# Prioritization of River Barriers

**Restoring free-flowing European Rivers: Prioritization Methods & Tools**

Tuesday, 8th June 2021 (Virtual Event)

14:00 – 17.00

Joshua Royte, Senior Scientist
The Nature Conservancy in Maine

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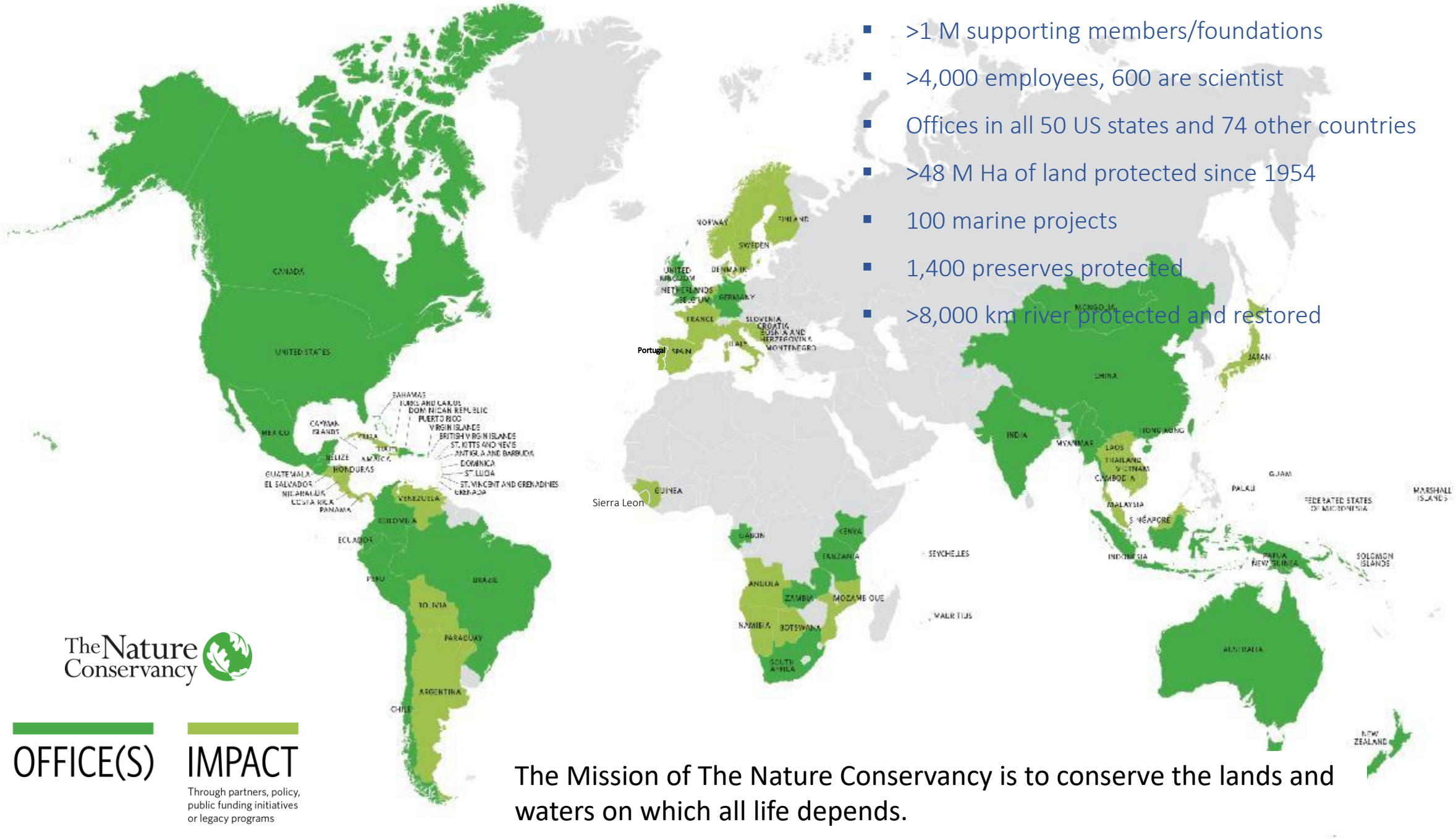
Protecting nature. Preserving life.




- >1 M supporting members/foundations
- >4,000 employees, 600 are scientist
- Offices in all 50 US states and 74 other countries
- >48 M Ha of land protected since 1954
- 100 marine projects
- 1,400 preserves protected
- >8,000 km river protected and restored

The Nature Conservancy

**OFFICE(S)** **IMPACT**

Through partners, policy, public funding initiatives or legacy programs

The Mission of The Nature Conservancy is to conserve the lands and waters on which all life depends.

# Importance of Connectivity

River health and long-term resilience

- Access to more kilometers/ha of habitat – more abundance
- Increased species/habitat diversity- more robust webs of life
- Access to critical habitats for life histories:
  - Need for warm and cold-water
  - Avoiding flood and drought
  - Access diverse geology (chemistry, substrates, slope, patterns)
- Fulfill life-history options
  - Searun fish (shads, salmons, eel, etc.)
  - Headwater species (rare fish, mussels, insects…)
- Floodplain interaction fortifies river and land
- Groundwater: water quality and temperature

# Interconnected Systems


# Cost of NOT Reconnecting Rivers

barrier removal/road upgrade

- Shortened design-life of structures (dams, road crossings)
- Annual maintenance
- Fish passage installation/maintenance and impact on fisheries
- Emergency storm damage repair costs
- Downstream infrastructure damage
- Ecological damage
- Transportation network disruption
- Loss of life (impoundments & floods)

# TNC Connectivity Projects

in North America, so far…

1. **Data**: Assessed >55.000 barriers & stream habitat
2. **Tools**: Interactive webtools for barrier prioritization/selection
3. **Policy**: permitting, dam liability and water extraction
4. **Finance Mechanisms**: for barrier removal & protection

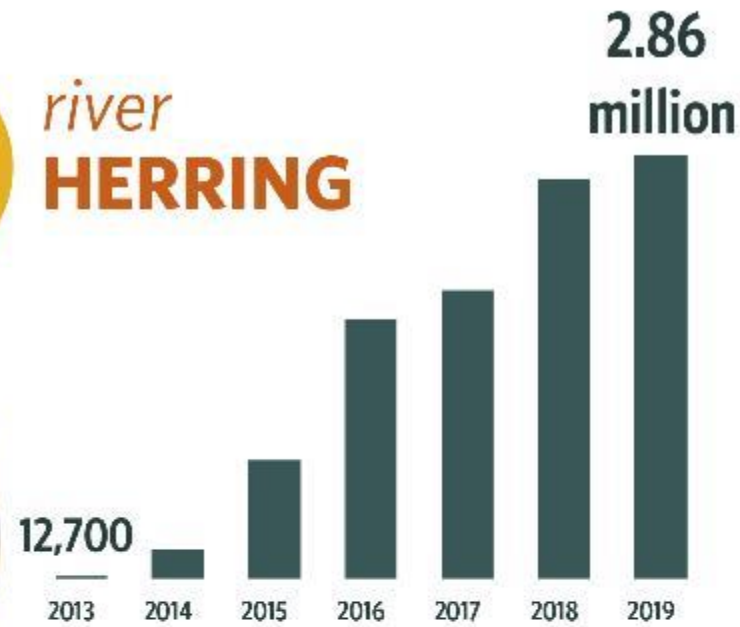
   >95 M USD public & private funds*
5. **Implementation**:
   - Protect >1.000 km riparian and whole watersheds
   - Remove 100s of stream barriers
   - Restore access to >10.000 km of habitat
6. **Monitoring**: track success/failure and fish trends

* 2008-2020

# Ecological Response

searun **FISH**

river **HERRING**




Penobscot River Restoration

*birds*

*marine*

*native* **FISH**

# Economic Response

river herring
**HARVESTS**

64,500 Euros

Town revenue quadruples over a 10 year period.


increased
**GROUNDFISH**

food
**RELIEF**

lobster
**INDUSTRY**

resource
**AVAILABILITY**

€ ↓ Emergencies, ↑ Design Life, ↓ Overall Cost

# Social Response

*restoring treatise*
**FISHING RIGHTS**

*healthier*
**FOOD SOURCE**

*boating*

*fishing*
**INCREASE**

*community*
**CONNECTIONS**

# Barriers to Barriers to Barrier Removal

- #1 Cultural attachment to dam & impoundment

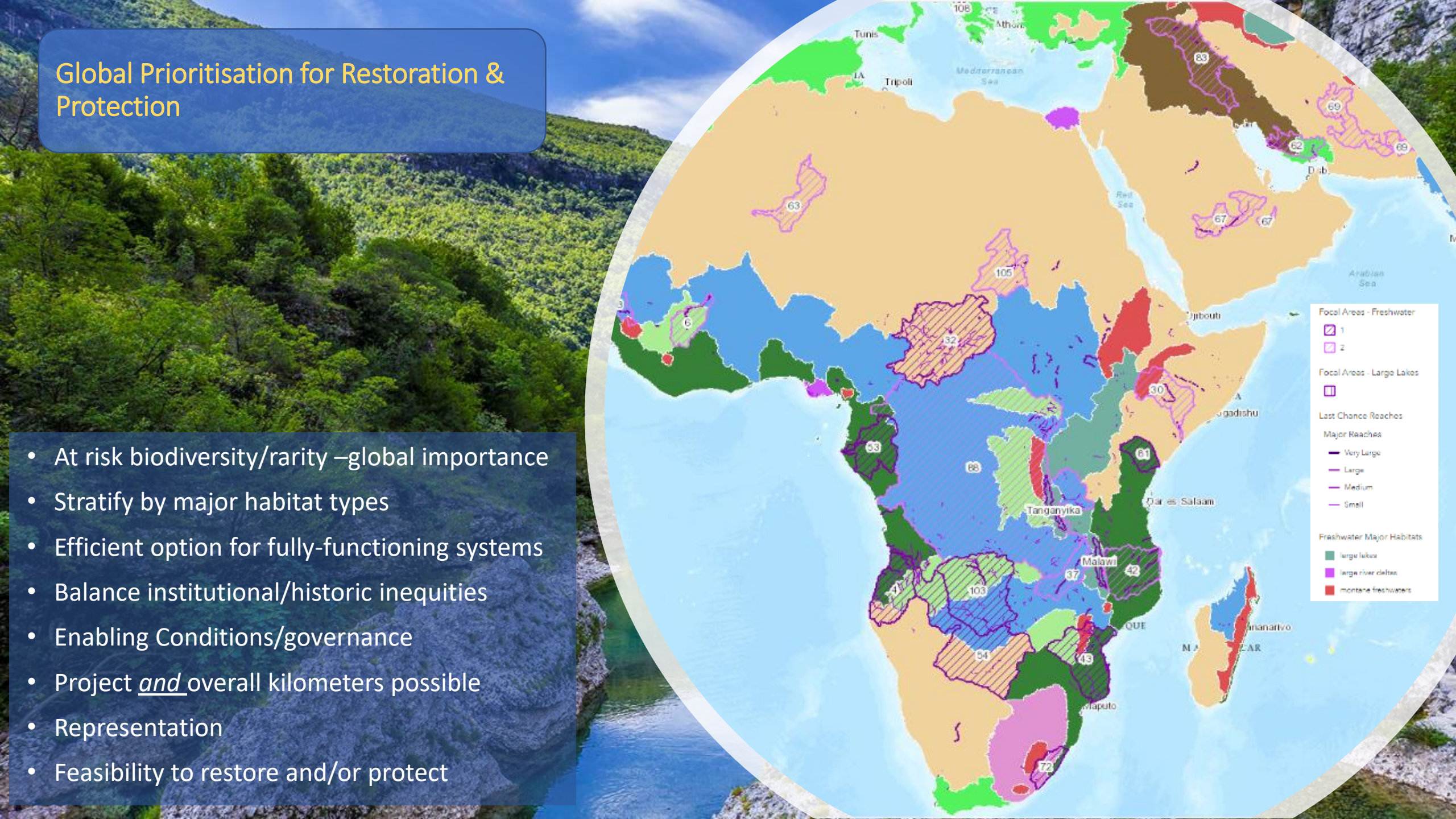
  *Therefore lack of local or national will power*
- Need for guiding policy
- Lack of technical expertise (multiple stages)
- Misunderstanding of risks and true costs
  - Ecological, Safety, Maintenance
- Lack of predictable funding mechanisms
- Pressure for new hydropower

  *growing need to avoid and protect against*
- Bias/hidden costs in hydropower economics
- Potential impact of invasive species spreading
- Excessive sediment and potential contaminants

The challenge requires prioritisation start with a broad set of potential projects, 1/10 - 1/20$^{th}$ may be implemented, often over 5-10 years to completion

# Global Prioritisation for Restoration & Protection

- At risk biodiversity/rarity –global importance
- Stratify by major habitat types
- Efficient option for fully-functioning systems
- Balance institutional/historic inequities
- Enabling Conditions/governance
- Project *and* overall kilometers possible
- Representation
- Feasibility to restore and/or protect

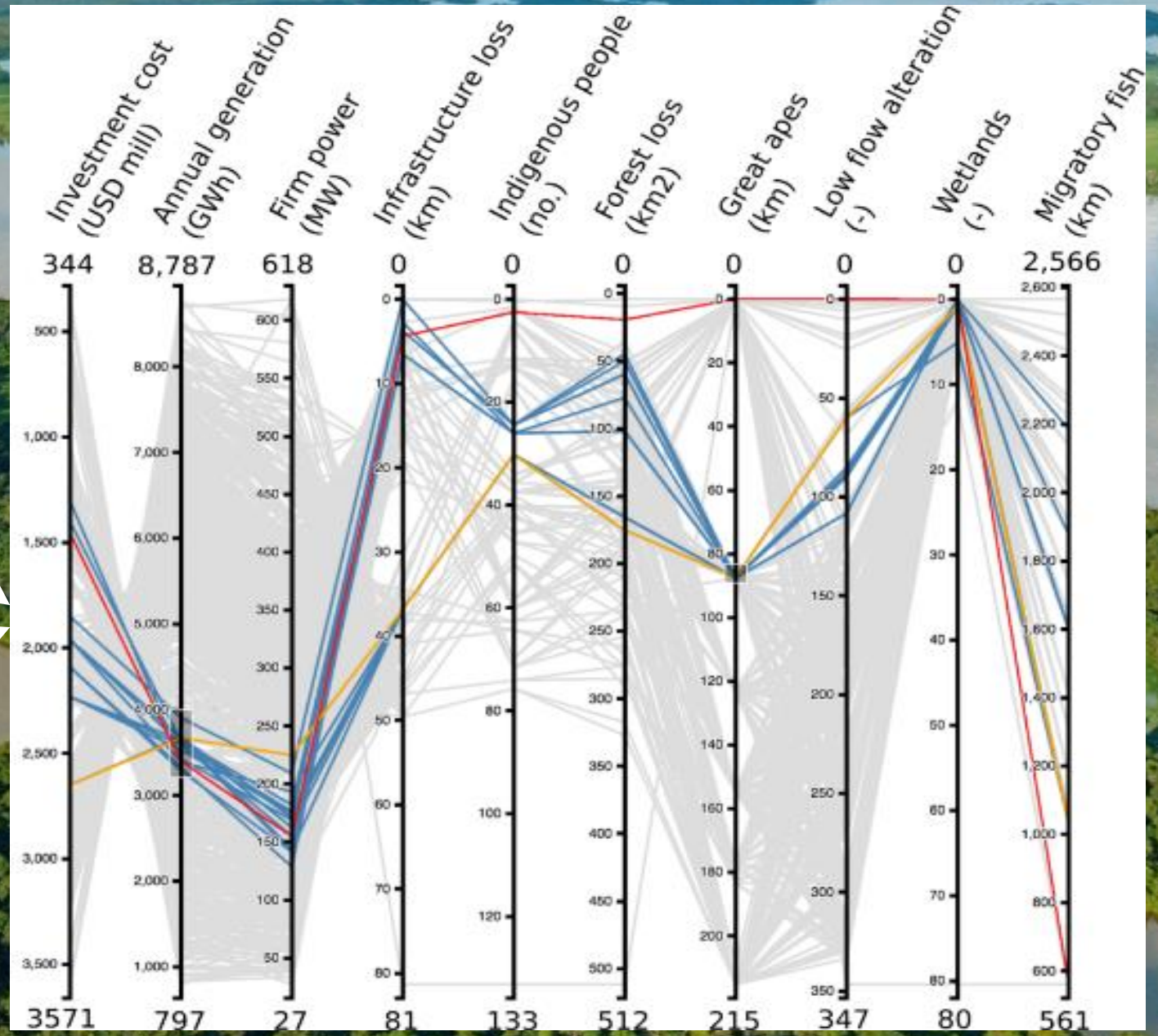


# Hydro by Design: Prioritisation to Avoid Dams in the worst places:

TNC work in Amazon, Gabon, DR Congo, Angola, Mexico, Nepal, Angola

Same type of metrics and process for **avoidance** as **restore** and **protect**

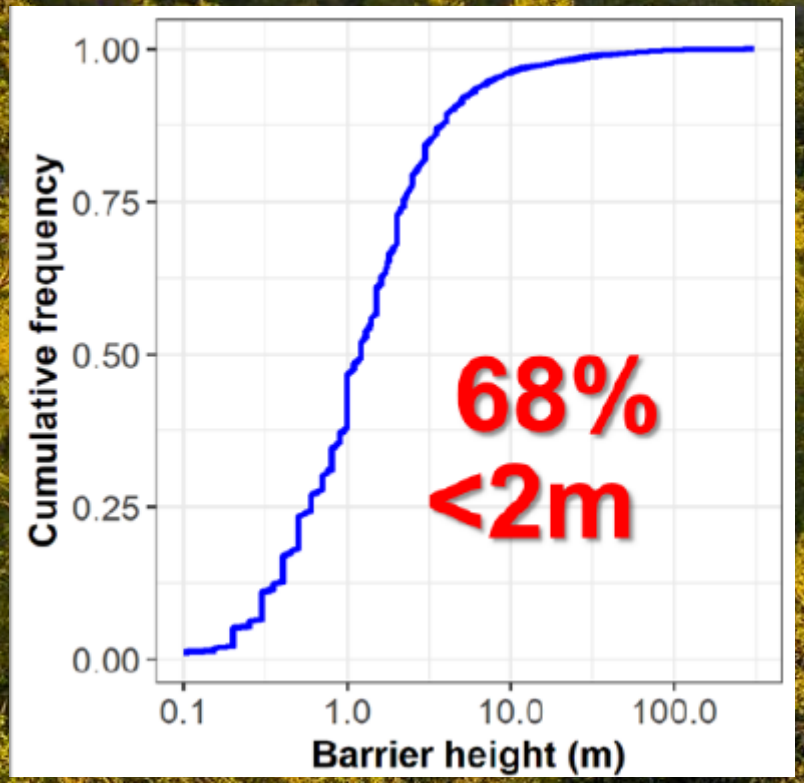
Scoring values important to ecosystems AND local and national stakeholders

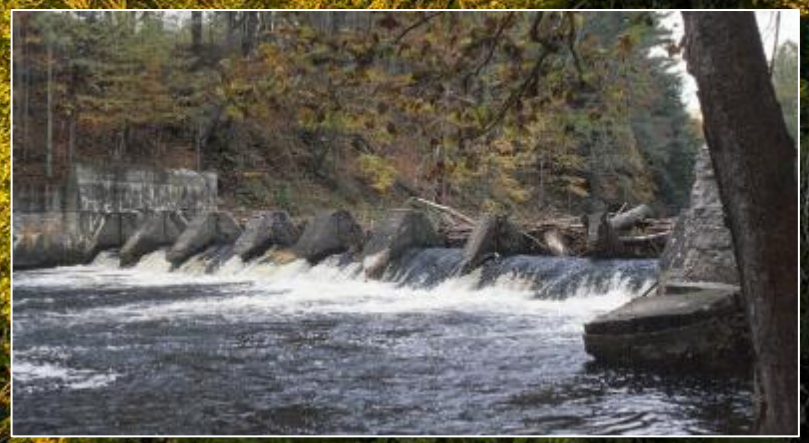



Key Partner: International Finance Corporation (IFC), Sounda HPP Alternatives Analysis

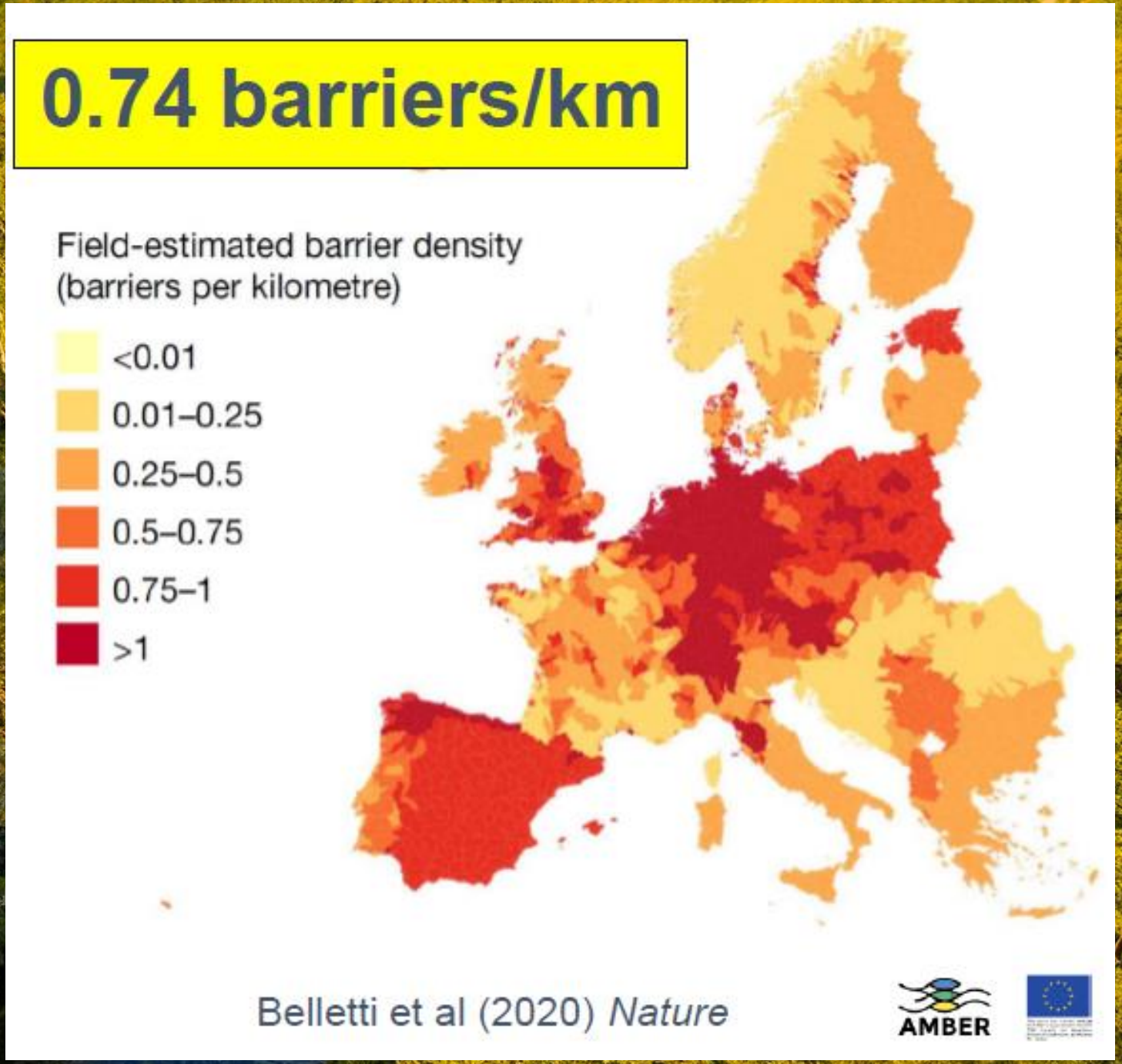
# Prioritization for Barrier Removal

## Over 1.2 Million Barriers in Europe's Rivers



**0.74 barriers/km**



# Importance of Restoration Focus on Small Barriers

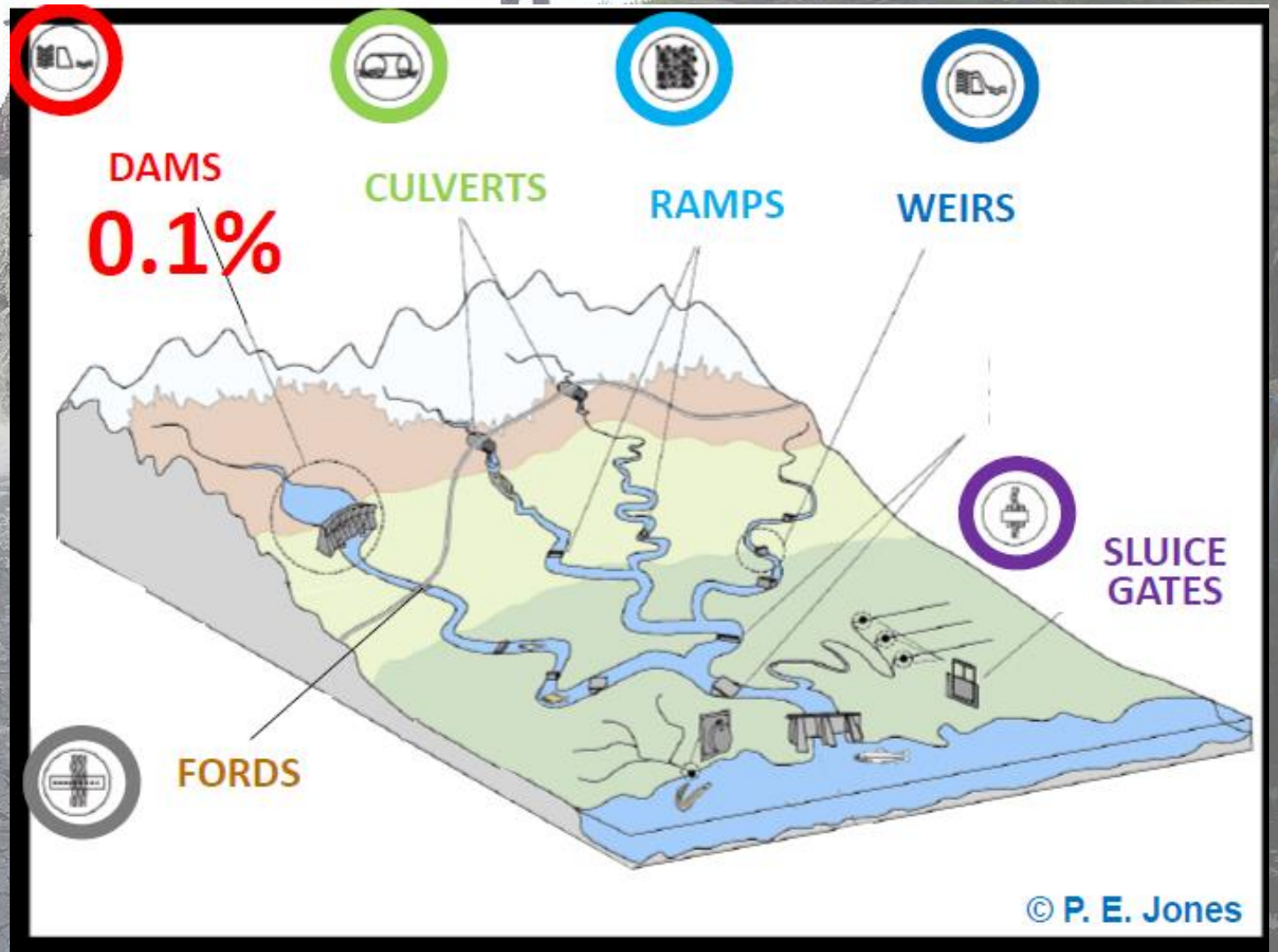
Most are smaller barriers

5% of Europe's Barriers cause 50% of damage

13% (~156,000) obsolete low-head structures

Only 1,200 are larger dams, but have
MUCH smaller overall impact

Garcia de Leaniz, Jones, and Börger 2020



# Barrier Prioritisation

Small barriers like Road Crossings


Small barriers dominate stream networks

Habitat gains are smaller but important

Relatively cheaper and less controversial to fix.

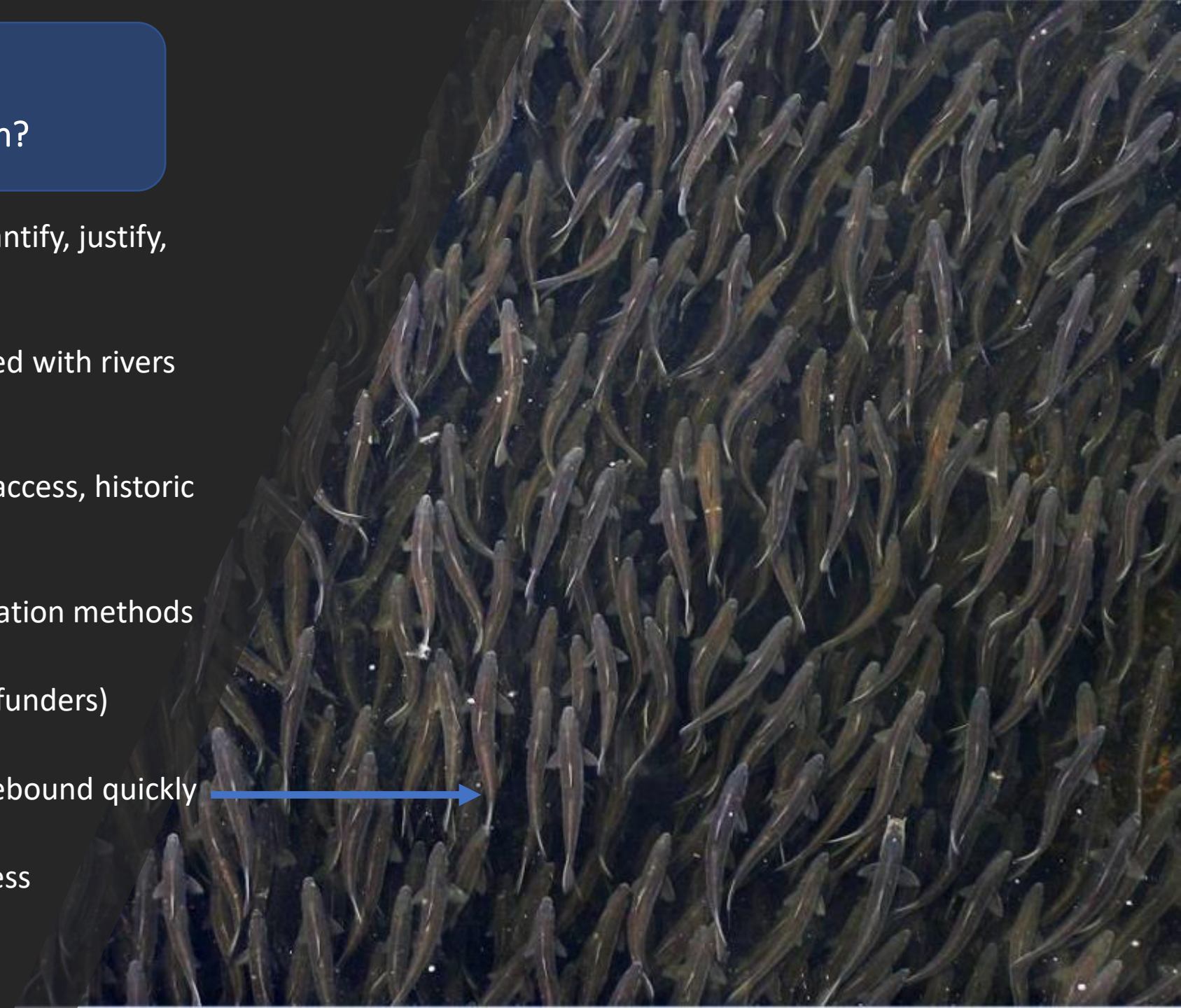
# Catchment and Barrier(s) Prioritisation

common metrics from global to local

- Priority biodiversity
- Representation (where feasible)
- Right scale for functional, lasting impact
- Connected diverse & resilient habitat types
- Added & overall km & ha. of habitat
- Likelihood of *ecological* success for catchment
- Good enabling socio-political conditions
- Efficiency of project(s) km/Euro

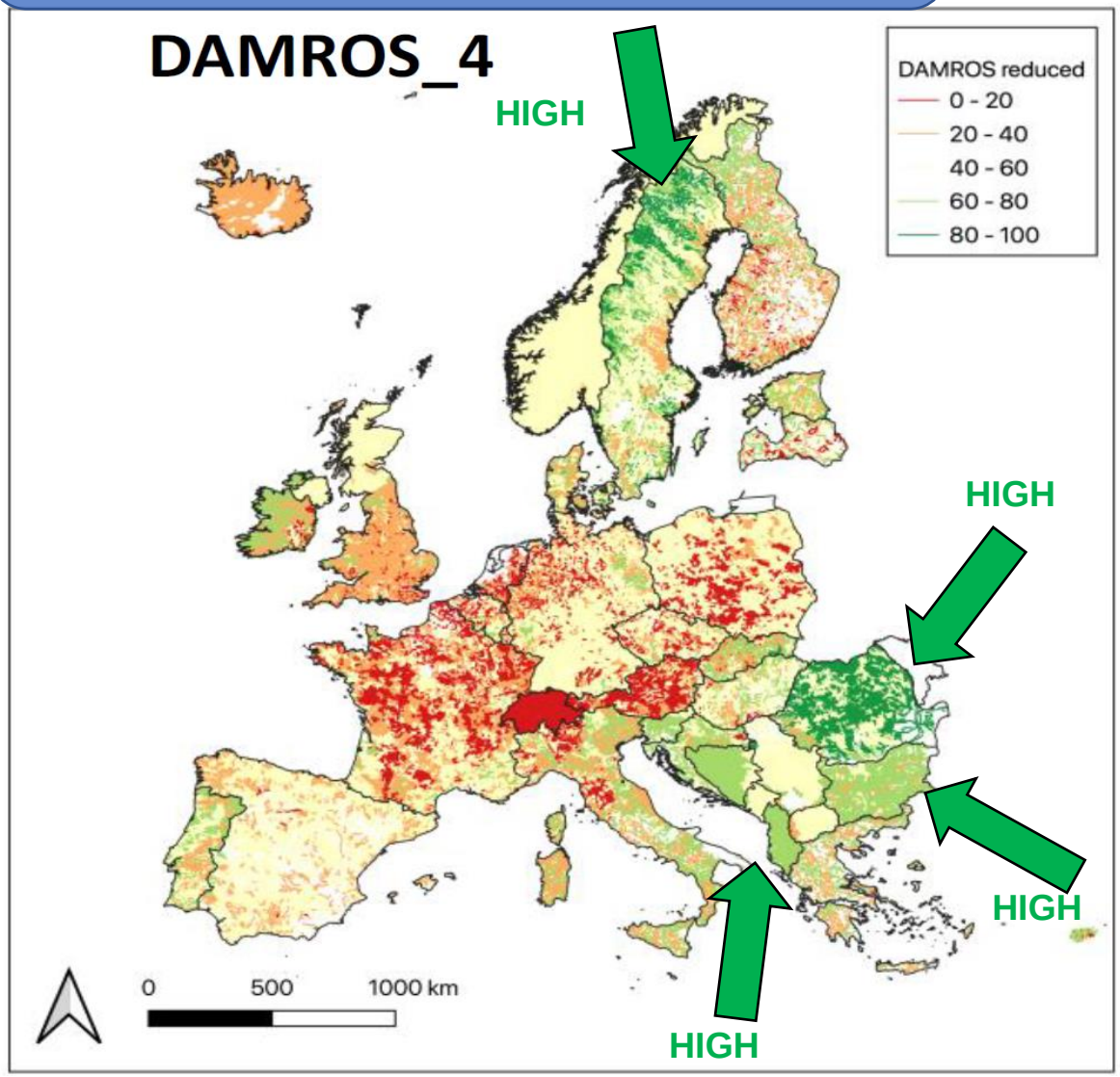
# Strategic Prioritisation:
## What Will Leverage More Restoration?

- Policy and Tools that will help others quantify, justify, embrace & expand on positive work.
- Demonstrate that communities connected with rivers have better sense of human well-being.
- Promote public amenities (parks, water access, historic recognition).
- Ensure learning of safe & efficient restoration methods
- Success brings success (public & private funders)
- Focus where fish, birds & other nature rebound quickly
- Revitalized rivers attract people & business



# Optimization Scenarios:

Benefits by country




Garcia de Leaniz et al (2021)

## DAMROS

### Dam Removal Opportunity Score

← (multiple scenarios this is example run 4)

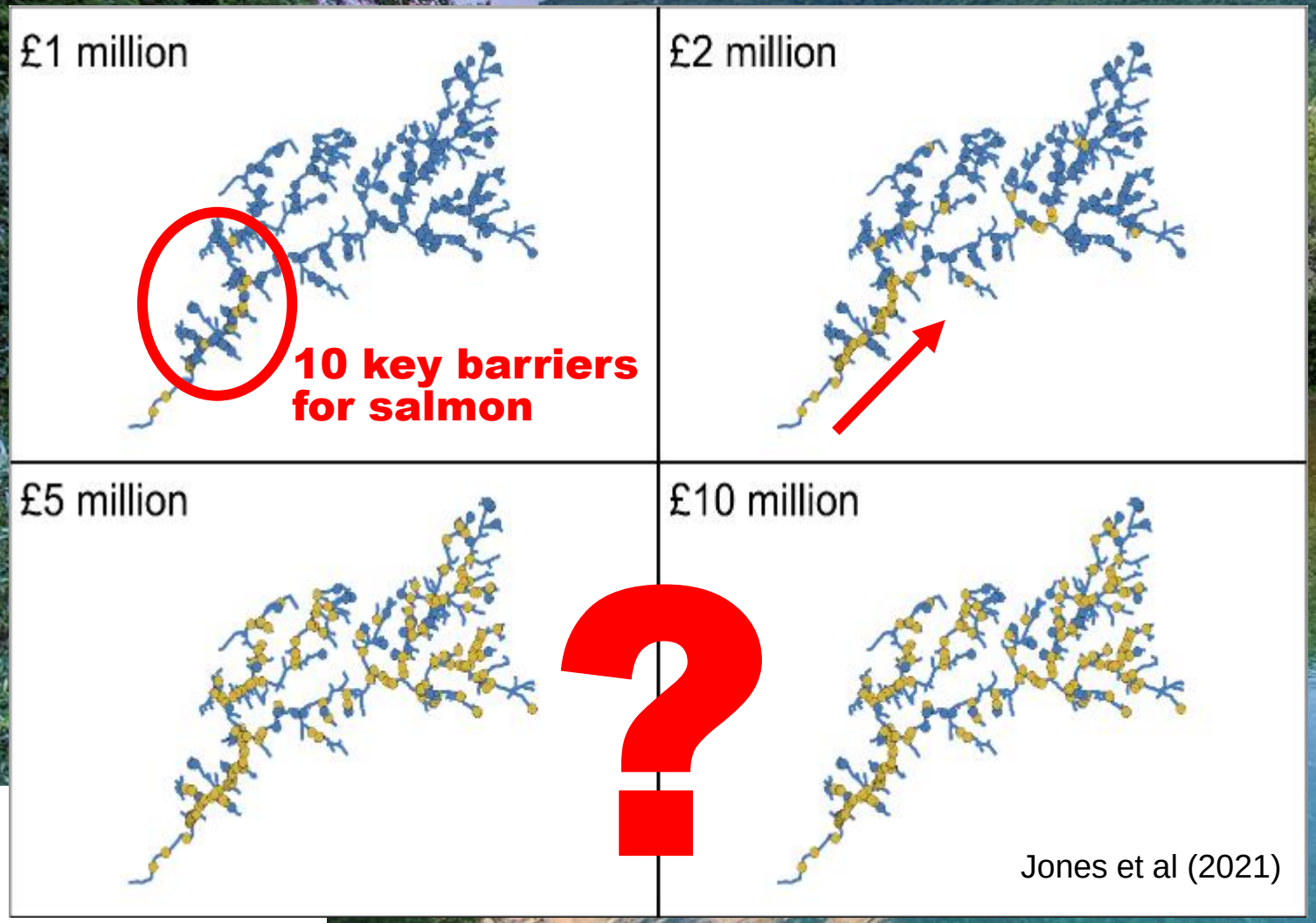
**Benefits and opportunities for barrier removal differ widely across Europe**

**A multi-scale spatial approach is recommended: Long list > Short list**

AMBER

# Optimization Systems

Best solutions for given investment




**Be clear about your funding approach since, there is never enough funding.**

1. **Most bang for your buck?**
   (most river miles or habitat for set value)

**OR**

2. **Least bucks for the desired bang?**

Carlos Garcia de Leaniz

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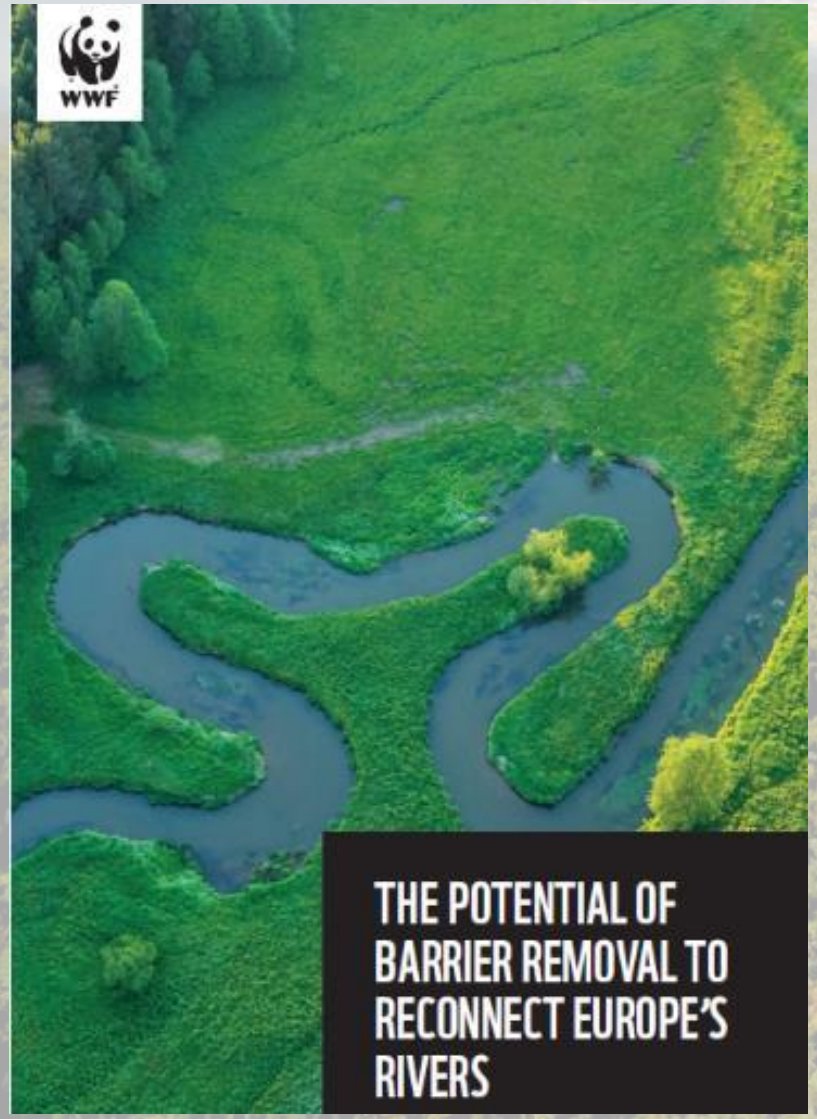
# WWF Prioritization:

Europe-Scale Barrier Scoring




Schwarz, FLUVIS 2020

**Key criteria for screening and ranking via workflow stream**

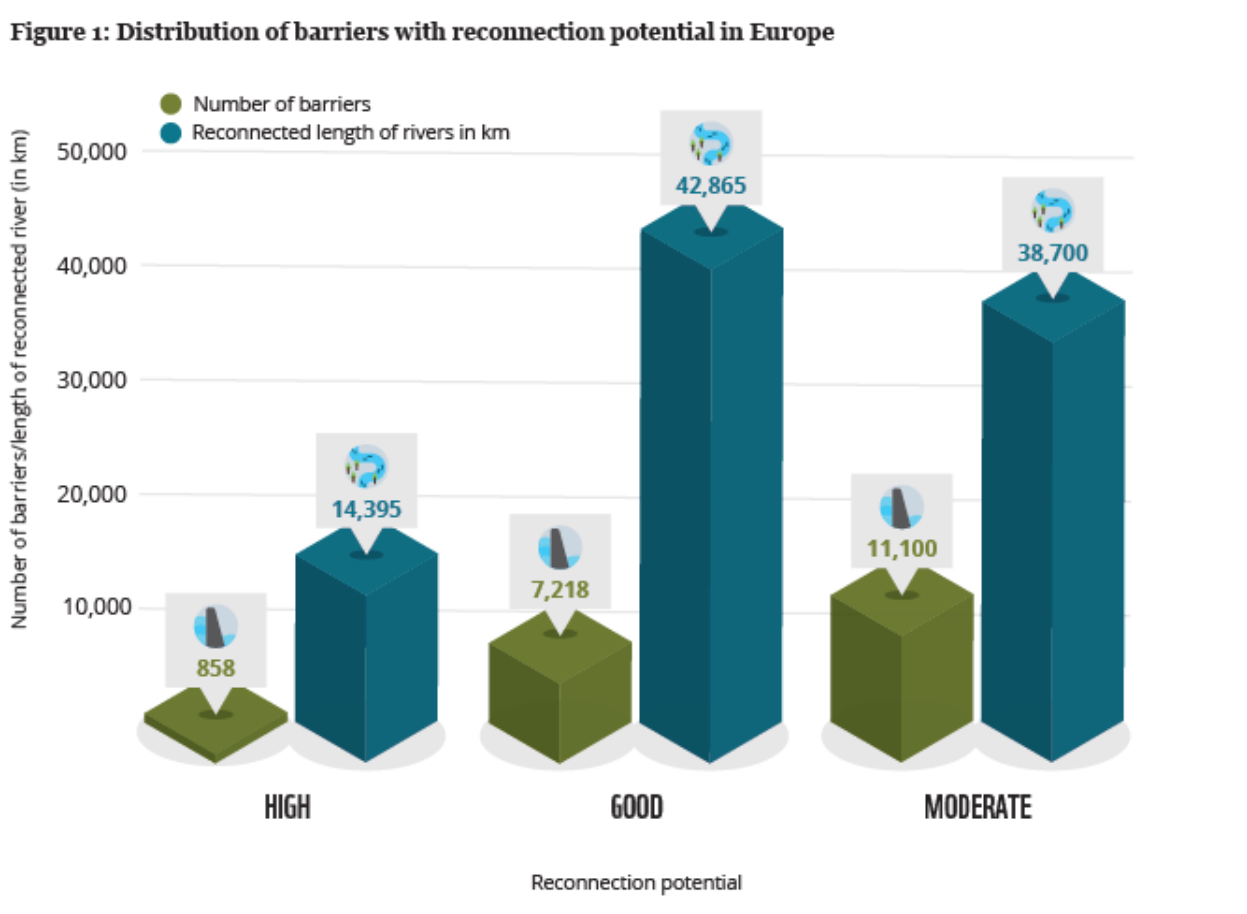
- Kilometers potentially reconnected
- % of upstream reach in natural cover
- % of upstream reach in riparian/floodplain
- % of upstream reach in protected area
- Position, in/out of protected area

European-scale planning, helping to advocate for focused dam removal at the right scale to meet EU Goals

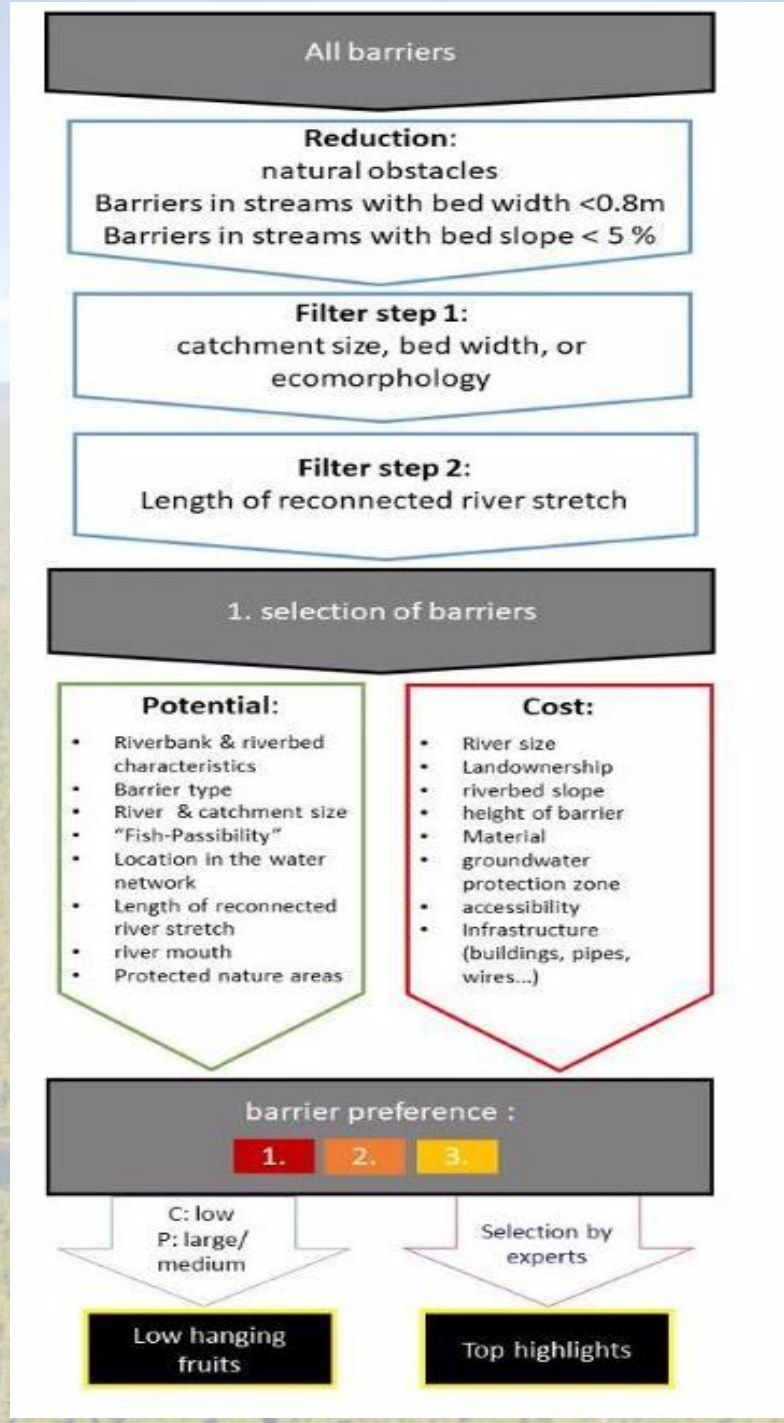
Excludes large hydro, drinking water supplies, road crossings, & barriers <0,5 m

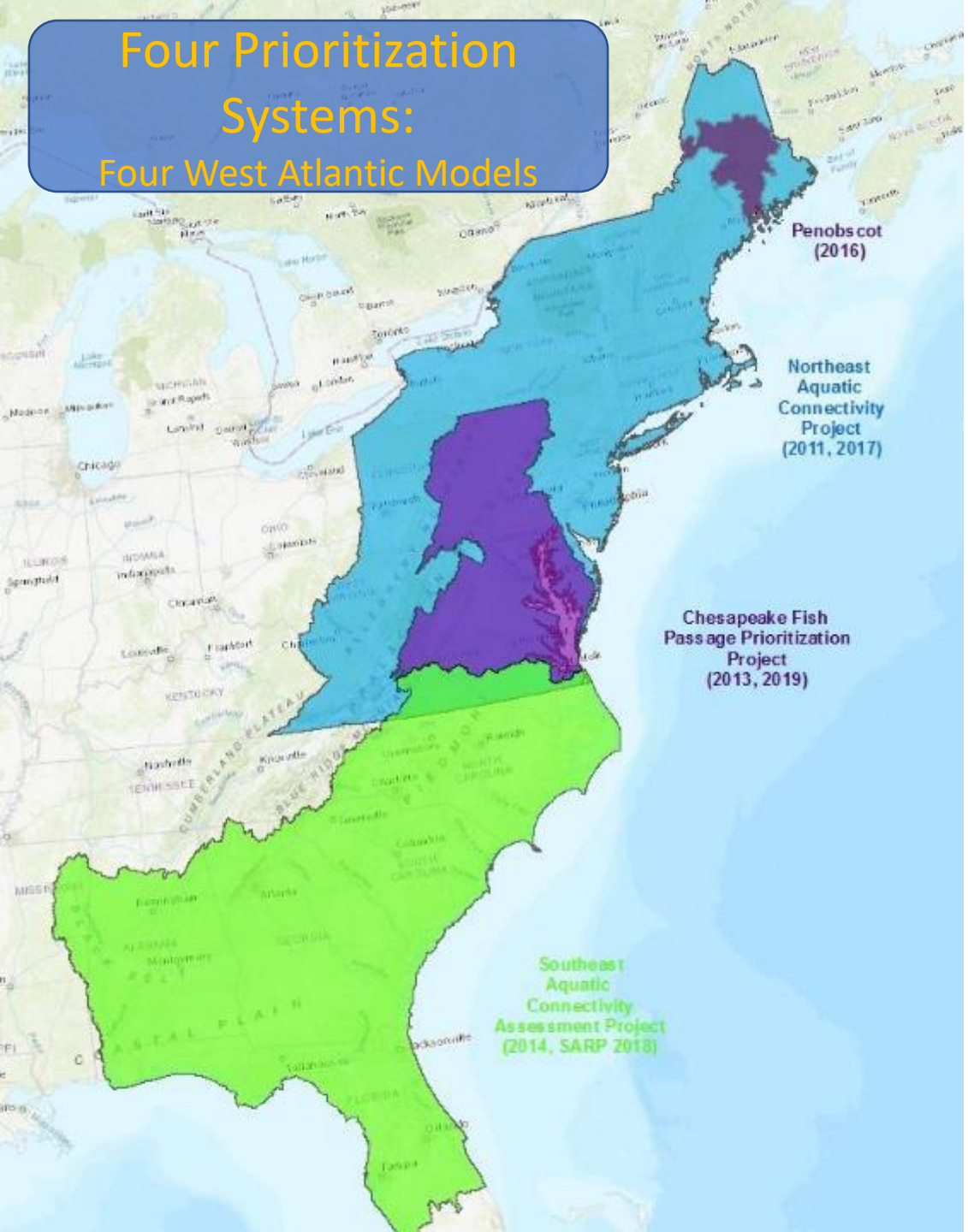
# Prioritization System: WWF

Barrier Selection: Filter and Rank




Additional breakdowns by country & region



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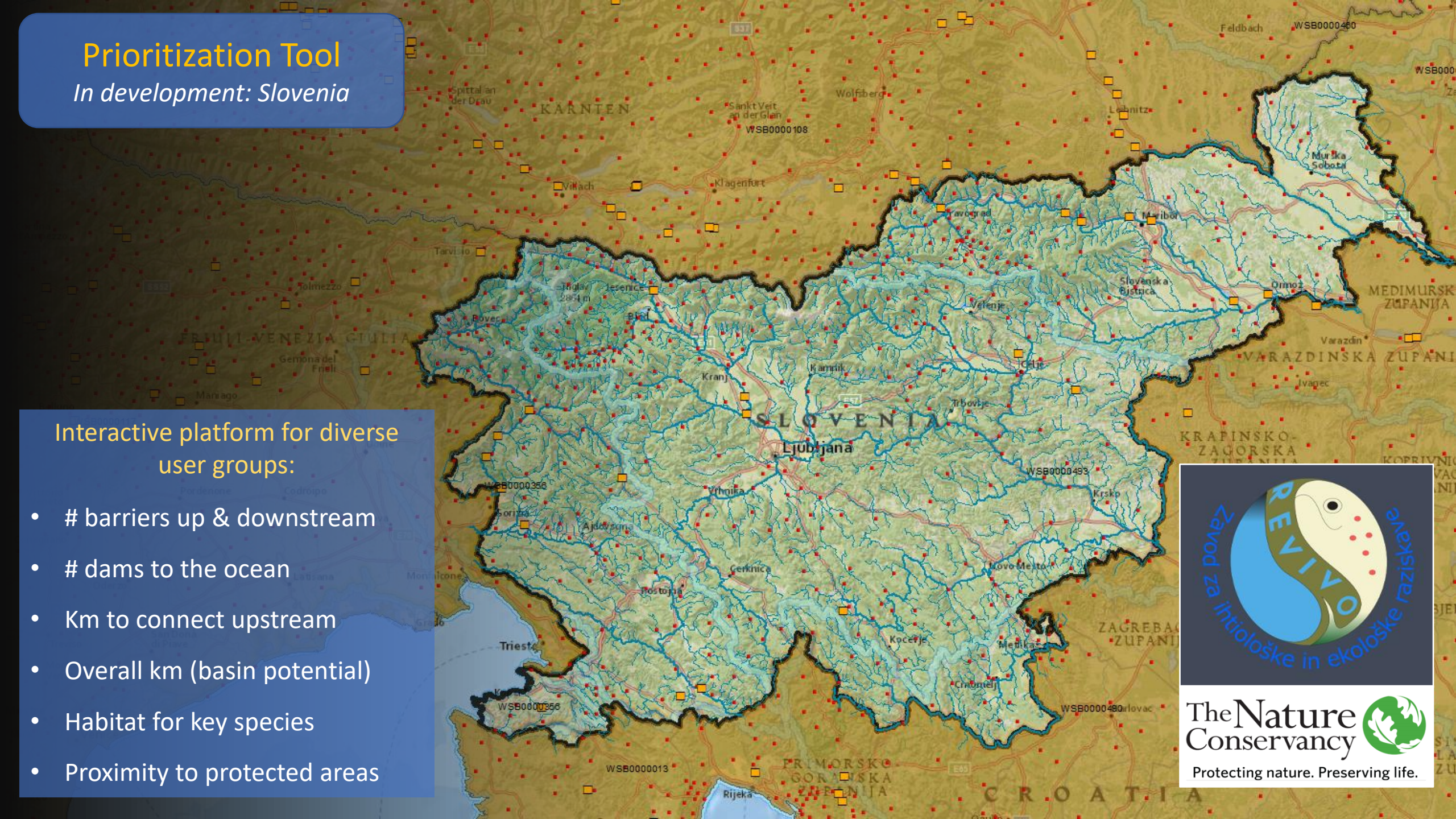
- Penobscot (2016) / Maine Statewide (2019)
  - https://maps.coastalresilience.org/maine/
- Northeast Aquatic Connectivity (2011 /2017)
  - https://maps.freshwaternetwork.org/northeast/
- Chesapeake Fish Passage Prioritization (2013, 2019)
  - https://maps.freshwaternetwork.org/chesapeake/
- Southeast Aquatic Connectivity Assessment Project (SEACAP) (2014)
  - http://maps.tnc.org/seacap
  - https://connectivity.sarpdata.com/priority

Outcomes for project applicants & private and governmental funding programs

Open-source tools create transparency in project scoring *and* inspire the collection of additional data to inc

# Prioritization Tool

*In development: Slovenia*




Interactive platform for diverse user groups:

- # barriers up & downstream
- # dams to the ocean
- Km to connect upstream
- Overall km (basin potential)
- Habitat for key species
- Proximity to protected areas

Zavod za ihtiološke in ekološke raziskave

REVIVO

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# Four West Atlantic Examples:
## Variations on a unified approach

- Calculate metrics for barriers, weight relative importance of each based on up and downstream physical and ecological and social values


- Variable user needs
- Focal species
- Functional habitat
- Highway projects→ linear prioritization
- Basin restoration groups for their local scale
- Metric availability vary by geography:
  - Maine: road crossings
  - Southeast: headwater biodiversity
  - Connecticut: project scoring

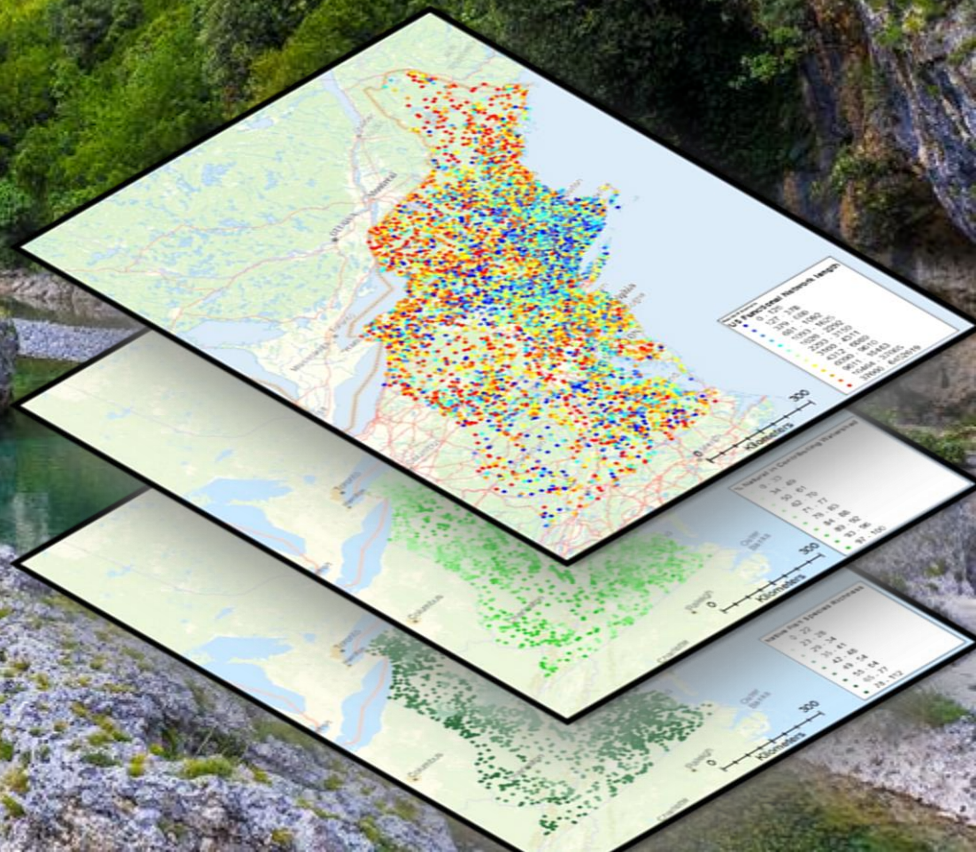
## TNC's West Atlantic Examples

Variations on a unified approach

Resource Managers/Experts define metrics to quantify, qualify and combine
Users apply Rank/scoring and Weighting of metrics for their priorities

Example high priority project:

- the most upstream habitat overall
- critical salmon sub-watersheds
- Hectares of herring spawning ponds
- Climate resilient settings
  - cold water
  - diversity of gradients
  - access to multiple habitat types
- Catchment supporting conditions
  - No storage → natural flows
  - 80% natural land-cover types
  - No point-source pollution discharge



# Example System

Pacific Northwest Salmon catchments

12-18 Salmon watersheds customize metrics and weightings based on key filters:

**Biological Filter:**

- Restores watershed processes
- Restores or improves watershed connectivity
- Removes limiting factor/s
- Has long lasting effects
- Restores or expands unique habitat
- Has well proven effectiveness

Socio-economic Filter:

- High likelihood of success
- Provides educational benefits
- Addresses landowner concerns
- Has measurable effects
- Feasible (no socio-political opposition)
- Likely to be funded
- Acceptable cost/benefit ratio

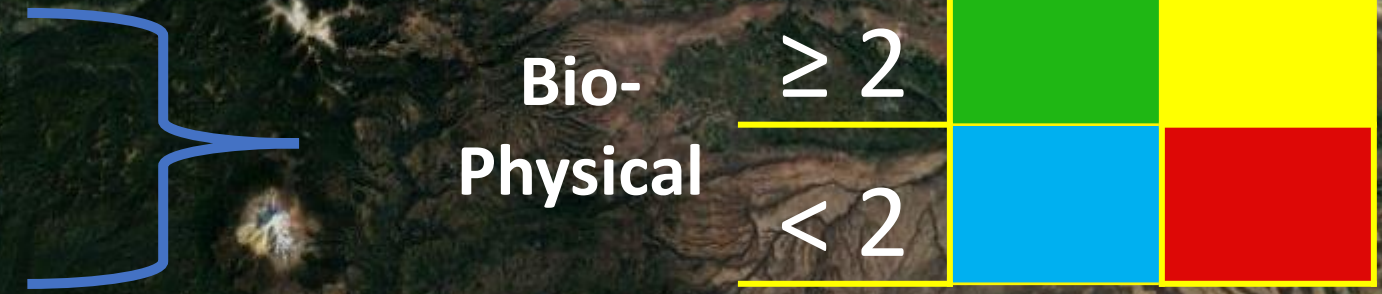
## Example System:
Pacific Northwest Salmon catchments

**Step 1. <u>Scoring Rubric (adaptable)</u>**

- Team develops attribute definitions & descriptions
- Data Sources must cover whole watersheds
- Scoring Chart: 0 to 4 scale

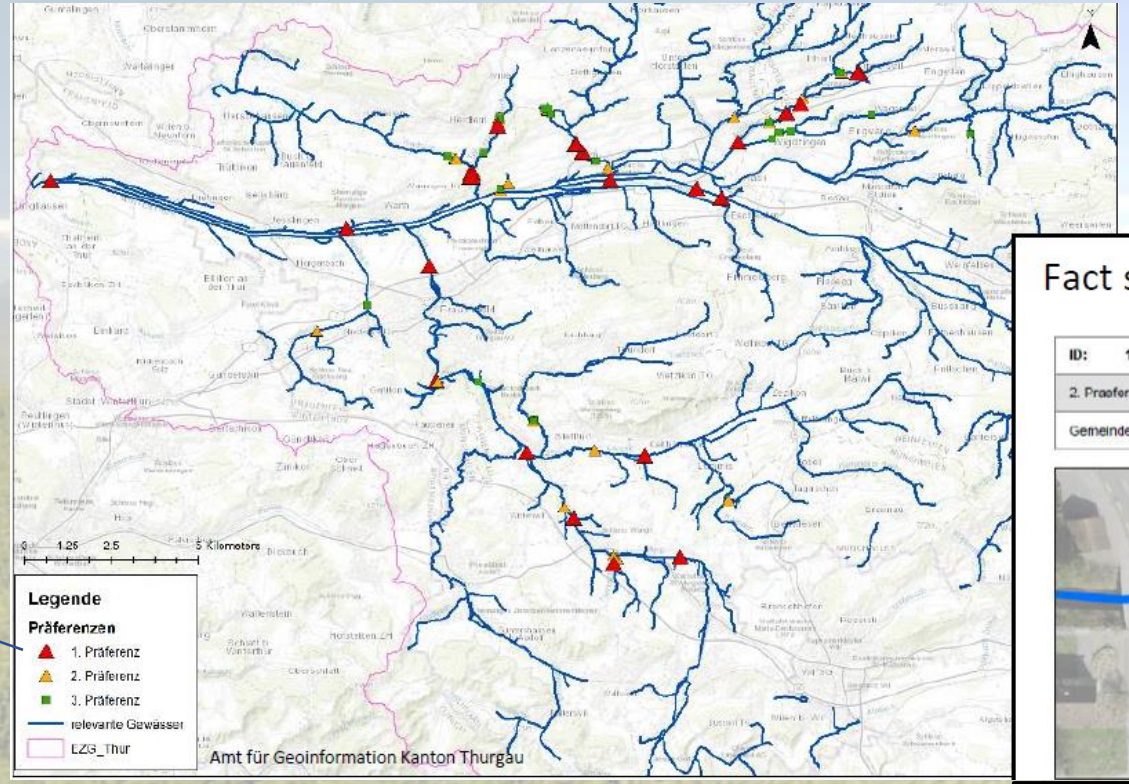
**Step 2. <u>Aggregate Weighted Scores</u>**

- Bio-Physical (Benefits)
- Socio-Economic (Feasibility)



# WWF-AquaViva Prioritization:

Basin-Scale Barrier Scoring

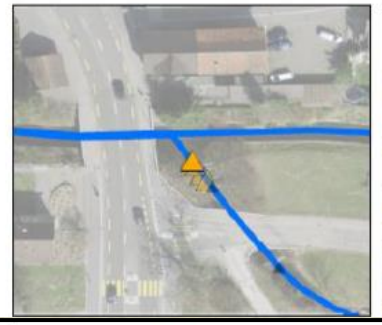


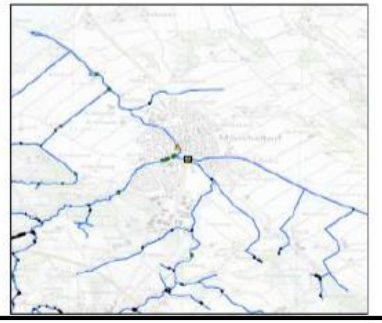

Top priority barriers

Already adopted by a river basin

## Fact sheet:

| ID: 107 | Bachname: | Bachnummer: 30507 | Bauwerk- bzw Absturznr: 1101 |
|---|---|---|---|
| 2. Praeferenz | Oekologisches Potenzial mittel | | Realisierung erachtet und weniger guenstig |
| Gemeinde: Monchaltorf | CH1903+ / LV95: 2697021 / 1240541 | | WGS84: 47.30951 / 8.721734 |





| Klassierung im Feld | |
|---|---|
| Gewässergrösse | 4.5 m |
| Einzugsgebietsgrösse | 13.5 km² |
| Ökomorphologie | künstlich / naturfremd |
| Bauwerkstyp | künstlich |
| Absturzhöhe | Absturz < 40 cm |
| Baustoff | |
| Uferbeschaffenheit | |
| Sohlenbeschaffenheit | |
| Gefälle | 2.2% |
| ID's in derselben | 470, 843, 709, 220, 581, 107 |

| Vernetzung | Die Schwelle liegt in einem Abschnitt, welcher mit dem Hauptgerinne vernetzt ist. |
|---|---|
| Mündungsbereich | |
| HVI | 2666 |
| Naturschutzgebiet | |
| Leitungen | |
| Anlagen | |
| Zugänglichkeit | |
| Grundwasserschutzzone | |
| Staatsparzelle | 3 |
| Feldbemerkungen | |

## Toolbox in ArcMap:

- Workflow FlussFrei.tbx
  - 01 Aufbau Gewässernetz
  - 02 EZGGrösse und Sohlengefälle
  - 031 Filter Hindernisse und Bauwerke
  - 032 Quantifizierung Habitatsvergrösserungsindex
  - 033 Filterung nach HVI
  - 034 Filterung der Hindernisketten
  - 04 Export Hindernisse nach Excel
  - 05 Import- und Bewertungsskript
  - 06 Erstelle Factsheet


Christian Hossli, project leader *Fluss frei!*

christian.hossli@aquaviva.ch

# Example Systems

## Finland's Dams ranking methods

- 5,200 inventoried dams in Finland
- Most are small hydro or obsolete dams
- Only 4% are grid-based hydro
- Small barriers: road crossings not in database

### Responsive to Opportunities: willing dam owners

- Fish population potential
- Water Framework: Status
  - Ecological, Water quality, Hydromorphic
- New habitat connected (km and type)
- Hydropower cost/benefits
- Cultural/Recreational values

Natural Resources and Bioeconomy
Research Report: 29/2021

# TNC Barrier Removal Prioritization

## Existing Program Examples

### Mitigation Funding Programme

(managed for US and State Agencies)
$20M from 2008-2020

- Creates most functional systems (35 point)
- Project readiness/feasibility (30 points)
- Cost effectiveness (area restored/$) (10 points)
- Other Benefits (education, scenic, recreation, community "sense of place") (5 points)

### US Dept. of Agriculture – TNC Grant

$26M from 2015-2025 (+partner match)

1) Screening (project in or out)
   - Ownership, permitting, historic, minimum habitat, stream network position
2) Project Ranking (best scores get most funding)
   - Miles of habitat
   - At-risk species habitat
   - Local, Regional and State Priority
   - Cost effectiveness ($/mile)
   - Complimentary projects
   - Reduces vulnerability of site
   - Proximity to other projects
   - Proximity to protected lands/waters
   - Enhances Carbon sequestration

# Summary

Optimization, screening and selection systems

- All require data and acknowledge gaps
  - Barriers: many small ones like road crossings
  - Social: acceptance, legal mechanisms, and political will
  - Surrounding Infrastructure
- Optimization helps focus on high potential networks
- Filtering, Ranking/scoring for evaluating potential removals

…….“But I still, haven’t found, what I’m looking for” - *Bono*

- Combined optimize, screen & scoring (*NOAA economist trying*)
- Provide functional ecological benefit
- Stronger data for feasibility and leverage
- Create momentum to <u>exceed</u> EU goals

# Thank you

Joshua Royte

jroyte@tnc.org

**HOLD THE DATE**

June 8th 14:00-17:00

European Barrier Prioritization Methods and Tools Workshop

The Nature Conservancy