

Our rivers in 2045

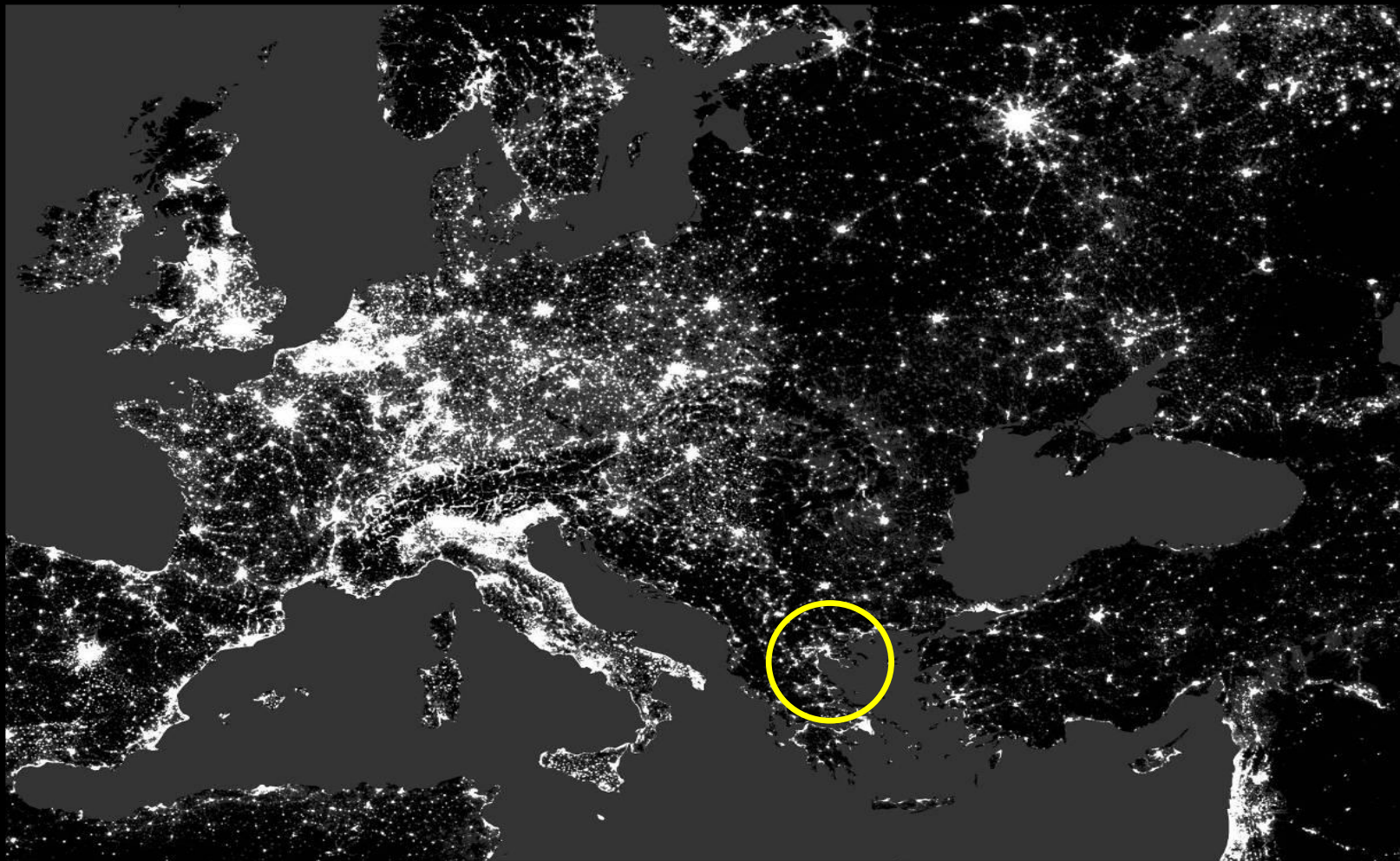


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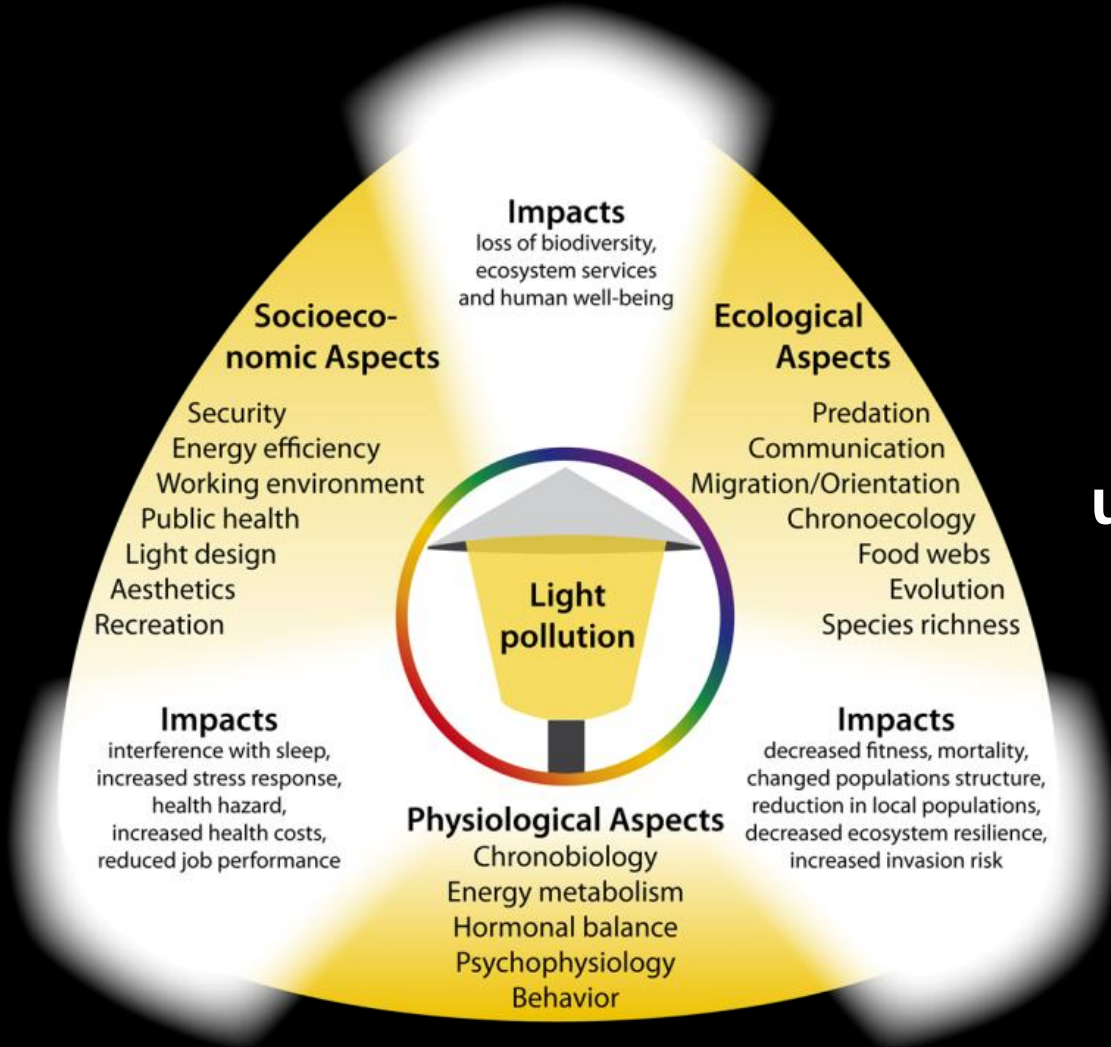


Increase of artificial light p.a. (worldwide): 6% (0–20%)

Electric power consumption (lighting, of total electricity): .

EU: 14%
GLOBAL: 19% (1,900 Mill t CO₂)

**Inn River
Valley, Austria**
(Photo: Christoph Malin)

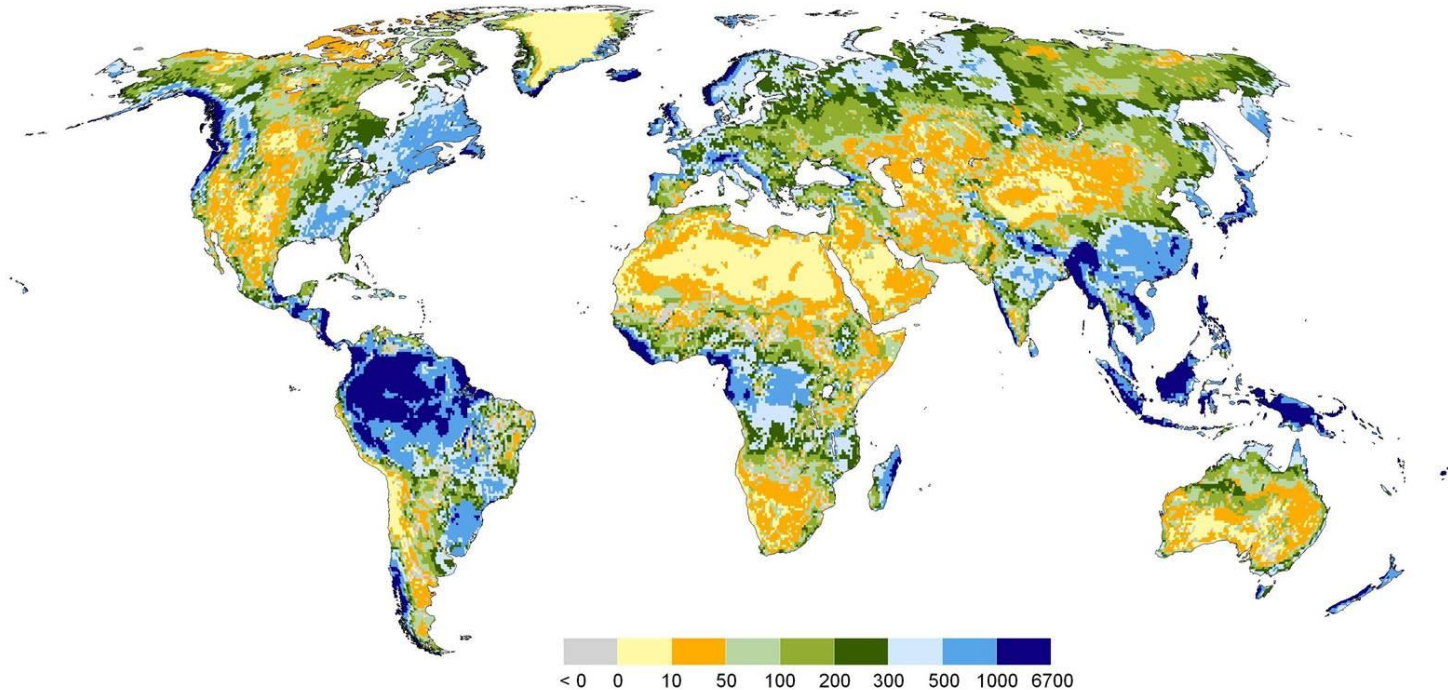


Self-experiment with unpredictable outcomes

(Hölker *et al.* 2010. Ecology & Society)

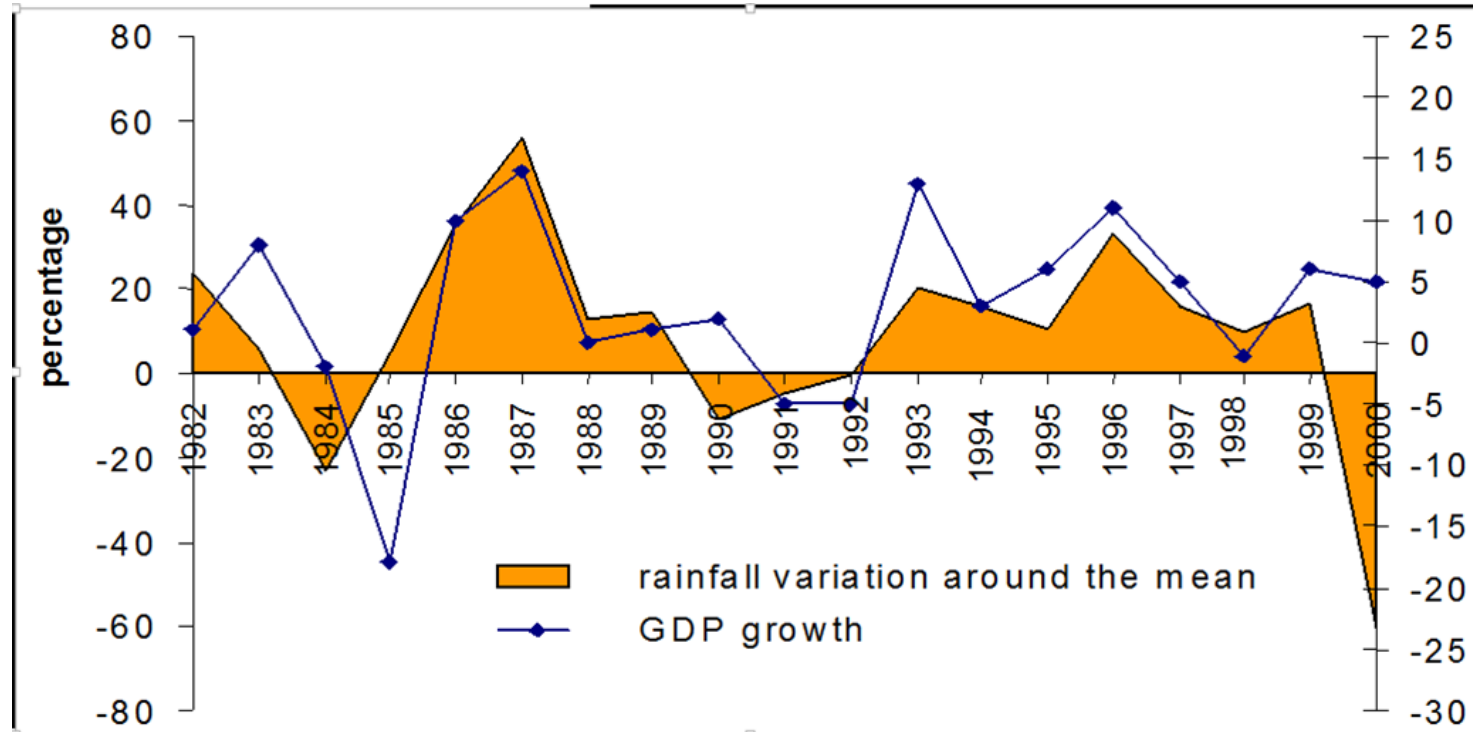
Global distribution of freshwater resources

(in mm; WaterGap Model; www.watgap.de)



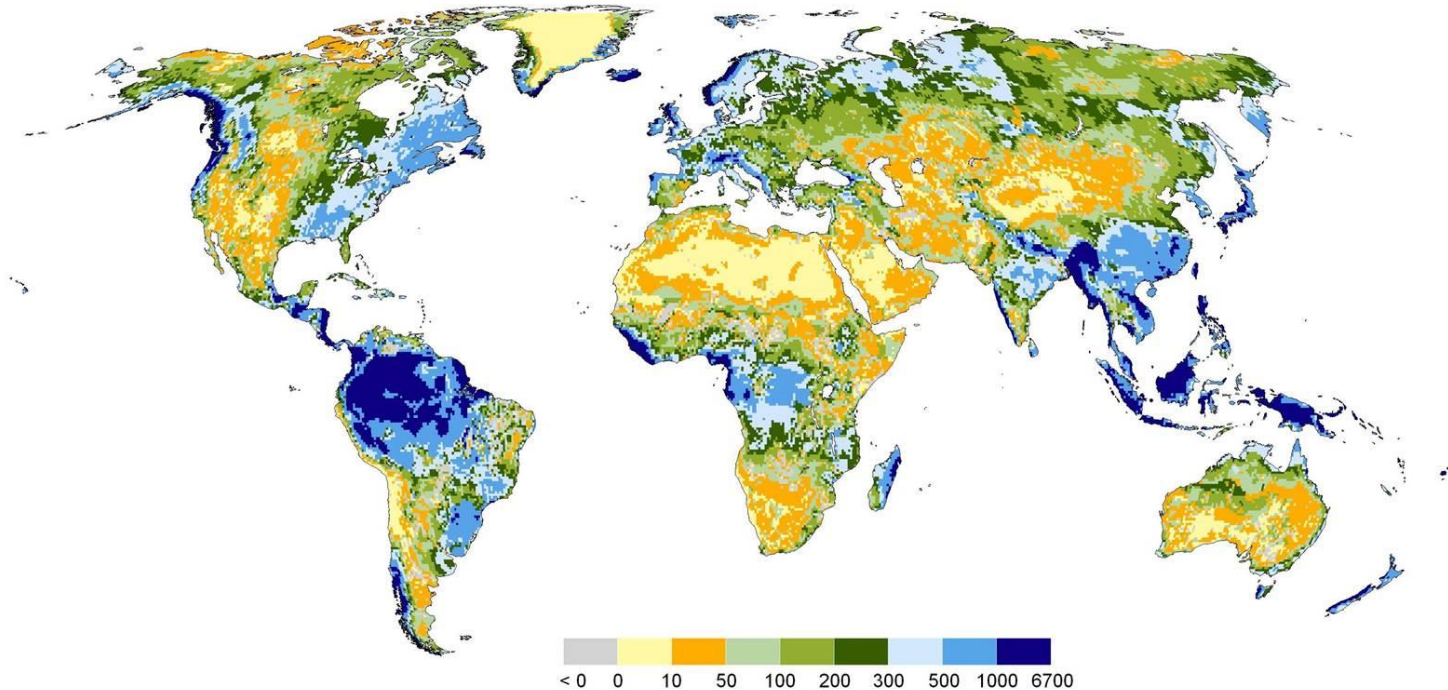
Africa: Rainfall and GDP growth

(from J. Bogardi, pers. comm.)



Global distribution of freshwater resources

(in mm; WaterGap Model; www.watergap.de)



Engineering solutions

www.forumforthefuture.org

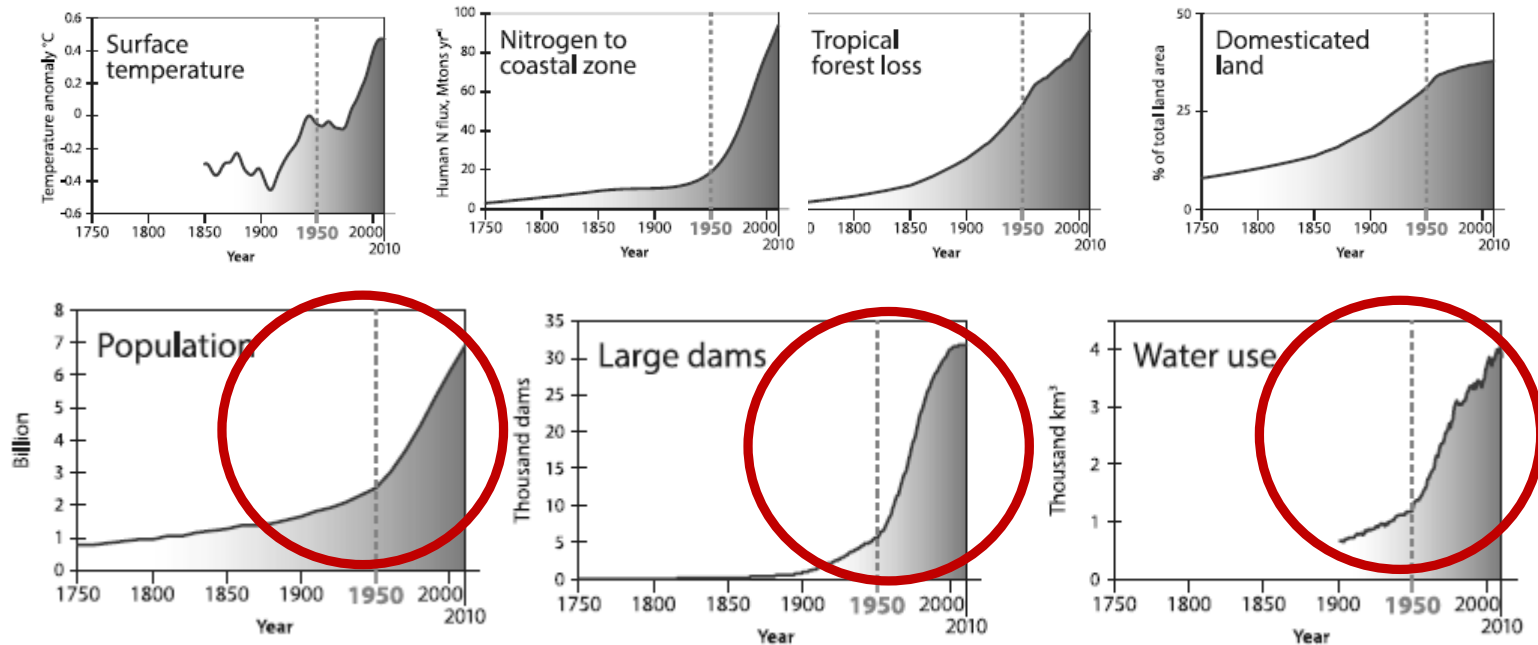


www.symbiont.ansp.org



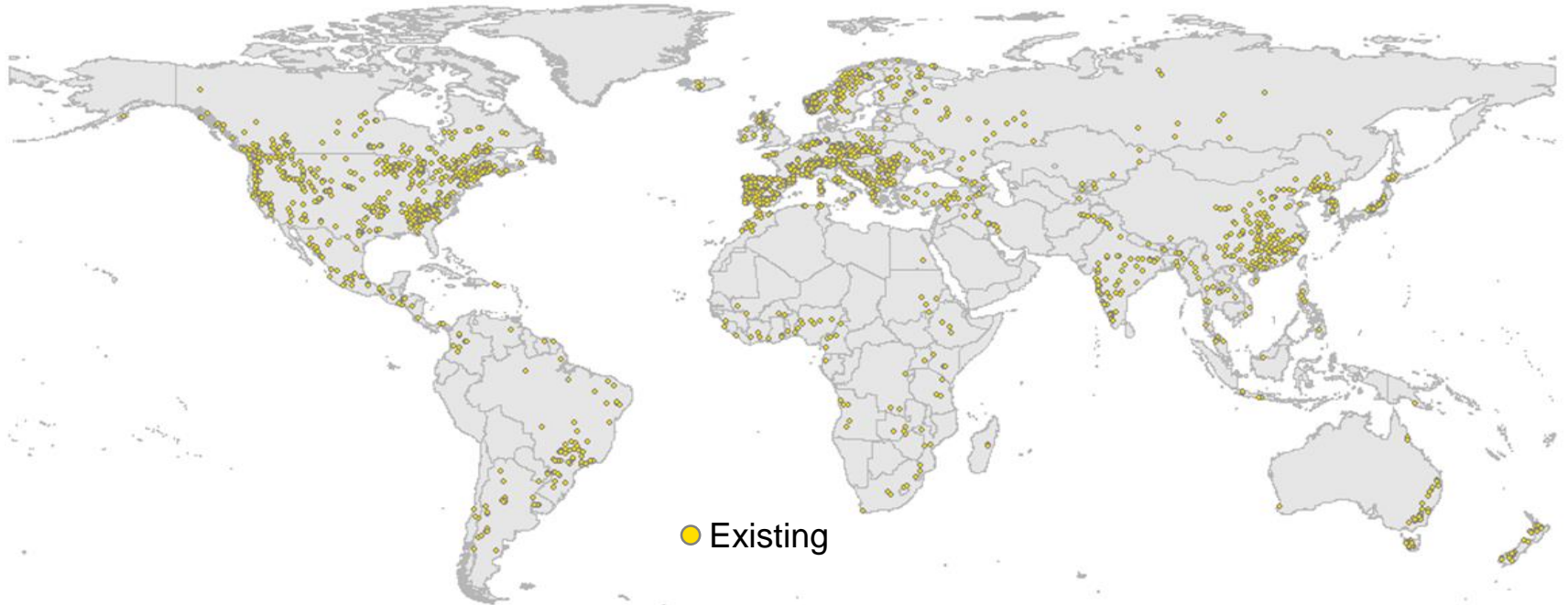
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Anthropocene: The big acceleration



(Young & Steffen, 2009)

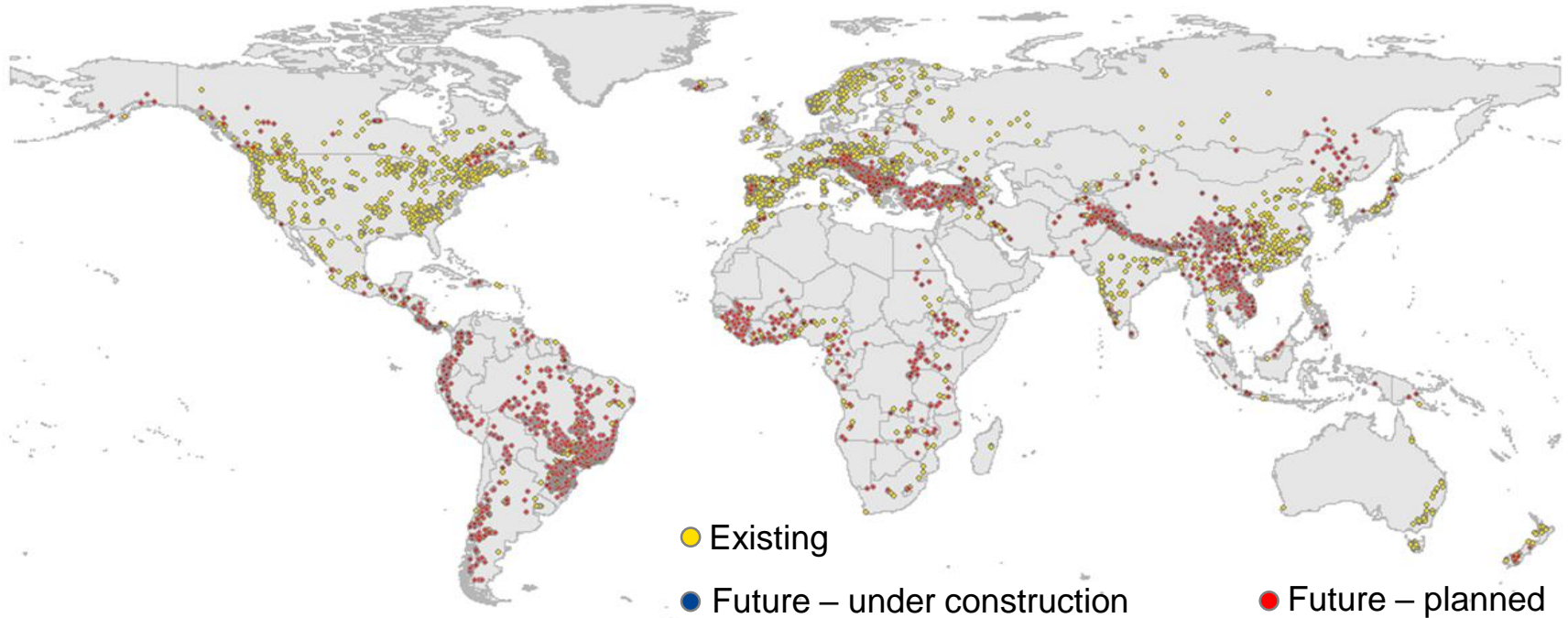
Spatial distribution of present large hydropower dams



(Lehner *et al.* 2011. GRanD database)

Global boom in dam construction

(about 3800 major dams, doubling total capacity)



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

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)

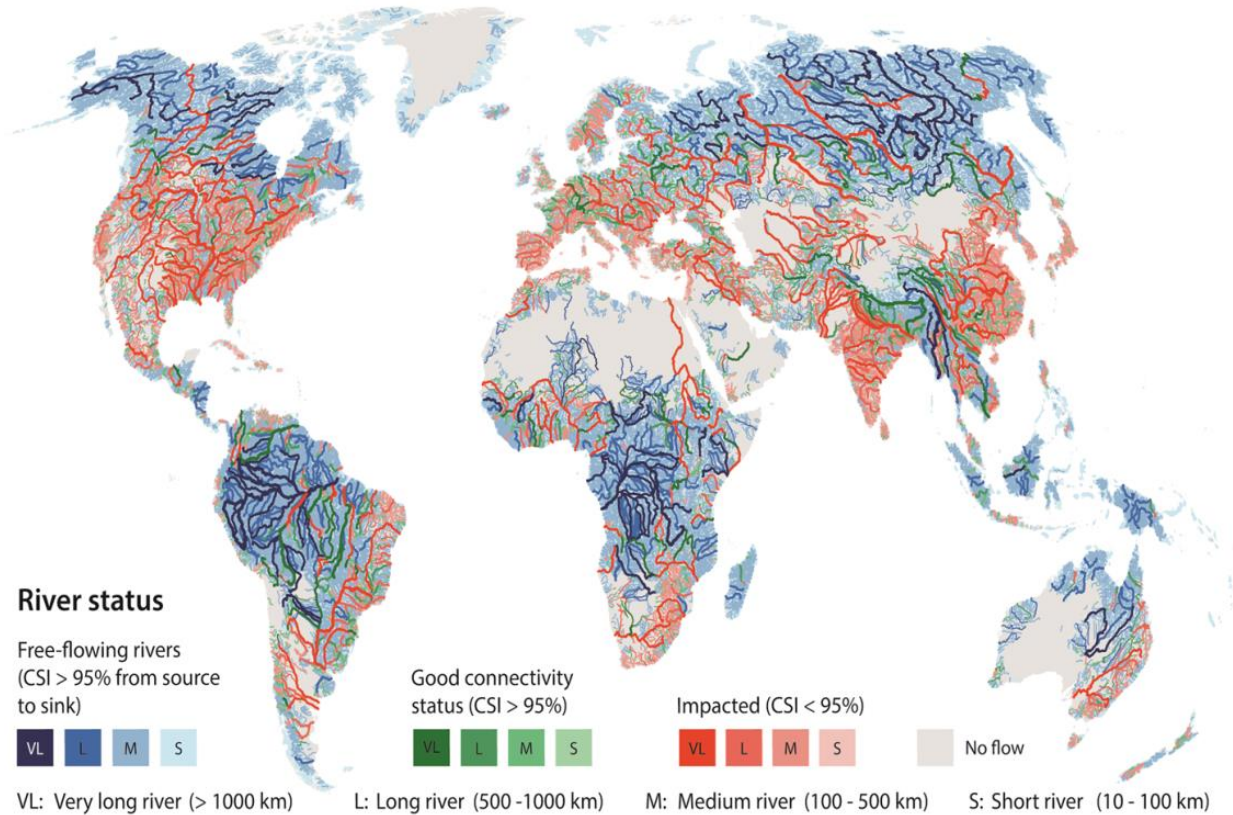
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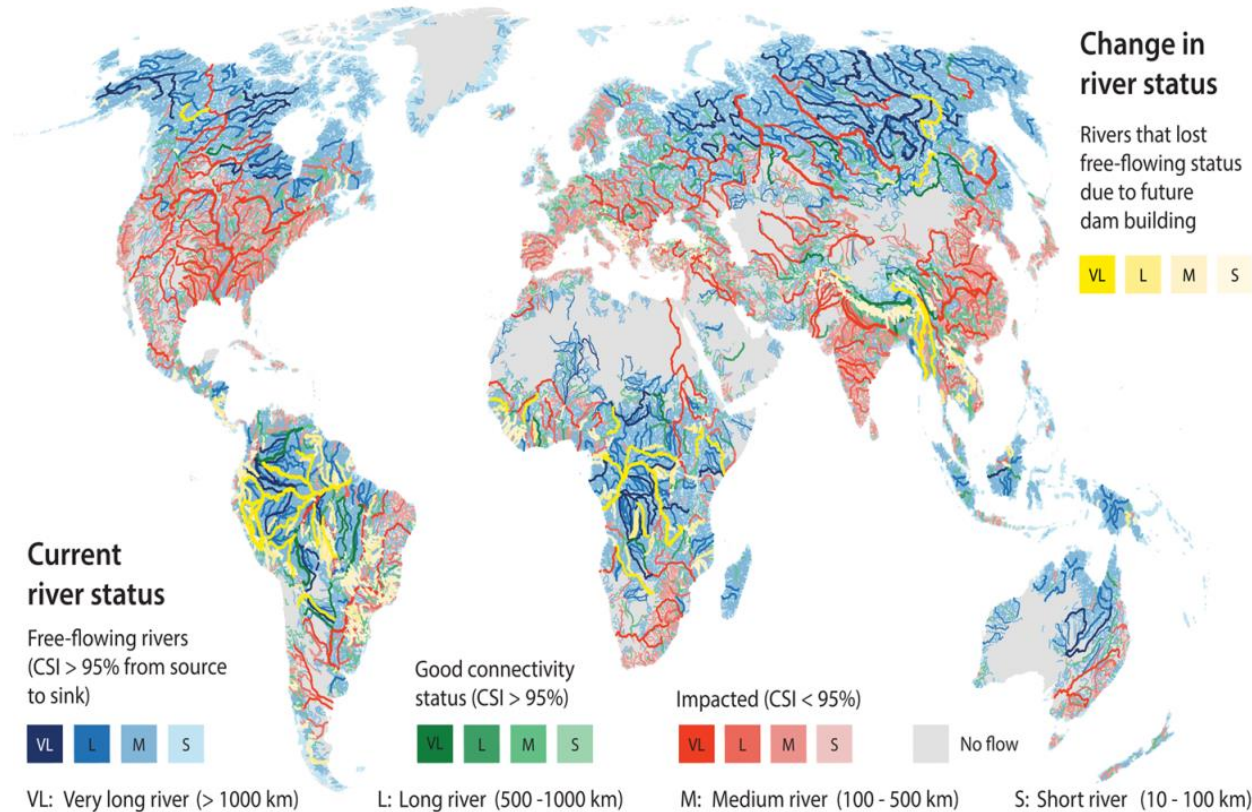
**Inn River
Valley, Austria**
(Photo: Christoph Malin)

Free flowing rivers are rare



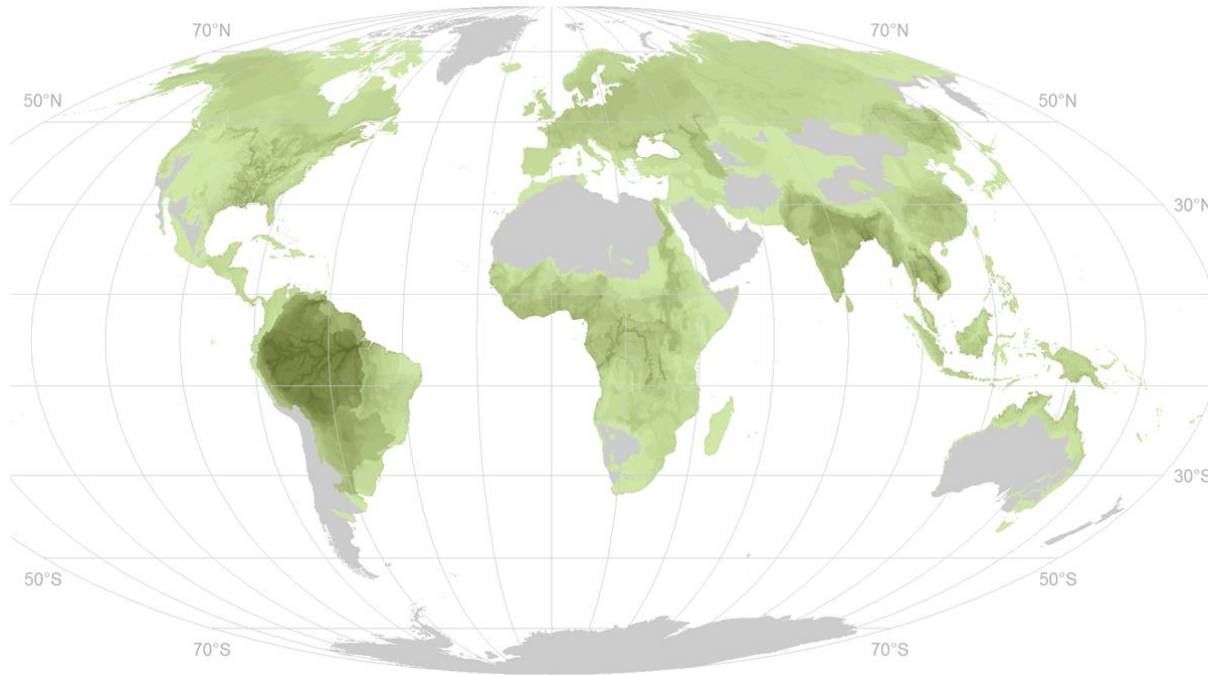
(Grill *et al.* 2019. Nature)

Free flowing rivers are becoming more rare



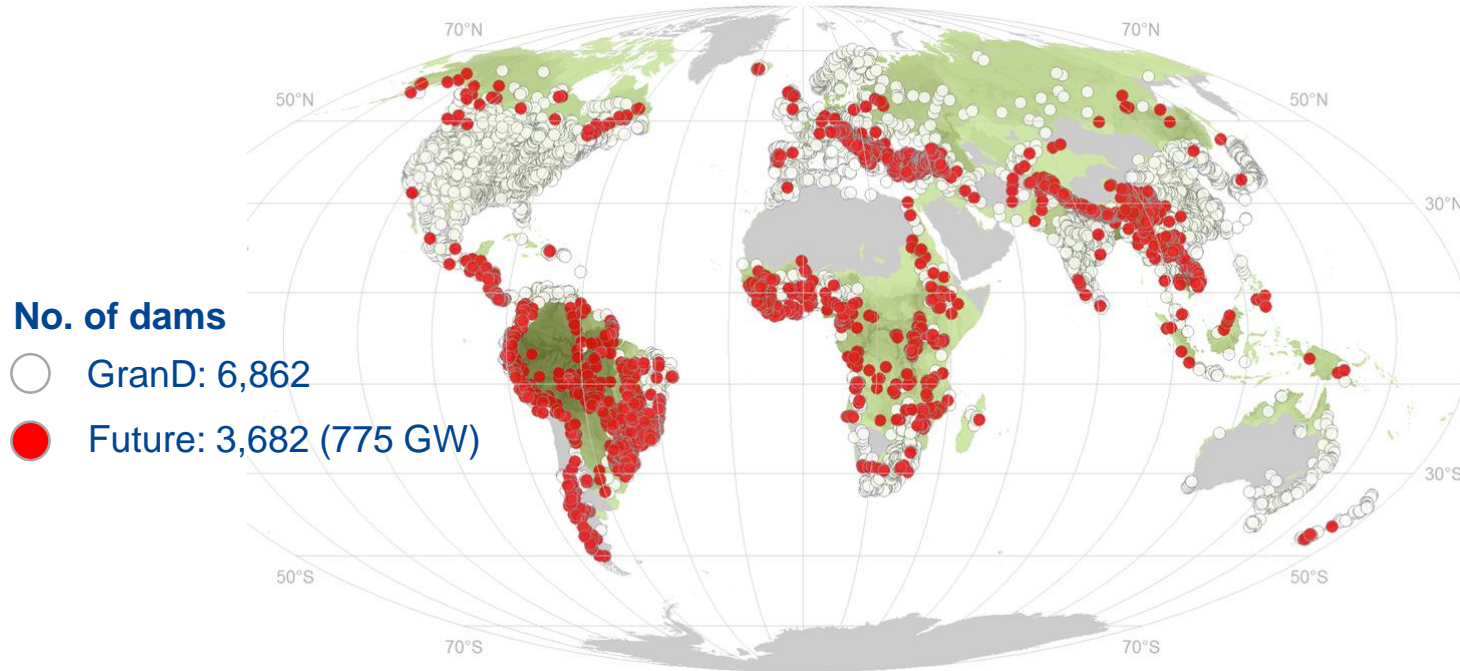
(Grill *et al.* 2019. Nature)

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)

Balkan: Existing freshwater megafauna



©Tony Gilbert

Beluga
Critically Endangered



©Juan Manuel

Stellate Sturgeon
Critically Endangered



©Reinhard Dirscherl

Russian Sturgeon
Critically Endangered



©Prazak

Huchen
Endangered



©Peter

Marble trout
Least Concern



©Georg Mittenecker

Northern pike
Least Concern



©Vilda-Rollin Verlinde

Eurasian Beaver
Least Concern



©Dieter Florian

Wels Catfish
Least Concern

Balkan: Extirpated freshwater megafauna



Adriatic Sturgeon
Critically Endangered

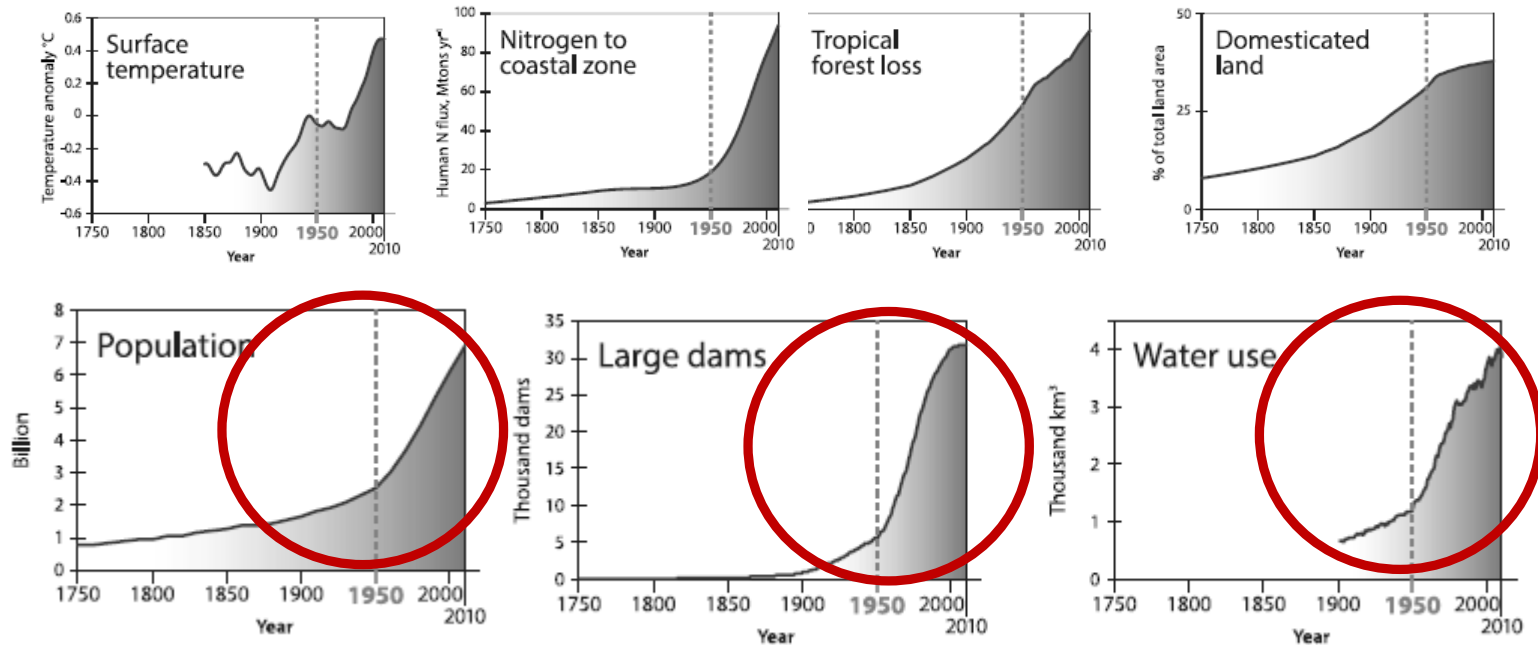


Ship Sturgeon
Critically Endangered



European sturgeon
Critically Endangered

Anthropocene: The big acceleration



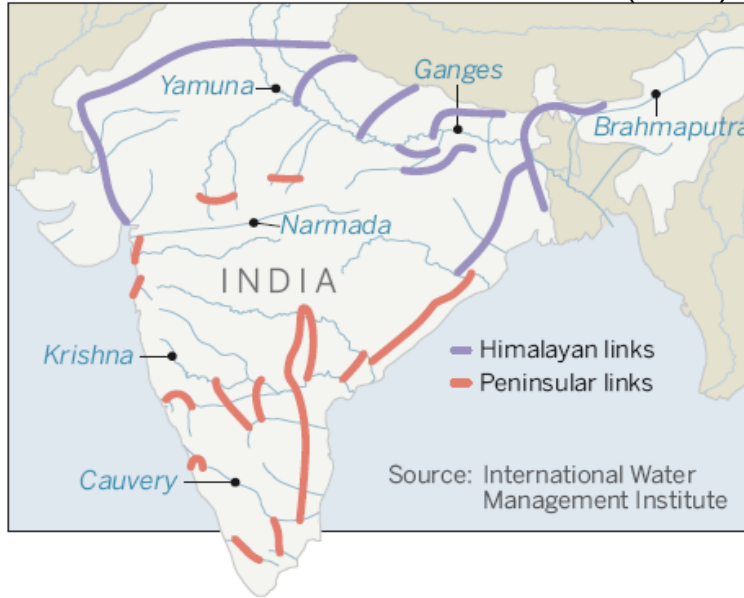
(Young & Steffen, 2009)

„Terraforming“: Megaprojects will shape our future globe

No more going with the flow

India's plan calls for 15,000 kilometers of canals and tunnels (not all are shown)

Science 345 (2014)



Nature 510 (2014)



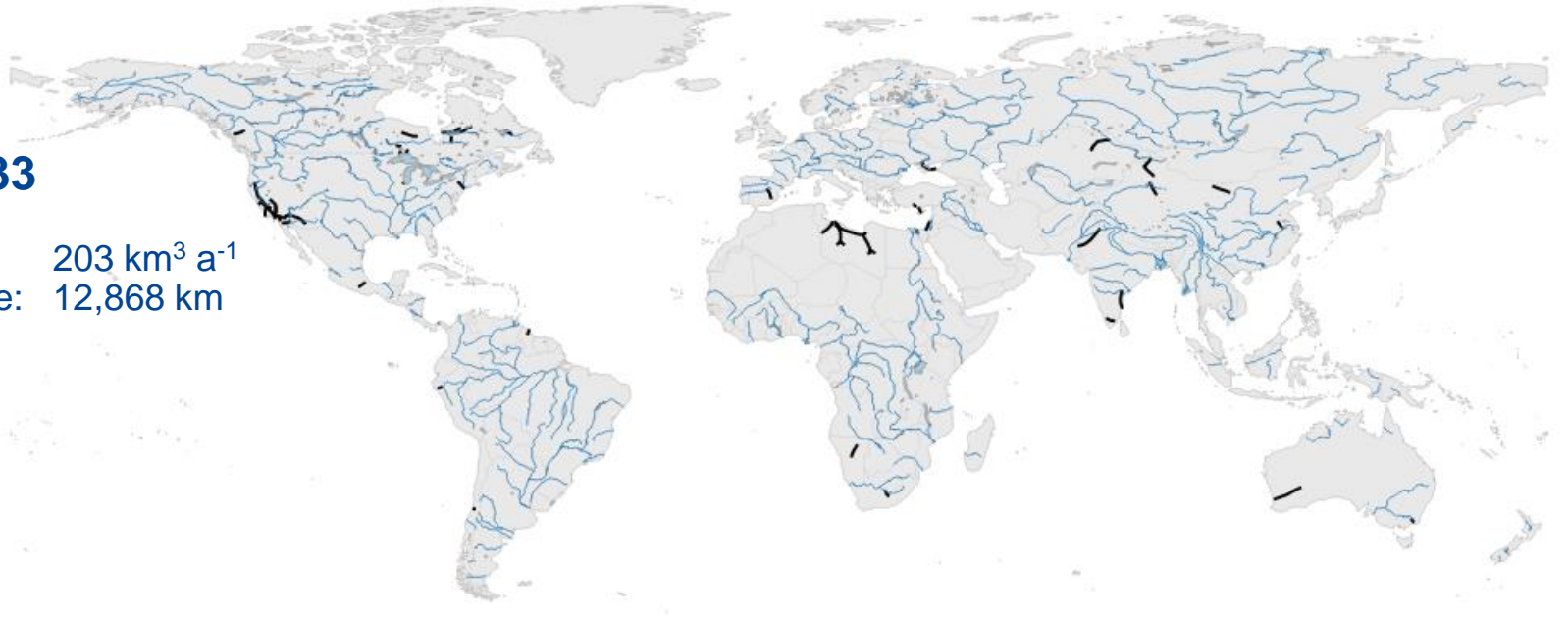
In Lanzhou, China, 700 mountains are being levelled to create more than 250 square kilometres of flat land.

Water transfer megaprojects

Present: 33

Total Volume: 203 km³ a⁻¹

Total Distance: 12,868 km



(Shumilova *et al.*, 2019. Front. Environm. Science)

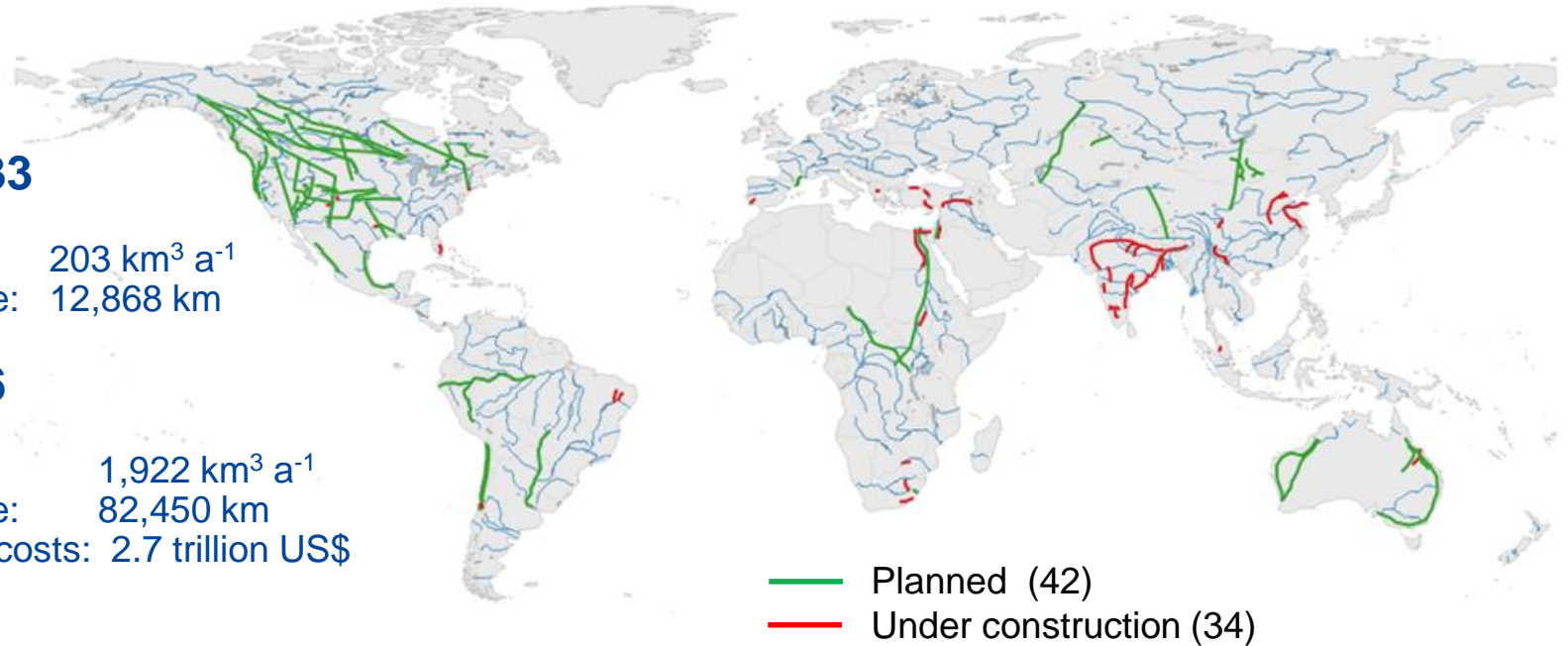
Water transfer megaprojects

Present: 33

Total Volume: 203 km³ a⁻¹
Total Distance: 12,868 km

Future: 76

Total Volume: 1,922 km³ a⁻¹
Total Distance: 82,450 km
Construction costs: 2.7 trillion US\$

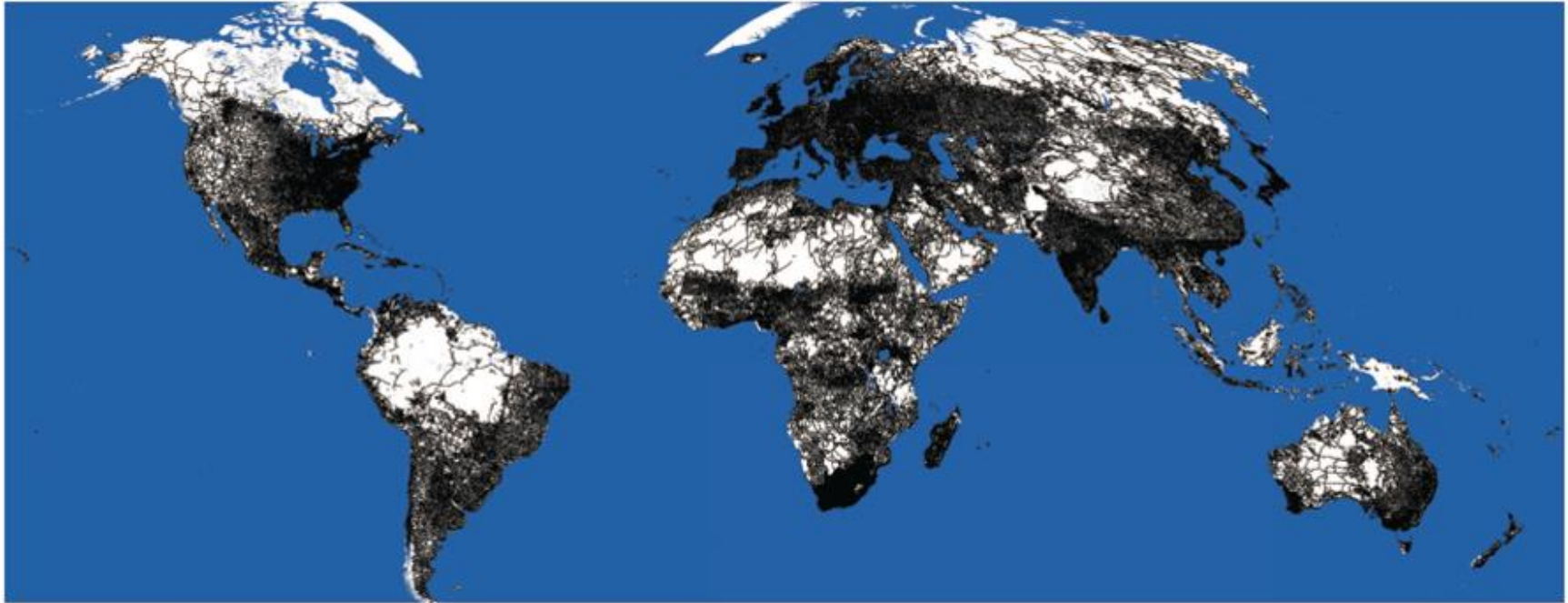


(Shumilova *et al.*, 2019. Front. Environm. Science)

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?

The global road network: Until 2050 an expansion by 25,000,000 km expected



(Laurance *et al.* 2014. Nature)

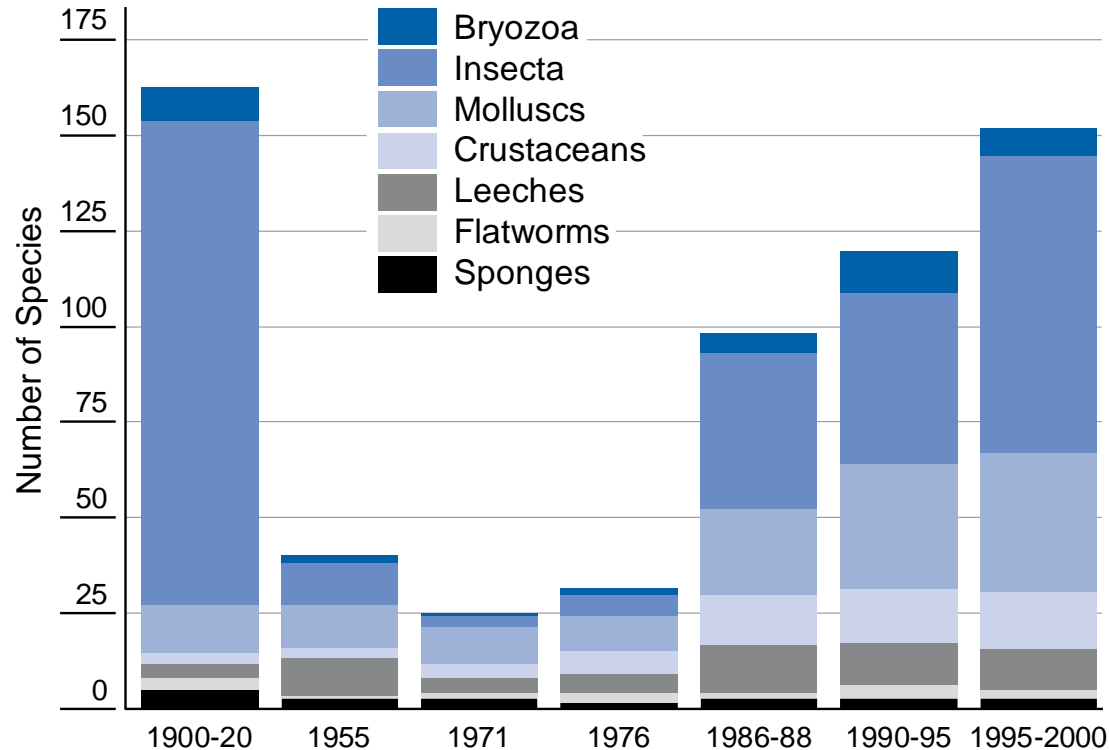
Any success stories?

The Rhine: The sewer of Europe



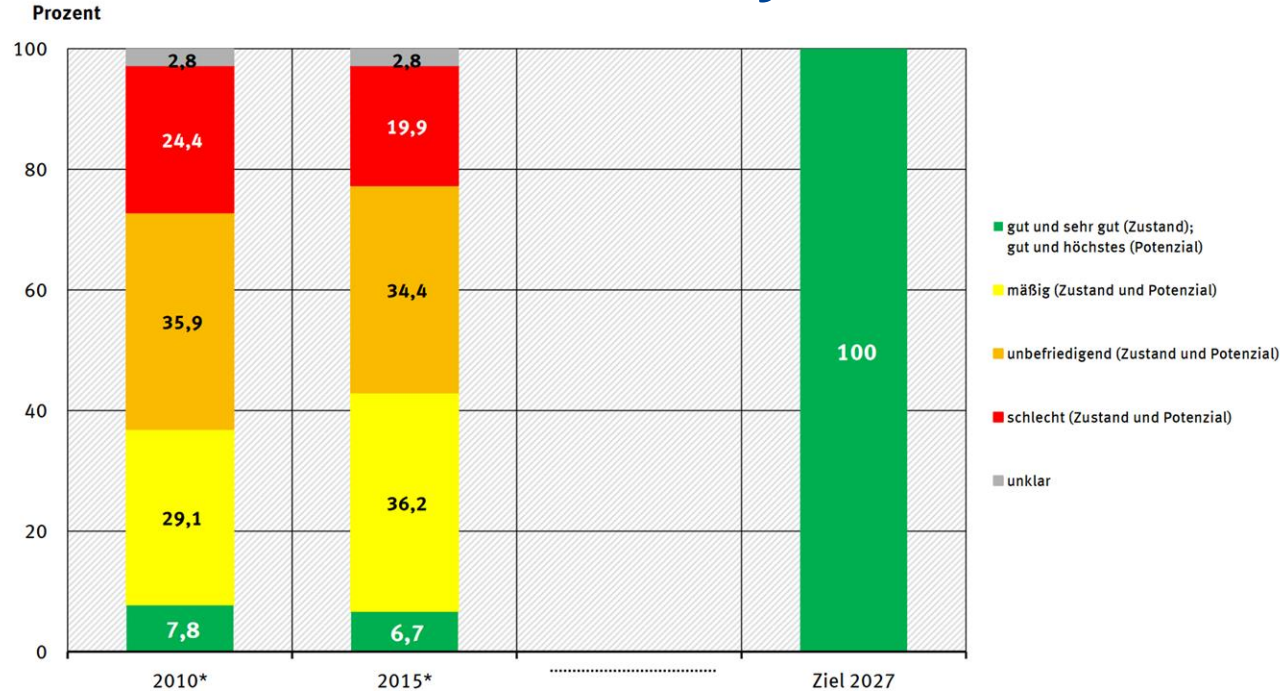
(Photo: Keystone)

The Rhine: Long-term development of benthic invertebrates



(IKSR 2002)

EU WFD: Ecological status of rivers & streams in Germany

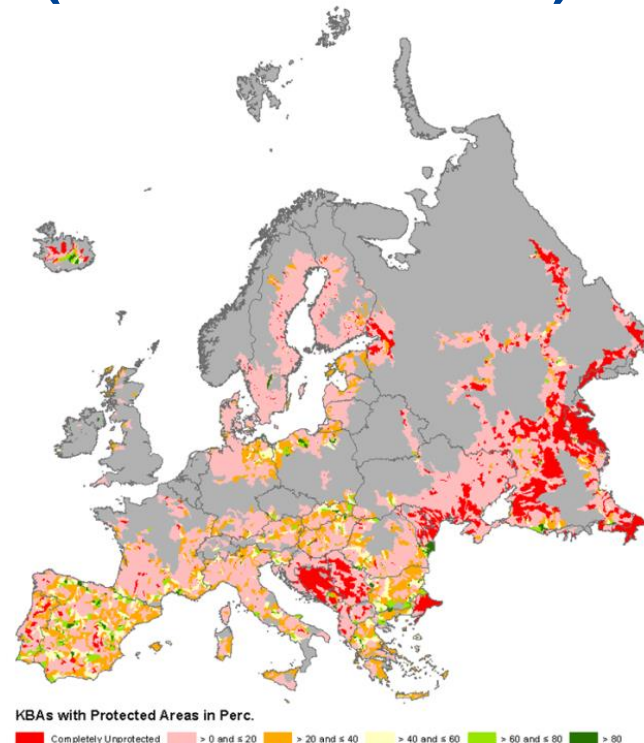
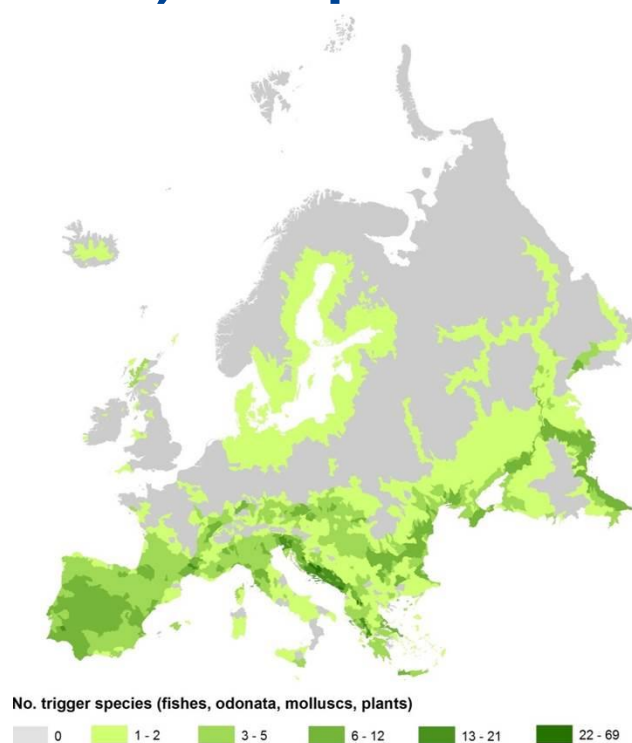


* Die Jahresangaben beziehen sich auf das Jahr der Berichterstattung an die EU. Für das Berichtsjahr 2010 wurden die Daten bis 2008 erhoben. Für das Berichtsjahr 2015 erfolgte die Datenerhebung in den Jahren 2009 bis 2014.

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

(EPA, Daten zur Umwelt, 2017)

Key Biodiversity Areas (KBAs; freshwater species) and protected areas (Natura 2000 etc.)



Biological Diversity = Libraries of Nature

Ecosystems



Species



Gene variations





Our rivers in 2045?

An engineered water future?

www.forumforthefuture.org



www.symbiont.ansp.org



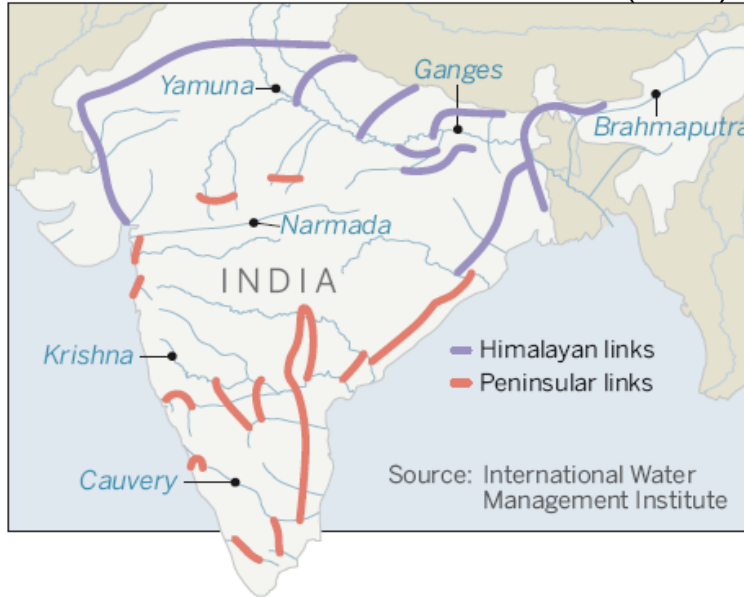
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The end of nature?

No more going with the flow

India's plan calls for 15,000 kilometers of canals and tunnels (not all are shown)

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In Lanzhou, China, 700 mountains are being levelled to create more than 250 square kilometres of flat land.

Our rivers in 2045!

Conservation



Restoration



Nature-based solutions





Thank you for listening



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