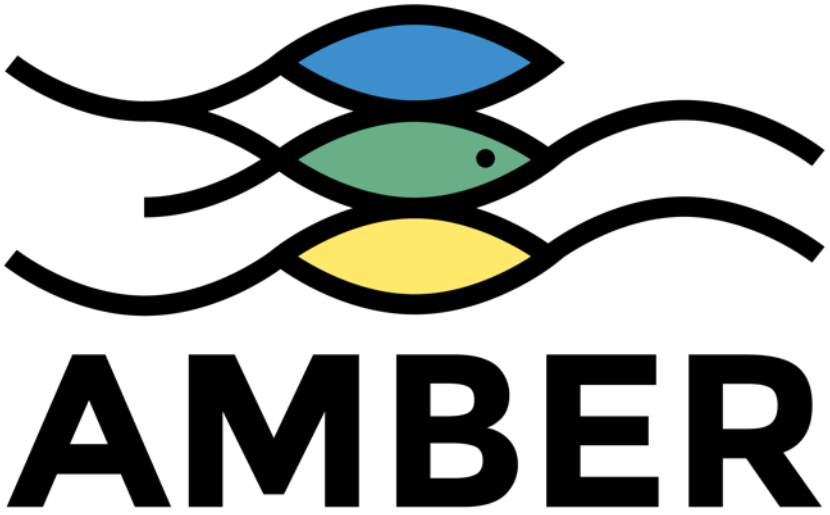
Seminario Impatto degli sbarramenti fluviali – 5 GIUGNO 2017 – MILANO

Presentazione del progetto di ricerca europeo AMBER: Reconnecting Europes Rivers, the smart way, obiettivi e primi risultati

Simone Bizzi

POLITECNICO
MILANO 1863

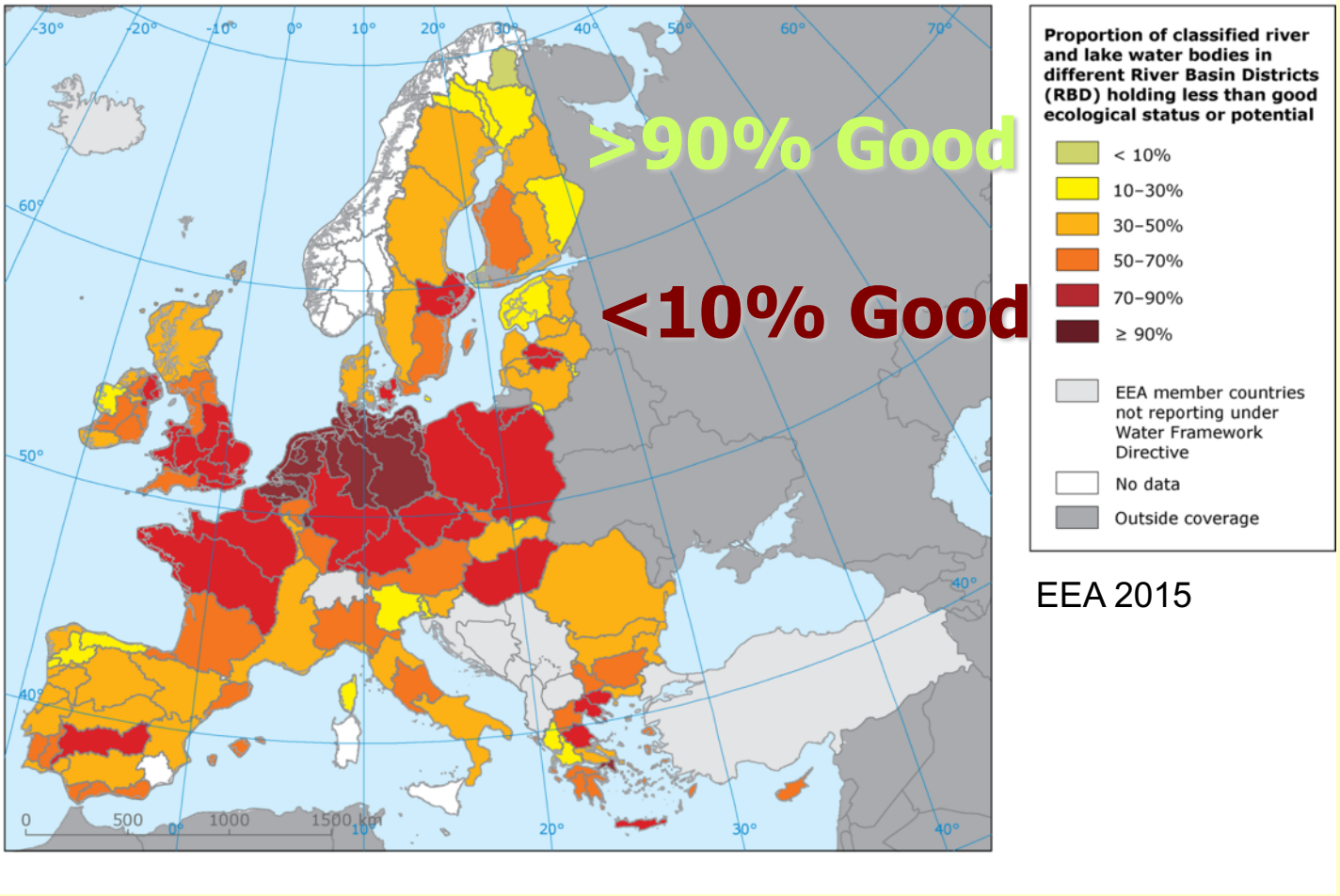
Reconnecting Europe's Rivers the Smart Way



Funded by the Horizon 2020 Framework Programme of the European Union

www.amber.international

Ecological Status of European Lakes & Rivers

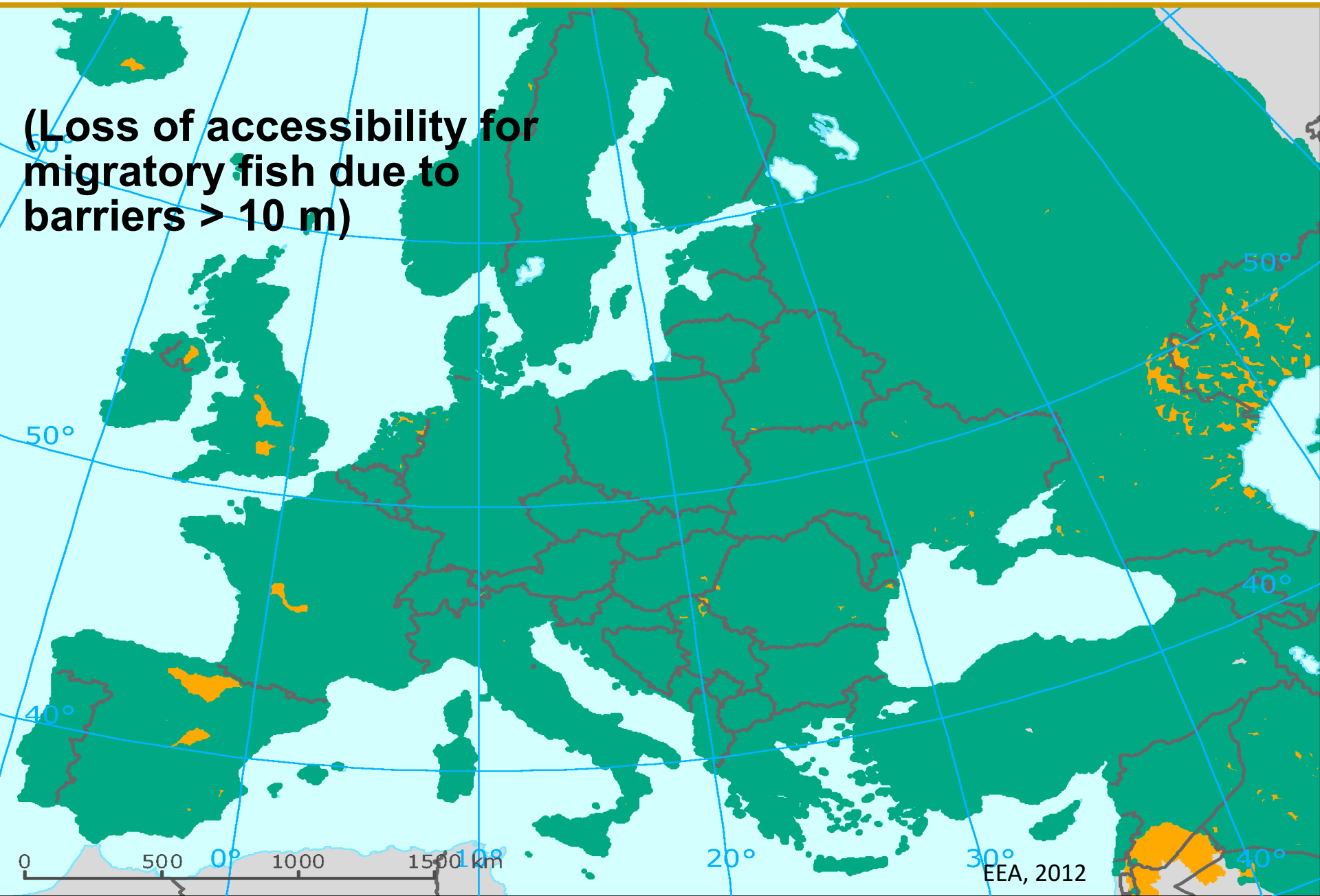


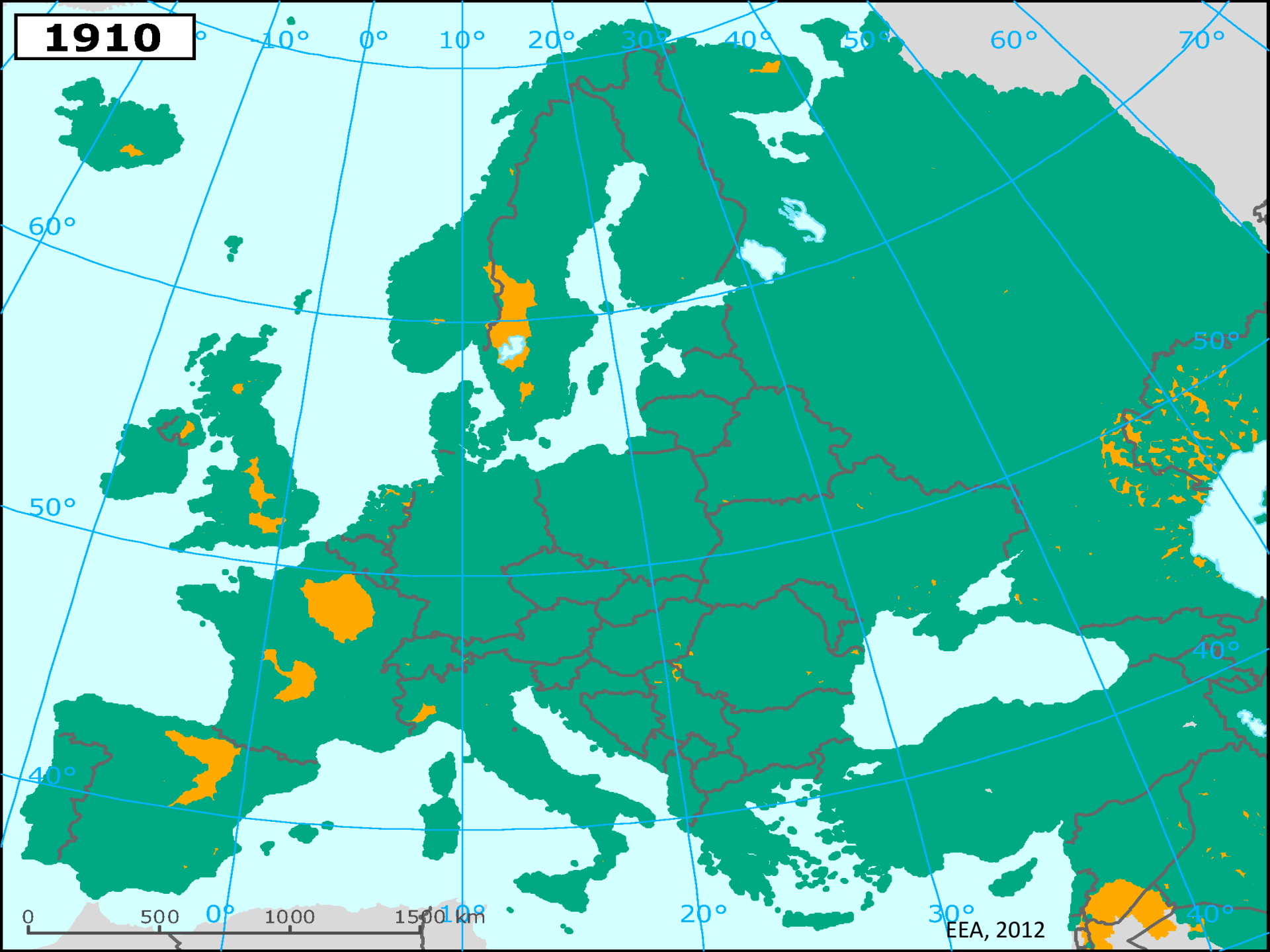
Most EU watersheds fail to meet WFD targets

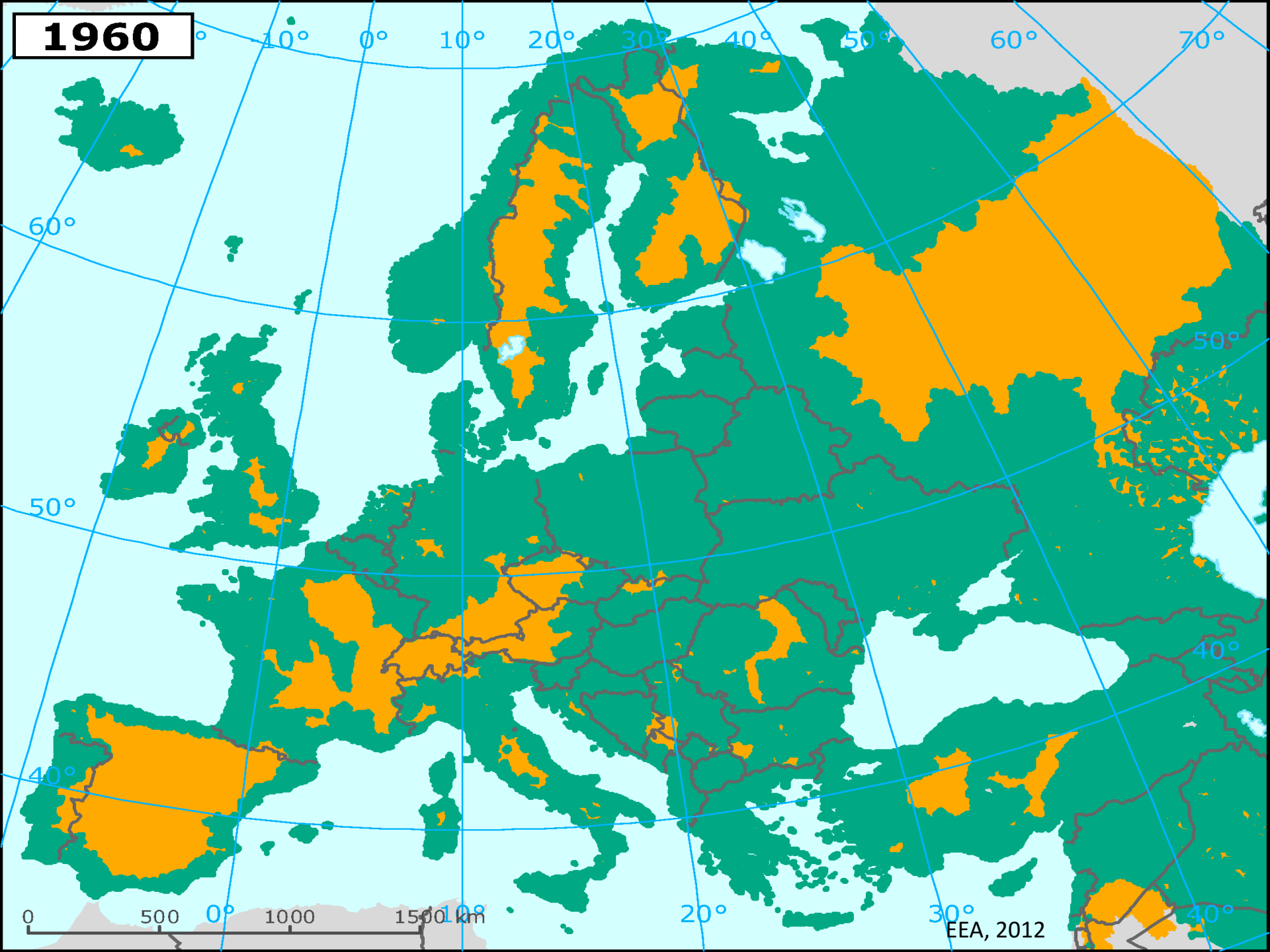
Habitat loss & fragmentation is a key problem!

1860

Fragmentation of major EU rivers




1910
10°
0°
10°
20°
30°
40°
50°
60°
70°
60°
50°
40°
50°
40°
0°
10°
20°
30°
40°
0
500
1000
1500 km
EEA, 2012


1960
10°
0°
10°
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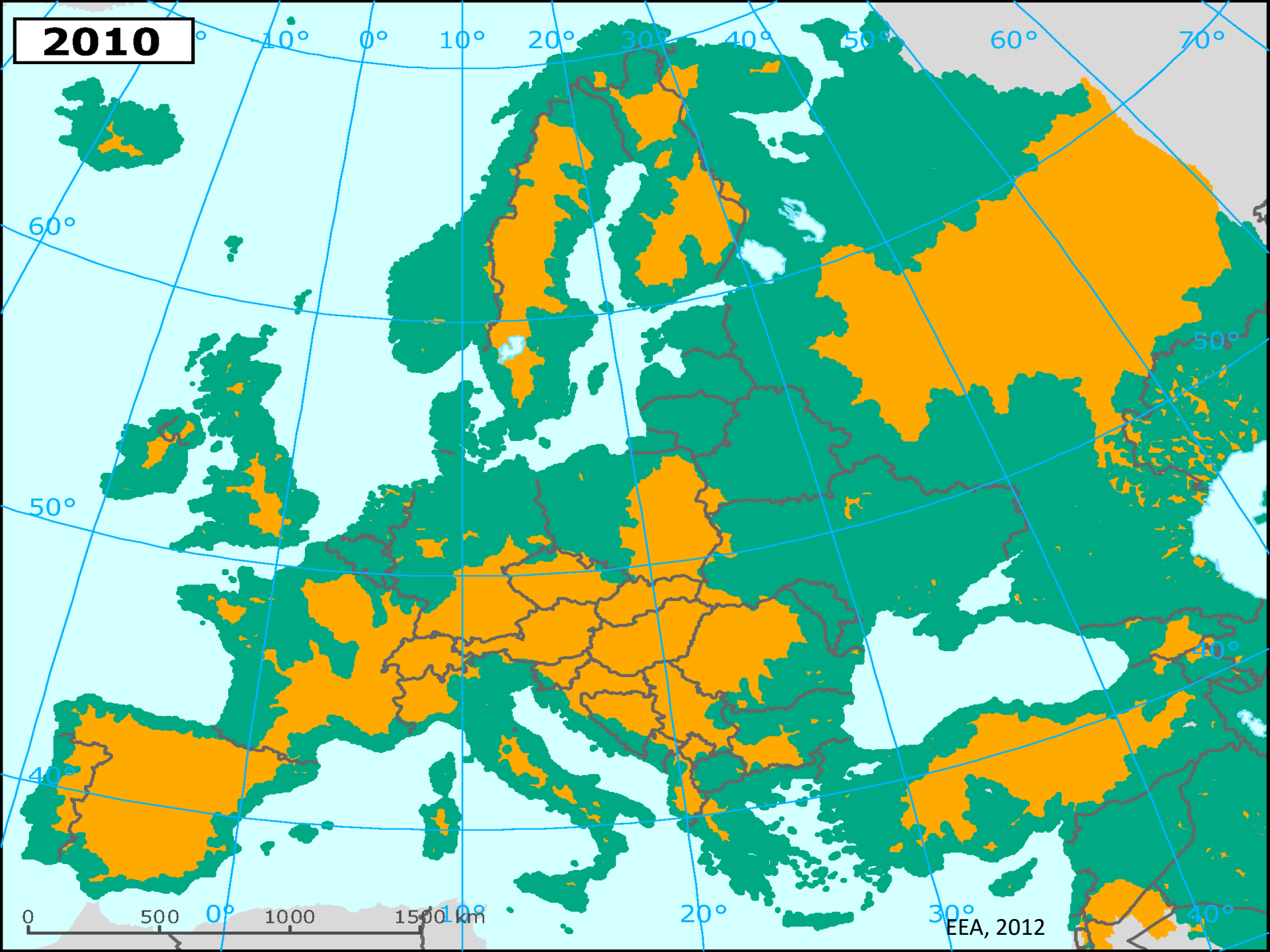
0
500
1000
1500 km
EEA, 2012


2010
10°
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60°
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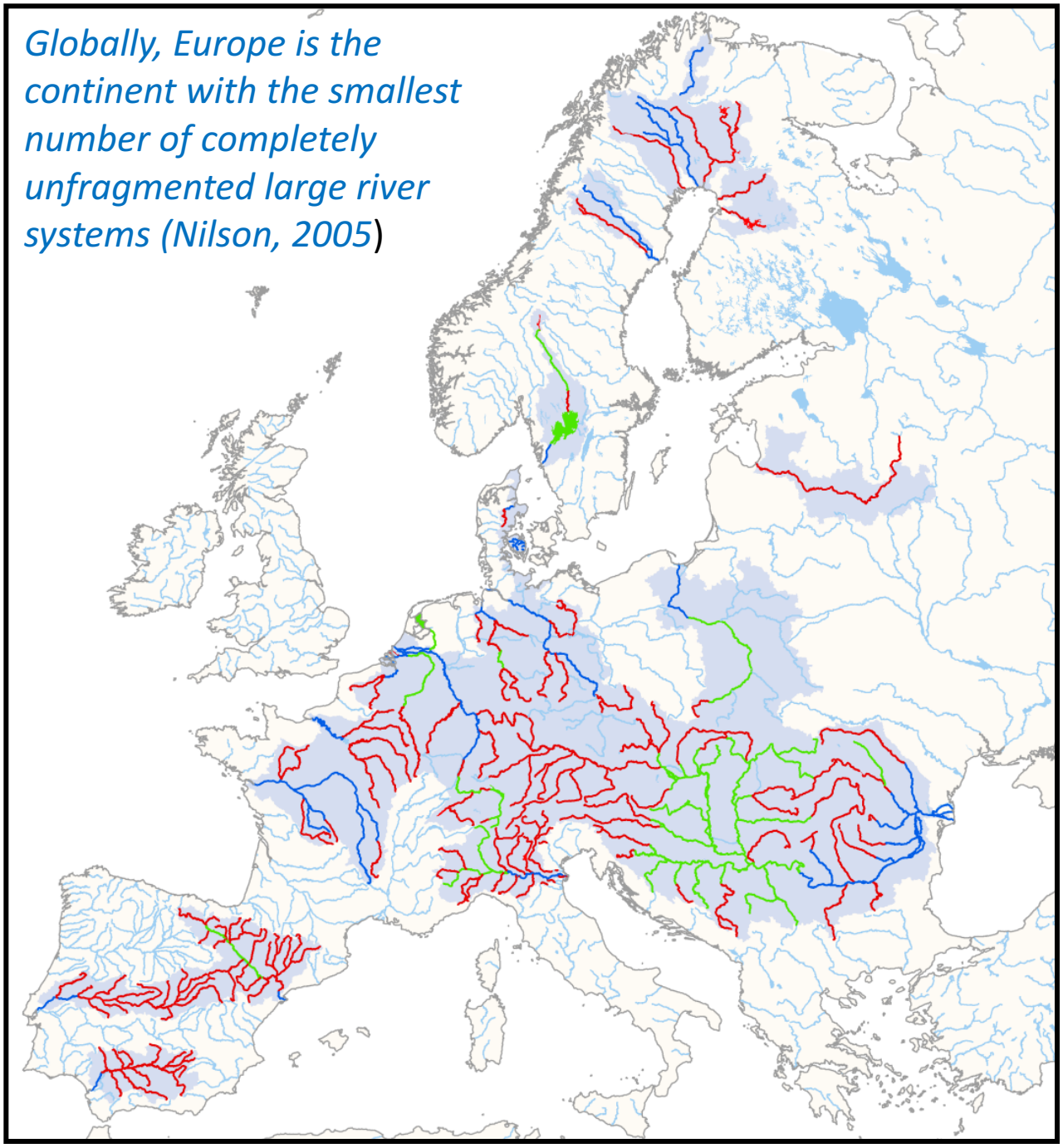
60°
50°
40°
50°
40°
0°
10°
20°
30°
40°
0
500
1000
1500 km
EEA, 2012

Globally, Europe is the continent with the smallest number of completely unfragmented large river systems (Nilson, 2005)



0 125 250 500 750 1,000 Kilometers

Accessibility for migratory fish
- Accessible from sea
- No barriers, but not connected to sea
- Inaccessible or poorly accessible
- Not yet evaluated

Despite the WFD, all major EU rivers remain poorly connected and unaccessible to migratory fish

PBL Netherlands Environmental Assessment Agency, Oct 2015

AMBER: Adaptive Management of Barriers in European Rivers

Horizon 2020, €6.2 M, 20 partners, 11 countries 2016-2020

8 Universities – Swansea, Durham, Highlands & Islands, Southampton (UK), Cork (Ireland), Oviedo (Spain), POLIMI Milan (Italy), DTU (Denmark).

4 Industrial partners - EDF (France), IBK (Germany), Innogy (Germany), Sydkraft (Sweden)

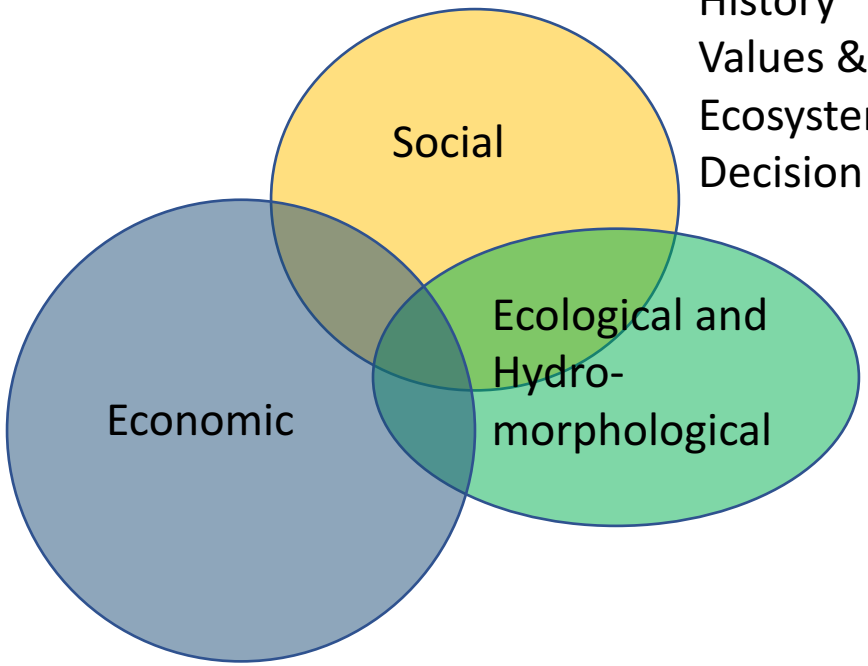
4 NGOs (WFMF (Netherlands), WWF (Switzerland), CNSS (France), AEMS (Spain)

4 National/EU Research Centres - IFI (Ireland), ERCE (Poland), SSIFI (Poland), Joint Research Centre (European Commission)

External advisory board Laura Wildman (Princeton Hydro, US), Martina Bussettini (ISPRA, IT), Josh Royte (The Nature Conservancy, US)

Adaptive Management of Barriers in European Rivers



History
Values & attitudes
Ecosystem Services
Decision making process

Water supply
Fisheries
Hydropower
Flood risk
management

Fish migration
River morphology &
Habitats
Sediment connectivity
Nutrients

AMBER

Challenges for restoring river connectivity in EU

1. Number of barriers in EU rivers is unknown

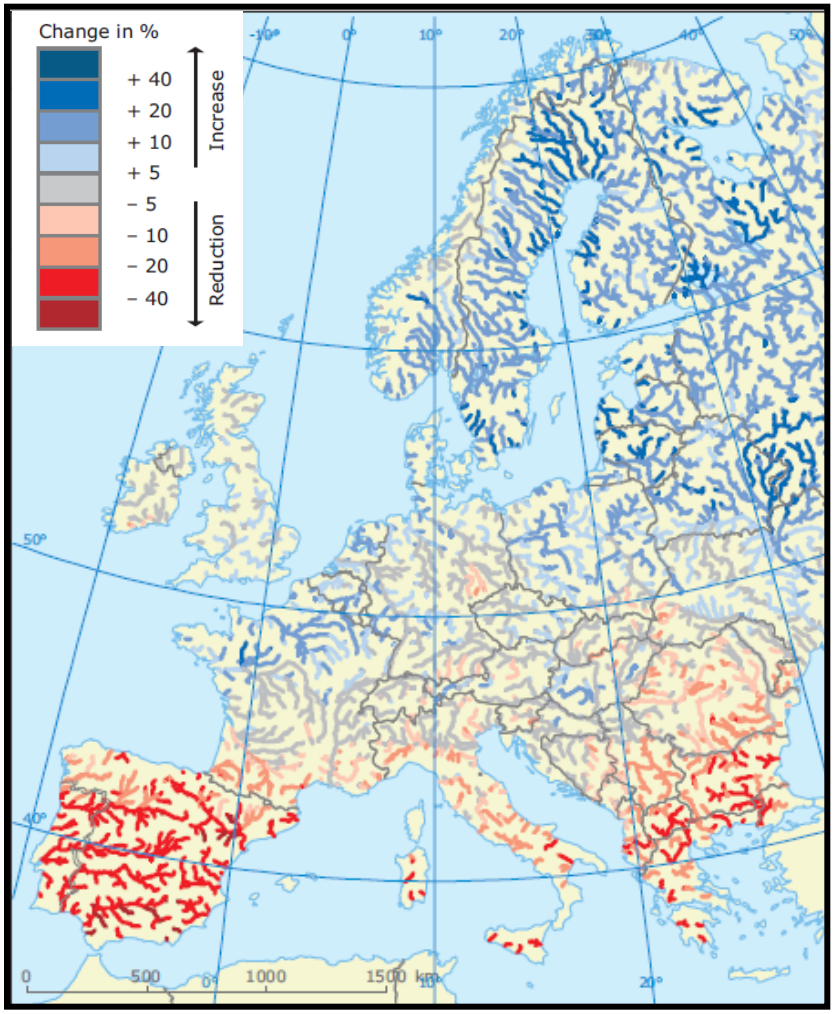
- Definition of 'barrier', country coverage, scale

2. … but certainly more than we can mitigate for

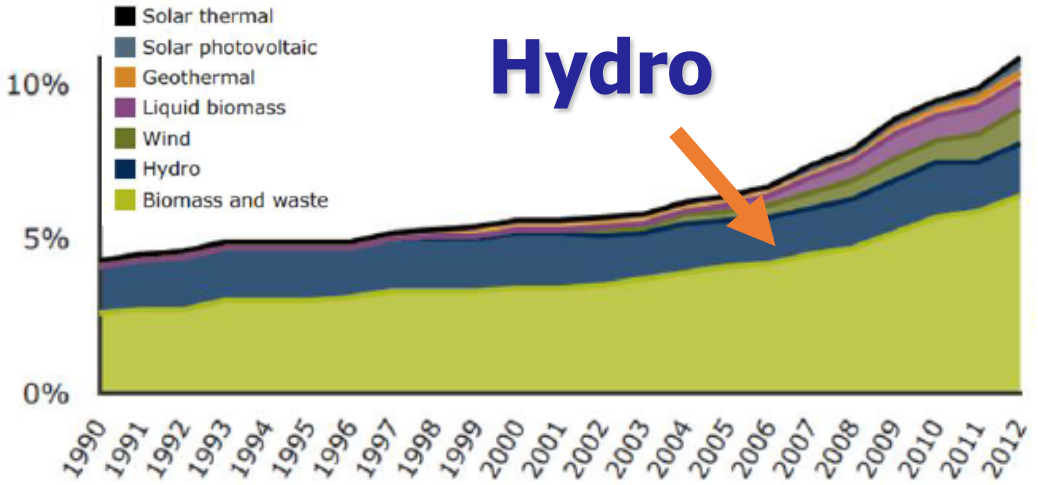
- Best estimate (based on regional data) =

0.6 to 1.8 million dams & weirs! (Garcia de Leaniz, pers.comm)

3. Prioritisation tools are required



Projected changes in river flows over baseline values (JRC 2012)



Breakdown of renewable energies/total

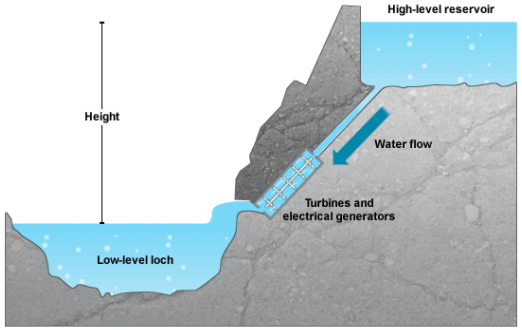
4. River flows will decrease, ...where water is most needed!

5. Increase in hydro to meet EU energy targets

6. Impacts of barriers will worsen

Hydroelectricity boom in Europe

- 2020 target of 20% energy from renewables
- Pumped Hydro-Storage (PHS) important for attenuating solar and wind electricity
- Expected investment of €26 billion in PHS alone between 2013 and 2020.



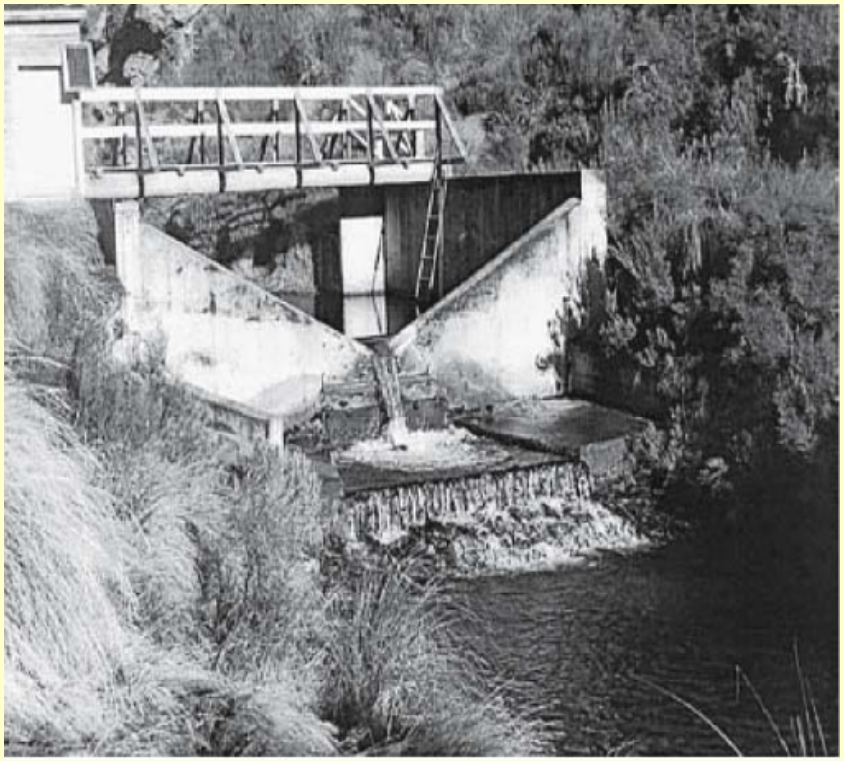
The European Market for Pumped Storage Power Plants, Ecoprog, April 2011. https://setis.ec.europa.eu/publications/setis-magazine/power-storage/europe-experience-pumped-storage-boom

7. Much is known about restoring fish [salmonid] passage, little about other taxa or fluvial processes

8. Not all barriers can – or should – be mitigated

i.e. Aquatic Invasive Species

topmouth gudgeon



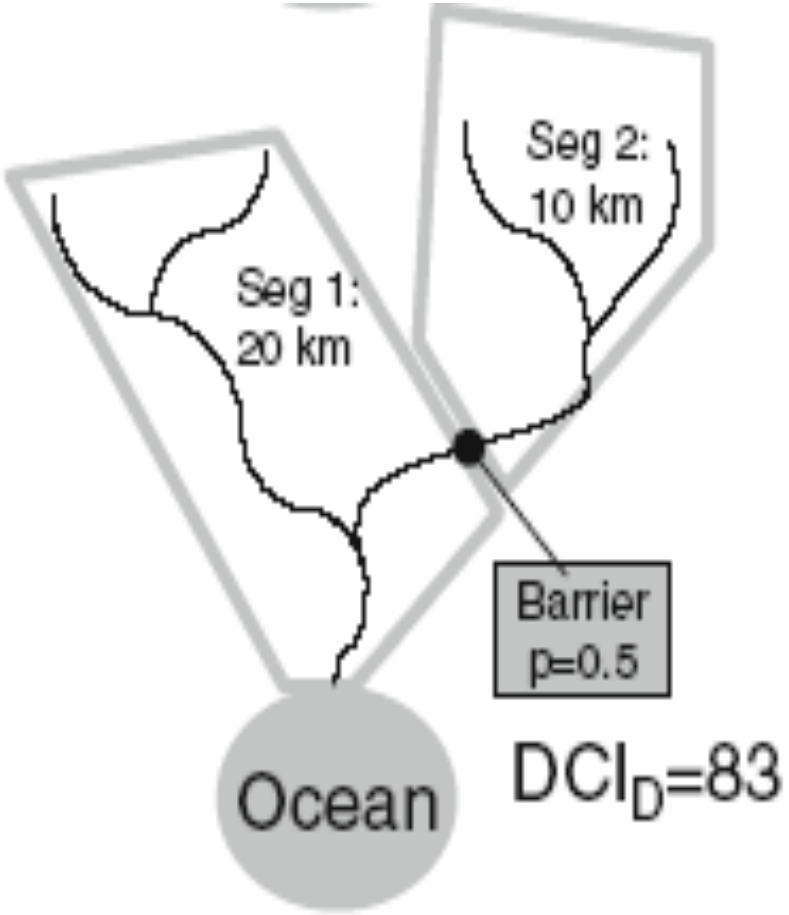
Barrier to prevent immigration of invasive salmonids (NZ)

8. Not all barriers can – or should – be mitigated

i.e. cultural heritage

Roman bridge (Cangas de Onis, R. Sella)

9. Better **decision & prioritization tools** are needed!



Dendritic connectivity index

Barrier Impacts:

- Number
- Location
- Passability (?)

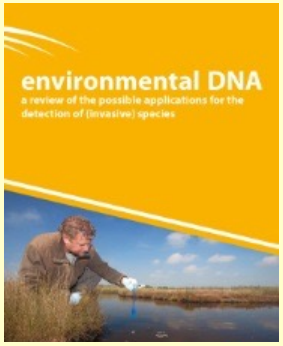
Barrier Mitigation:

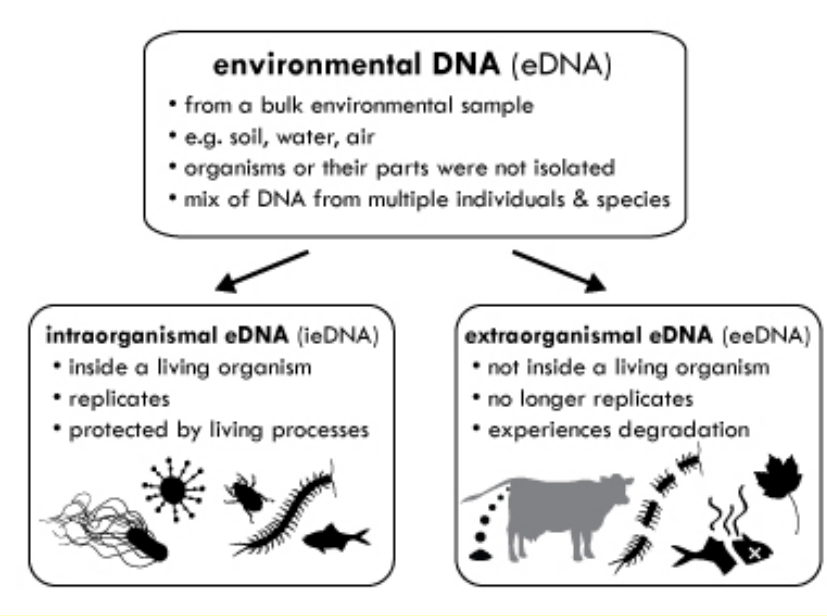
- Cost
- Opportunity
- Benefits (?)

New opportunities for restoring river connectivity

1. New technologies

- eDNA/meta-barcoding





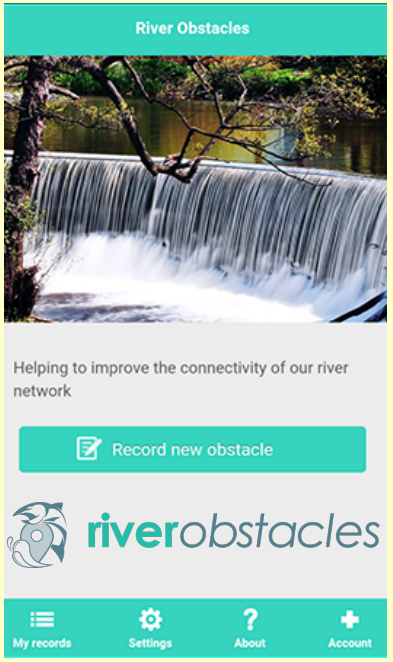
- Drones for quick surveying & remote sensing

- Modelling P/A (PREDICTS approach)

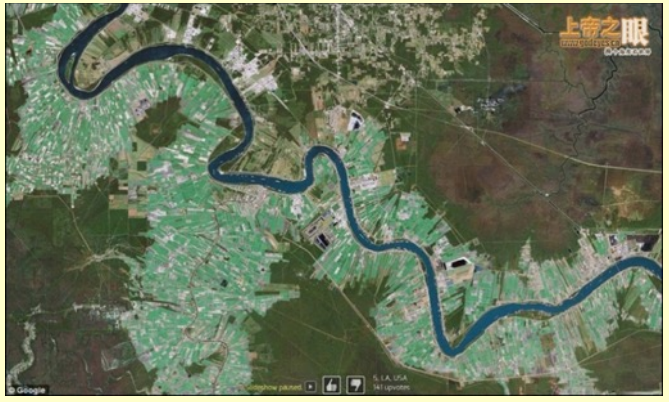
New opportunities for restoring river connectivity

2. Citizen science & local engagement

- Smartphone apps/ CS portals



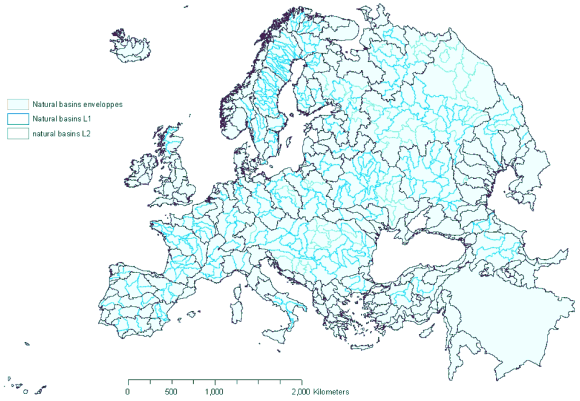
- Google Earth



Adaptive **M**anagement of **B**arriers in **E**uropean **R**ivers




1. European Barrier Atlas



2. Barrier guidance
- strategic
- adaptive
- practical

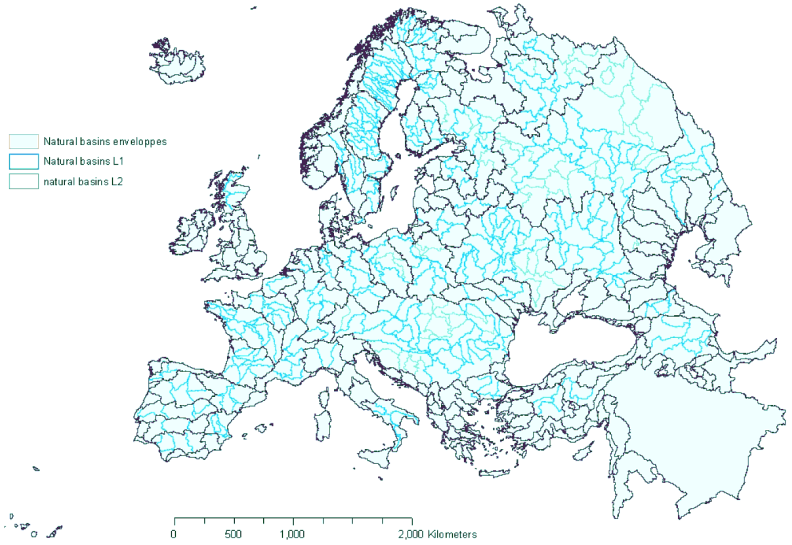
removal

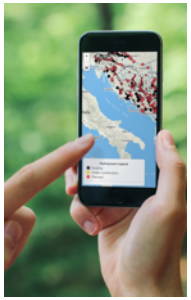
Planning (location)

mitigation

Selected AMBER products

- European stream barrier inventory and atlas (2019)
- Barrier assessment smartphone app (2017)





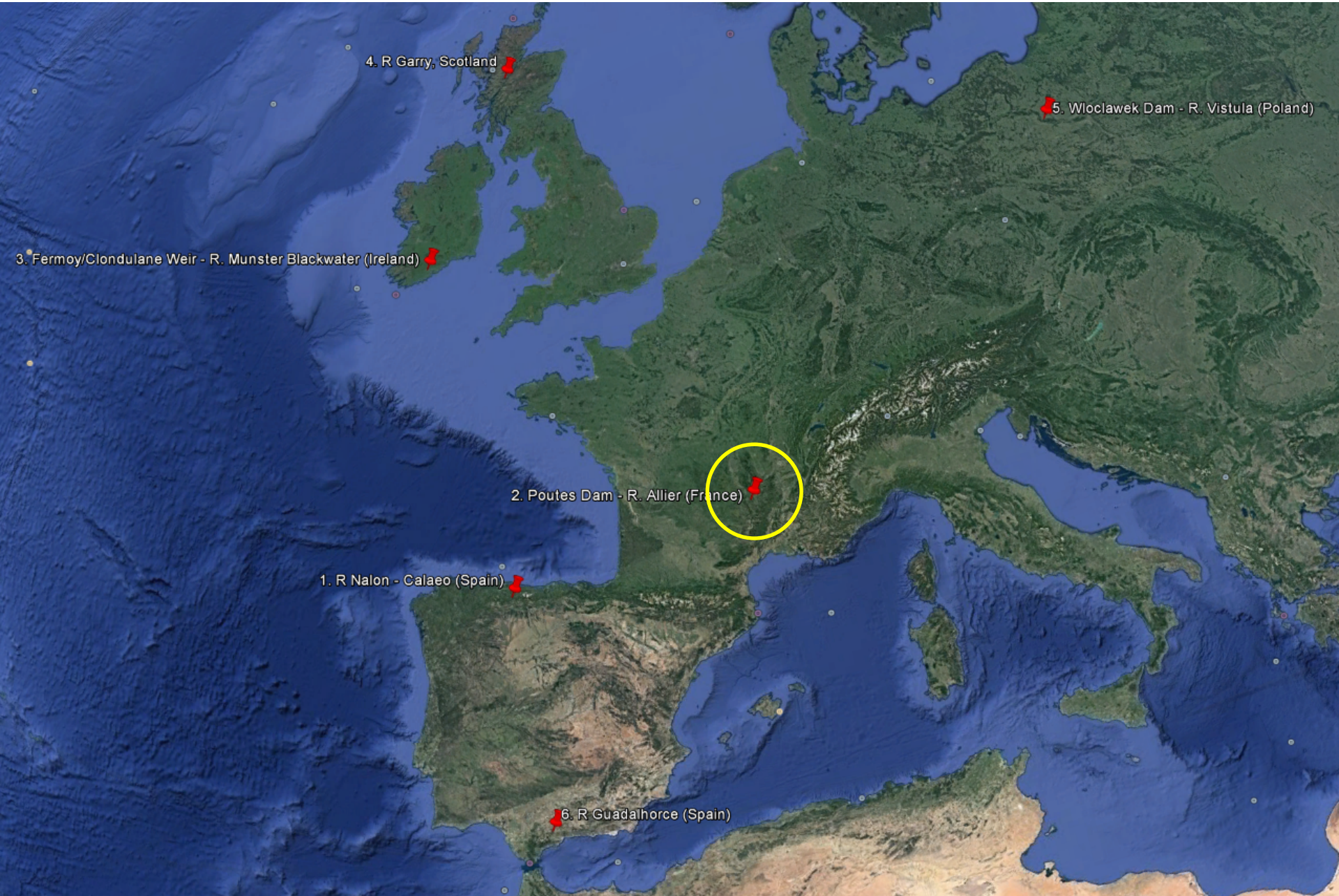
Selected AMBER products

- Adaptive barrier management guidance and decision support tools:
  - River infrastructure assessment and classification software tool (passability and hydropower potential) (2018)
  - Toolkit molecular methods (2017)
  - Remote Sensing based Rapid habitat assessment methodology (2018)
  - Habitat modelling toolkit (2018)
  - Barrier impacts on sediment connectivity (2018)

Selected AMBER products

- Book: Best Practice Guidance on Adaptive Barrier Management in Europe (2020)
- Scientific Publications

6 Main Case Studies



France - Poutès Dam – River Allier 1941

France - Poutès Dam – River Allier

6 Main Case Studies

Ireland - Munster Blackwater – Clondulane Weir

Ireland - Munster Blackwater – Fermoy Weir

6 Main Case Studies

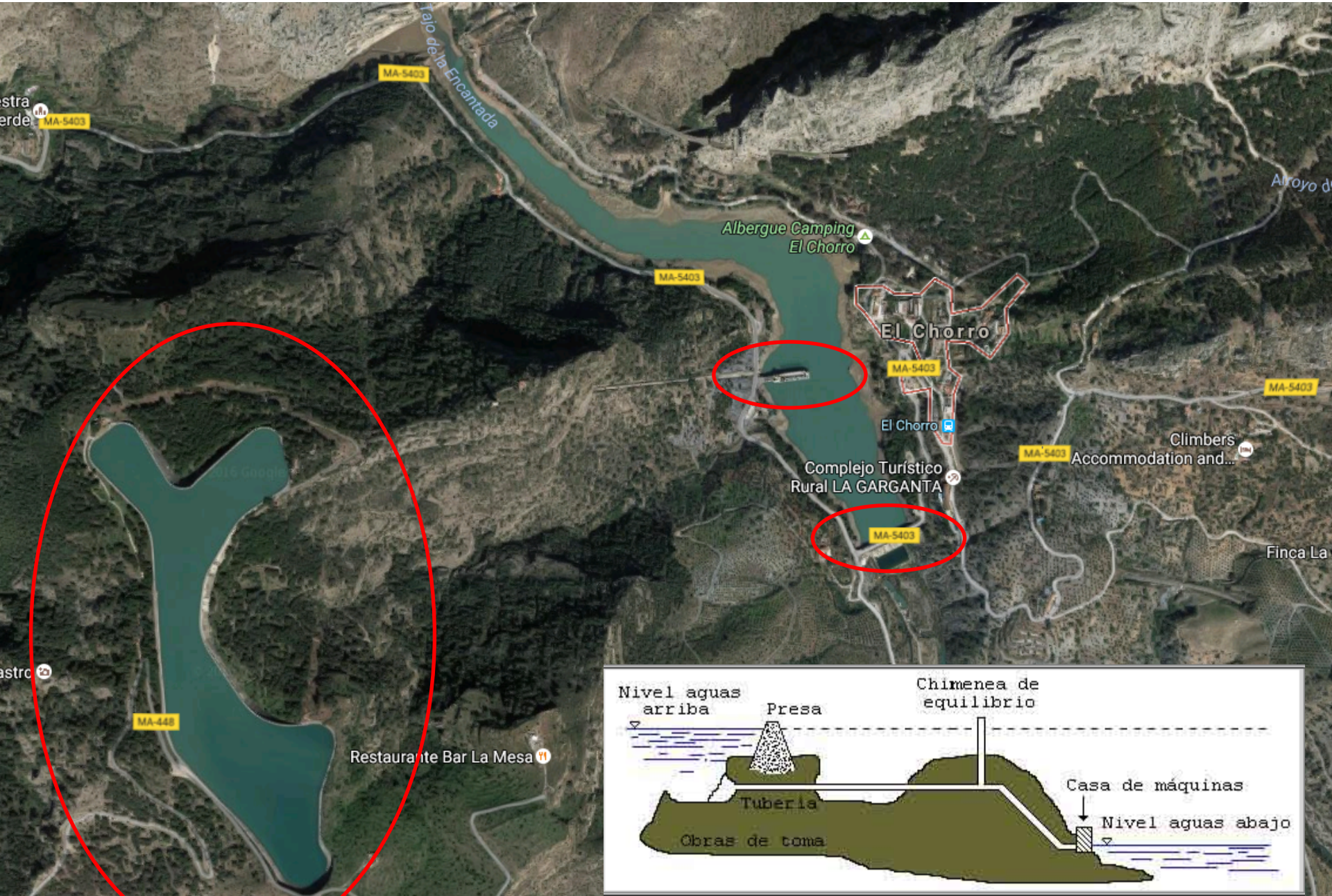
UK (Scotland) - River Garry - Loch Garry Dam

6 Main Case Studies

Poland - River Vistula - Włocławek Hydropower Dam

6 Main Case Studies

Spain - Guardalhorce – Salto de Encantada pumped storage dam



The AMBER team

THE AMBER ATLAS

UN ATLANTE EUROPEO DELLE BARRIERE

Barbara Belletti (POLIMI)
Simone Bizzi (POLIMI), Wouter van de Bund (JRC),
Pao Fernandez Garrido (WFMF)

AMBER LAUNCH EVENT – LET IT FLOW
Milano, 30 November 2016

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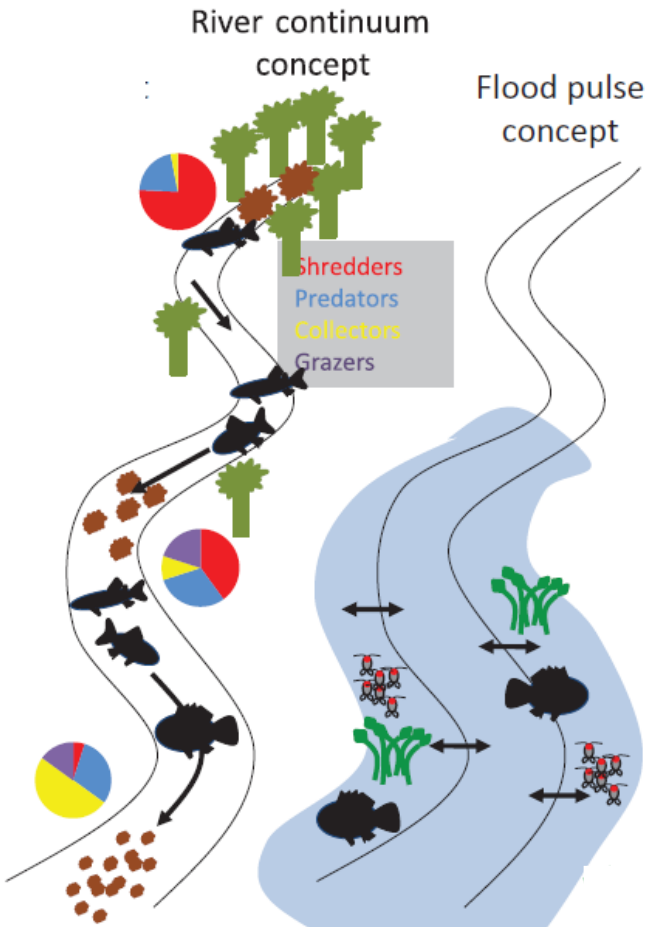
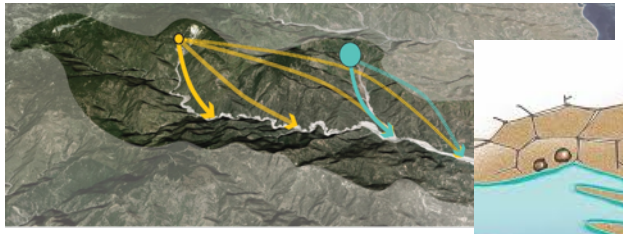
River connectivity…

...concerns water, sediment and organisms



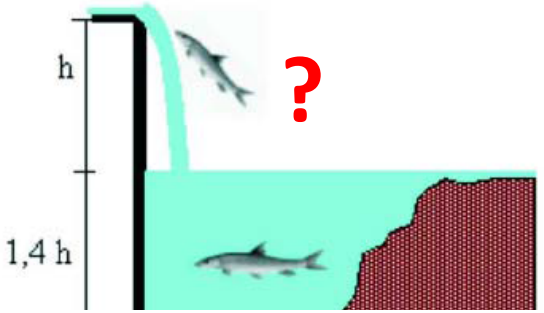


…provides ecosystems services

AMBER

Vs. river fragmentation…

…impairs water, sediment and organisms



RIVER FRAGMENTATION: WHAT EXTENT? WHERE?

… and disrupts ecosystem services

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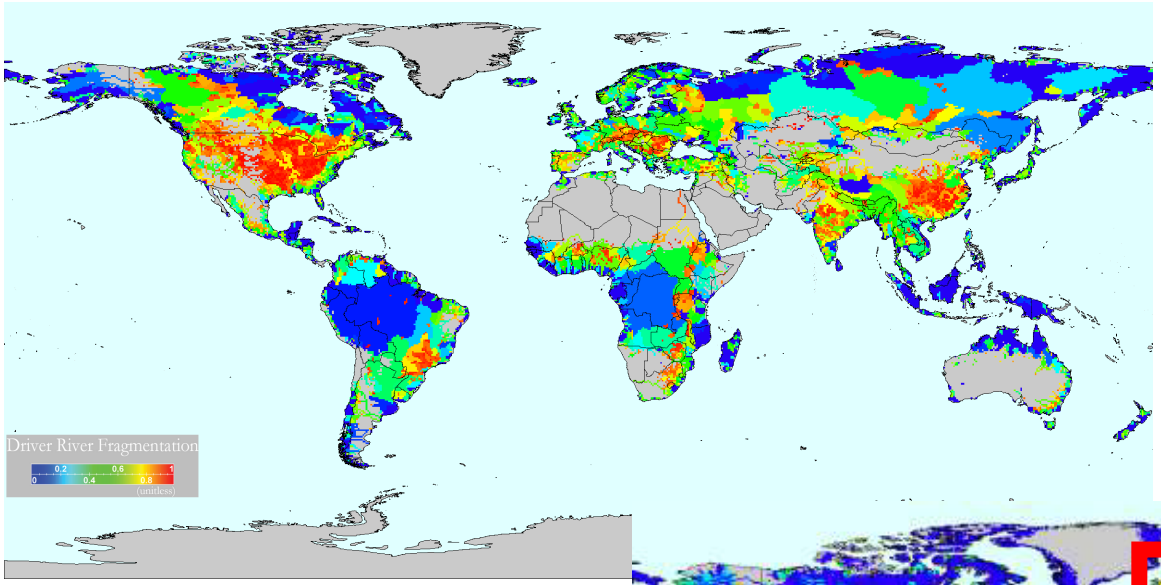
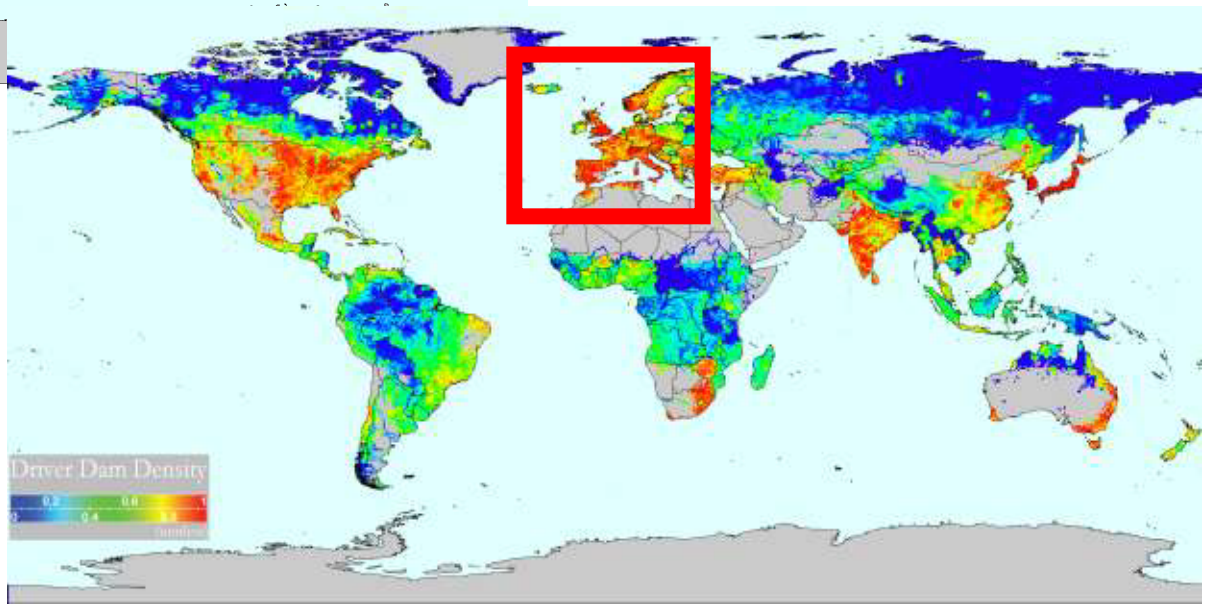
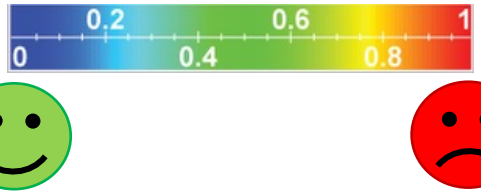
River fragmentation: a worldwide issue



Vörösmarty et al. 2010 (Nature)

What about Europe?





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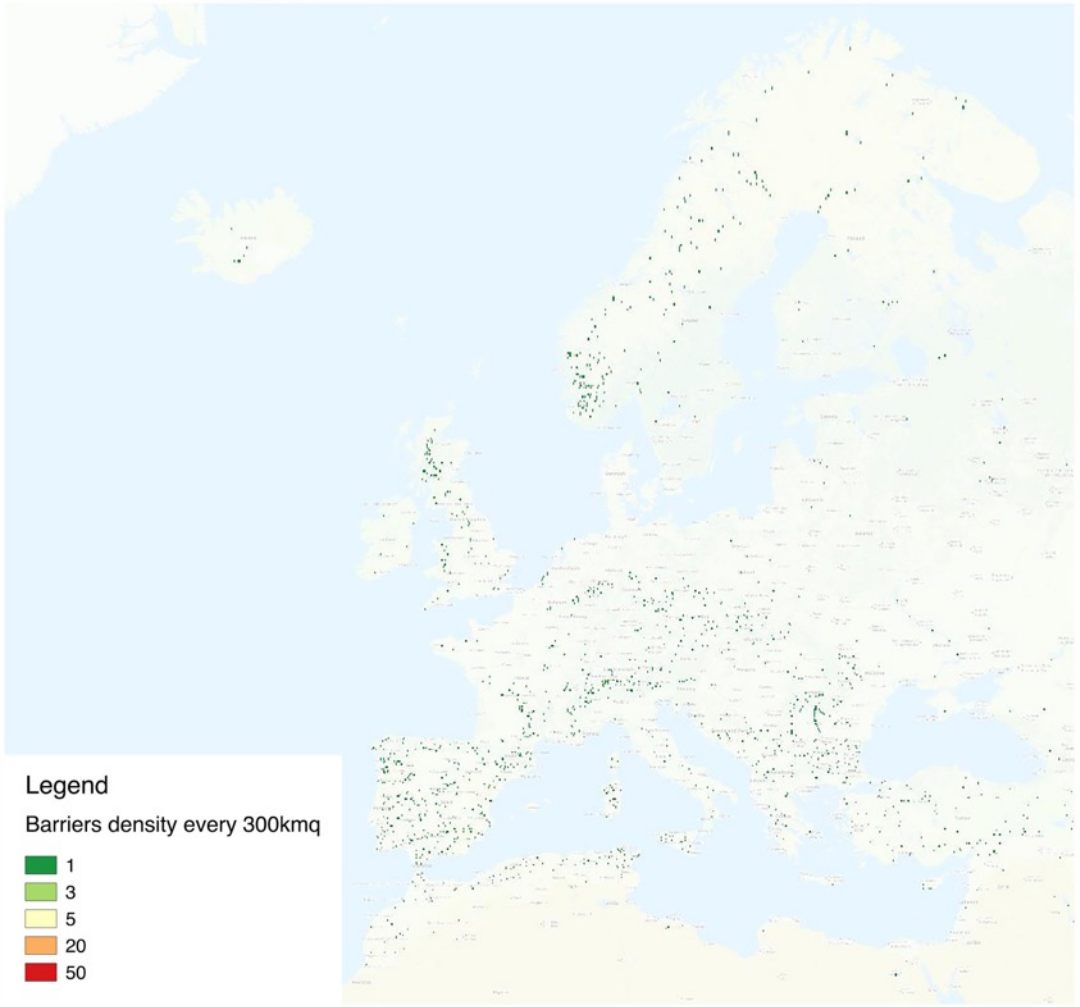
Existing data:
Continental, National, Regional scale

Continental

Major dams (> 10 m)

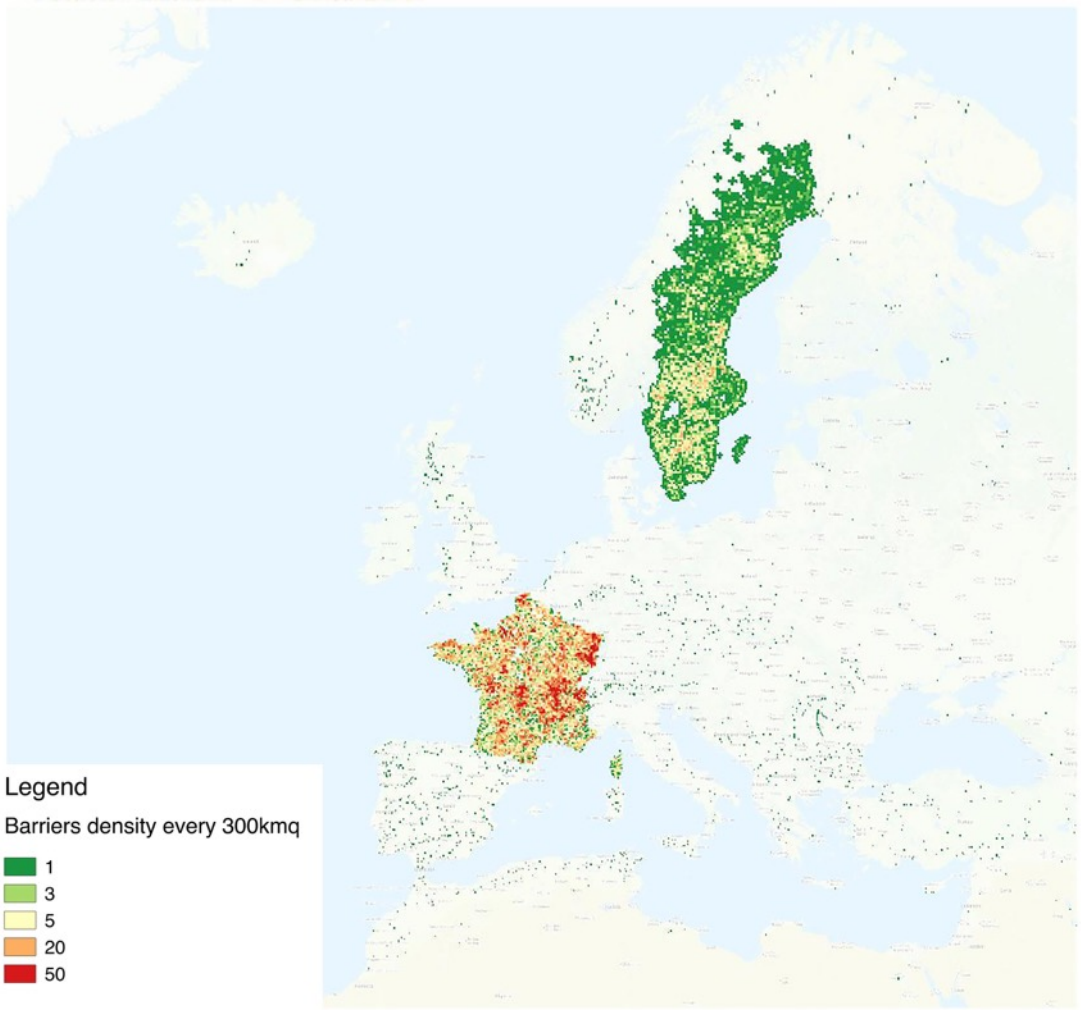


AMBER

Existing data:
Continental, National, Regional scale

All barriers
(also < 10 m)

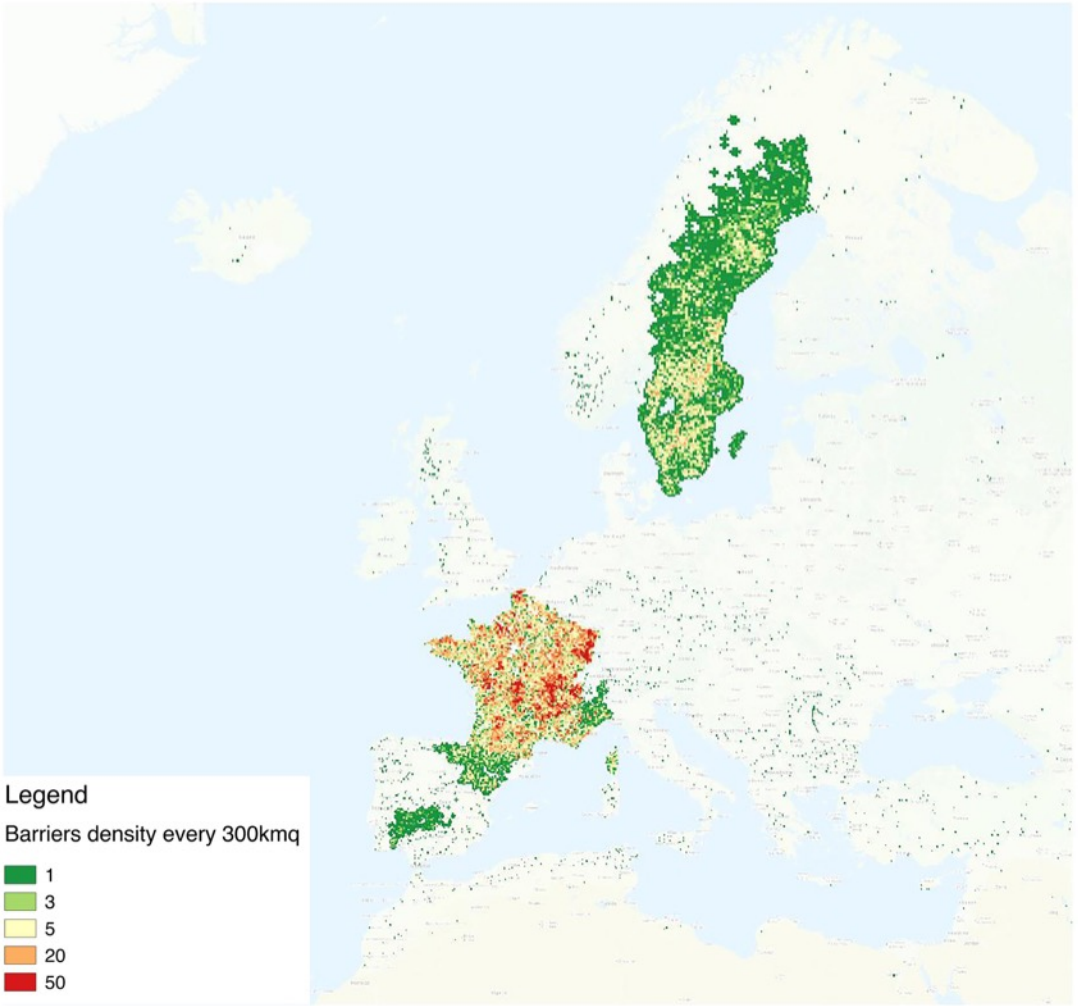
Continental + national



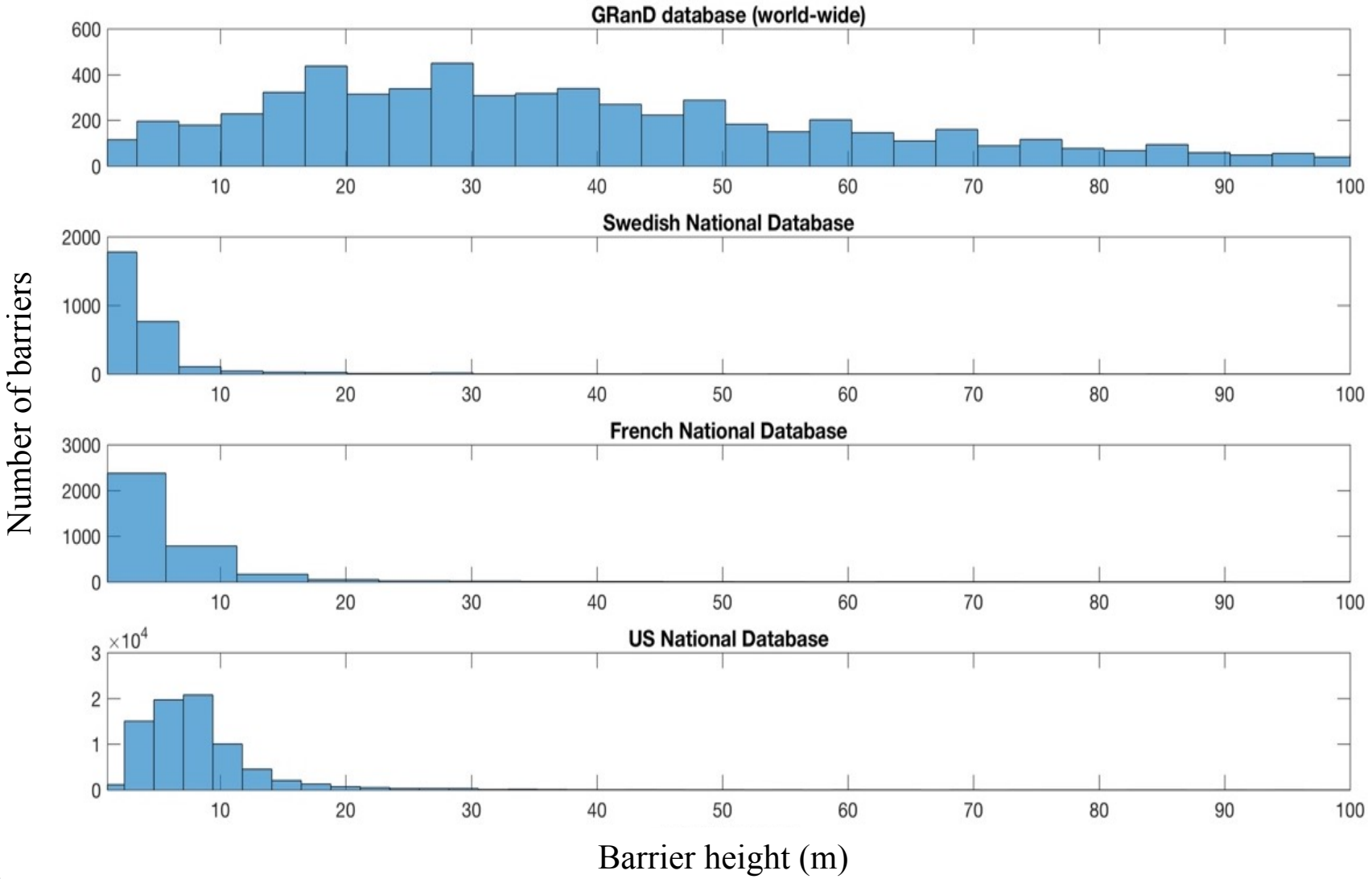
Existing data:
Continental, National, Regional scale

Continental + national + regional

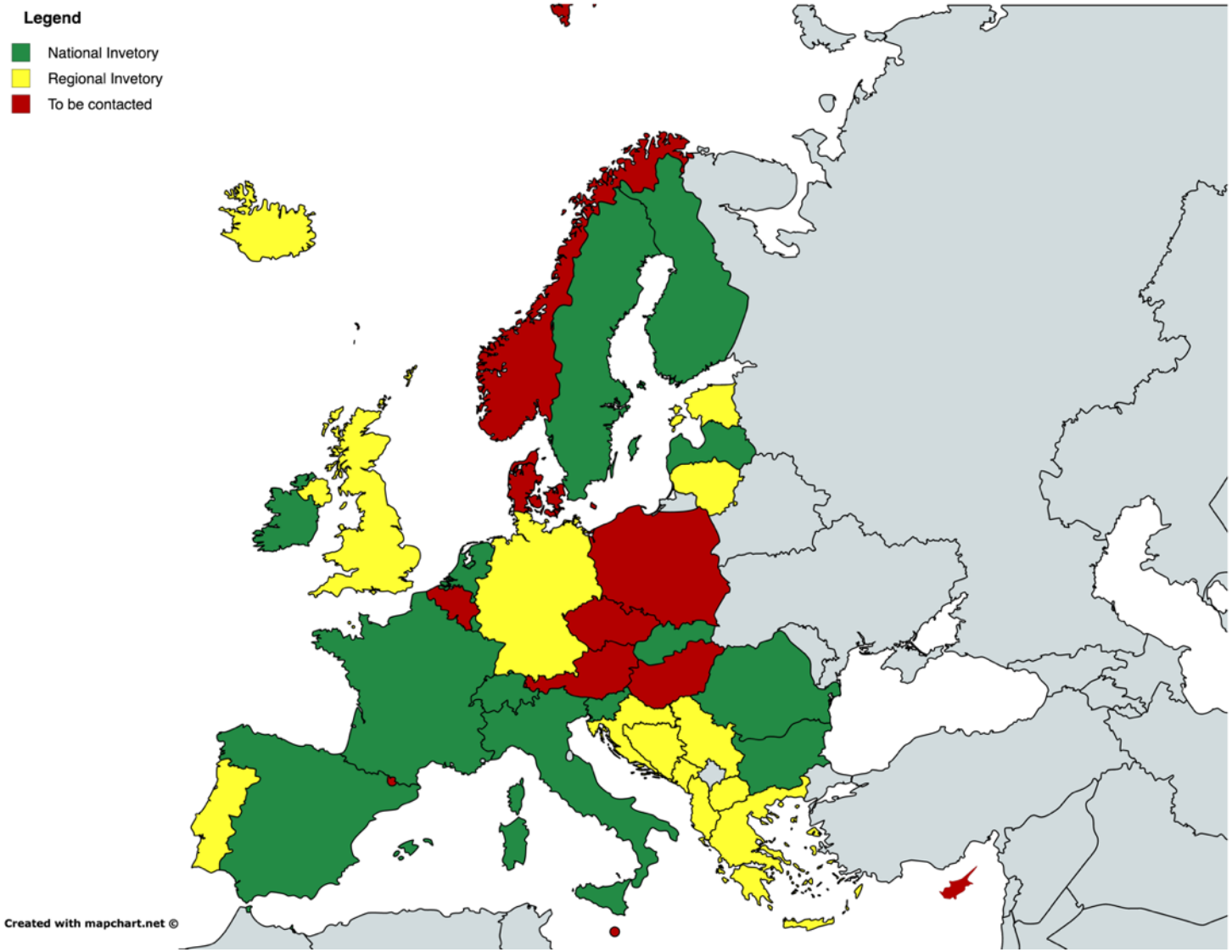
All barriers
(also < 10 m)



Type of barriers for different datasets



Data availability: a first survey



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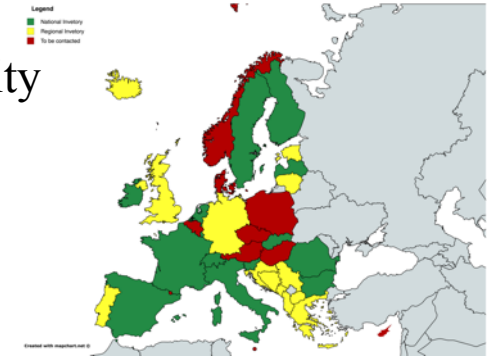
Summary: need for a pan-EU ATLAS

PROBLEM (many) …

National and regional (and provincial!) databases

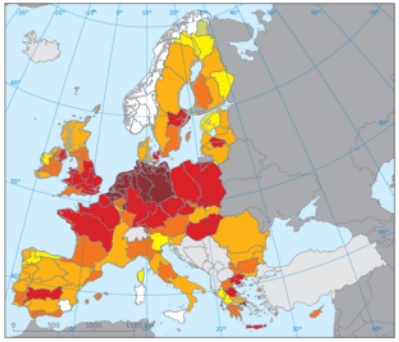
Scattered data availability

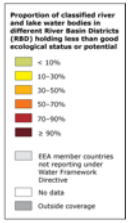


Databases
"incomplete"

Fragmentation extent

…SOLUTION
(a starting point)





WDF &
Ecological state

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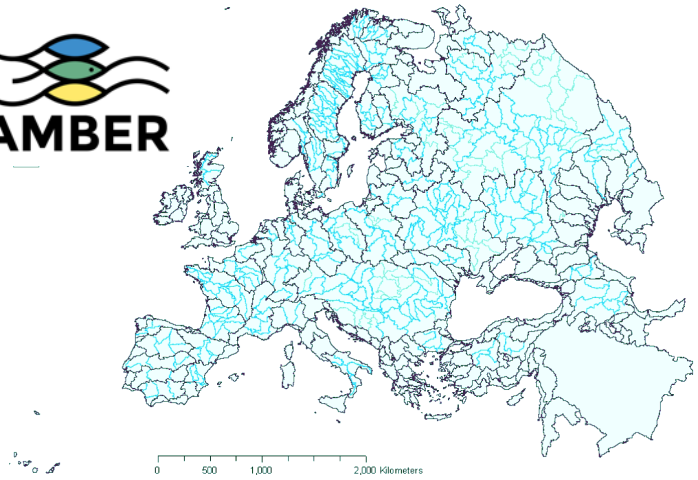


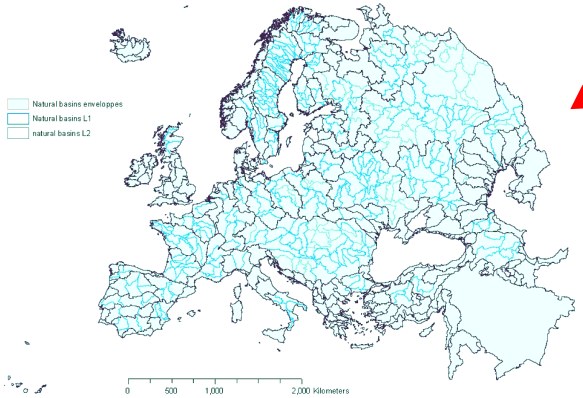
European Barrier Atlas

AMBER ATLAS

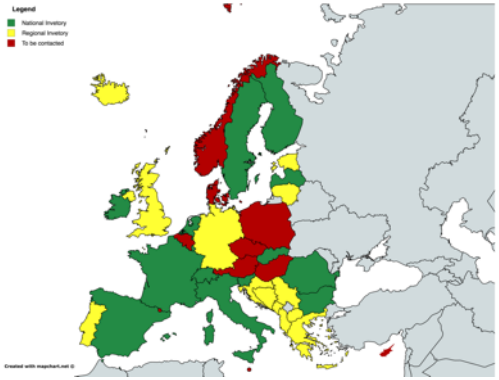
All barriers matter

Barrier ID-card

ATLAS_ID	*New ID defined within AMBER*
Source_ID	*ID of the source database*
URL	*Link to data source*
Country	*EU country*
X_coord	*Latitude (WGS84)*
Y_coord	*Longitude (WGS84)*
River	*Name of the river*
Basin	*Name of river basin*
Height	*Barrier height (m), i.e. the structural height*
Type	*Dam, weir, spillway, etc.*
Year	*Date of building (end)*



Post-processing



All existing databases

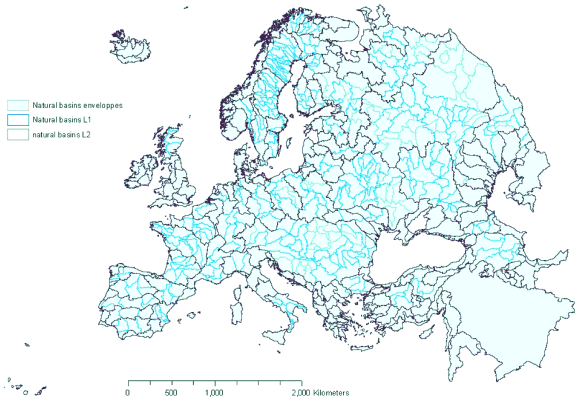
European Barrier Atlas

Data validation

A common pan-EU data coverage - ECRINS

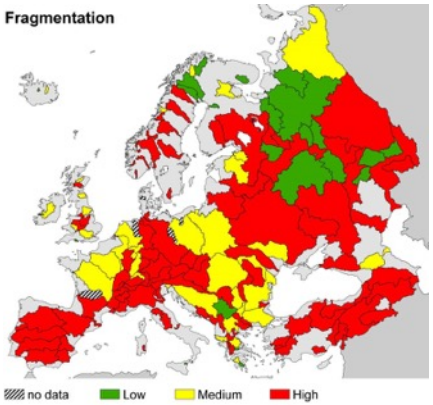
AMBER

ATLAS outcomes



European Barrier Atlas

Fragmentation of EU rivers



Data accessibility and gaps

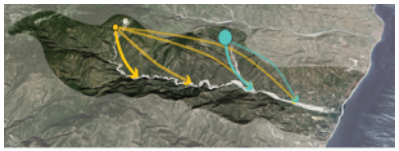
Protocol for barrier reporting

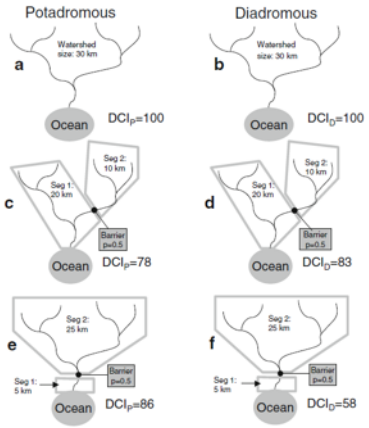
Data storage

Impact assessment

Management

Research





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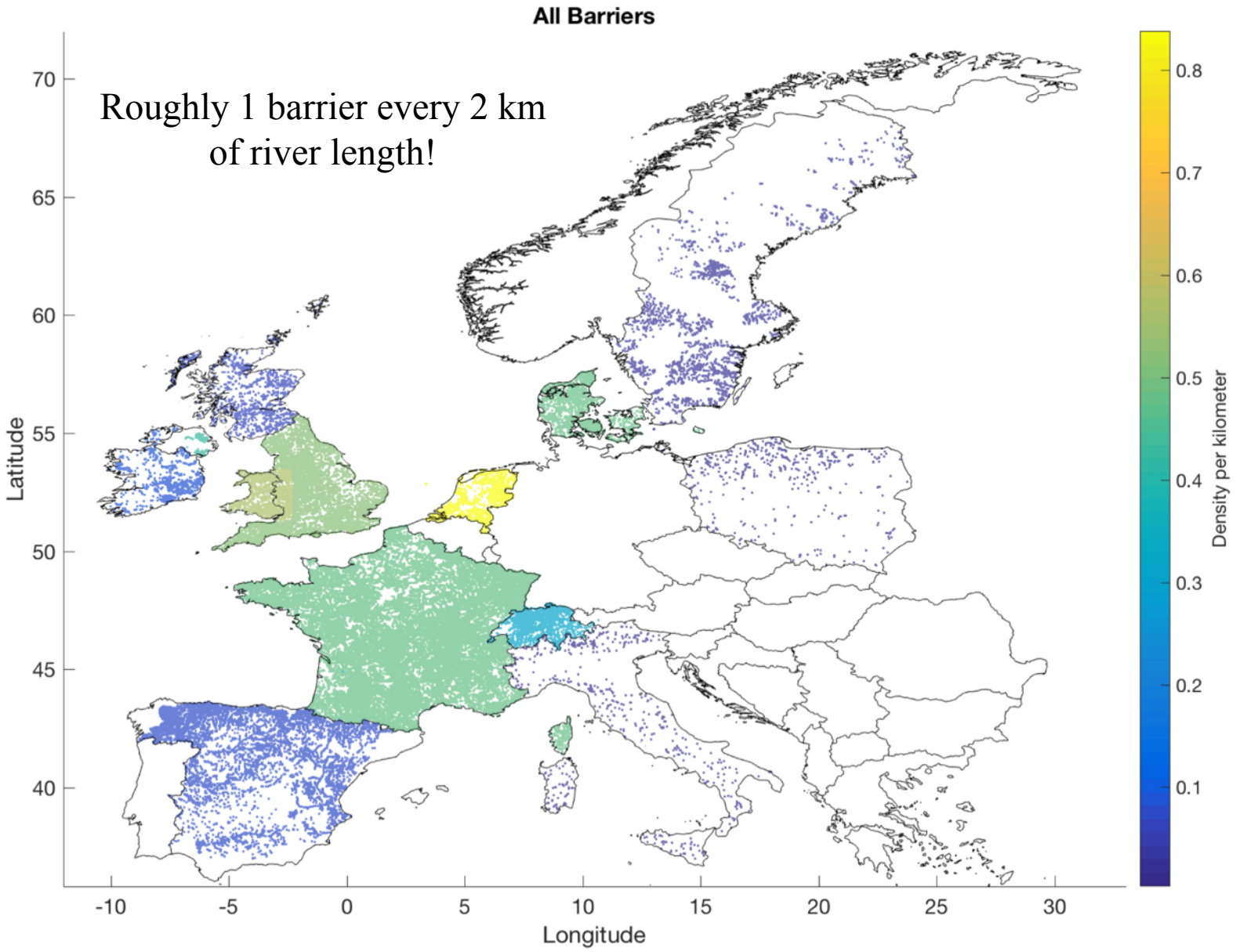

All Barriers
Roughly 1 barrier every 2 km
of river length!
Latitude
70
65
60
55
50
45
40
-10
-5
0
5
10
15
20
25
30
Longitude
Density per kilometer
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1

Data validation and update

AMBER APP

Barrier Tracker

DATA VALIDATION

Dam existence

Effective
data coverage

DATA UPDATING

Citizen science

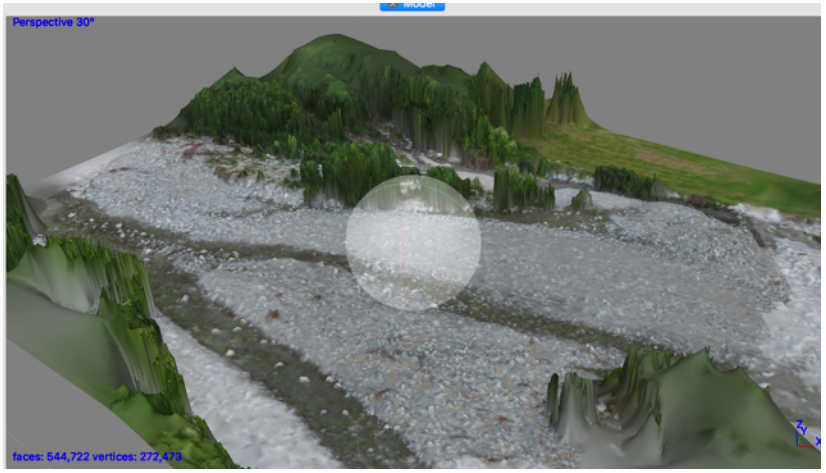
BARRIER MONITORING?

AMBER

sUAS Geomorphic mapping

LOW COST MAPPING OF :

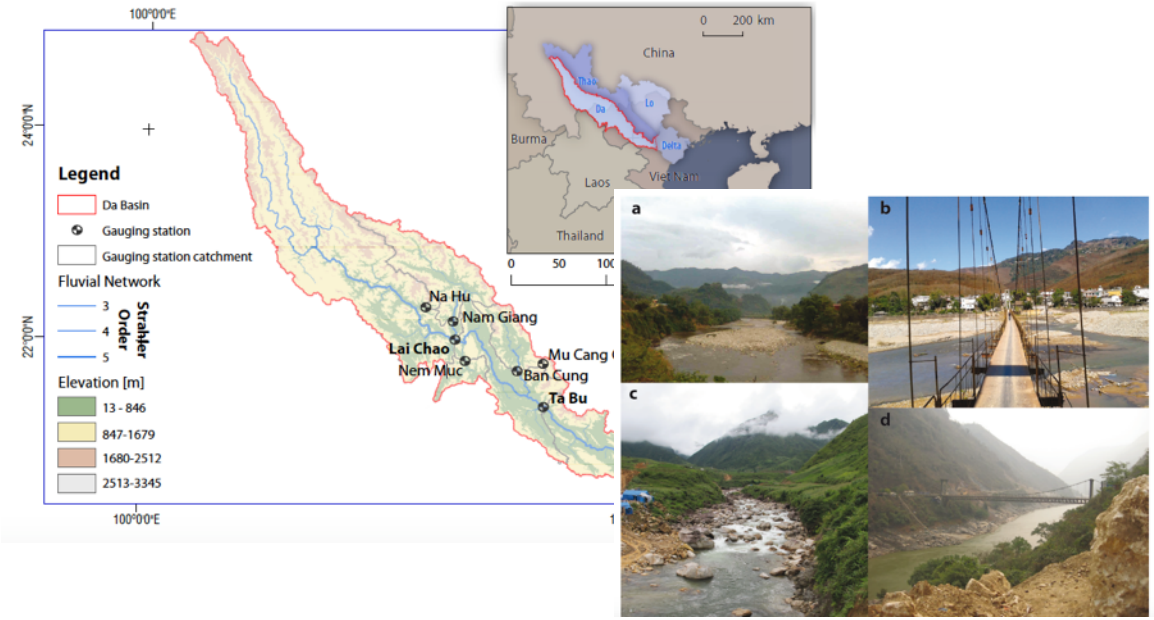
- HABITAT/GEOMORPHIC UNIT MAPPING
- DEM PRODUCTION
- GRAIN SIZE MAPPING
- CHANNEL PROCESSES (CHANGE DETECTION)

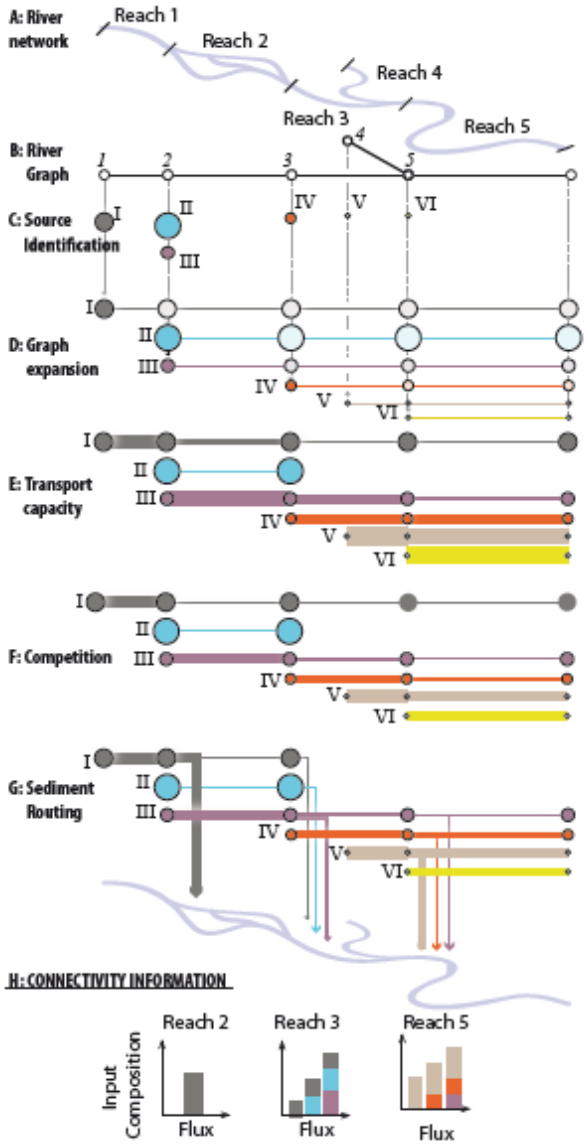


Conceptualizing river network connectivity:
CASCADE (CAtchment SEdiment Connectivity And DElivery) model[1]

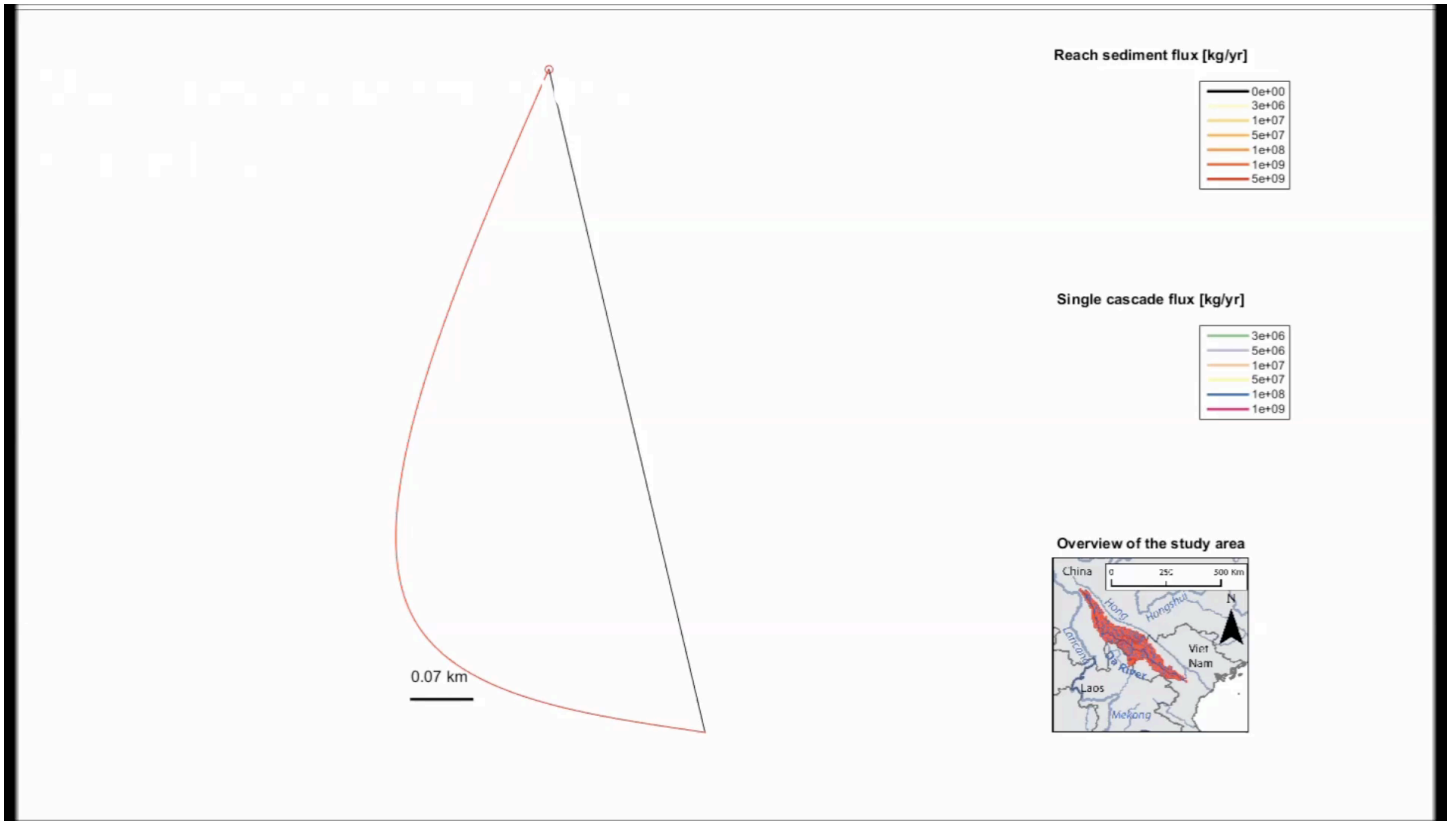
Inputs

- **DEM**
- **Orthophotos**
- **Hydrological data**
- Sediment Transport observations
- Geomorphological maps





Conceptualizing river network connectivity:
Building the CASCADE model



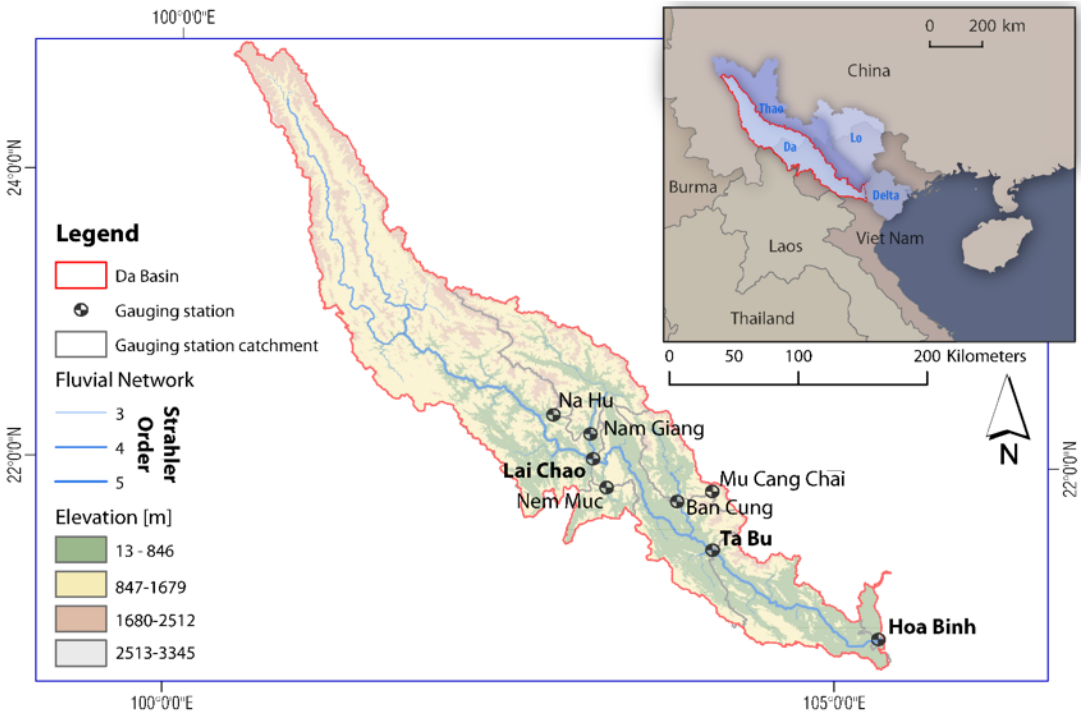
River Da case study:
CASCADE initialization

Available input data:

- 8 long term gauge records
- DEM (Aster 30 m GDEM)
- Scaling laws[2]

$$W_{AC} = f(Ad, I)$$
$$Q_{Bf} = f(Ad)$$

7433 km of river network



[2]*Schmitt et al., 2014, Geomorphology*

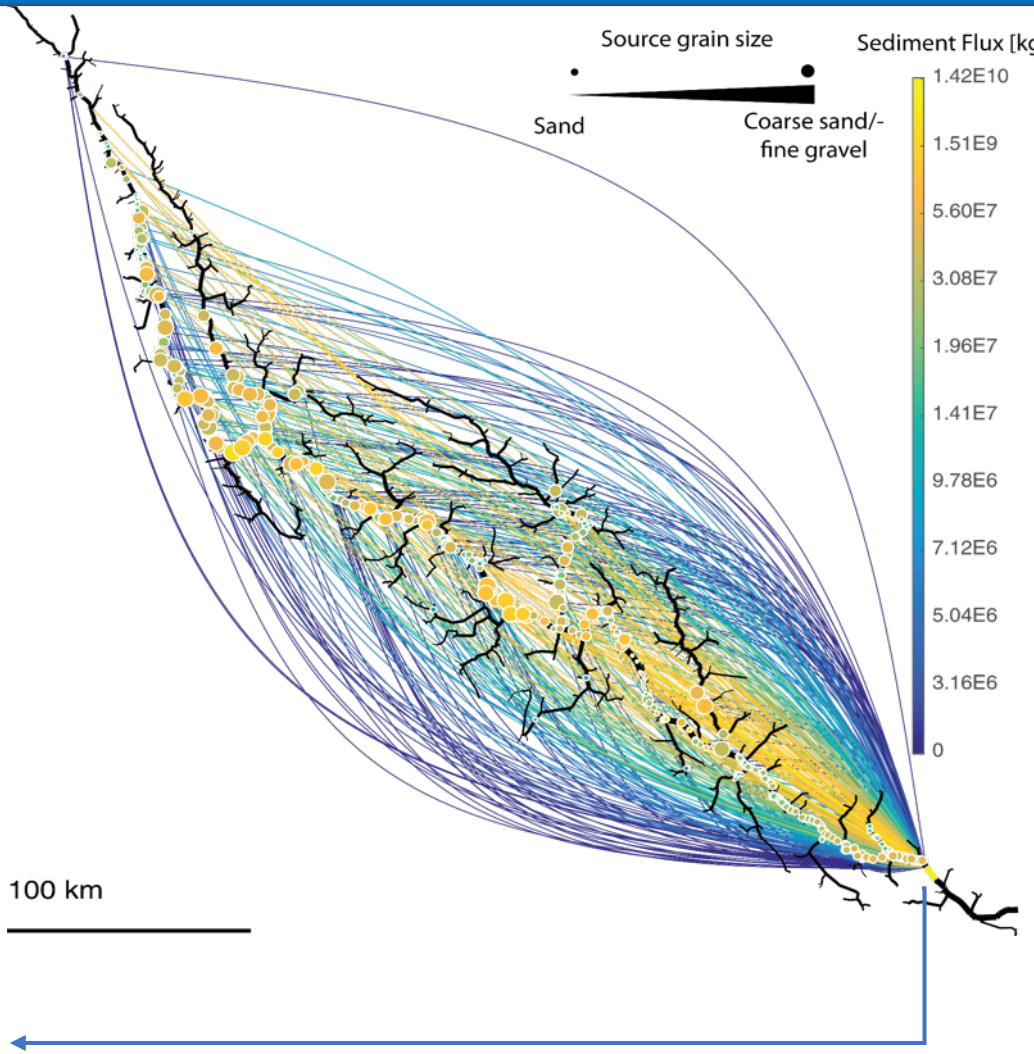
River Da case study:
CASCADE outputs

Analyzing reach connectivity

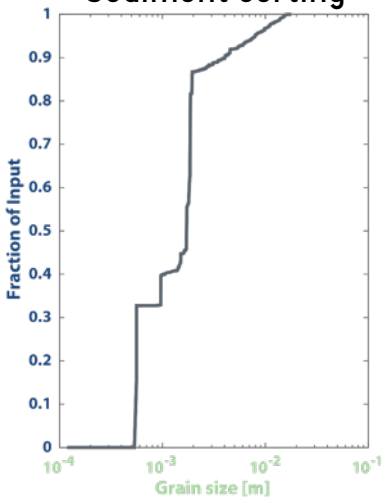
Where are sources located

Source–sink deliveries

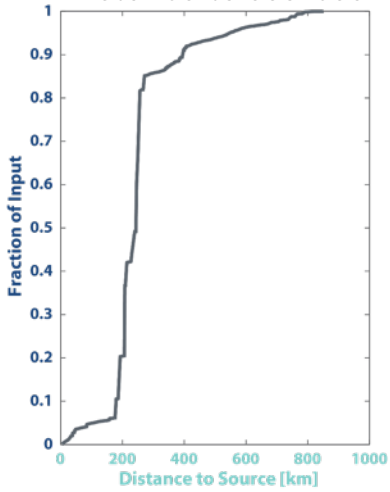
This information is available for all reaches



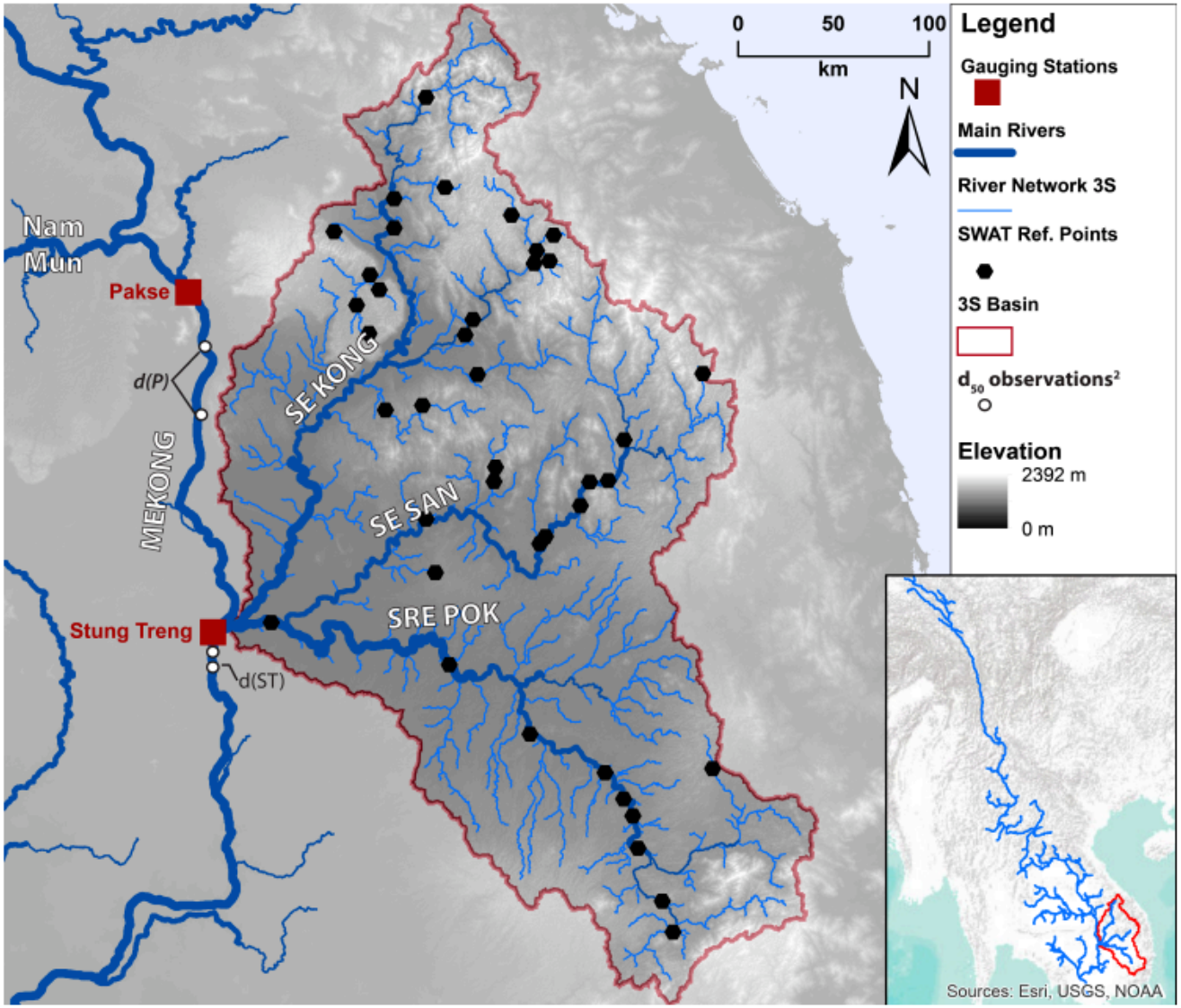
Sediment sorting



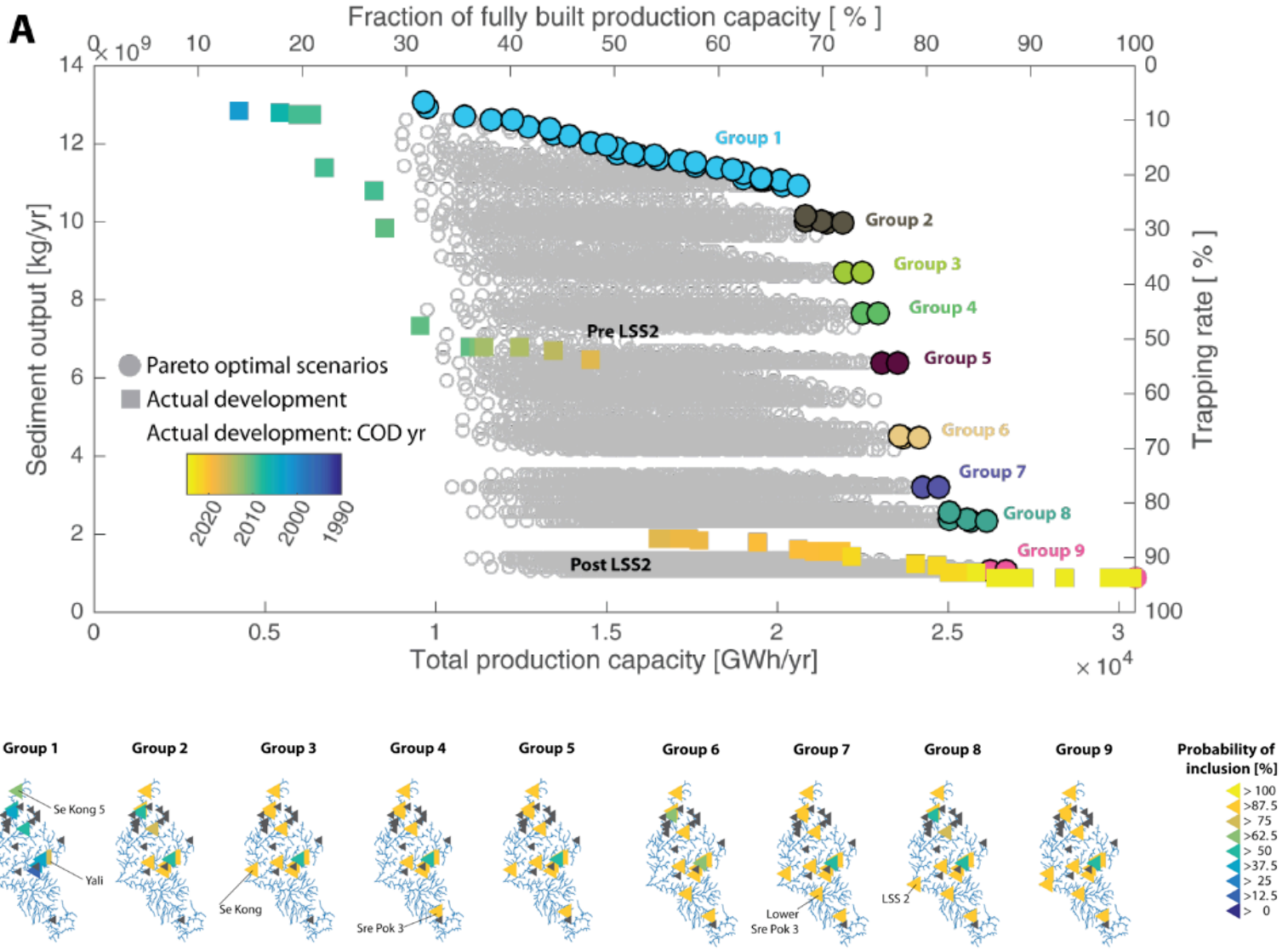
Distance to sources



3S case study:



3S Hydropower development vs sediment connectivity



Thanks for your attention!

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