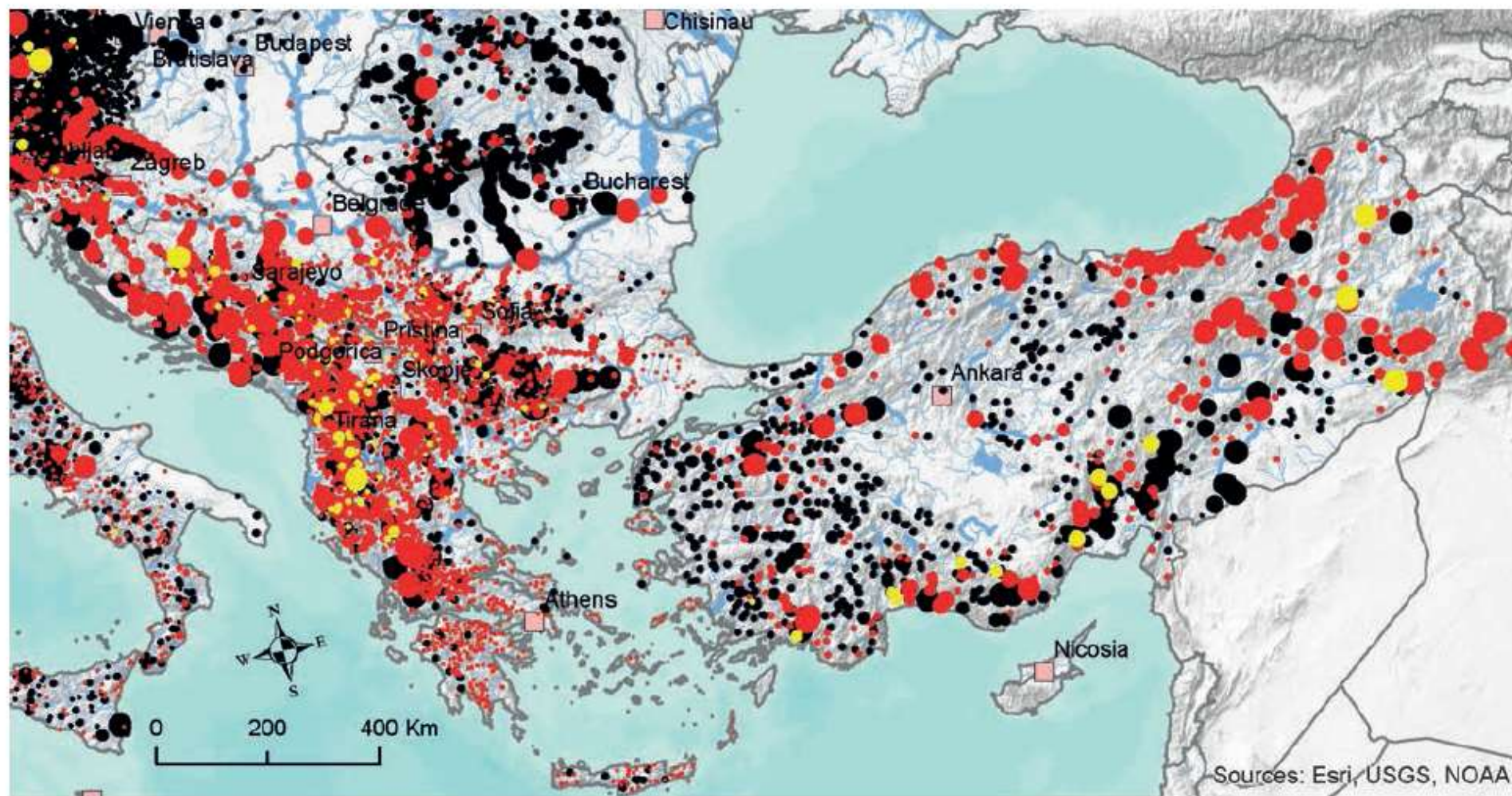
## EU WFD: Ambitious goals, limited actions



\* Die Jahresangaben beziehen sich auf das Jahr der Berichterstattung an die EU. Für das Berichtsjahr 2010 wurden die Daten bis 2008 erhoben. Für das Berichtsjahr 2015 erfolgte die Datenerhebung in den Jahren 2009 bis 2014.

Quelle: Umweltbundesamt, Berichtsportal WasserBLICK; Bundesanstalt für Gewässerkunde 2015, Bewirtschaftungspläne für die Periode 2016 bis 2021







## Balkan: Existing freshwater megafauna



©Tony Gilbert

Beluga

Critically Endangered



©Juan Manuel Borrero

Stellate Sturgeon

Critically Endangered



©Reinhard Dirscherl

Russian Sturgeon

Critically Endangered



©Prazak

Huchen

Endangered



©Peter Valic

Marble Trout

Least Concern



©Georg Mittenecker

Northern Pike

Least Concern



©Vilda-Rollin Verlinde

Eurasian Beaver

Least Concern



©Dieter Florian

Wels Catfish

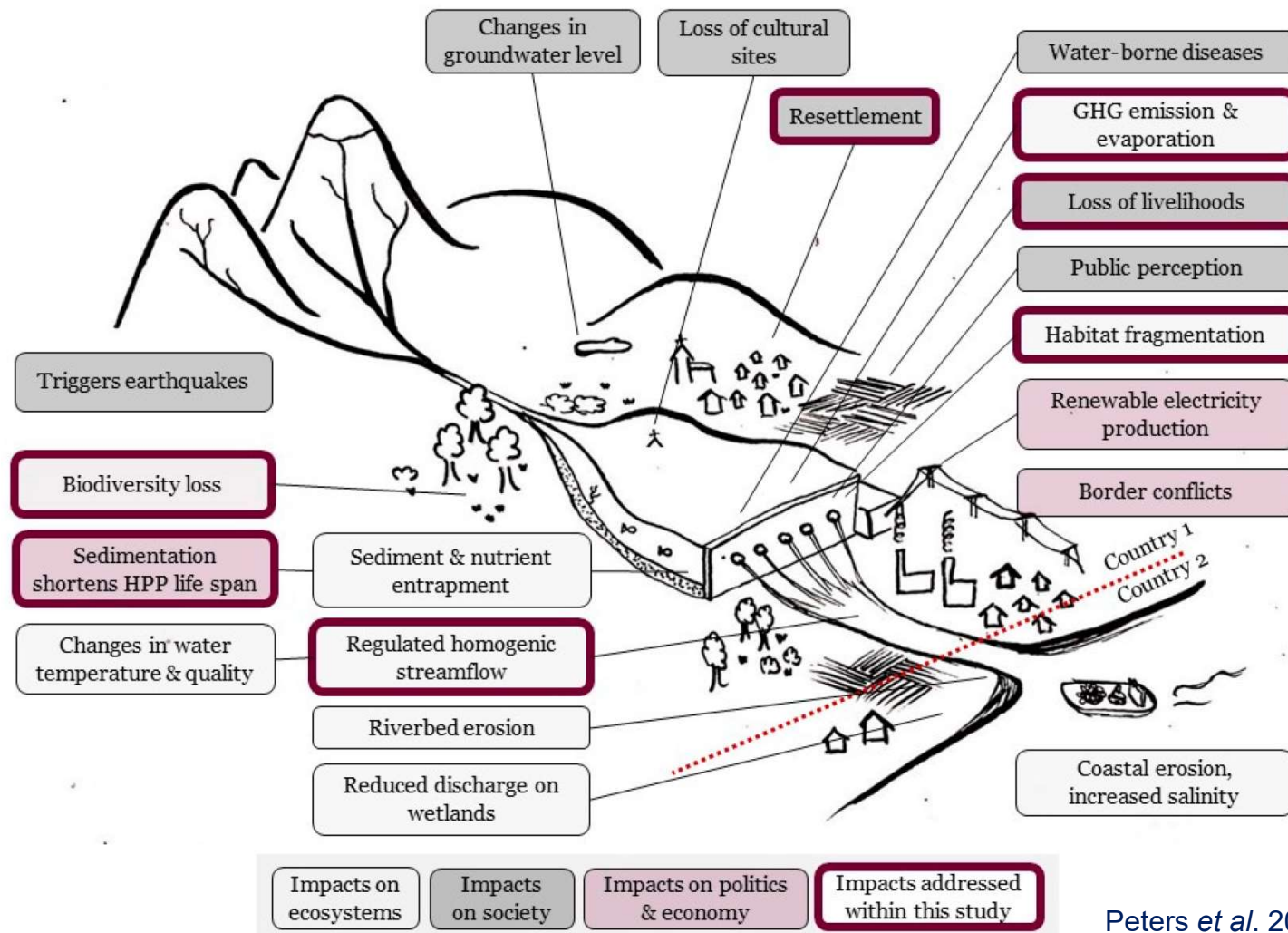
Least Concern



# Vjosa River

(Foto: Gregor Subic)







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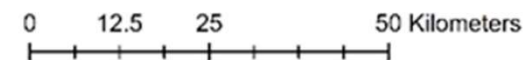
## Vjosa Catchment



### Planned HPP [Top quartile in specific scenario(s)]

- Planned HPP not within the top quartile of any scenario
- ▲ Conservationist
- Economist
- ◆ Climate Protector
- ◆ Conservationist, Climate Protector
- Economist, Climate Protector
- ✱ Conservationist, Economist, Climate Protector

Peters *et al.* 2021. Sustainability.



## Innovative solutions for hydropower

(Moran et al. 2018. PNAS, 115, 11891ff)

- Environmental impact assessments (EIAs) and social impact assessments (SIAs) need to be capable of stopping a dam from being built.
- EIAs and SIAs must be carried out by firms serving citizens rather than the dam builders, and they are essential tools worldwide.
- Hydropower designs need to truly allow fish passage and mimic the seasonal river flows.
- Greater transparency with society about the true costs and benefits (including social, cultural, economic, political, and environmental costs and the costs of dam removal at the end of the dam lifespan) is needed.
- Innovative technologies that do not require damming the river or resettling population are needed.

**Thank you for your attention!**

**Klement Tockner**

[www.senckenberg.de](http://www.senckenberg.de)

[klement.tockner@senckenberg.de](mailto:klement.tockner@senckenberg.de)

