



Katarzyna Suska SSIFI

AMBER: Let it Flow

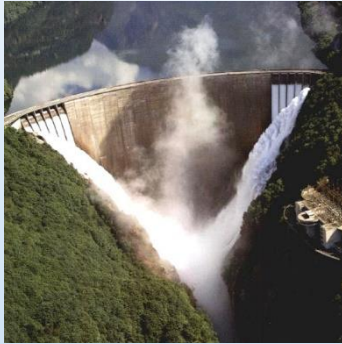
Piotr Parasiewicz et al

S. Sakowicz Inland Fisheries Institute

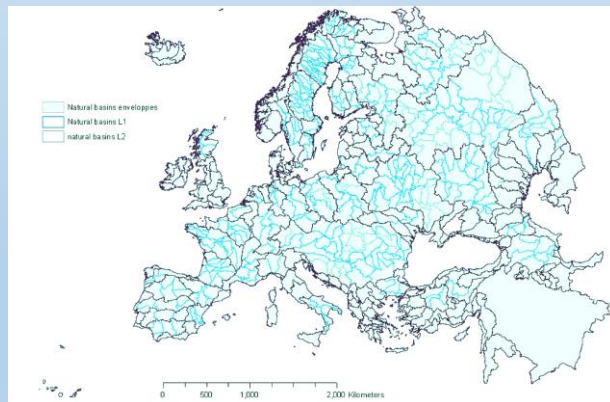


This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 689682.

A_{daptive} M_{anagement} of B_{arriers} in E_{uropean} R_{ivers}



1. European Barrier Atlas



2. Barrier guidance

- strategic
- adaptive
- practical



Collaborative?

20 participant institutes:



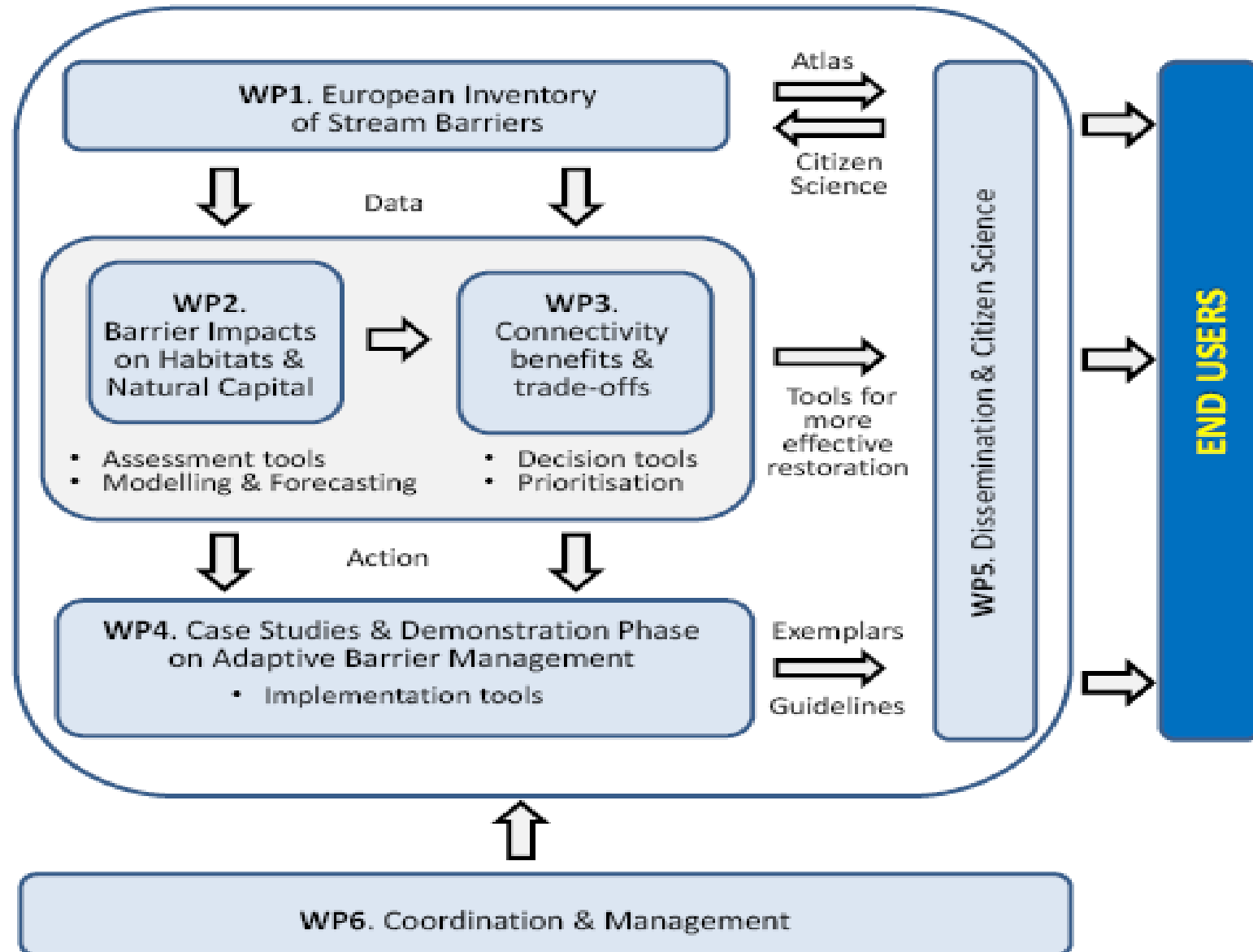
8 Universities - Swansea, Durham, Highlands & Islands, Southampton, Cork (Ireland), Oviedo (Spain), Milan (Italy), DTU (Denmark).

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

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

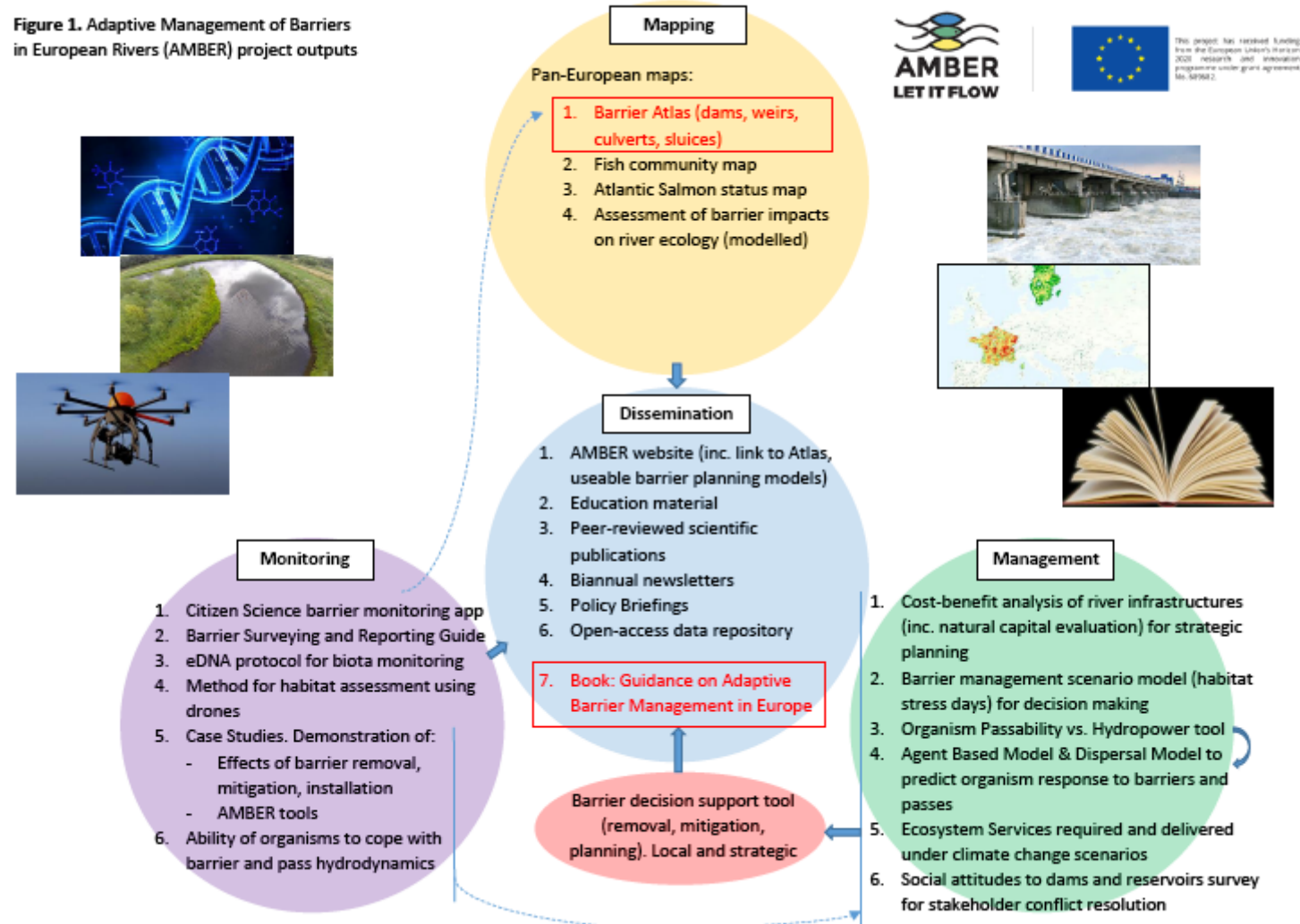
4 Government organisations - IFI (Ireland), ERCE (Poland), SSIFI (Poland), Joint Research Centre (Italy)

AMBER Pert diagram



AMBER outputs

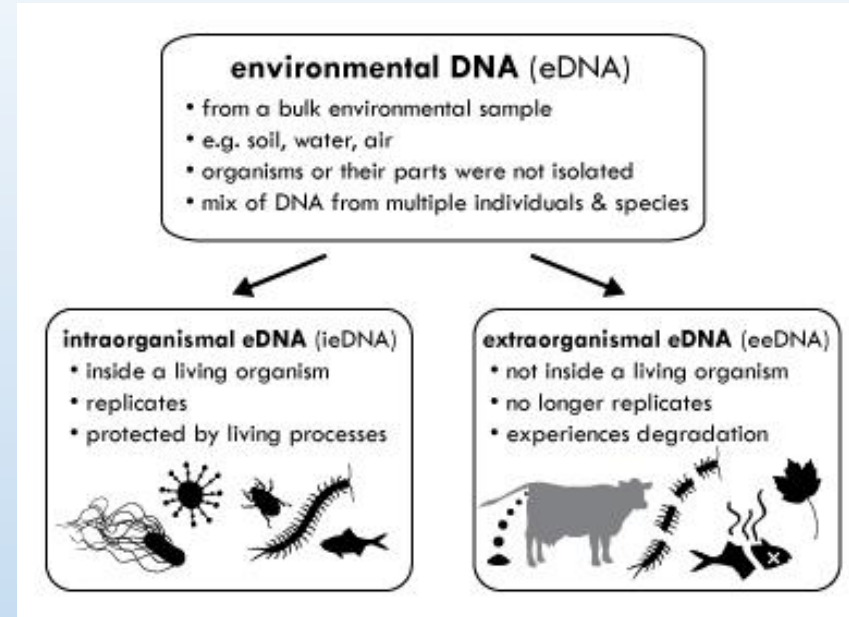
Figure 1. Adaptive Management of Barriers in European Rivers (AMBER) project outputs



New opportunities for restoring river connectivity

1. New technologies

- eDNA/meta-barcoding



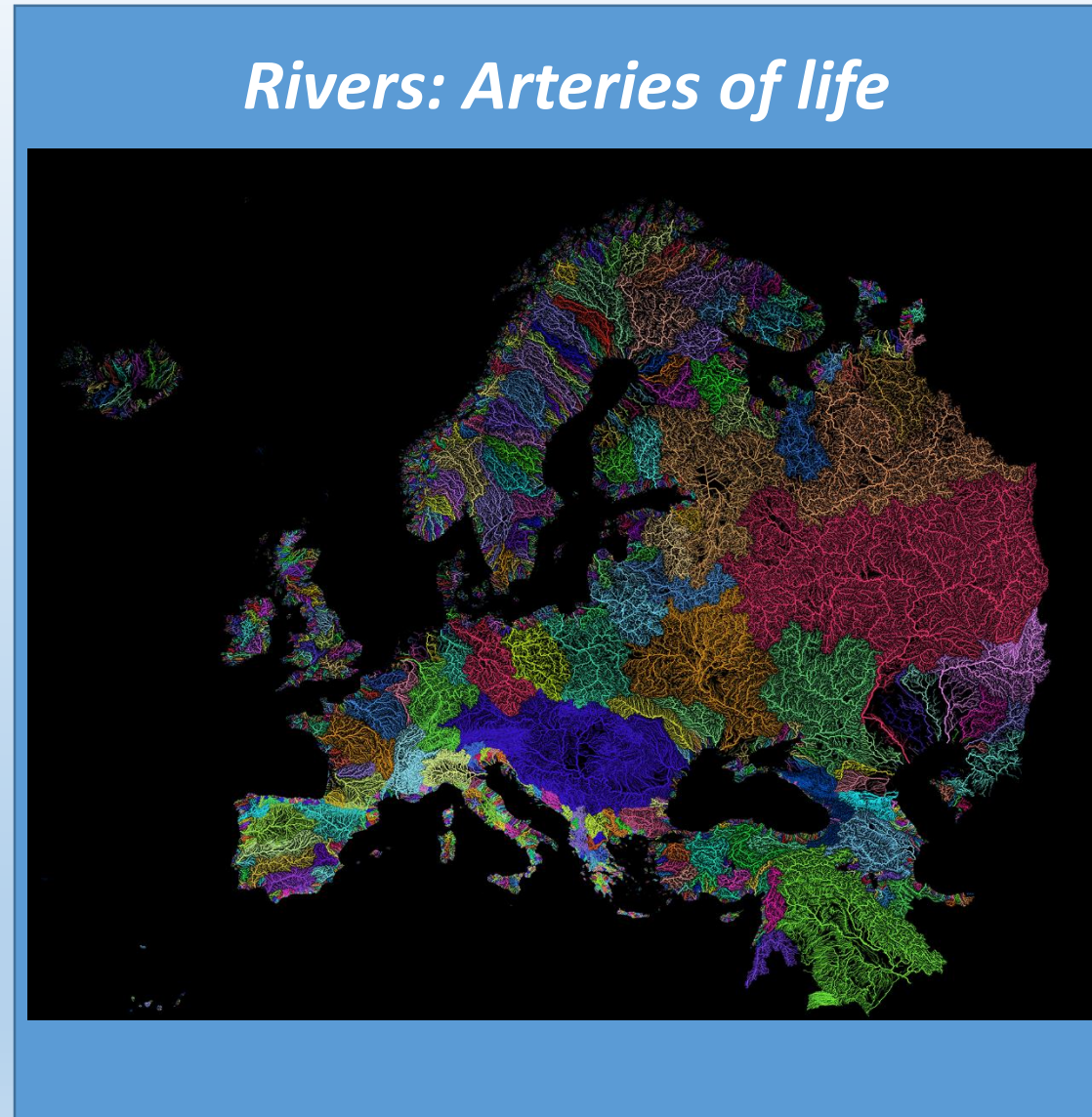
- Drones for quick surveying & remote sensing



- Modelling P/A (PREDICTS approach)

European Rivers systems

- Connecting continents with oceans
- Biological distribution pathways
 - transportation
 - communication
 - processess



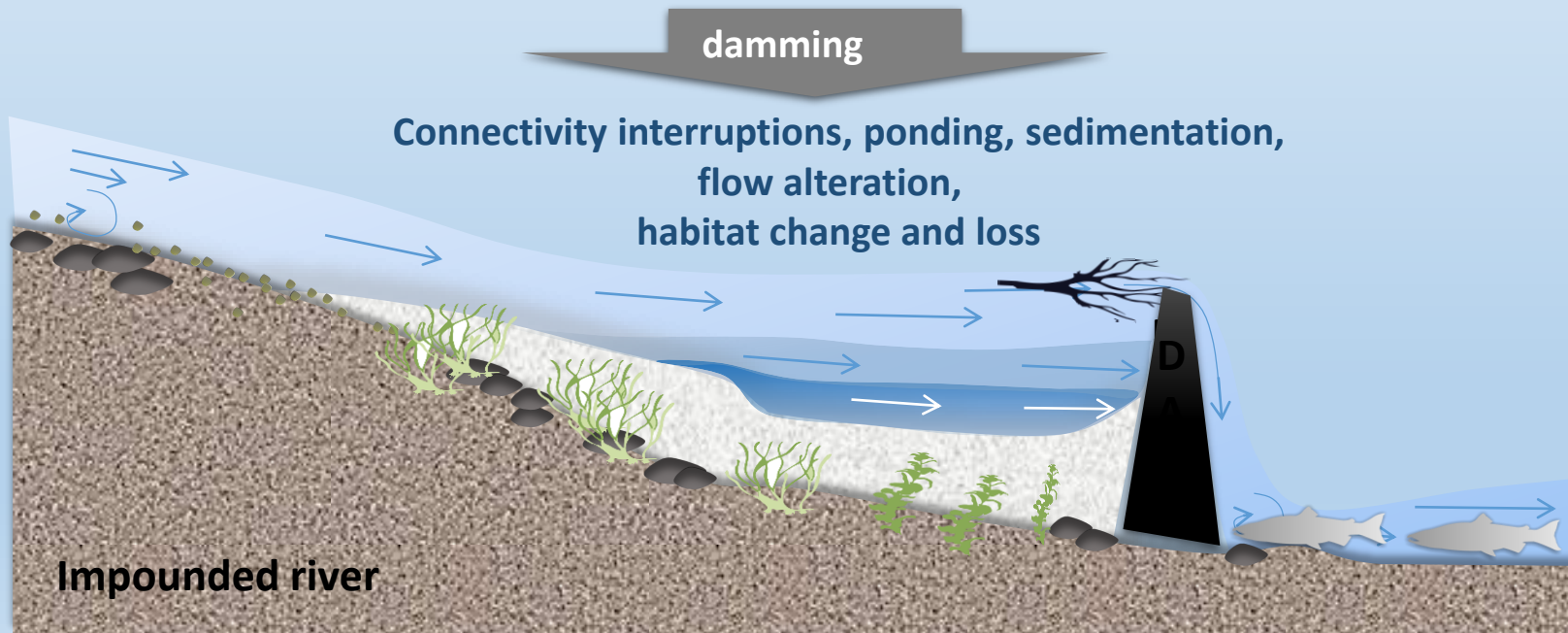
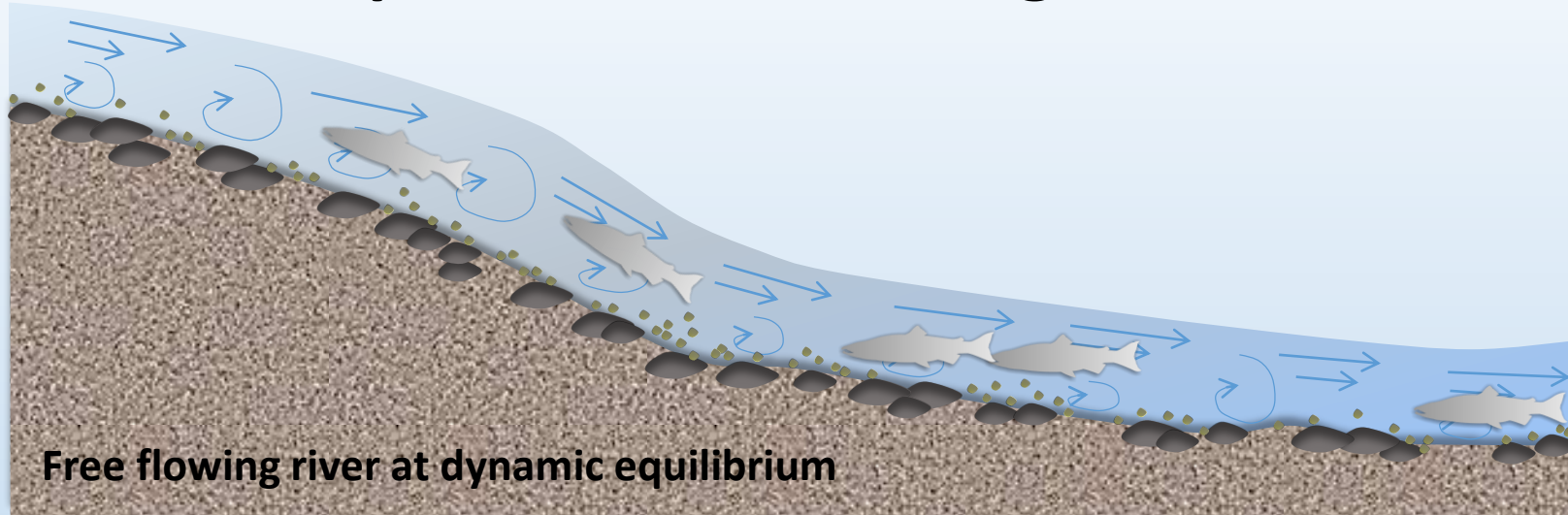
Impacts of dams

- altered or stopped fish upstream migration
- fish mortality:
 - dewatering
 - turbines



Phot. P. Prus, M. Adamczyk SSIFI

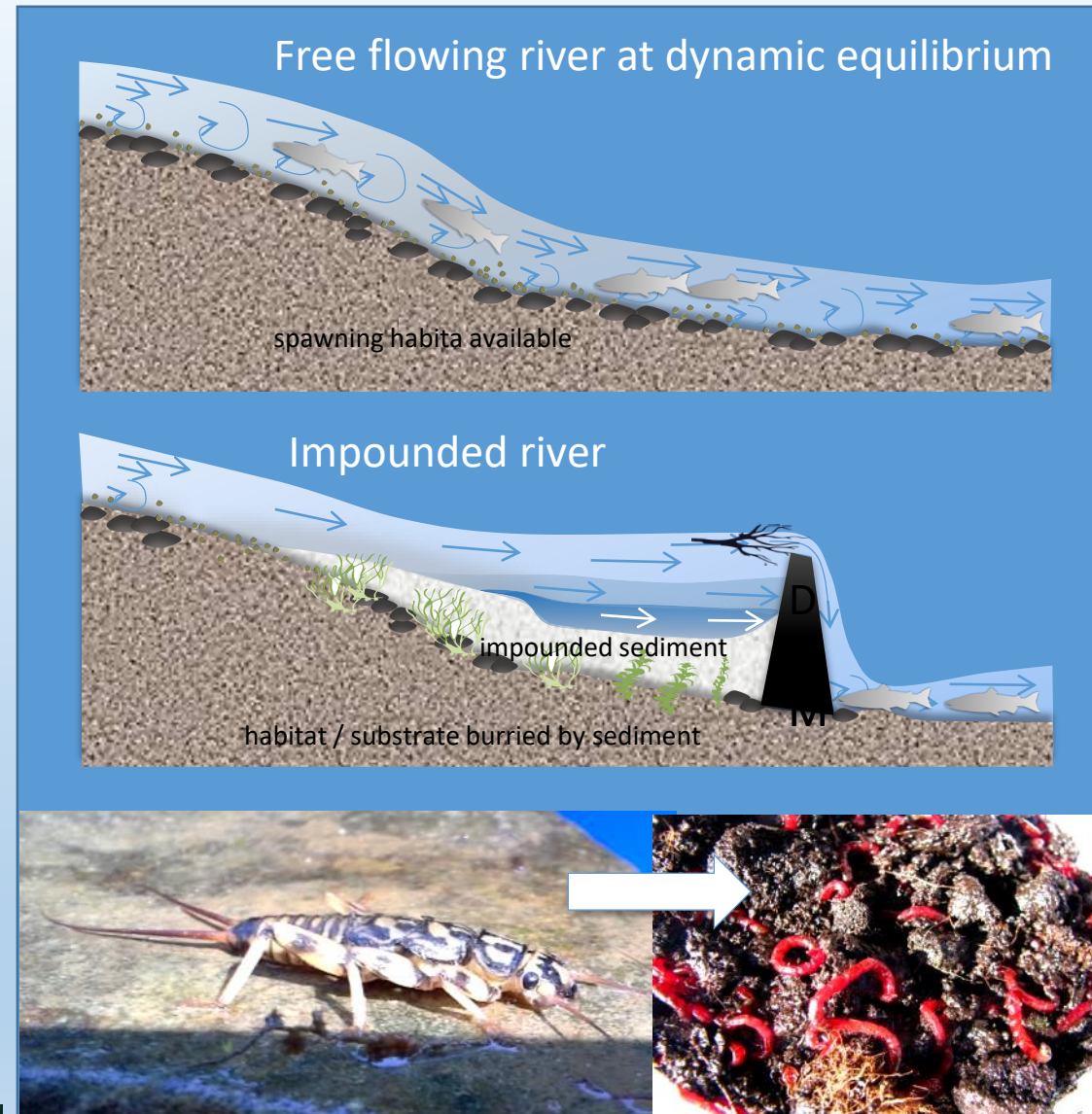
Dam impact on free flowing river



Modified from L. Wildman - The Effects of Dams on Floodplain Function

Dam impact on upstream habitat

- higher depth
- low velocity
- substrate siltation
- high temperature
- low oxygen
- eutrophication
- vegetation shift
- benthos shift



Phot. P. Parasiewicz SSIFI

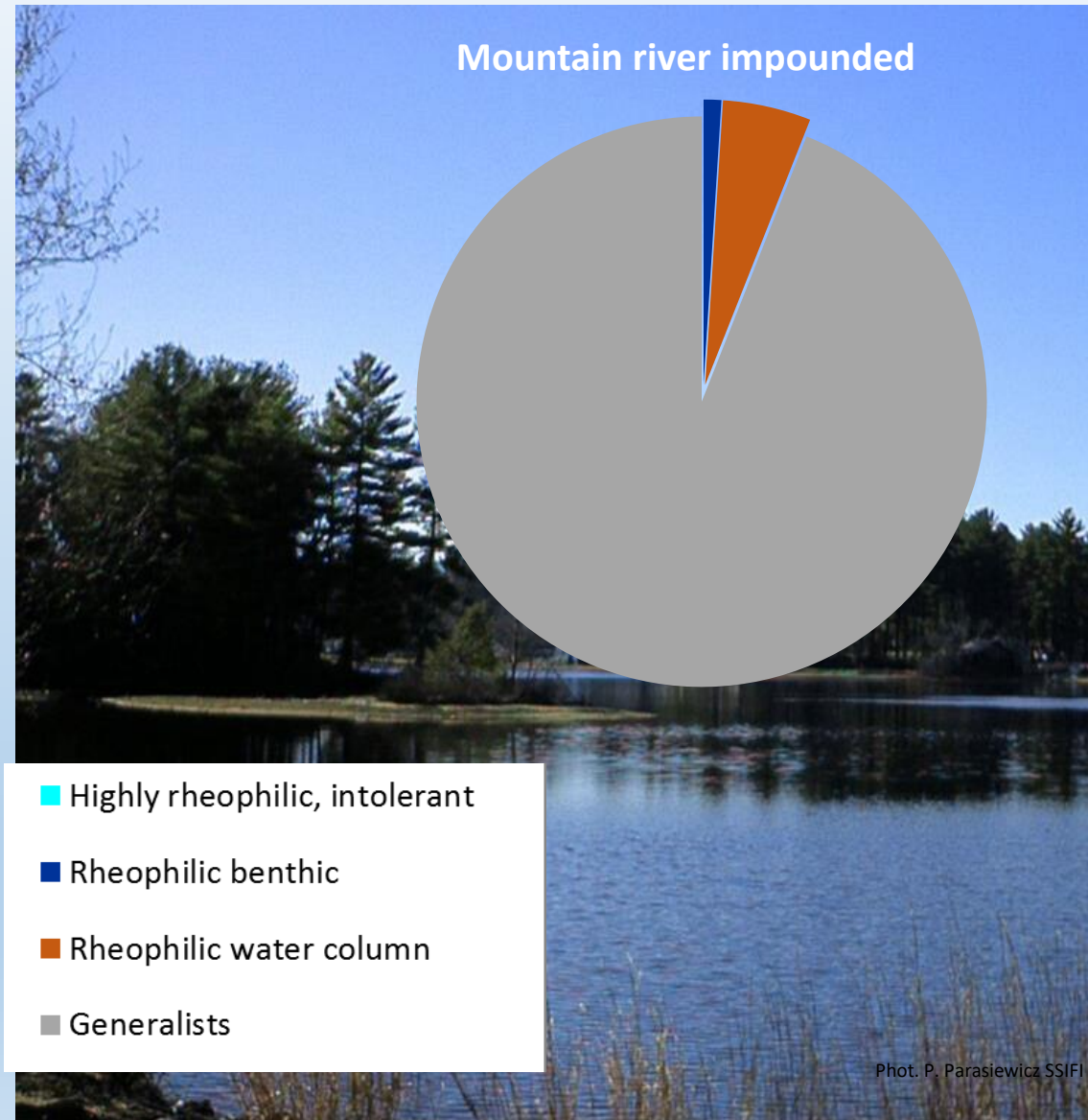


Upstream

- rheophilic fish guilds in undisturbed river



- change of lotic into lentic habitats
- altered fish community
- generalists - tolerant fish in impounded river



Dam impact on downstream habitat

- flow regime
 - fluctuations:
 - depth
 - velocity
 - temperature
- blocked sediment
 - riverbed erosion
 - sediment armoring
- Dewatering (mortality)



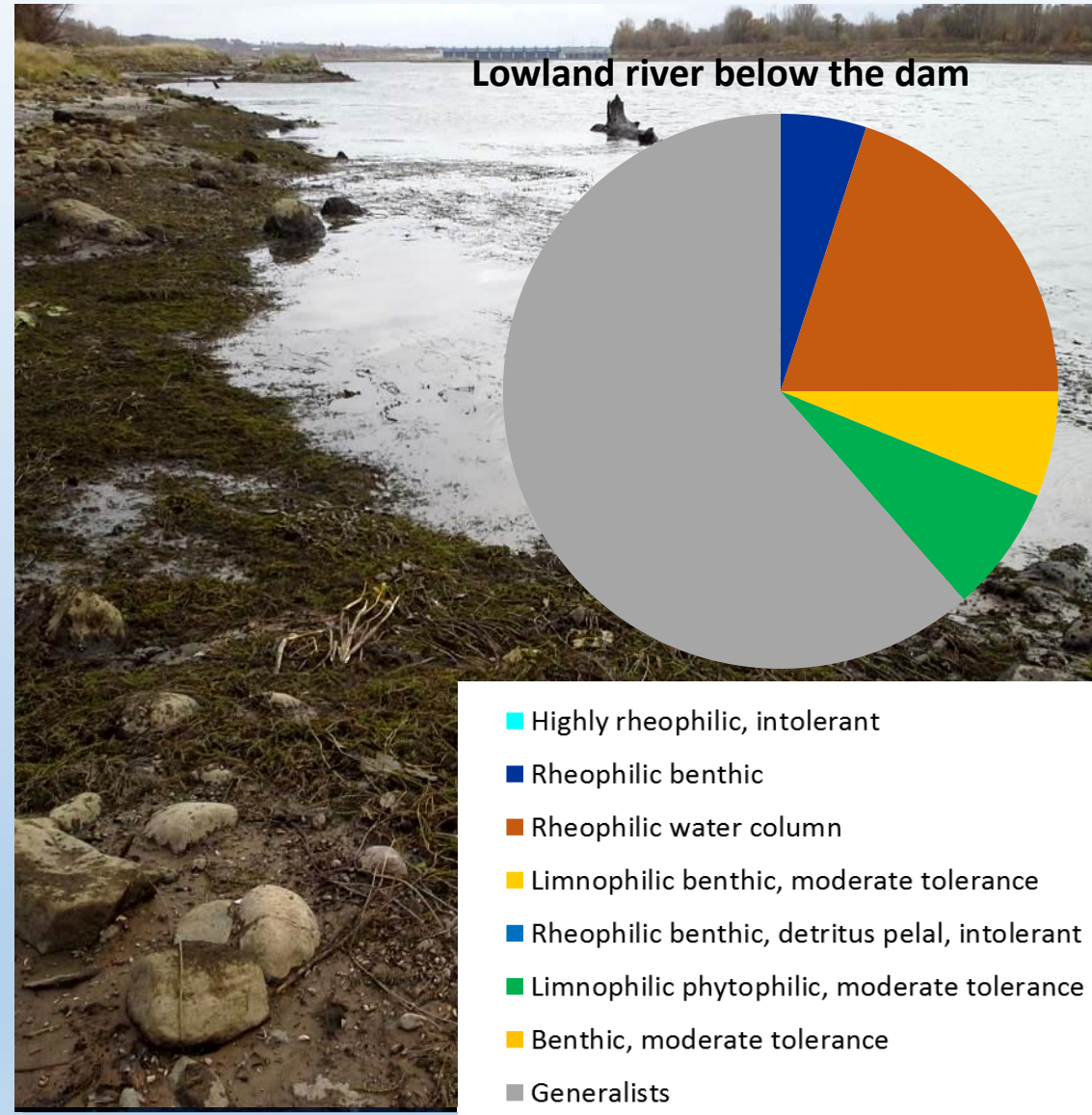
Phot. K. Susuka, P. Parasiewicz SSiFI

Downstream

- change of habitat quality and stability
- rapid bottom erosion



- altered fish community

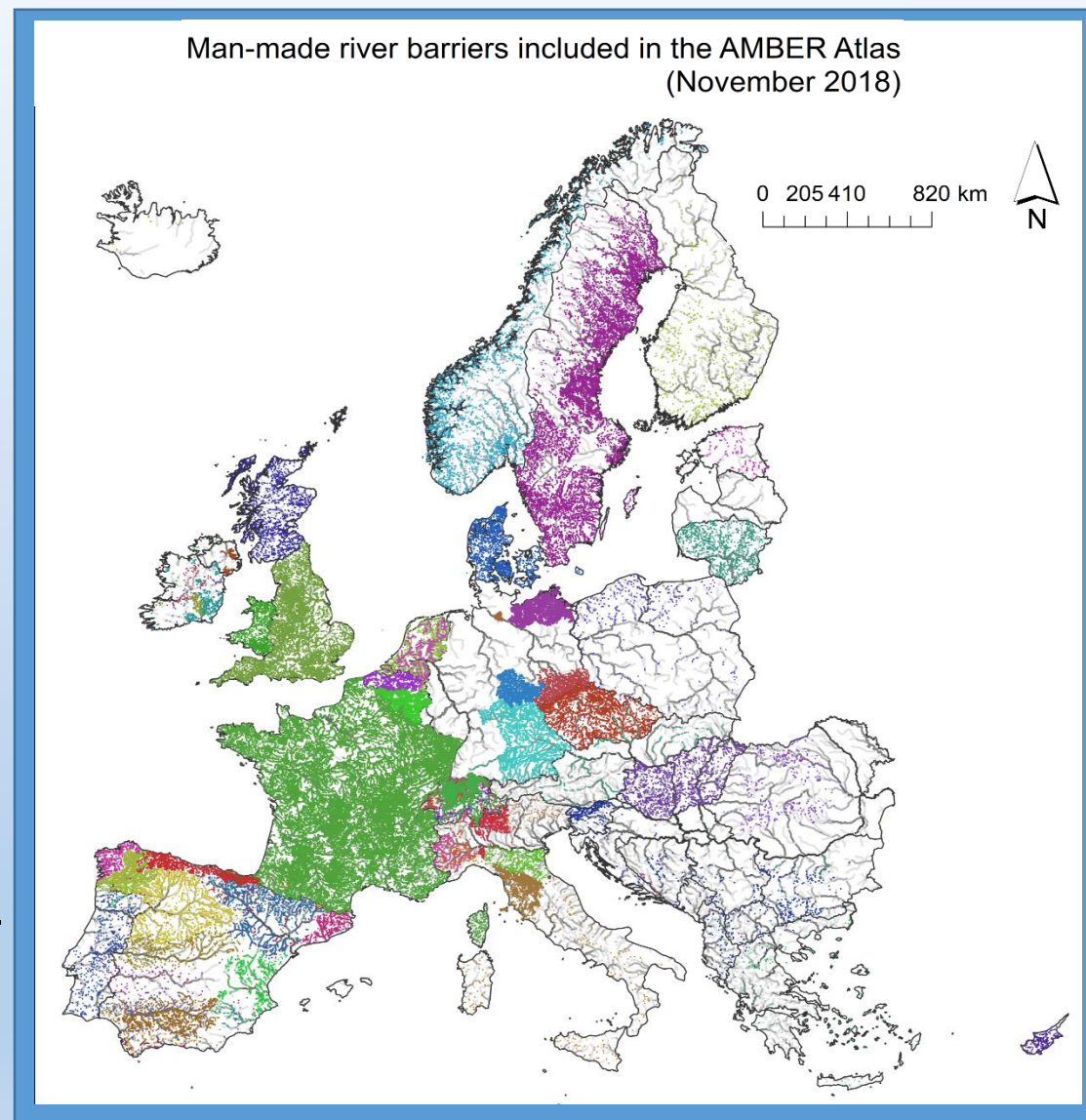


Phot. M. Adamczyk SSIFI

Barriers on European Rivers

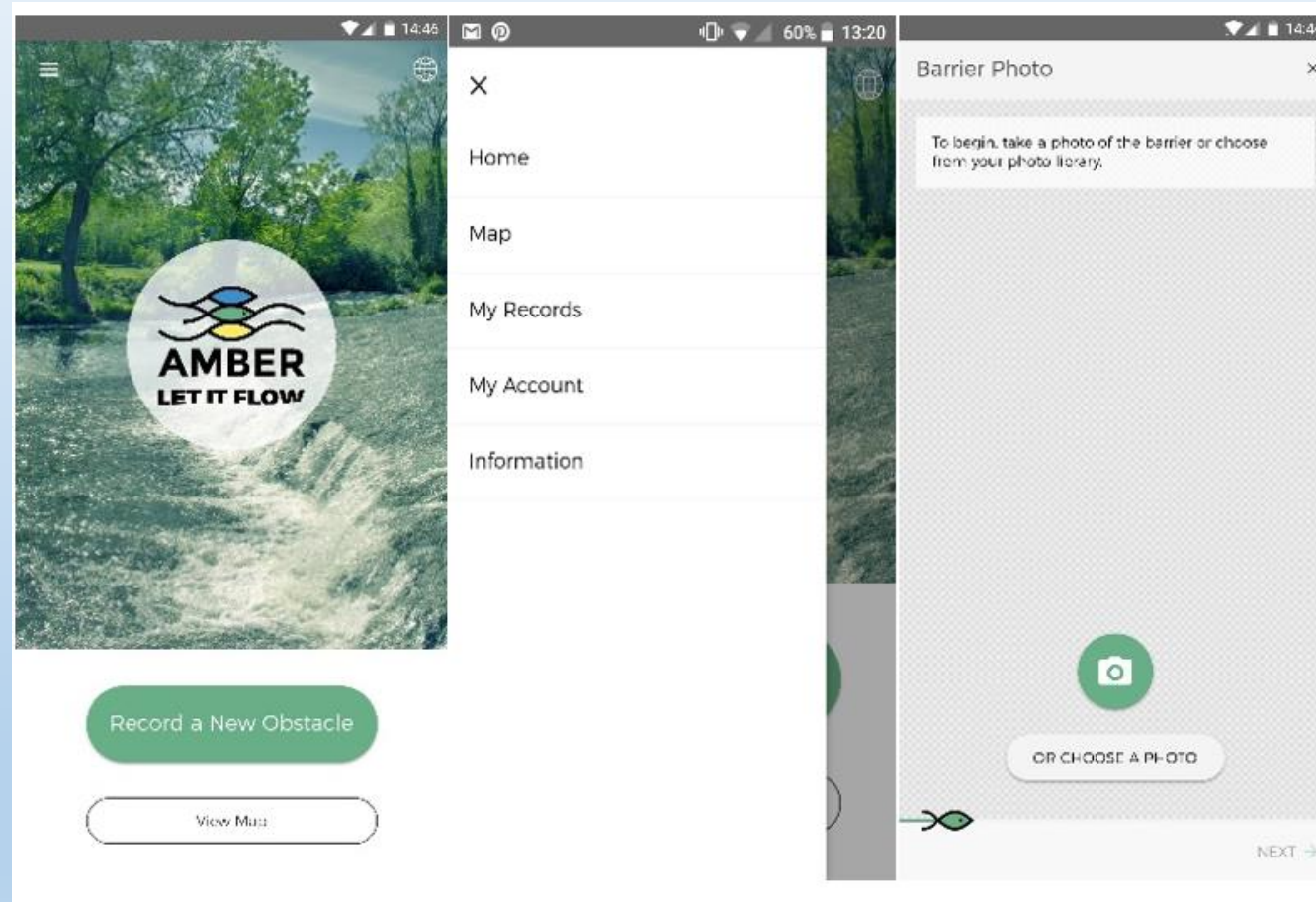
- **400.000** recorded in AMBER ATLAS (status Nov 2018)

> A barrier every river kilometer



SOURCE: AMBER project

AMBER Barrier Tracker



River MacHT based on Intercalibration Database

European rivers classified into Macrohabitat types (MacHT)

0 250 500 1 000 km



McHT0227EN

- 1 Highland, medium sediment rivers
- 2 Mountain, Alpine and subalpine rivers
- 3 Central European lowland, medium sediment rivers
- 4 Central European lowland, large-medium sediment rivers
- 5 Highland and lowland, large-medium sediment rivers
- 6 Boreal large-medium sediment rivers
- 7 Boreal lowland rivers
- 8 Mediterranean mountain and upland rivers
- 9 Mediterranean highland rivers
- 10 Mediterranean lowland rivers
- 11 Western European and Atlantic rivers
- 12 Lowland medium sediment and organic rivers
- 13 Boreal-Atlantic large-medium sediment rivers
- 14 Atlantic medium-large sediment rivers
- 15 North Atlantic lowland, medium-large sediment rivers
- all other rivers
- LAKES

MacHT classes calculated based on:

European rivers classified into Macrohabitat types (MacHT)

0 250 500 1 000 km



McHT0227EN

- 1 Highland, medium sediment rivers
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- 14 Atlantic medium-large sediment rivers
- 15 North Atlantic lowland, medium-large sediment rivers
- all other rivers
- LAKES

MacHT classes calculated based on:
Environmental Zones of Europe, catchment size,
Strahler order of stream and geology.

Catchment Characterisation and Modelling River and
Catchment Database, version 2.1 (CCM2) (Vogt, J.V.
et al., 2007) is used to present running waters as river
segments, catchments and determination of catchment
size and Strahler stream order.

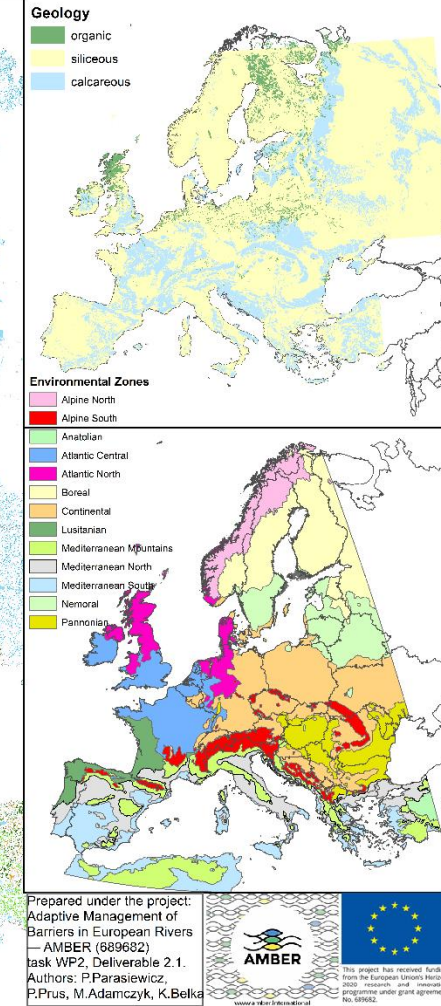
European Soil Database v2.0 (ESDB v 2.0; Panos, 2006)
have been used to derive geological class of organic substrate.

IHME1500 - International Hydrogeological Map of Europe
1:1,500,000 has been used to derive
geology class siliceous and calcareous.

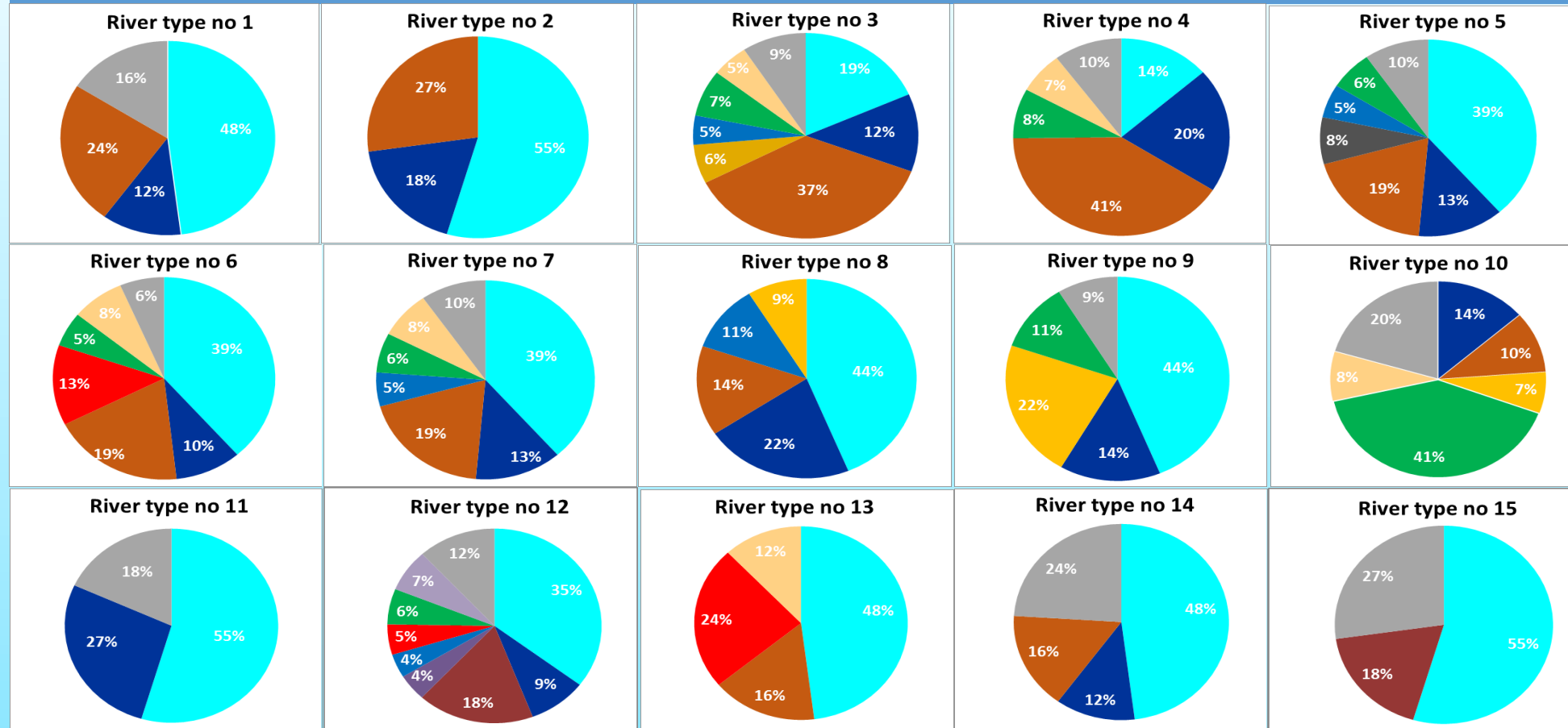
Environmental Zones of Europe are
derived from the Environmental
Stratification of Europe version 8:
Metzger, Marc J. (2018).
The Environmental Stratification
of Europe, [dataset].
University of Edinburgh.
<https://doi.org/10.7488/ds/2356>.

Political borders from Water Information System for
Europe Water Framework Directive (WISE WFD)
database (EEA, 2017).

version: cart190227



Fish MacroHabitat River Types



- Highly rheophilic, intolerant species
- Rheophilic water column species, preferring sandy-gravel bottom substrate
- Limnophilic water column species of moderate tolerance
- Intolerant, water column species
- Limnophilic phytophilic species of moderate tolerance
- Generalists - tolerant species
- Rheophilic benthic species, preferring sandy-gravel bottom substrate
- Limnophilic benthic species of moderate tolerance
- Intolerant, rheophilic benthic species, preferring detritus or pelal bottom substrate
- Limnophilic lithophilic species of moderate tolerance
- Benthic species of moderate tolerance

D2.2 Conceptual model of barrier impact on fish habitats GEP: reference

	BARIER DESCRIPTION	PHOTO	PICTOGRAM
1	Dam - a barrier that blocks or constrains the flow of water and raises the water level. Fish passage facility provided		
2	Weir - a barrier aimed at regulating flow conditions and water levels. Fish passage facility provided		
3	Sluice - a movable barrier aimed at controlling water levels and flow rates in rivers and streams. Not blocking migration when open		
4	Culvert - a structure aimed at carrying a stream or river under an obstruction. Connected to river bed and substrate, free flowing		
5	Ford - a structure in a river or stream which creates a shallow place for crossing the river or stream by wading or in a vehicle. Water depth guarantee fish passing most of the year		
6	Ramp - a ramp or a bed sill is a structure aimed at stabilizing the channel bed and reducing erosion and is recognizable by its stair-like shape. Space in-between stones guarantee fish passing		

Table 4. Weighted remaining habitat proportion (wRHp) with regard to barrier type and FCMacHT.
Red – severe habitat loss (<10), **orange** – major habitat loss (10-50%), **yellow** – significant habitat loss (50-75%), **green** – moderate habitat loss (75-90%), **blue** – low habitat loss (>90).

no.	River FCMacHT type	Dam wRHp %	Weir wRHp %	Sluice wRHp %	Culvert wRHp %	Ford wRHp %	Ramp wRHp %
1	Alpine	11	28	37	73	85	90
2	Continental	43	49	55	83	89	94
3	Mediterranean Highland	59	61	66	91	93	98
4	Mountain Highland Atlantic Continental	38	47	53	83	89	95
5	Boreal Lowland	46	52	57	84	90	95
6	Lowland Atlantic	63	63	66	93	93	99
7	Boreal Highland Costal	12	29	37	72	84	90
8	Mediterranean Mountain	34	44	50	81	87	92
9	Boreal Large	30	41	48	79	87	92

D2.2 Conceptual model of barrier impact on fish habitats GEP: no-fish pass



















	BARIER DESCRIPTION	PHOTO	PICTOGRAM
1	Dam - a barrier that blocks or constrains the flow of water and raises the water level. Dam without fish pass migration		
2	Weir - a barrier aimed at regulating flow conditions and water levels. Weir without fish pass migration		
3	Sluice - a movable barrier aimed at controlling water levels and flow rates in rivers and streams. Sluice built on unpassable weir and without a fish pass		
4	Culvert - a structure aimed at carrying a stream or river under an obstruction. Culvert with crest blocking the upstream migration		
5	Ford - a structure in a river or stream which creates a shallow place for crossing the river or stream by wading or in a vehicle. Unpassable ford blocking the river most of the time		
6	Ramp - a ramp or a bed sill is a structure aimed at stabilizing the channel bed and reducing erosion and is recognizable by its stair-like shape. Unpassable barrier during low flood periods		

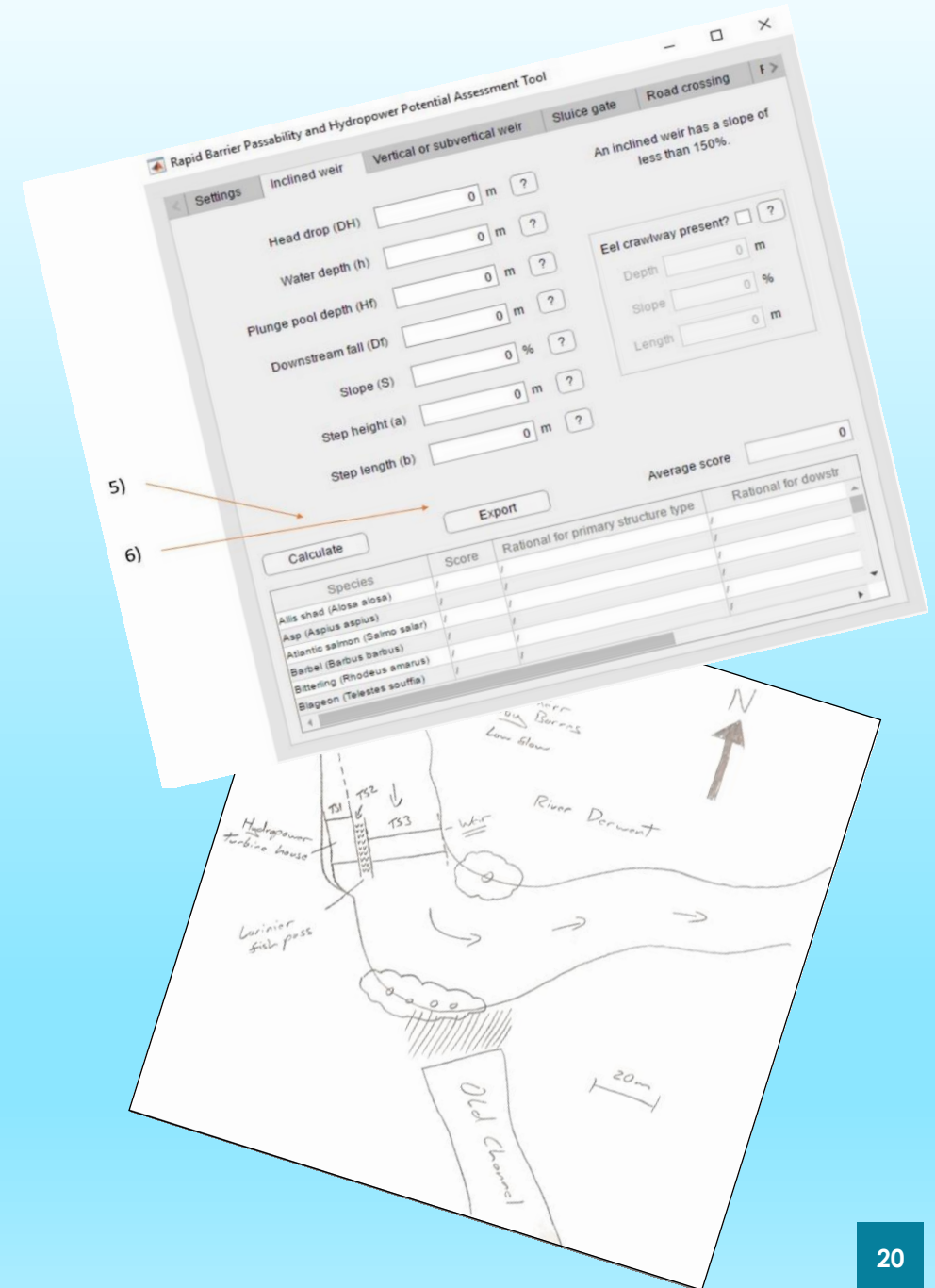
Table 5. Migration penalized weighted remaining habitat proportion (*wRHp*) with regard to barrier type and FCMacHT.

Red – severe habitat loss (<10), **orange** – major habitat loss (10-50%), **yellow** – significant habitat loss (50-75%), **green** – moderate habitat loss (75-90%), **blue** – low habitat loss (>90).

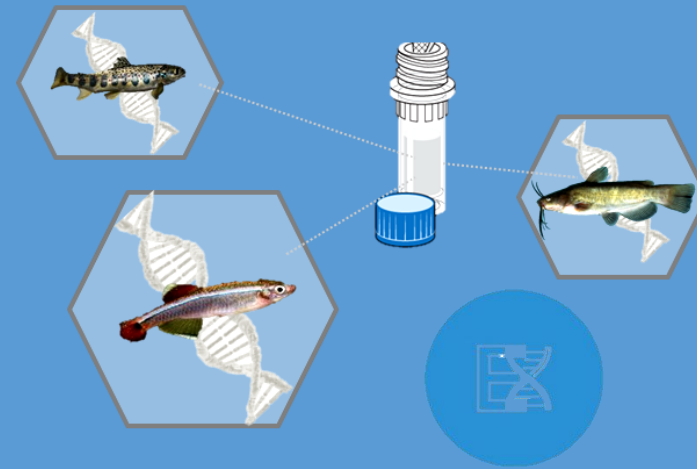
							
no.	River <i>FCMacHT</i> type	Dam <i>wRHp</i> %	Weir <i>wRHp</i> %	Sluice <i>wRHp</i> %	Culvert <i>wRHp</i> %	Ford <i>wRHp</i> %	Ramp <i>wRHp</i> %
1	Alpine	0	3	12	48	60	65
2	Continental	18	24	30	58	64	69
3	Mediterranean Highland	34	36	41	66	68	73
4	Mountain Highland Atlantic Continental	13	22	28	58	64	70
5	Boreal Lowland	21	27	32	59	65	70
6	Lowland Atlantic	38	38	41	68	68	74
7	Boreal Highland Costal	0	4	12	47	59	65
8	Mediterranean Mountain	9	19	25	56	62	67
9	Boreal Large	5	16	23	54	62	67

Rapid Barrier Passability Assessment Tool

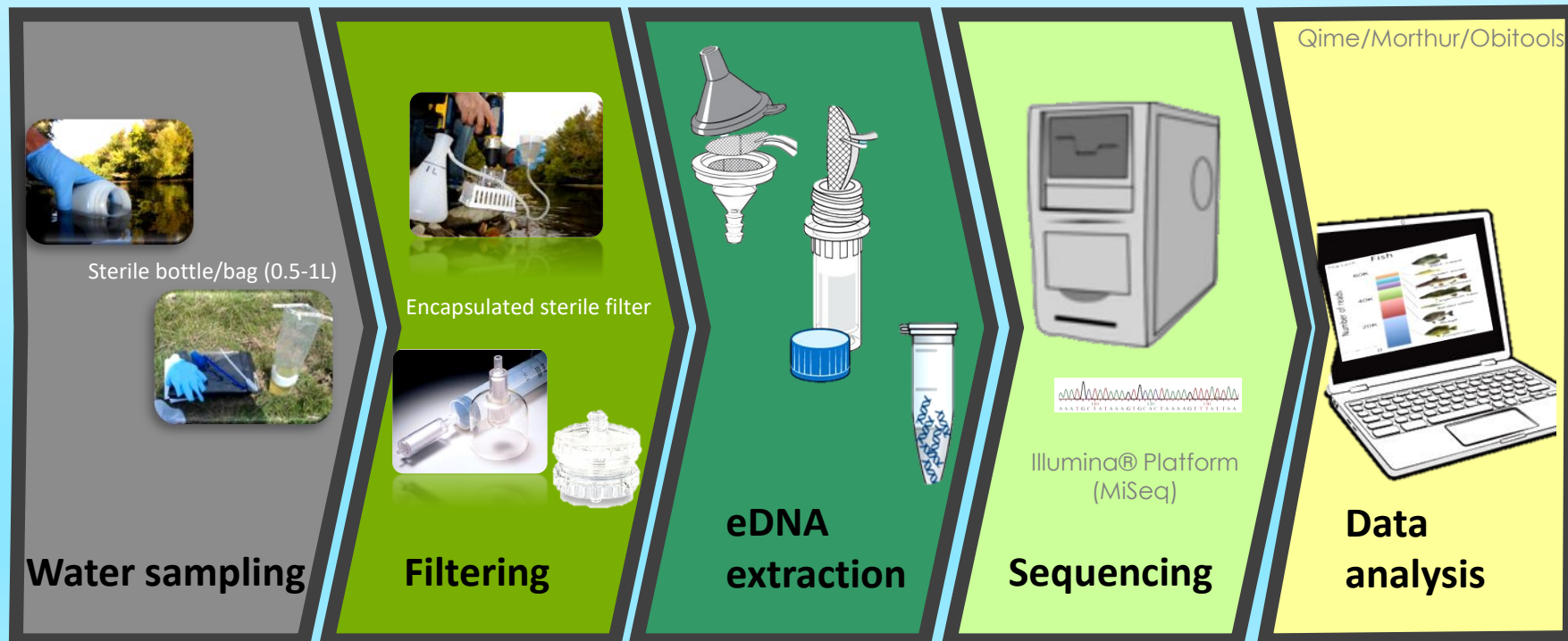
- Barrier types assessed include:
 - Sloping weir, vertical weir, culvert, rock ramp, ford, sluice gates.
- 47 different species/lifestages assessed
- Typical input parameters include:
 - Slope, head-drop, water depth, plunge pool depth, step heights etc...
- The tool was coded in Matlab but functions as a stand-alone bit of software that will run on a standard Windows computer.
- Software and installation and user guide available of AMBER website.



Task 2.5 Molecular toolkit: development of primers, protocols and pipelines (D2.5 - 100%)



eDNA workflow

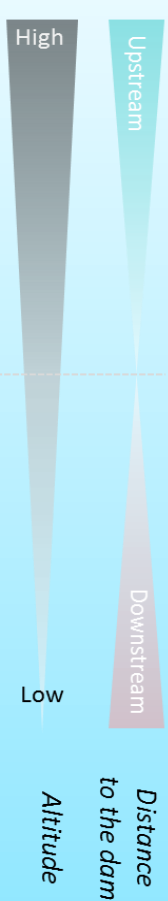
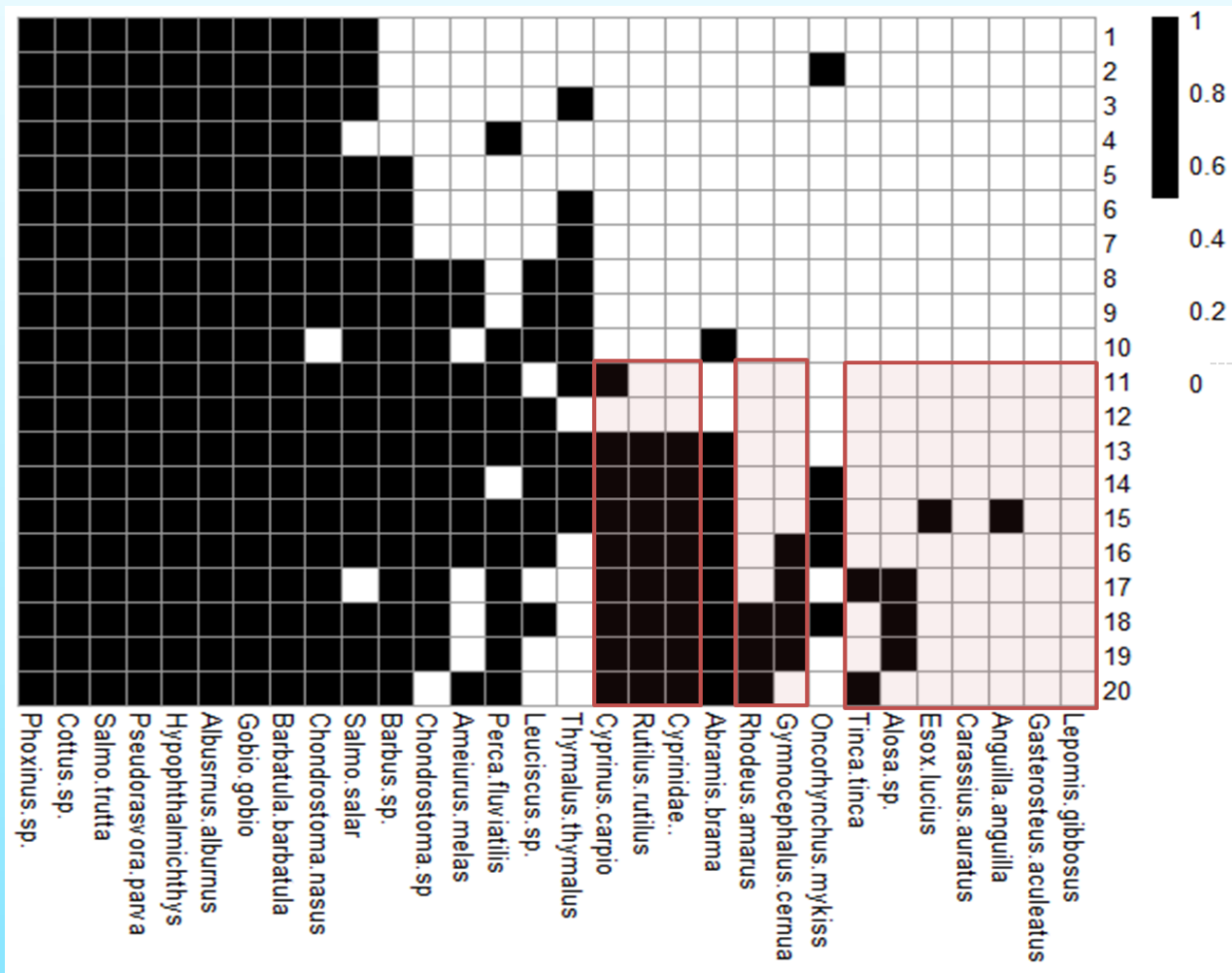


CASE STUDY: River Allier (France)

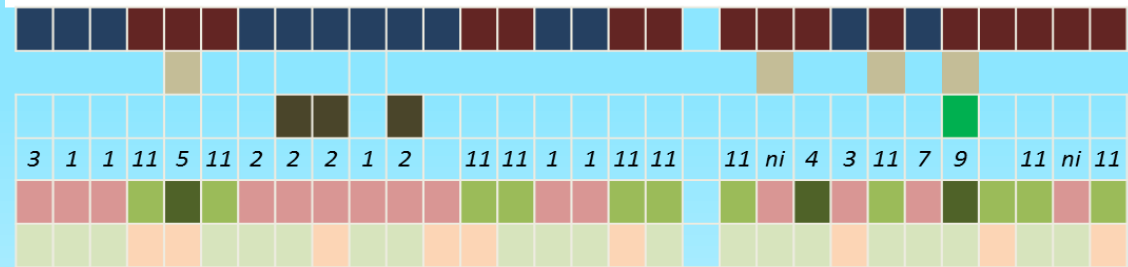
eDNA

Fish –Preliminary Results

Presence/Absence table



- Altitude and distance to the dam are significant predictors of the presence of some species such as: *Abramis brama* (Freshwater bream), *Rutilus rutilus* (Roach), *Rhodeus amarus* (European bitterling), *Gymnocephalus cernua* (Ruffe) and *Ameiurus melas* (Black bullhead).
- Altitude and cumulative height are significant predictors of the presence of *Alosa* sp. (Shads).
- A higher relative proportion of rheophilic species is detected upstream the Poutès dam



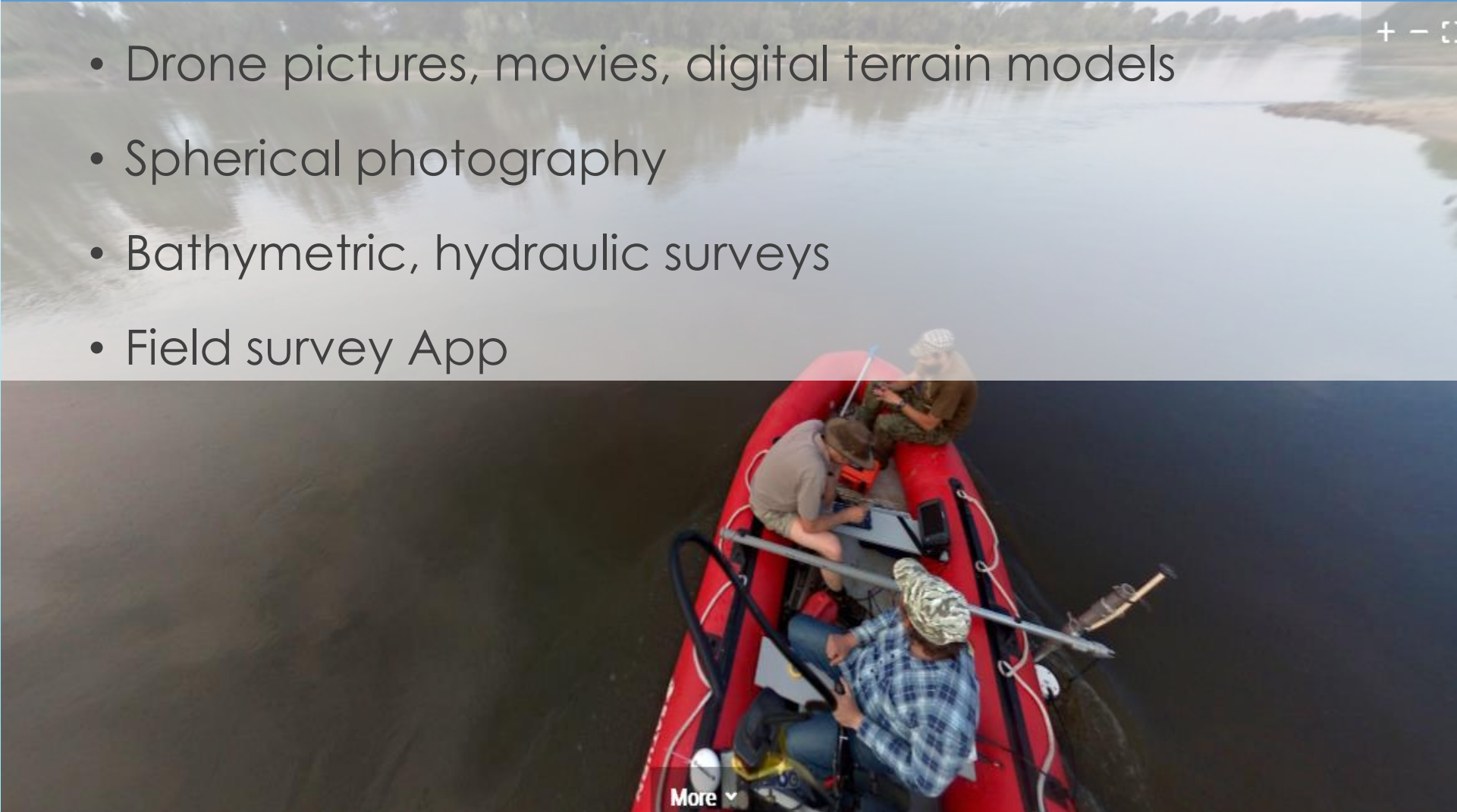
Investigating and mitigating impact of barriers

- Define habitat changes up- and downstream
- Develop mitigation scenarios
- Compare and select



Rapid stream mapping

- Drone pictures, movies, digital terrain models
- Spherical photography
- Bathymetric, hydraulic surveys
- Field survey App

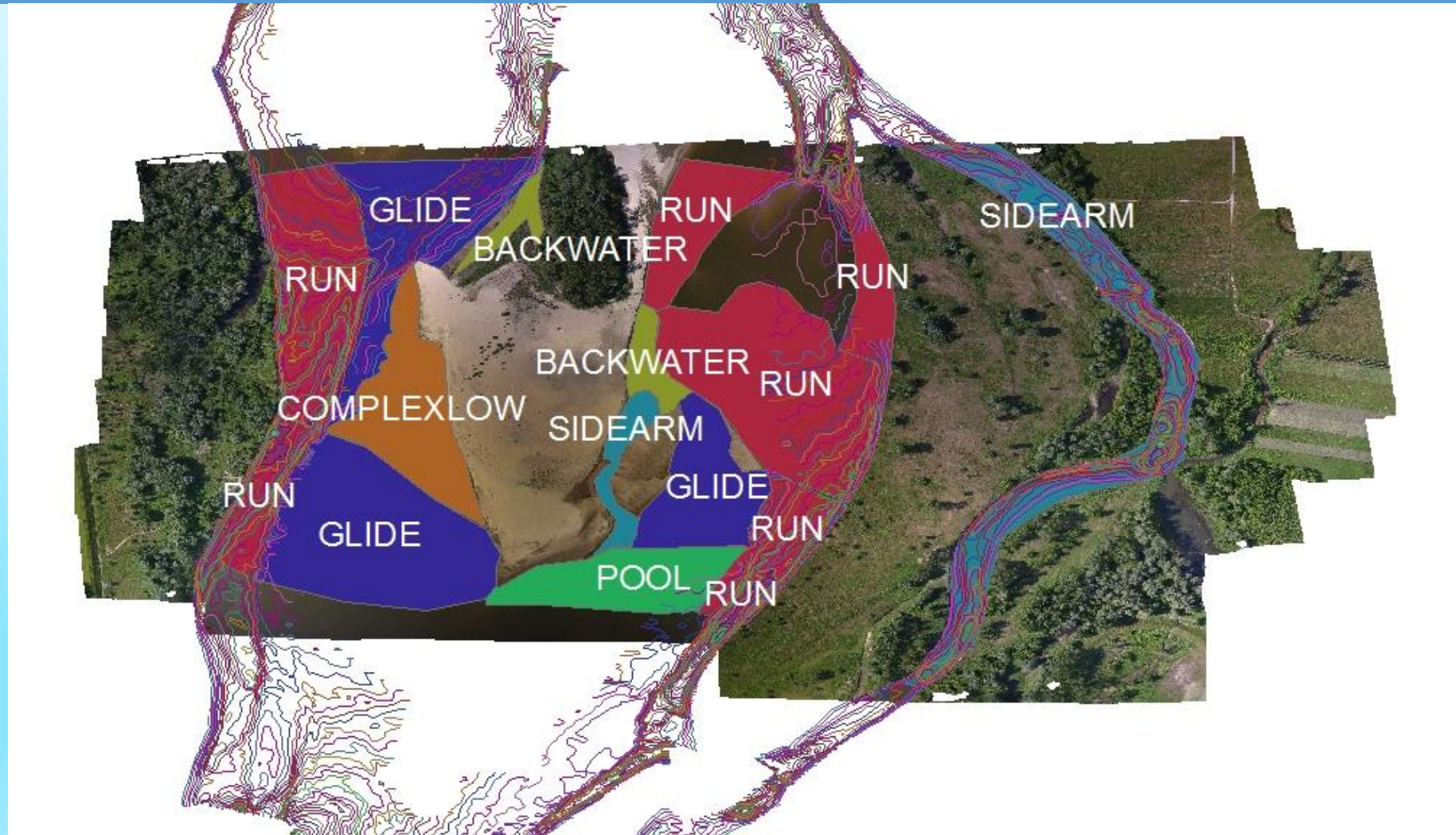


Mapping of large rivers



Middle Vistula River, 2016

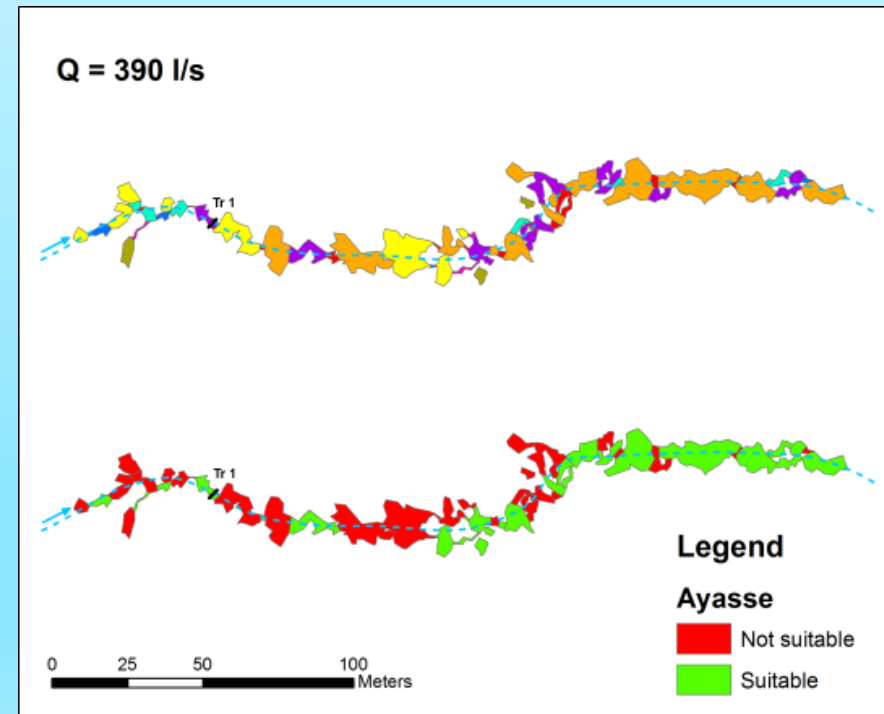
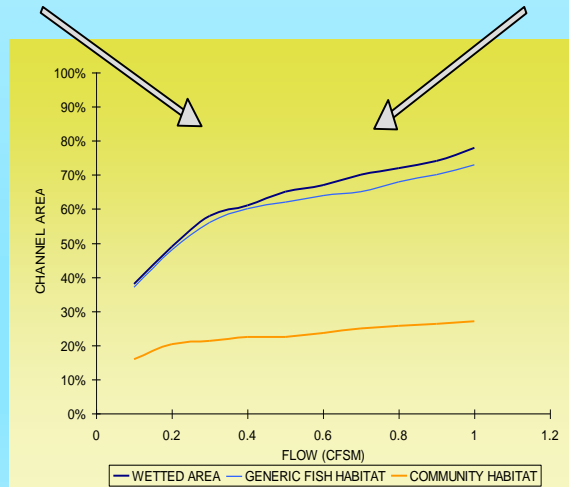
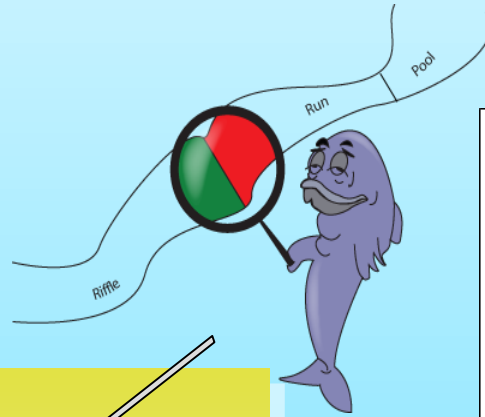
Wisła River UAV photos + bathymetry + HMU



3D model of Sesia River (IT) obtained from drone work



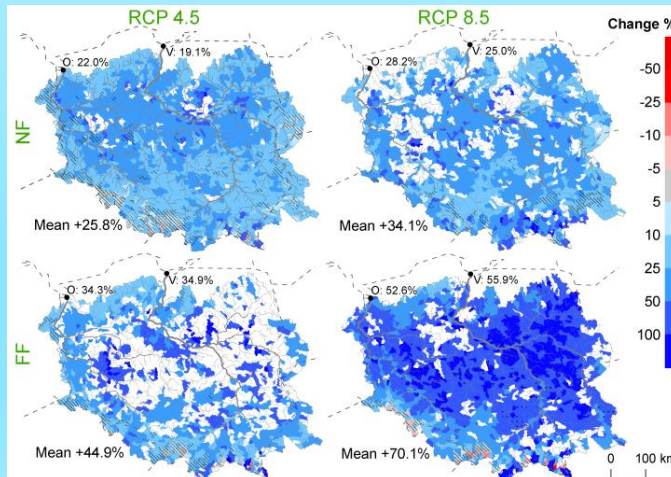
Habitat models of barrier effects on riverine habitats



Modelling stream barrier effects under different scenarios of climate change

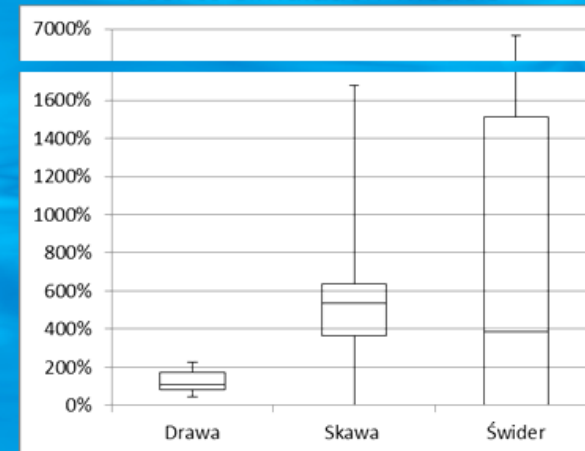
- Develop scenarios for impact of climate change on fragmentation in representative watersheds
- Habitat time series analysis
- Test model validity
- Apply Restoration Alternatives Analysis

Predicted changes in low flow patterns



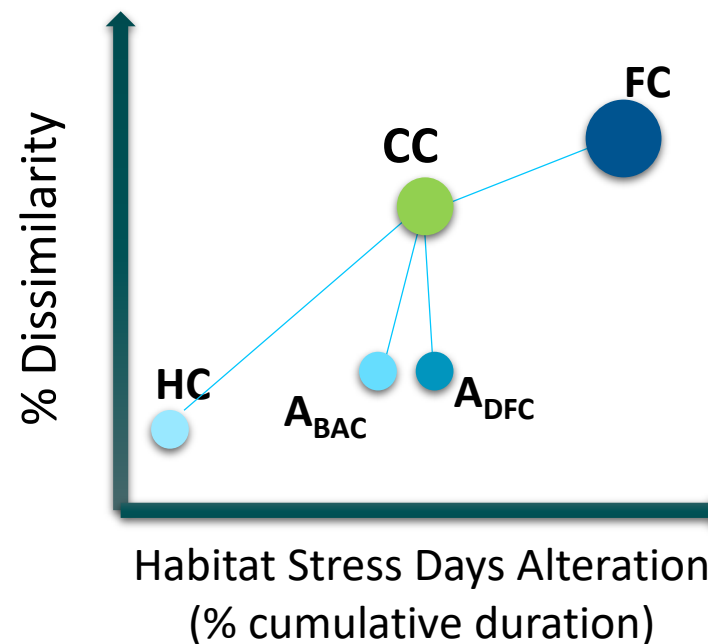
Piniewski et al. (2017)

Frequency increase of rare habitat deficits acc. to simulation models



Modelling stream barrier effects under different scenarios of climate change

- Develop scenarios for impact of climate change on fragmentation in representative watersheds
- Test model validity
- Apply Restoration Alternatives Analysis



HC - historical conditions

CC - current conditions

FC - future conditions

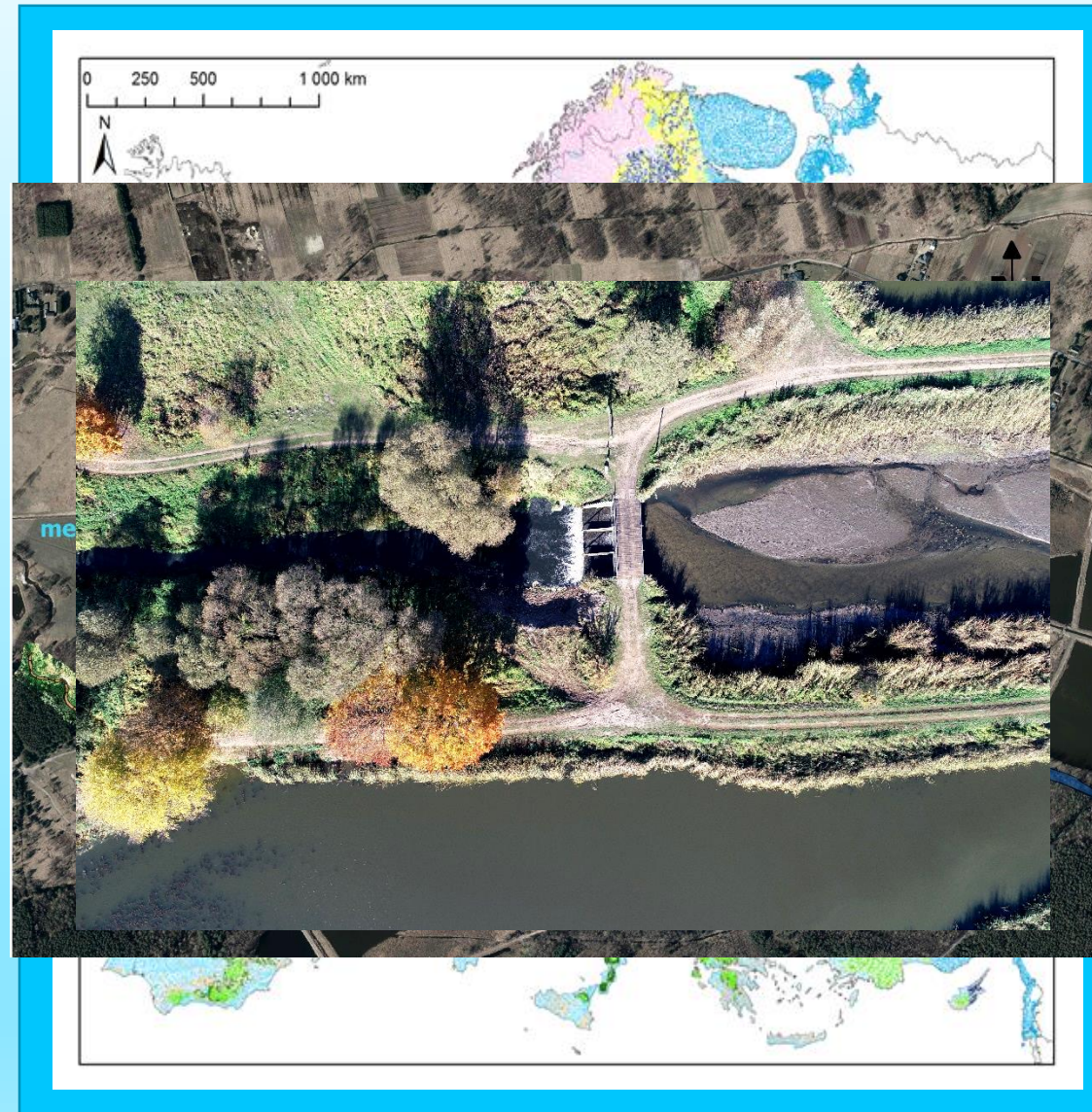
A_{DFC} - **Desired Future Conditions** alternative

A_{BAC} - **Best Available Conditions** alternative

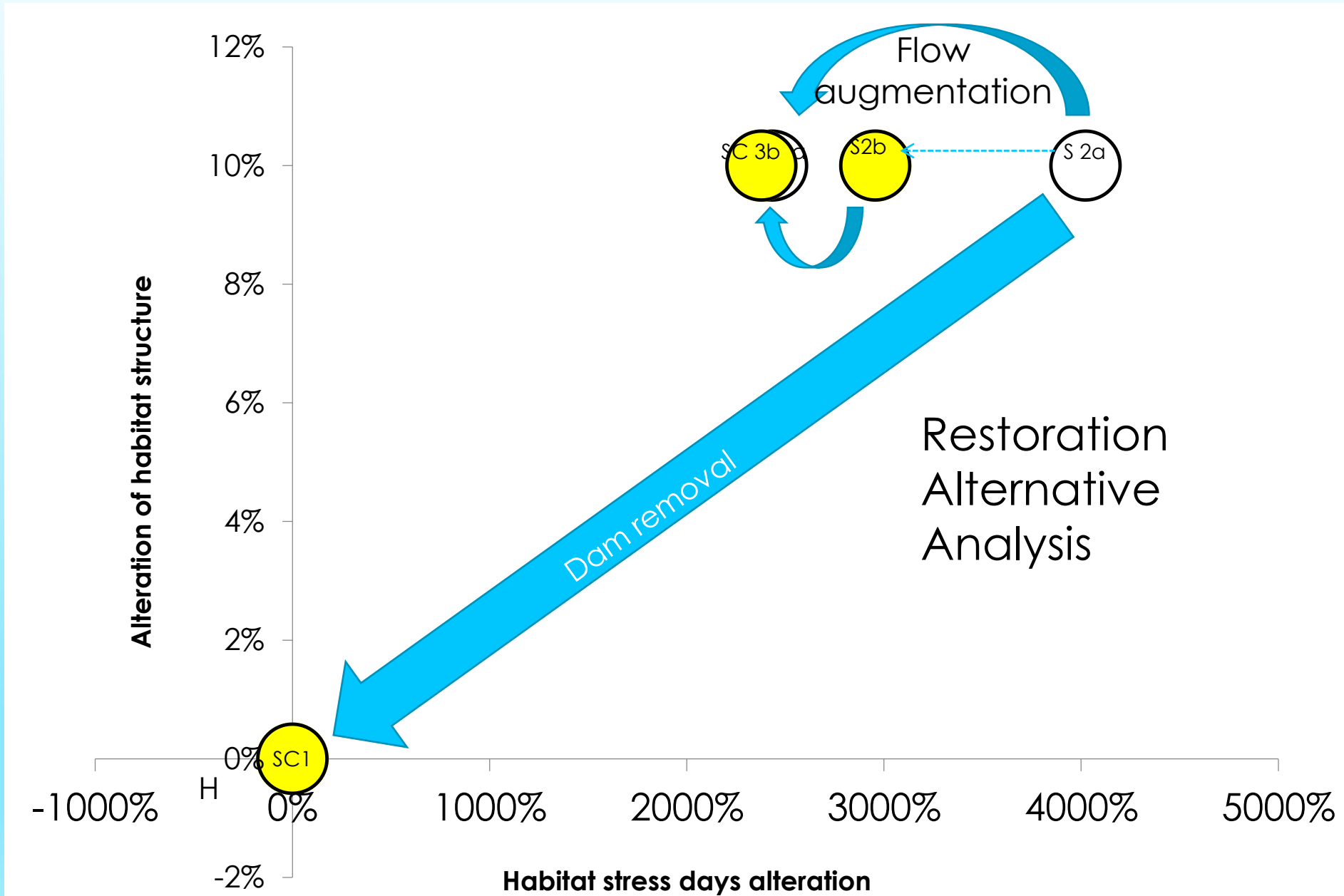
MesoHABSIM MODEL

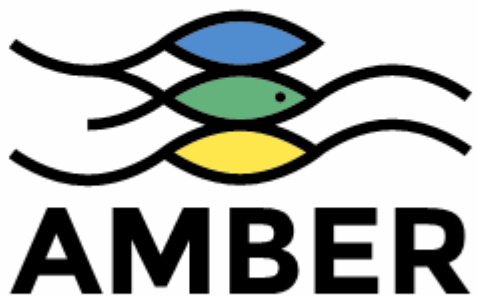
Example of application: Mienia River (Central Poland)

- Watershed Area 256 km²
- Stream Order 1-3 (Strahler)
- Siliceous surficial geology
- Low gradient, sandy bottom
- Average width 5 m
- Has many small barriers and a dam to supply water for fish farm
- No fish passage



UAV Phot. K. Suska SSIFI





AMBER

www.amber.international

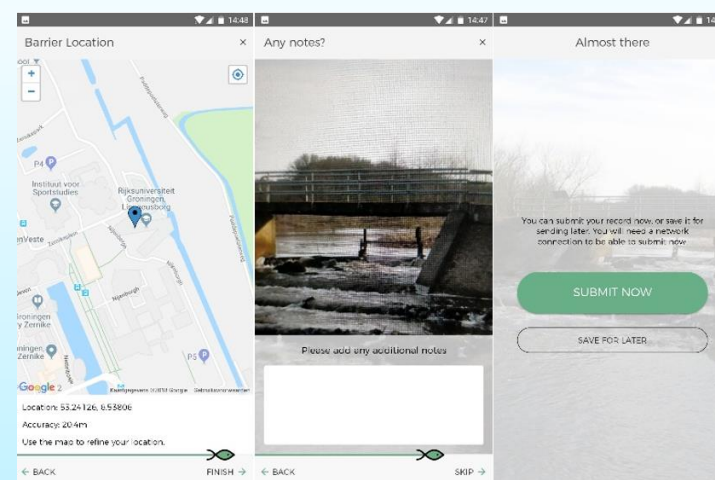


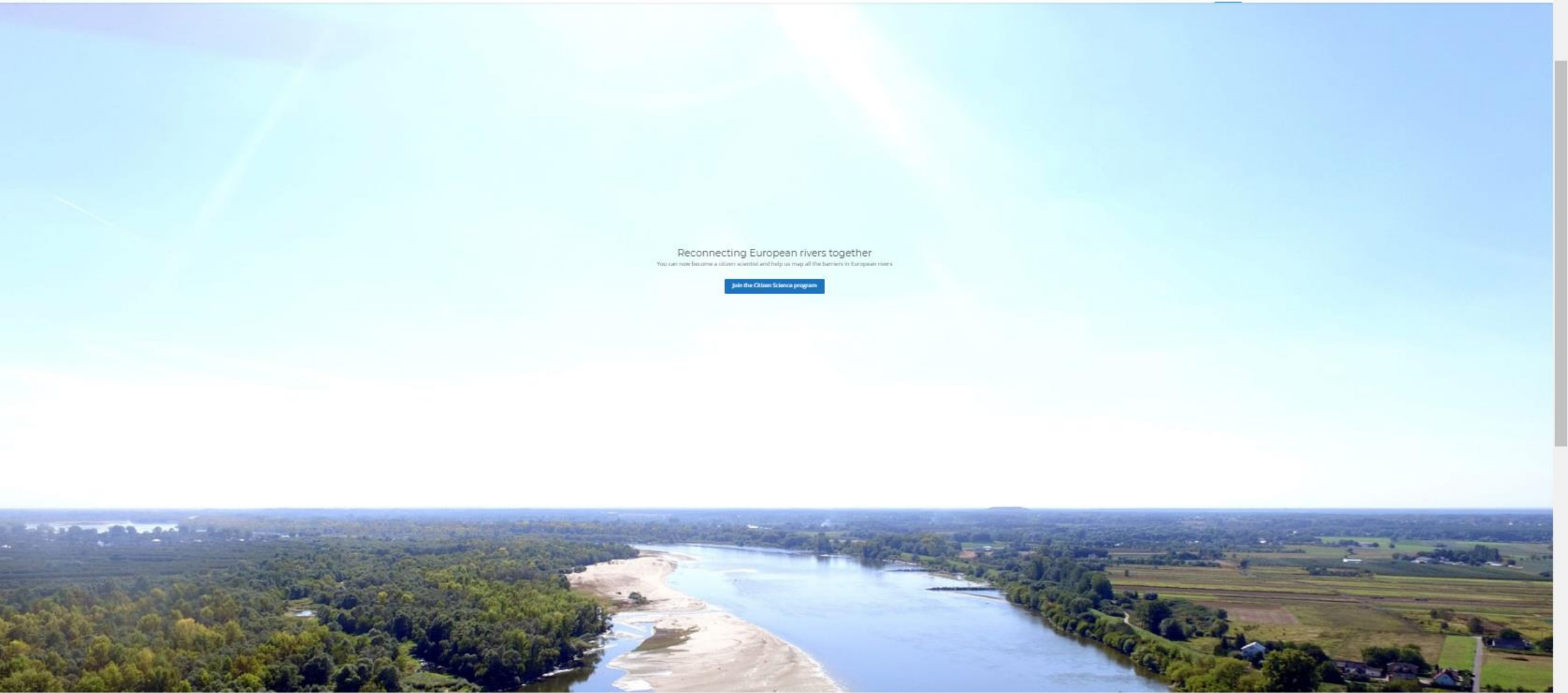
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 689682.

AMBER FIELD DATA COLLECTION MANUAL

This is the 1.0 version of the AMBER FIELD MANUAL. This document is a part of deliverable 5.10 – BOOK ON BEST GUIDANCE ON ADAPTIVE BARRIER MANAGEMENT IN EUROPE, of the AMBER project, which has received funding from the European Union's Horizon 2020 Programme for under Grant Agreement (GA) #689682.

1





Reconnecting European rivers together
You can now become a citizen scientist and help us map all the barriers in European rivers

[Join the Citizen Science program](#)

What is AMBER about?

