

# SWIMWAYS OF EUROPEAN IMPORTANCE (SEI) SELECTION CRITERIA DEVELOPMENT

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Trans-European  
Swimways Network



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WORLD FISH MIGRATION  
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## Background

Some of the main causes of the decline of freshwater fish species include modifications of hydrological flows, physical alterations of waterbodies, and hydropower installations. These factors are very widespread in Europe, with more than 1 million barriers, such as dams and dikes, present in European rivers. These barriers hinder the natural movement of migratory freshwater fish, disturbing the connectivity between habitats needed throughout their life cycle, and have caused a decline of 93% of their populations in the last 50 years<sup>1</sup>.

To address these issues, Wetlands International Europe together with the IUCN, World Fish Migration Foundation and UNEP-WCMC developed the first Trans-European Swimways Programme<sup>2</sup> that aims to improve the conservation status of migratory freshwater fishes across Europe. The programme emphasizes the critical role of river connectivity and prioritizes barrier removal and preventing additional new barriers.

The identification of Swimways of European Importance (SEI) is very timely to promote their restoration in the context of the EU Nature Restoration Law and the Global Biodiversity Framework.

## Objective

A key objective of the Trans-European Swimways Programme is identifying the most important swimways of Europe [i.e., Swimways of European Importance (SEI)].

This report describes the rationale behind the set of **biological criteria** developed for identifying SEI based on available biological data in 2023.

## Preliminary criteria

[Worthington et al. \(2022\)](#)<sup>3</sup> have proposed three types of criteria for the identification of global swimways:

- **Biological:** based on migratory freshwater fish distributions, abundance, threat status, endemism, and ecological factors.
- **Economic:** based on the financial value of swimways, considering factors like employment, revenue generation from fishing industries, and the contribution to recreational fishing.
- **Social:** assessing the swimways' impact on communities, encompassing cultural significance, livelihood support, and the well-being of surrounding areas and their people.

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<sup>1</sup> <https://worldfishmigrationfoundation.com/living-planet-index-2020/>

<sup>2</sup> <https://europe.wetlands.org/download/7704/?tmstv=1701871645>

<sup>3</sup> Worthington, T. A., Van Soesbergen, A., Berkhuisen, A., Brink, K., Royte, J., Thieme, M., Wanningsen, H., & Darwall, W. (2022). Global Swimways for the conservation of migratory freshwater fishes. *Frontiers in Ecology and the Environment*, 20(10), 573-580. <https://doi.org/10.1002/fee.2550>



They have also envisaged that swimways will be identified at various scales, like the Key Biodiversity Areas<sup>4</sup> and to the selection of Important Birds<sup>5</sup>. Similarly, we propose a set of comparable criteria for three geographic levels: global, European and subregional (EU).

**The basis of the criteria for SEI is to identify rivers of high species richness for migratory freshwater fishes with various threatened and protected status.** According to the Red List we classified as threatened those species classified as Critically Endangered, Endangered or Vulnerable. The following criteria reflects the global, regional and subregional Red Lists as well as protection status of the species:

**A. Global**

- **A1:** The Swimway supports a significant number of globally threatened migratory freshwater fish species.

**B. European**

- **B1:** The Swimway supports a significant number of migratory freshwater fish species threatened in Europe.
- **B2:** The Swimway supports a significant number of migratory freshwater fish species listed in the appendices of the Bern Convention.

**C. EU**

- **C1:** The Swimway supports a significant number of migratory freshwater fish species threatened in the European Union.
- **C2:** The Swimway supports a significant number of migratory freshwater fish species listed in the annexes of the EU Habitats Directive.

## Materials and methods

### Data

For the development of the SEI criteria, different datasets were used, provided by the International Union for Conservation of Nature (IUCN). This data underwent pre-processing by the UN Environment Programme's World Conservation Monitoring Centre (UNEP-WCMC).

The following datasets have been used:

- **IUCN Red List data<sup>6</sup>:** This dataset provides the latest (2022) information on the conservation status of migratory freshwater fishes in Europe.
- **Distribution of native migratory freshwater fishes in Europe:** This dataset includes spatial information related to all native freshwater fish species in Europe.
- **Dissolved distribution polygons** for each species based on presence, origin, and seasonality codes (IUCN).
- **Red List categories:** The dataset includes Red List categories for all native freshwater fish species in Europe.
  - **Globally threatened and Near Threatened species (GT):** species with their global Red List Categories
  - **Threatened and Near Threatened species in Europe (ET):** species with their regional (European) Red List Categories.

<sup>4</sup> <https://portals.iucn.org/library/node/49979>

<sup>5</sup> <http://datazone.birdlife.org/site/ibacriteria>

<sup>6</sup> IUCN 2023. The IUCN Red List of Threatened Species. Version 2022-2. <https://www.iucnredlist.org/>

- **Threatened and Near Threatened species in the EU (EUT):** This dataset specifically lists species that are Threatened or Near Threatened within the European Union (EU).
- **Species listed on the Habitats Directive (HD):** This dataset includes species that are listed under the Habitats Directive, annexes II, IV and V.
- **Species listed in the appendices of the Bern Convention (BC):** a regulatory framework for the conservation of habitats and species in Europe.
- **List of 136 migratory freshwater fish species in Europe:** This list identifies the species that we recognize as migratory freshwater fish within the European region, according to the Trans-European Swimways Programme. We have considered both diadromous and potamodromous species as migratory fish.
- **Hydro RIVERS<sup>7</sup>:** layers at Hydro BASINS level 6. To depict the rivers in Europe, a cut-off based on mean annual discharge ( $5 \text{ m}^3/\text{s}$ ) was used.
- **Map of Europe:** limited by the Ural River and the Ural and Caucasus Mountains (Figure 1).

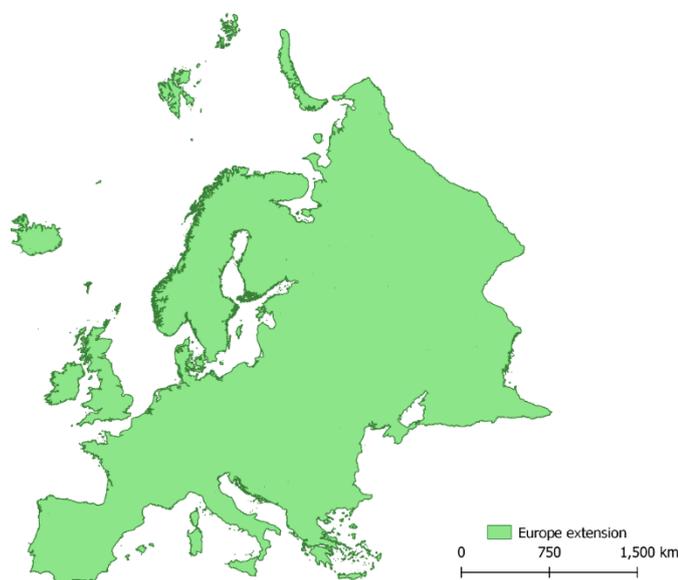


Figure 1. Extent of Europe considered in this report

In collaboration with UNEP-WCMC, we compared the original list of 136 migratory freshwater fish species from the Trans-European Swimways Programme with the latest data held by the IUCN. After sorting out the taxonomic differences between the various lists, we have considered **92 migratory freshwater fish species** for the application of the European swimways criteria (species listed in the Annex).

### Defining thresholds for the ‘significant number’

The proposed criteria for swimways includes a term “significant number of [...] species”. Therefore, it is necessary to specify what a “significant number” means for different categories of species.

Our starting point is that the Swimways of European Importance should represent the most important rivers according to species richness. However, we did not want to set the thresholds arbitrarily. Therefore, we have tested two thresholds for selecting the top 10% and

<sup>7</sup> <https://www.hydrosheds.org/products/hydrorivers>



the top 20% of the river sections with the highest species richness for each of the five criteria (A1, B1, B2, C1 and C2).

### Globally, regionally, and sub-regionally important river sections

Many of the migratory freshwater fishes are on both the global, the European and the EU Red Lists as threatened or near threatened species. Most of species are also listed in the appendices of the Bern Convention and/or in the Annexes of the Habitats Directive. Therefore, and depending on the species composition of a given river section, it can qualify the section under multiple selection categories (Figure 2).

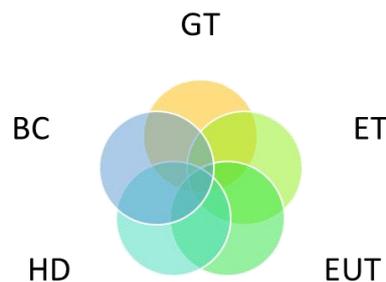


Figure 2. Possible overlaps between the different threatened and protection categories.

## Results

### Total species richness

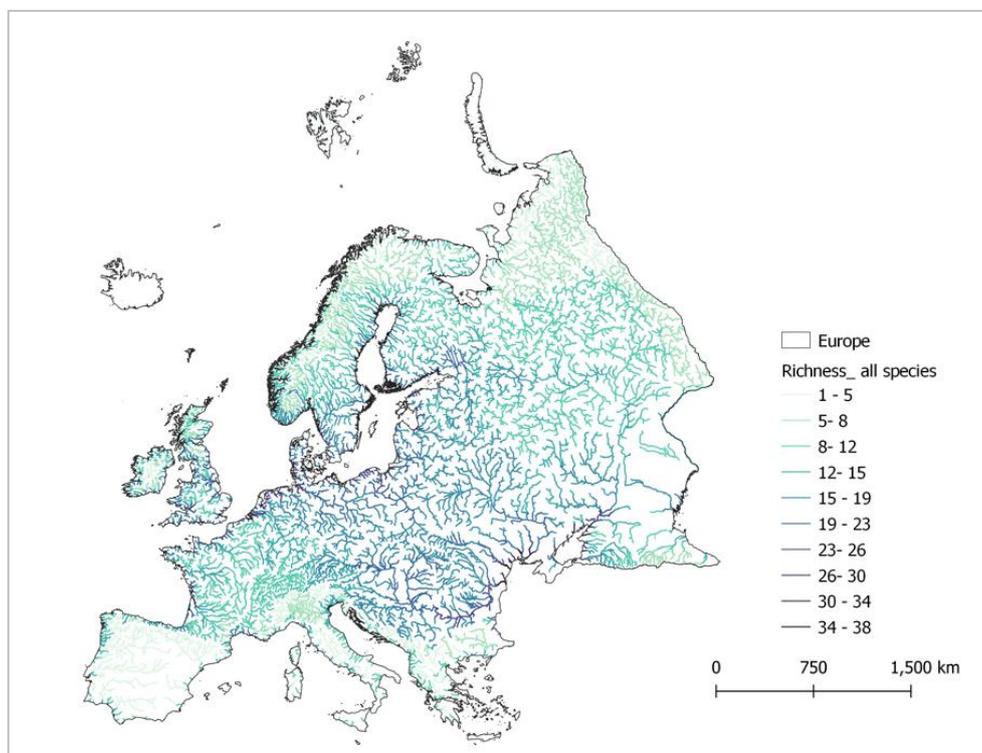


Figure 3. Richness of migratory freshwater fishes in European rivers

Figure 3 shows the richness of migratory freshwater fishes in the European rivers without considering their Red List or protection status. The rivers with the highest overall species richness are in Central Europe with decreasing numbers towards the more peripheral areas of the continent. It is remarkable that the Mediterranean areas support only a limited number



of migratory freshwater fish species. This is in stark contrast with the overall distribution of threatened freshwater fishes in Europe<sup>8</sup> but reflects the fact that the majority of the species in these regions are sedentary.

### A1 - Global Red List

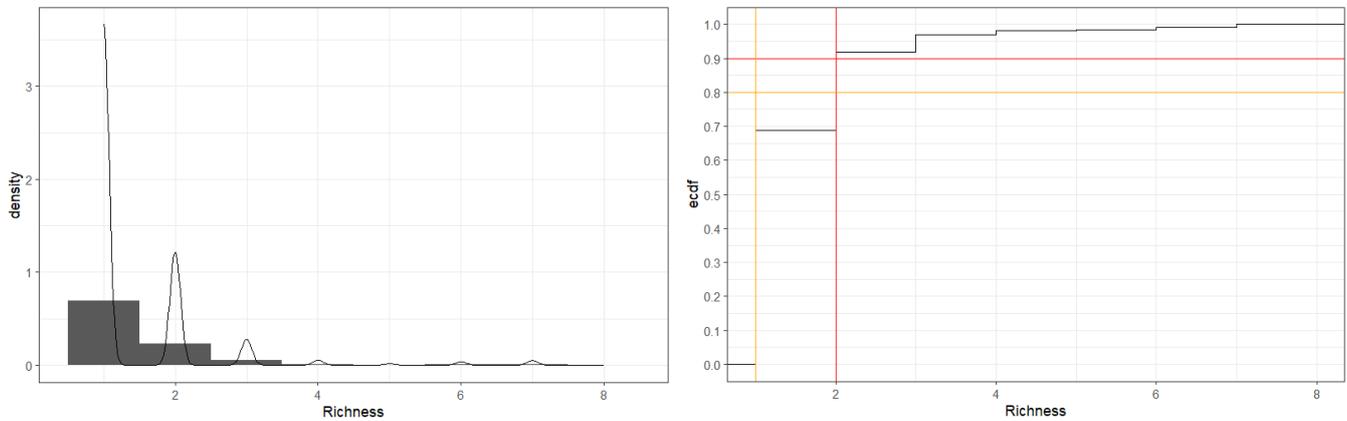


Figure 4. Distribution of river sections by the richness of migratory freshwater fishes threatened at the global level.

For the "Globally Threatened" category, we made an accumulation chart to determine the thresholds for species richness at 10% and 20%. As Figure 4 shows, the river sections in Europe hold a maximum of 8 migratory freshwater fish species that are threatened at the global level.

Almost 70% of the river sections support only one species. All the rivers that hold more than 1 species could qualify for the top 20% of the river sections and sections that support more than 2 species for the top 10% (Figure 5).

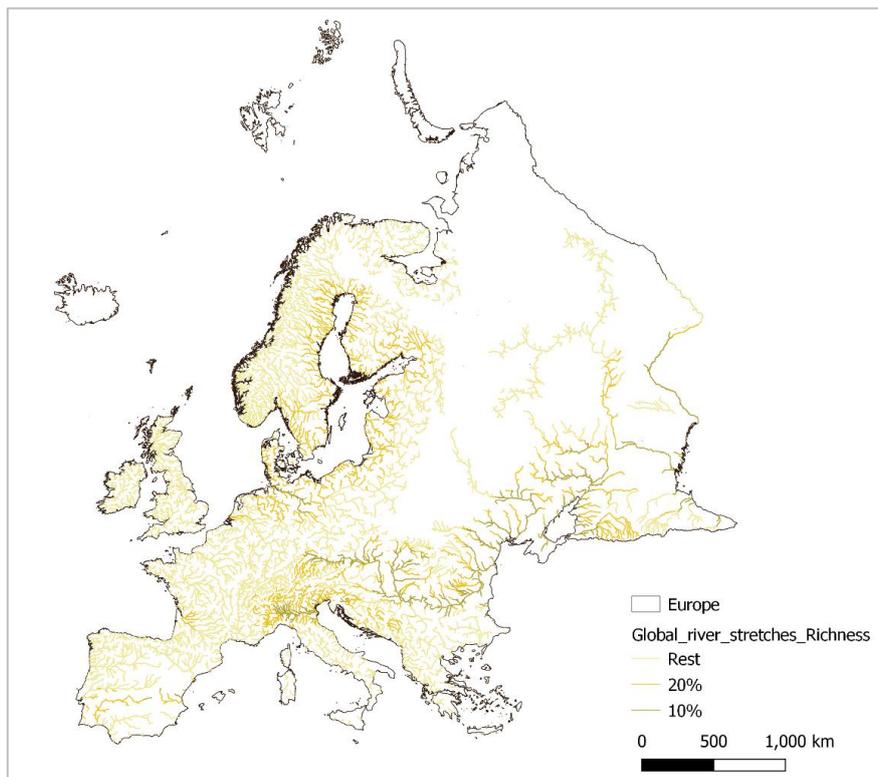


Figure 5. River sections meeting the thresholds for of globally threatened migratory freshwater fishes.

<sup>8</sup> <https://www.iucnredlist.org/>



The richness of globally threatened species is mainly determined by the overall species richness, but there are some important differences. Besides the rivers flowing into the Black Sea, the Po River appears as a very important one, as well as the Guadiana and the Jucar River. In northern Europe, only the Elbe River emerges as very important for globally threatened species.

### B1 - European Red List

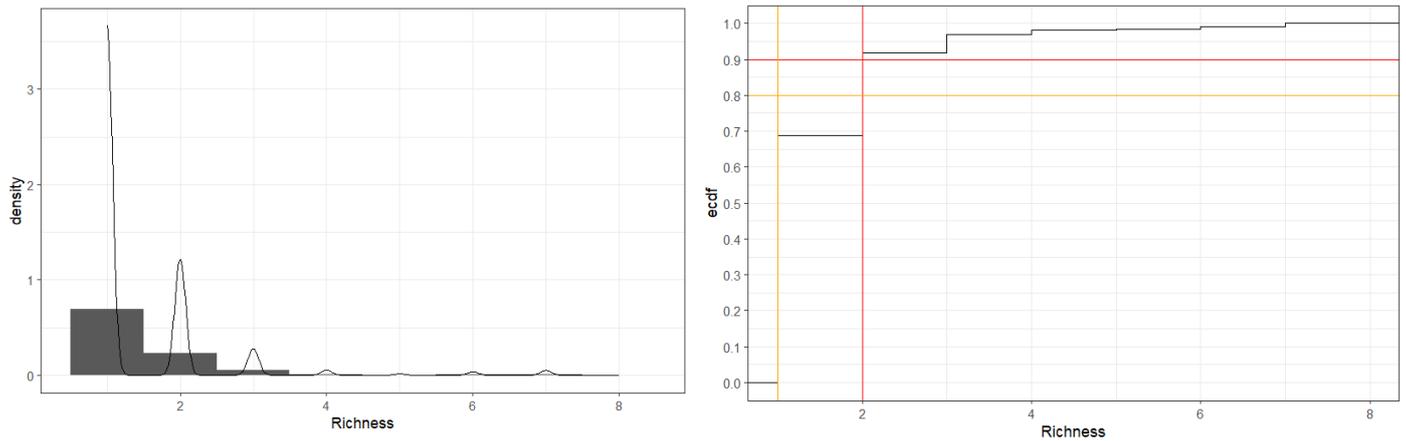


Figure 6. River sections meeting the thresholds for migratory freshwater fishes threatened in Europe.

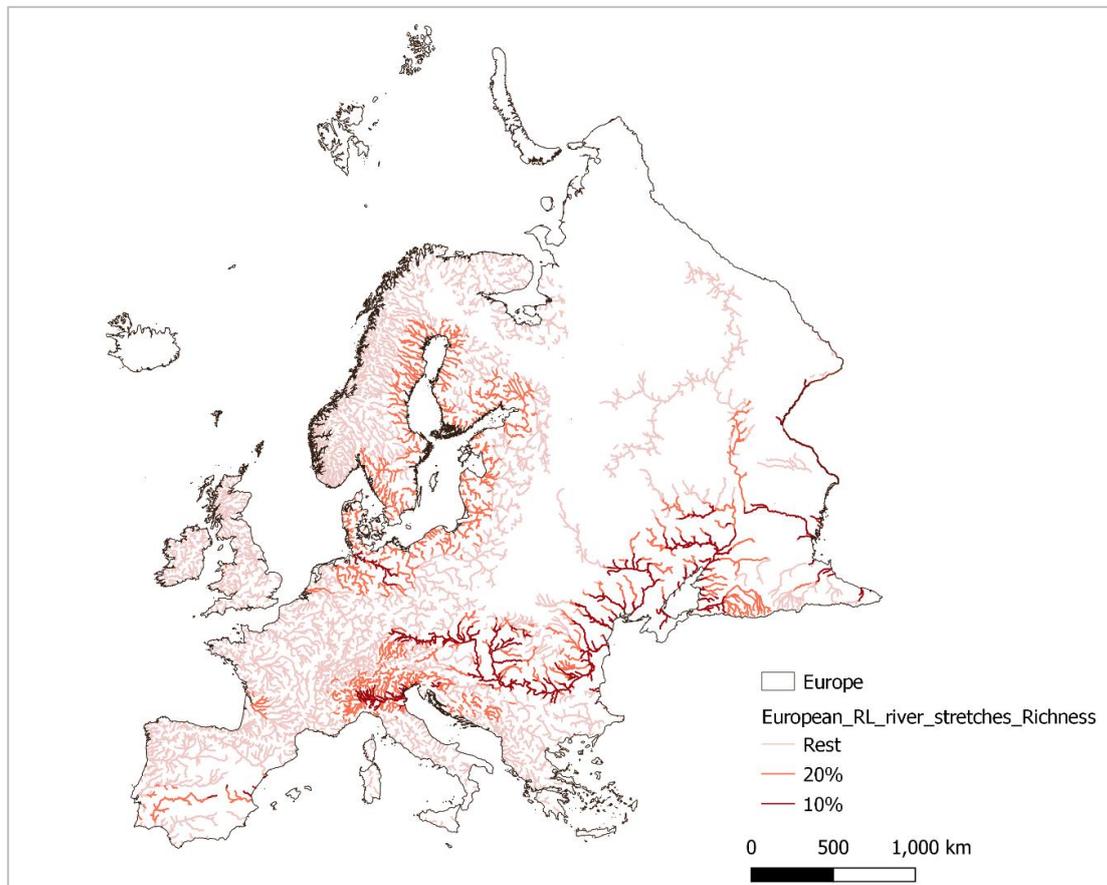


Figure 7. Distribution of river sections by the richness of migratory freshwater fishes threatened at the European level.



Reflecting the high continental endemism of the European ichthyofauna, the European Red List status of migratory freshwater fishes is almost identical with their global status (Figure 6). Therefore, both the thresholds and the distribution of species richness is identical (Figure 7).

### B2 - Bern Convention

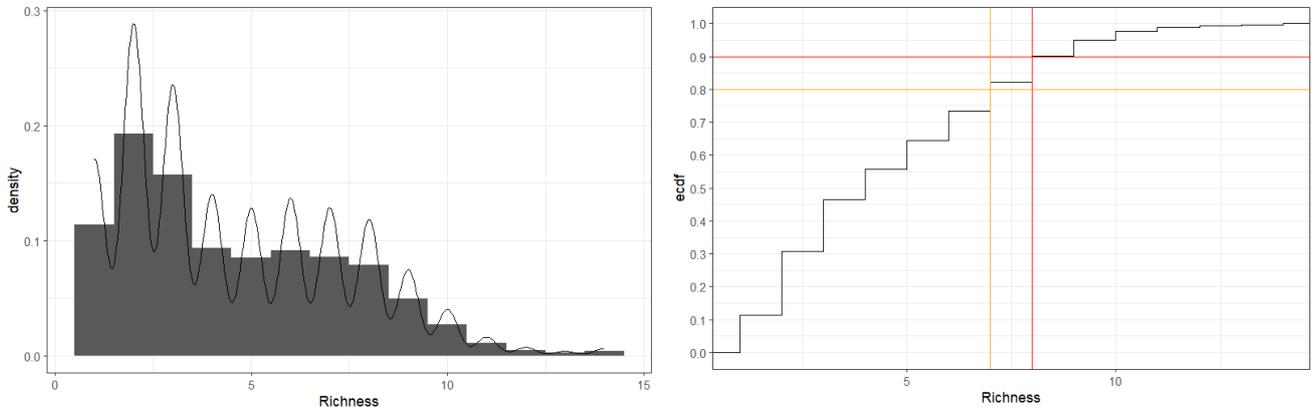


Figure 8. Distribution of river sections by the richness of migratory freshwater fishes listed in the Appendices of the Bern Convention.

The maximum number of species listed in the appendices of the Bern Convention is 14. The top 20% of the river sections support more than 7 species while the top 10% support more than 8 species (Figure 8). Using this criterion results in identifying a more extensive network of rivers (particularly in Germany, Czechia, and Poland) than under any of the other threatened species' criteria (Figure 9).

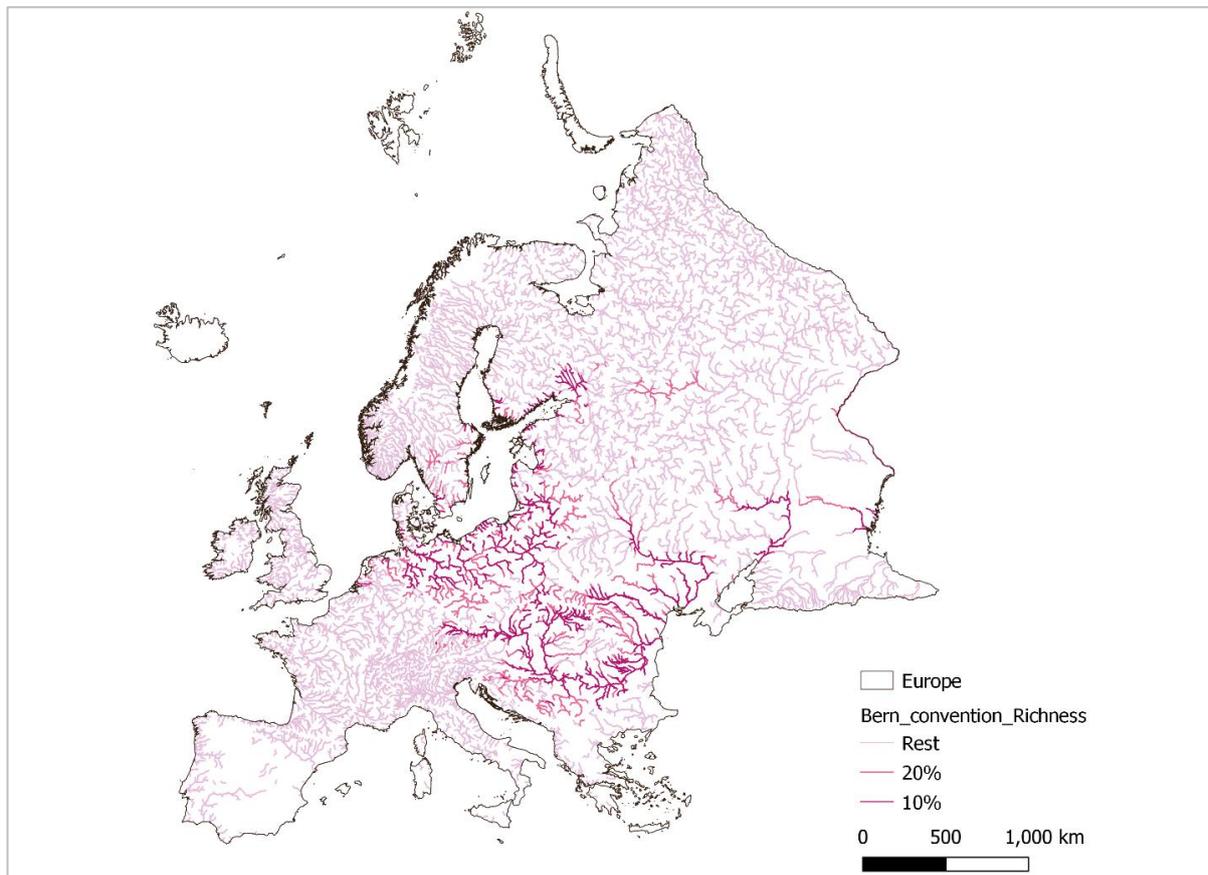


Figure 9. River sections meeting the thresholds for migratory freshwater fishes listed in the appendices of the Bern Convention.



### C1 – European Union Red List

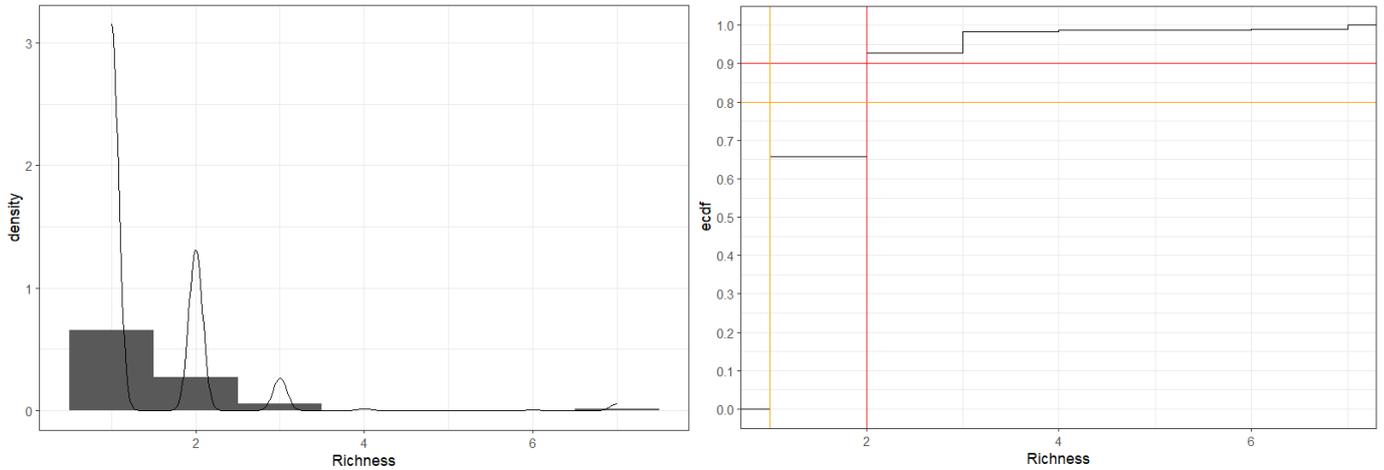


Figure 10. Distribution of river sections by the richness of migratory freshwater fishes threatened at the European Union level.

In principle, the same pattern emerges in the case of the European Union threatened Red List compared to Global and European threatened lists (Figure 10). The only difference is that this criterion is applicable only for the EU Member States and selects only river within the EU (Figure 11).

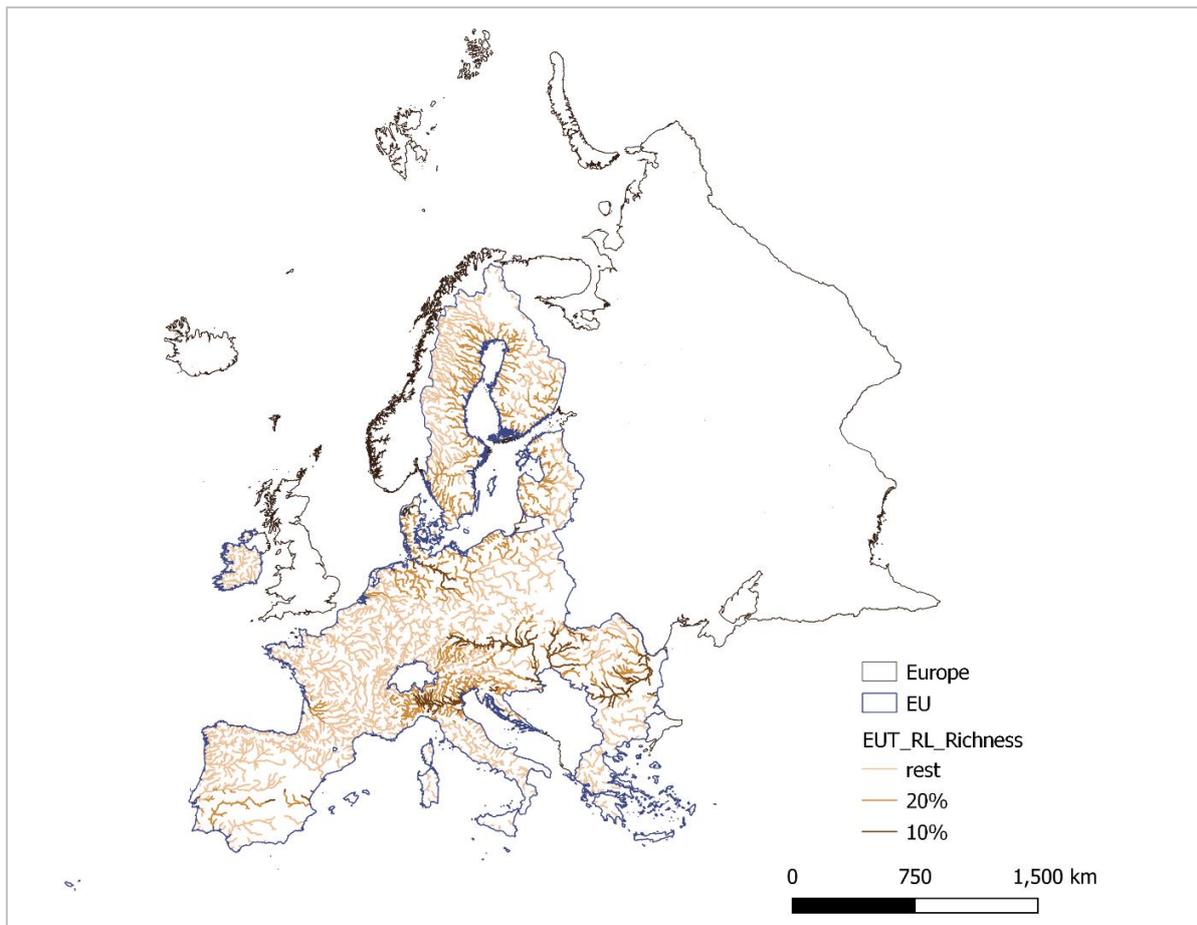


Figure 11. River sections meeting the thresholds for migratory freshwater fishes threatened in the EU28.



### C2 - EU Habitats Directive

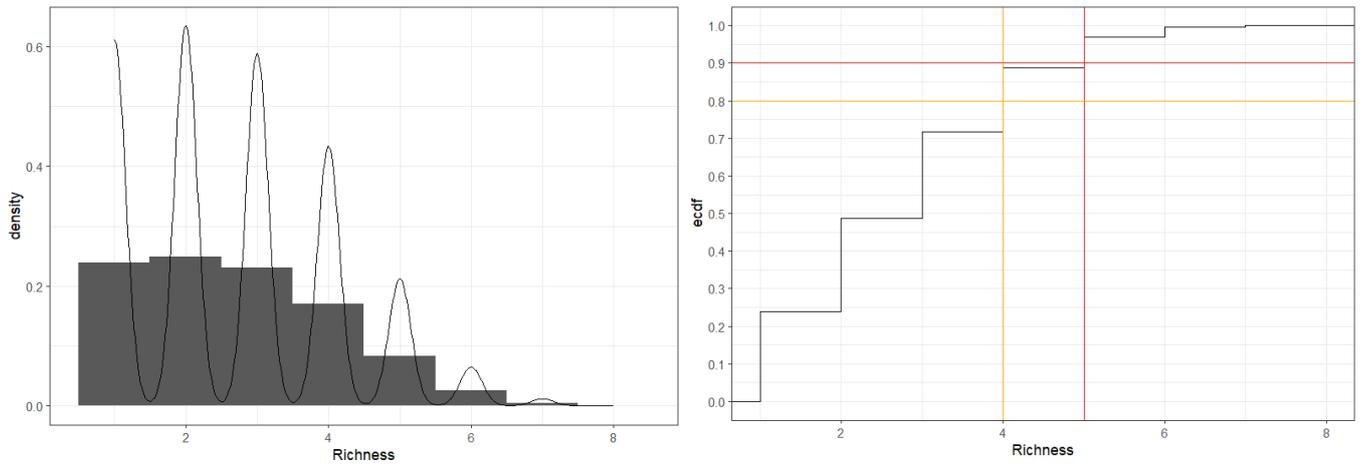


Figure 12. Distribution of river sections by the richness of migratory freshwater fishes listed in the annexes of the EU Habitats Directive.

Rivers in the European Union support a maximum of 8 species under the EU Habitats Directive. The top 20% supports more than 4 species, while the top 10% more than 5 species (Figure 12). As this directive applies only to the European Union, only river sections in the EU can qualify under this criterion. Compared with the previous criterion, richness of species protected under the Habitats Directive identifies some rivers in France that would not qualify under other criteria (Figure 13).

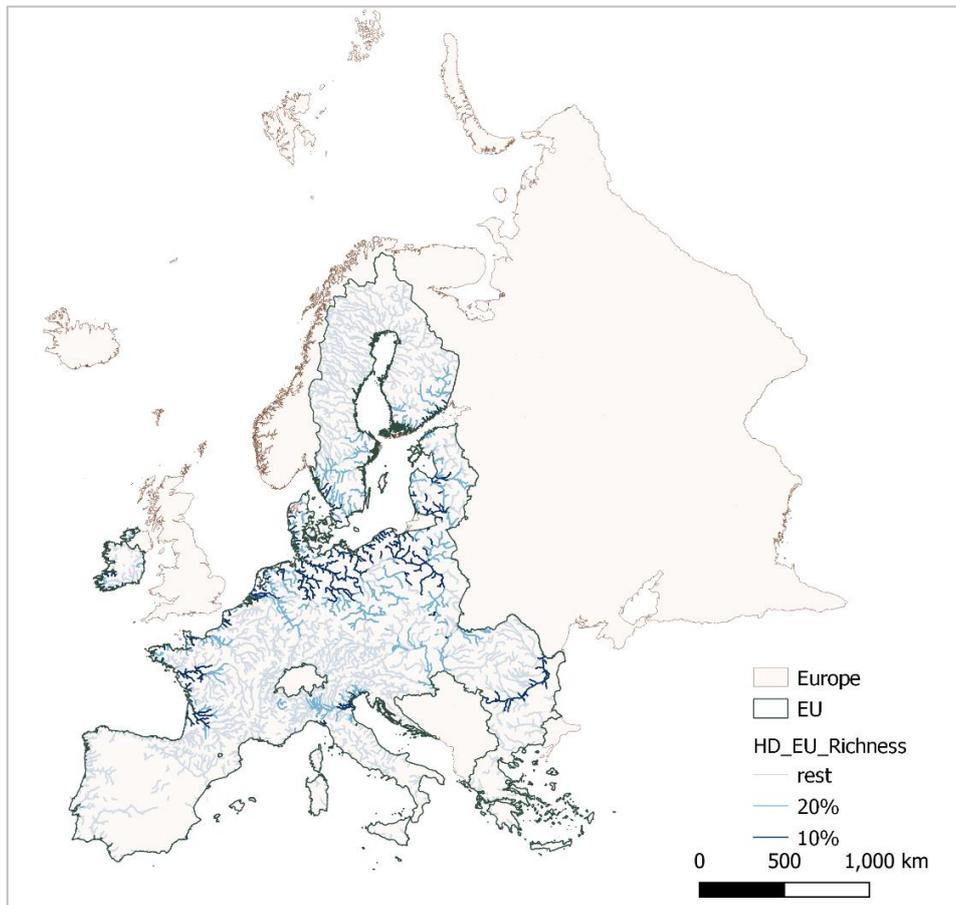


Figure 13. River sections meeting the thresholds for migratory freshwater fishes listed in the annexes of the Habitats Directive.



## Discussion

### Consolidated maps

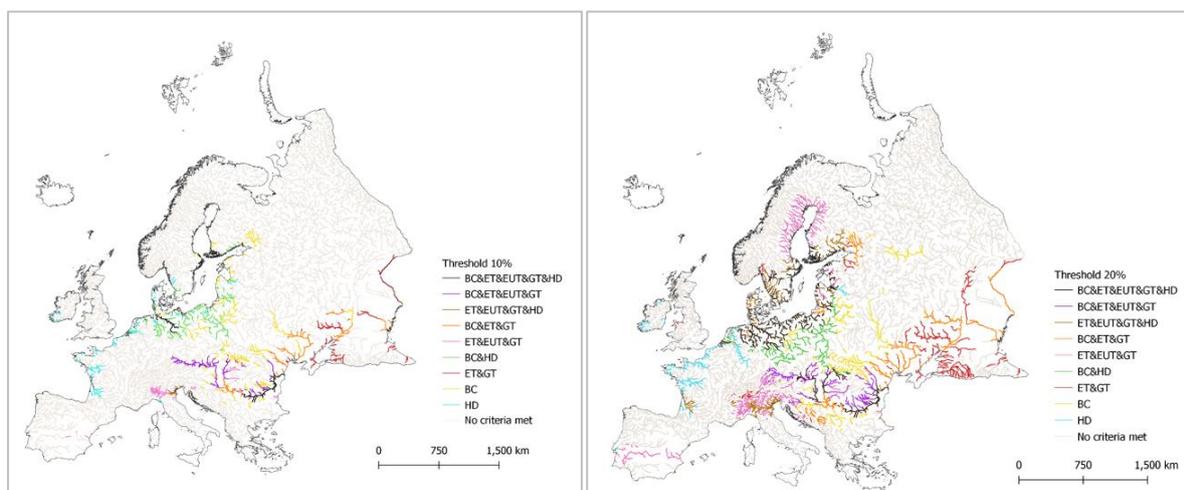


Figure 14. Combination of river sections that qualify under any of the criteria for the top 10% (left) or the top 20% (right) of the river sections.

Figure 14 shows the result of combining the rivers sections that meet one or more criteria at the 10% or at the 20% threshold levels.

At the 10% threshold, only the lower sections of the Danube and the Elbe rivers meet all five selection criteria. The Danube and Tisza Rivers also meet the combined criteria for the three Red List criteria and the Bern Convention. The lower section of the Po River qualifies for the three Red List criteria and the Habitats Directive, while Eastern European rivers qualify for the global and European Red List criteria as well as for the Bern Convention. Rivers in the Baltic mainly qualify both for the Bern Convention and for the Habitats Directive, while rivers along the Atlantic coast of Europe only qualify for the Habitats Directive. It is notable that the 10% thresholds would not identify almost any Swimways of European Importance in Scandinavia and Iberia. In addition, the 10% threshold identifies mainly the lower sections of large rivers.

At the 20% threshold, i.e., applying thresholds for just one or two species lower for the various criteria, the network becomes more extensive and better distributed. The Danube and the Tisza River as well as several rivers in Germany and Poland qualify for all five criteria under this threshold. Other trends that emerge under the 20% threshold include globally important swimways in Fennoscandia and Iberia, and the length of rivers qualifying under the Bern Convention and the Habitats Directive extend remarkably in France, the Netherlands, Germany, Poland and the Baltic Countries.

Figure 15 allows a direct comparison of the extent of river sections identified using the 10% or the 20% thresholds. Lighter colours of lines (without a dark outline) show the additional areas brought in by the less restrictive 20% threshold.

Figure 15 and Table 1 & Table 2 show that the majority (72% at the 20% level and 46% at the 10% level) of the Swimways of European Importance would be globally important, 21% and 44% would be regionally important and only 6% or 10% would be subregionally important at the 20% and 10% levels respectively.

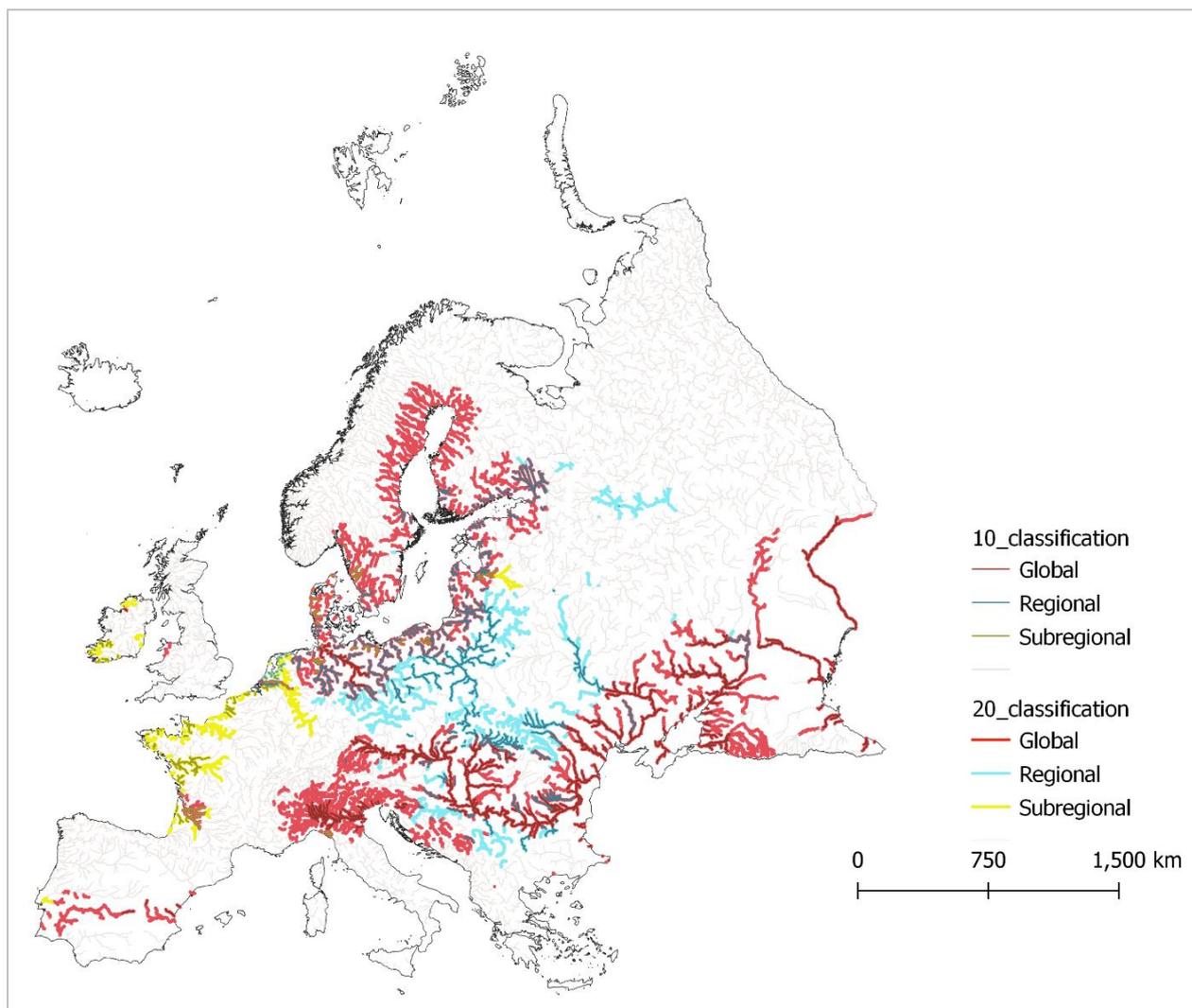


Figure 15. Globally, regionally and subregionally Swimways of European Importance.

## Lengths

According to the Hydro Rivers database, the total length of rivers in Europe is 2,448,260 km. As we used filtered data with an annual discharge of more than 5 m<sup>3</sup> per second, only 328,238 km of rivers in Europe (i.e., only 13%) was considered for this report. The length of rivers with an annual discharge of more than 5 m<sup>3</sup> per second in the European Union is 147,090 km (i.e., 44% of the European rivers with the same level of discharge).

According to Table 1, the Swimways of European Importance in Europe would include 110,047 km of rivers (i.e., 33.5% of all rivers with a discharge over 5 m<sup>3</sup> per second) at the 20% level and 49,809 km (i.e., 15.2% of all rivers with a discharge over 5 m<sup>3</sup> per second) at the 10% level.

According to Table 2, the total length of Swimways of European Importance in the EU would include 73,150 km (i.e., 49.7% of all rivers with a discharge over 5 m<sup>3</sup> per second) at the 20% level and 32,655 km (i.e., 22.2% of all rivers with a discharge over 5 m<sup>3</sup> per second) at the 10% level.



Table 1. Total length of river sections in Europe meeting any combination of the criteria at 20% or at 10% levels compared to the length of rivers with an annual discharge over 5 m<sup>3</sup> per second.

EUROPE	Length (20%) in km	% at 20	Length (10%) in km	% at 10
BC	14,360.5	4.4	13,774.57	4.2
HD	6,903.6	2.1	4,935.22	1.5
BC+HD	8,607.1	2.6	7,992.48	2.4
ET+GT	13,364.4	4.1	5,478.66	1.7
ET+EUT+GT	18,714.4	5.7	3,111.22	0.9
ET+EUT+GT+HD	9,006.2	2.7	653.53	0.2
ET+EUT+GT+BC	8,270.4	2.5	5,160.19	1.6
BC+ET+GT	13,578.8	4.1	5,755.65	1.8
ET+EUT+GT+BC+HD	16,350.9	5.0	2,787.99	0.8
<b>All criteria</b>	<b>110,047.38</b>	<b>33.3</b>	<b>49,808.73</b>	<b>15.2</b>

Table 2. Total length of river sections in the European Union meeting any combination of the criteria at 20% or at 10% levels compared to the length of rivers with an annual discharge over 5 m<sup>3</sup> per second.

EU	Length (20%) in km	% at 20	Length (10%) in km	% at 10
BC	4,407.0	3.0	7,855.17	5.3
HD	6,903.6	4.7	4,935.22	3.4
BC+HD	8,607.1	5.9	7,992.48	5.4
ET+EUT+GT	18,714.4	12.7	3,111.22	2.1
ET+EUT+GT+HD	9,006.2	6.1	653.53	0.4
ET+EUT+GT+BC	8,270.4	5.6	5,160.19	3.5
ET+EUT+GT+BC+HD	17,242.0	11.7	2,947.21	2.0
<b>All criteria</b>	<b>73,150.6</b>	<b>49.7</b>	<b>32,655.02</b>	<b>22.2</b>



## Conclusions

Through using the best available data on species richness and threatened status in European rivers at three different scales, we explored how many kilometres of rivers would classify as biologically important. We used two thresholds: the 10% of river sections with the highest number of species and the 20% of river sections with the highest number of species. These resulted in identifying over 110,000 km of rivers in Europe which could be considered part of a Swimway of European Importance.

The stricter 10% thresholds identify only some of the major rivers and could be hardly regarded as truly Trans-European. The identified areas consist of mainly lower sections of large rivers, with major geographic biases such as ignoring Fennoscandia and Iberia. Using the 20% thresholds appears to be more geographically balanced, and more likely to include the entire swimways of individual species.

Further work at the level of individual swimways shall focus on looking at the ecological functioning of the scoped swimways to identify whether they cater for all the requirements of their qualifying species (i.e., are they connected to the sea in case of diadromous species, are spawning grounds included).

A detailed technical report should look at the threats to each of the identified SEI considering major barriers impeding fish migration, status and objectives of the River Basin Management Plans, designation as acceleration areas for renewable energy development, plans for developing inland navigation under the Trans-European Transport Network, coverage by protected (Natura 2000 areas), protected area pledges and conservation and restoration plans in the Prioritized Action Framework.



## Annex

List of migratory fish species considered on the criteria:

<i>Abramis brama</i>	<i>Chelon labrosus</i>	<i>Luciobarbus guiraonis</i>
<i>Acipenser gueldenstaedtii</i>	<i>Chondrostoma nasus</i>	<i>Mugil cephalus</i>
<i>Acipenser naccarii</i>	<i>Chondrostoma prespense</i>	<i>Osmerus eperlanus</i>
<i>Acipenser nudiventris</i>	<i>Chondrostoma soetta</i>	<i>Parachondrostoma</i>
<i>Acipenser oxyrinchus</i>	<i>Chondrostoma</i>	<i>arrigonis</i>
<i>Acipenser ruthenus</i>	<i>vardarense</i>	<i>Parachondrostoma miegii</i>
<i>Acipenser stellatus</i>	<i>Clupeonella cultriventris</i>	<i>Parachondrostoma</i>
<i>Acipenser sturio</i>	<i>Cobitis tanaitica</i>	<i>turiense</i>
<i>Alburnus mandrensis</i>	<i>Coregonus albula</i>	<i>Pelecus cultratus</i>
<i>Alburnus mento</i>	<i>Coregonus lavaretus</i>	<i>Petromyzon marinus</i>
<i>Alburnus sarmaticus</i>	<i>Coregonus maraena</i>	<i>Platichthys flesus</i>
<i>Alburnus schischkovi</i>	<i>Coregonus megalops</i>	<i>Pleuronectes platessa</i>
<i>Alburnus scoranza</i>	<i>Coregonus renke</i>	<i>Pomatoschistus microps</i>
<i>Alburnus vistoncus</i>	<i>Coregonus widegreni</i>	<i>Pungitius pungitius</i>
<i>Alosa alosa</i>	<i>Cyprinus carpio</i>	<i>Rutilus frisii</i>
<i>Alosa fallax</i>	<i>Dicentrarchus labrax</i>	<i>Rutilus heckelii</i>
<i>Alosa immaculata</i>	<i>Eudontomyzon danfordi</i>	<i>Rutilus meidingeri</i>
<i>Alosa maeotica</i>	<i>Eudontomyzon mariae</i>	<i>Rutilus rutilus</i>
<i>Alosa tanaica</i>	<i>Gasterosteus aculeatus</i>	<i>Salmo ferax</i>
<i>Anaocypris hispanica</i>	<i>Gymnocephalus baloni</i>	<i>Salmo labrax</i>
<i>Anguilla anguilla</i>	<i>Hucho hucho</i>	<i>Salmo nigripinnis</i>
<i>Aspius aspius</i>	<i>Huso huso</i>	<i>Salmo peristericus</i>
<i>Atherina boyeri</i>	<i>Lampetra fluviatilis</i>	<i>Salmo stomachicus</i>
<i>Aulopyge huegelii</i>	<i>Lampetra planeri</i>	<i>Salmo trutta</i>
<i>Ballerus ballerus</i>	<i>Lethenteron</i>	<i>Salvelinus alpinus</i>
<i>Ballerus sapa</i>	<i>camtschaticum</i>	<i>Salvelinus perisii</i>
<i>Barbus balcanicus</i>	<i>Leuciscus burdigalensis</i>	<i>Sander lucioperca</i>
<i>Barbus barbus</i>	<i>Leuciscus leuciscus</i>	<i>Sander volgensis</i>
<i>Barbus plebejus</i>	<i>Liza aurata</i>	<i>Squalius cephalus</i>
<i>Barbus prespensis</i>	<i>Liza ramada</i>	<i>Squalius squalus</i>
<i>Barbus waleckii</i>	<i>Liza saliens</i>	<i>Thymallus thymallus</i>
<i>Blicca bjoerkna</i>	<i>Luciobarbus graellsii</i>	<i>Vimba vimba</i>



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