AMBER BARRIER TRACKER

Using Citizen Science to Track Barriers in Europe

DAM REMOVAL EUROPE

WORLD FISH MIGRATION FOUNDATION

European Commission

AMBER

SUMMARY

For the last 4 years citizens have been tracking longitudinal river barriers in Europe through the **AMBER Barrier Tracker app**. More than 2800 people have recorded the location, type and conservation status of more than 10500 barriers in 40 countries. This information can potentially pinpoint those barriers that are obsolete and whose removal would be most beneficial. These data can also be used to improve the accuracy of existing national inventories of river barriers and to make well-informed river management decisions relative to barrier removal prioritization. Dam Removal Europe (DRE) has recently launched a promotional campaign of the app which was focused mainly – but not exclusively – on 18 countries where the app performance was limited, and barrier under-reporting was significant. The campaign resulted in the recording of 300 new barriers in 12 of those countries. In total the campaign contributed to the registration of ~250 new users and the recording of ~600 new barriers. The promotion of the app should continue as well as the efforts to establish the app as a valuable restoration tool for water management authorities.

INTRODUCTION

AMBER Barrier Tracker[1] (Fig. 1) is a free and user-friendly app that allows users to report the location, features, and status of river barriers and to upload photos of these structures. All these information can be used to pinpoint obsolete barriers or barriers with expired license and help prioritize their potential removal. It was launched in April 2018 during the World Fish Migration Day and was promoted within the framework of the EC-funded Horizon 2000 "Adaptive Management of Barriers in European Rivers" **(AMBER)** project to raise awareness among citizens about the different types of riverine barriers and to be used as a tool towards an ever-growing inventory of barriers fragmenting European rivers with continuously increasing accuracy. This information can be utilized by policy makers, water management authorities and conservationists so they make well-informed river management decisions and also locate barriers which do not appear in their official inventories. The AMBER Barrier Tracker app has been able to harness the power of citizen science, a continuously growing practice that involves the public in scientific research and scientific knowledge production through field-based observations of the natural world and can be employed by decision makers, research funding organizations, the scientific community, etc. (Merenlender et al. 2016; Haklay et al. 2021).

Figure 1. The AMBER Barrier Tracker app interface

1. AMBER Barrier Tracker app is available on **Google Play** and **App Store**

European rivers' fragmentation status

The first pan-European estimation of river fragmentation in Europe caused by artificial barriers was conducted as part of the AMBER project and reported the existence of at least 1.2 million barriers in 36 European countries (with a mean density of 0.74 barriers per kilometer), 15% of which (~200000) are considered obsolete (Belletti et al. 2020). However, the real magnitude of river fragmentation at the pan-European scale is mostly unknown, while in many countries there is only a limited overview of existing barriers. This information deficiency hampers well informed decisions about prioritization and execution of barrier removals.

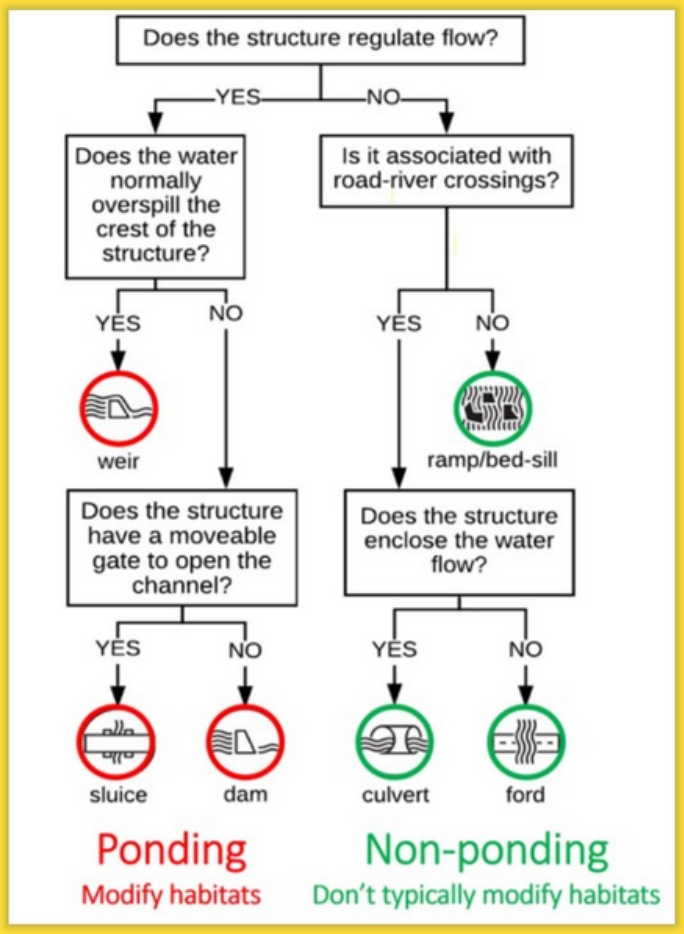


Figure 2. Types of longitudinal river barriers based on their features and impact on water flow and fluvial processes (Garcia de Leaniz and O'Hanley 2022, adapted from Jones et al. 2020; presented with permission from the authors)

What is a longitudinal river barrier?

Artificial longitudinal river barriers are "any built structures that interrupt or modify the flow of water, the transport of sediments, or the movement of organisms and can cause longitudinal discontinuity" (Belletti et al. 2020) and can be categorized into six main types (Fig. 2), based on their features and impact on water flow and the fluvial habitats. Minimum height thresholds should not be considered when identifying such barriers (Garcia de Leaniz and O'Hanley 2022).

AMBER Barrier Tracker app Summer 2022 Campaign

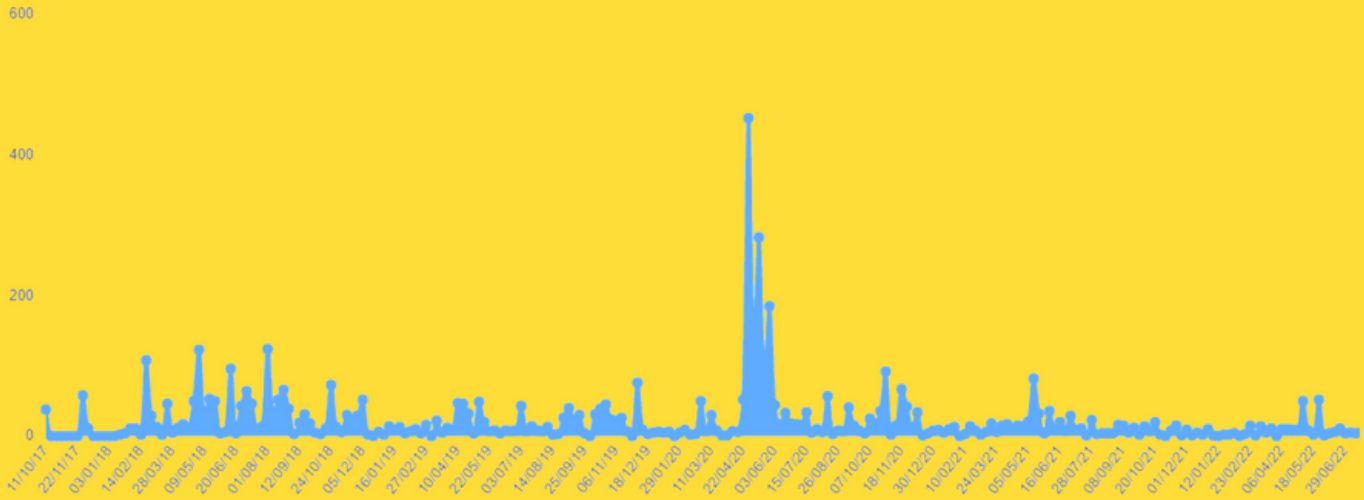
During the summer of 2022, DRE launched a campaign to promote the app – mainly in Norway, the Baltic countries, the Balkans, and the Danube basin, where stakeholder engagement in this citizen science program is limited and barrier under-reporting is significant (76 - 98%; Belletti et al. 2020). More than 1300 NGOs, University departments, research institutes, regional/national park authorities, angling associations, scout groups, kayaking/canoeing/rafting/hiking clubs, environmental education centers, summer camps and tourist/visitor centers were contacted via email during the campaign.

Based on the records submitted through the AMBER Barrier Tracker app until July 14, 2022 (day the campaign was launched), DRE reports that:

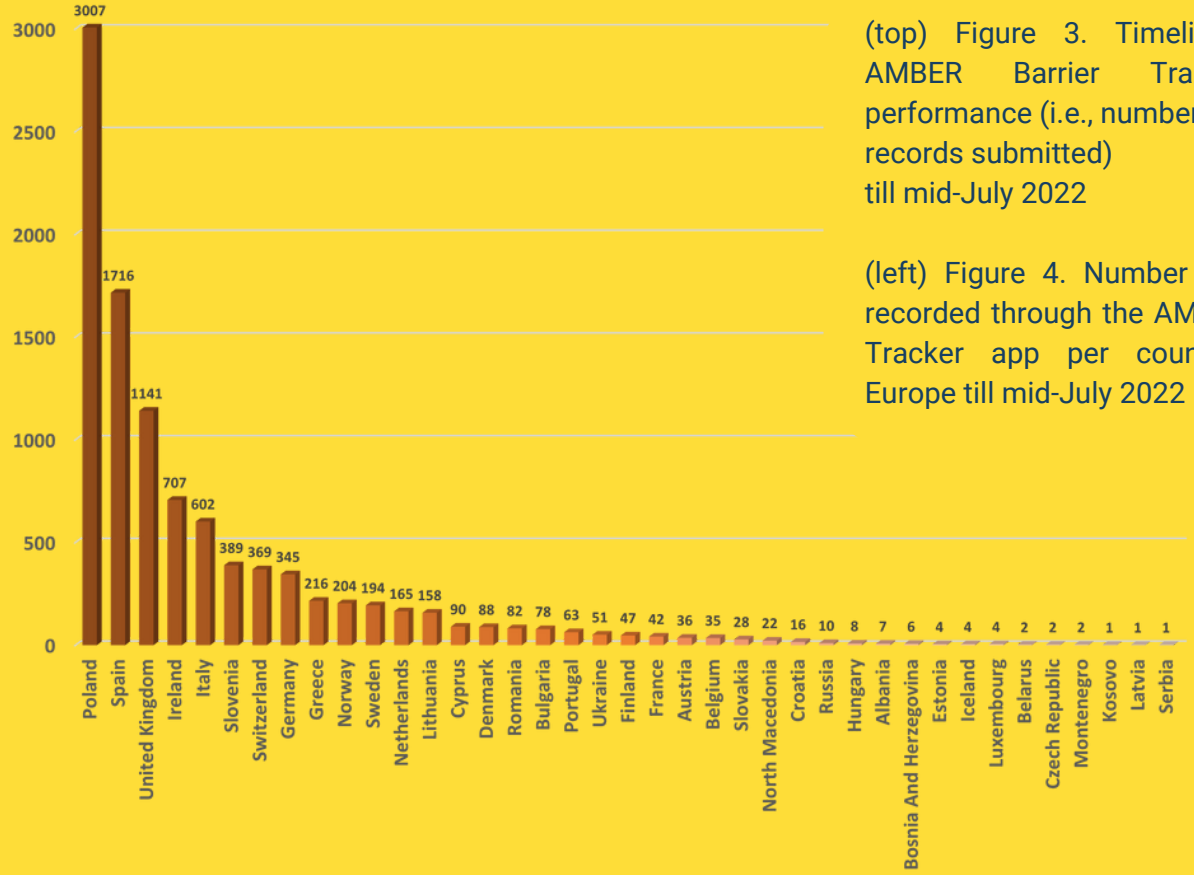
- **More than 2614 users had registered to the app**
- **The app users were consistently more active during late spring and early summer (Fig. 3)**
- **Most recorded barriers (76.6%) were low structures (<2 m) and 92.7% were lower than 5 m high**
- **Almost a quarter of recorded barriers (24%) were out of use and not serving any purpose**

- **Almost half (47.7%) of the recorded barriers were weirs (Fig. 6)**

- **9943 barriers[2] had been recorded in 39 European countries (Fig. 4). Most of these barriers were in Poland (30.2%), Spain (17.3%), and the United Kingdom (11.5%)[3] (Fig. 4-5), where the app was most popular**



(top) Figure 3. Timeline of the AMBER Barrier Tracker app performance (i.e., number of records submitted) till mid-July 2022



(left) Figure 4. Number of barriers recorded through the AMBER Barrier Tracker app per country across Europe till mid-July 2022

2. These are the accurate records. There is a double verification procedure to evaluate the submitted records. The main evaluation is performed by experts, which classify the records in the proper category (correct, incorrect, plausible, unlikely, likely). A Photo Classification Tool is also available for all users in the AMBER portal, aiming to evaluate the submitted records and to train the public on how to recognize the types of barriers and to assess their status, performance, etc.

3. UK has its own app called "**River Obstacles**" to harness the power of citizen science, while France has its own web application called "GEOBS – ROE", as well as a network of several thousand trained people to collect information/data on river connectivity and hydro-morphology which you can find on the "**SANDRE**" platform.

DAM REMOVAL EUROPE

Dam Removal Europe (DRE) is a coalition of seven organizations: the World Wildlife Fund, The Rivers Trust, The Nature Conservancy, the European Rivers Network, Rewilding Europe, Wetlands International, and the World Fish Migration Foundation. The overall ambition of DRE is to restore the free-flowing state of rivers and streams in Europe. In that respect, DRE aims to establish barrier removal as a restoration tool and to mainstream this practice. Through a bottom-up process DRE has created a continuously growing European network and is working towards a holistic approach to remove barriers.

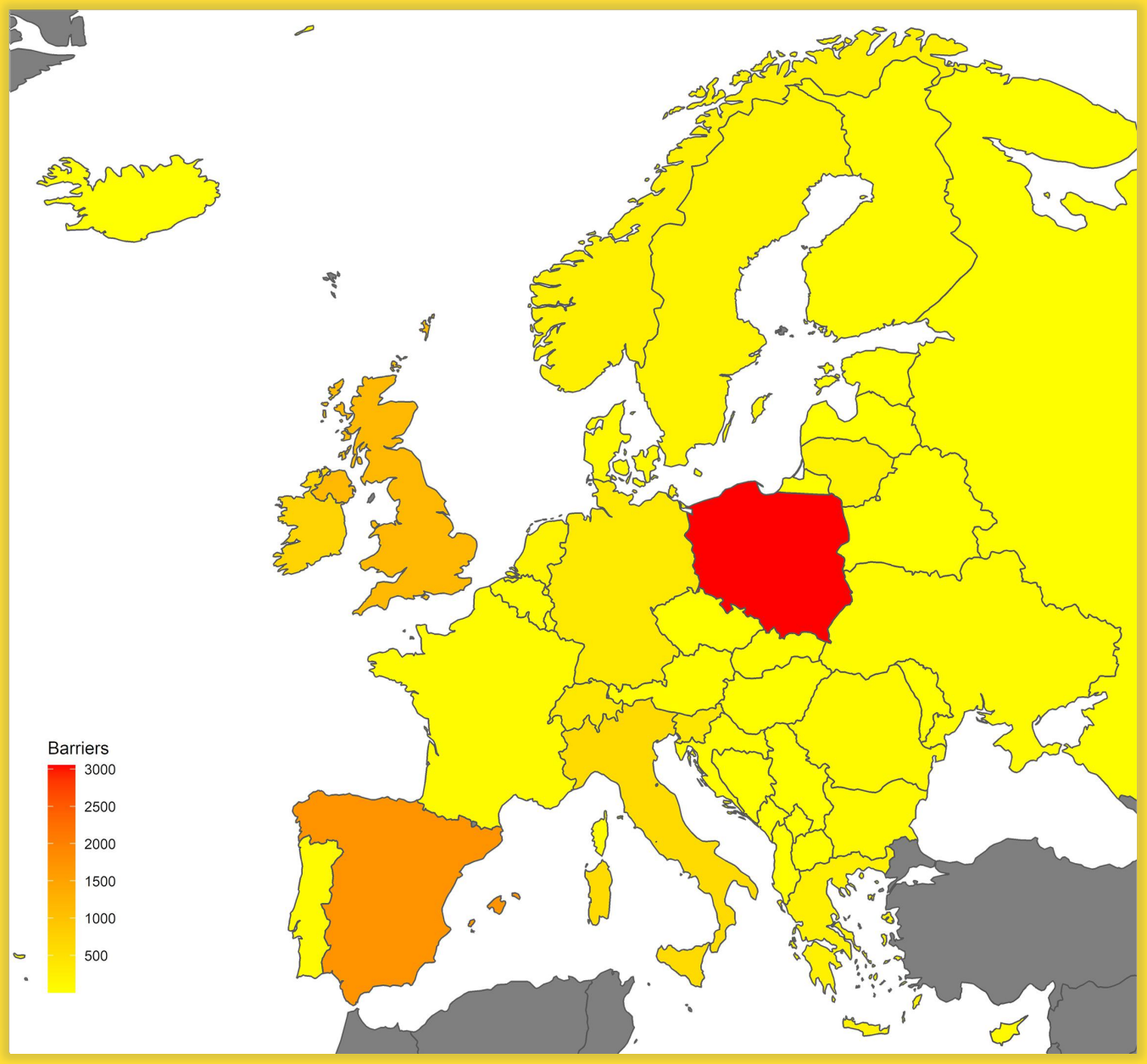


Figure 5. Number of river barriers recorded through the AMBER Barrier Tracker app till mid-July 2022

Since the day the DRE summer campaign was launched and until the 6th of November 2022, **246 new users registered to the app and 595 new barriers were recorded in Europe.** The number of new records per country that the DRE campaign was focused on is presented in Figure 7.

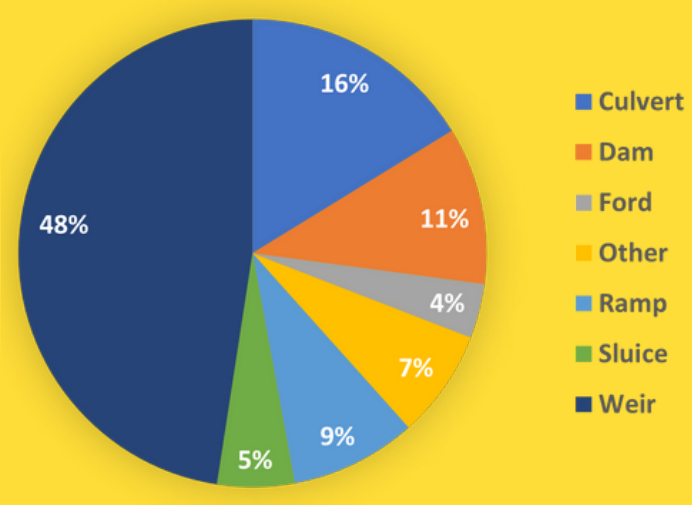


Figure 6. Type of barriers recorded through the AMBER Barrier Tracker app till mid-July 2022

LOW HANGING FRUIT

All artificial river barriers cause detrimental effects on longitudinal continuity and fluvial ecosystems. However, barrier impacts vary depending on many factors, including barrier type, location, age, and condition. In this respect, not all barrier removal projects are alike, and each one faces its own challenges. Thus, such projects need to be scaled and prioritized based on barrier features (dimensions, age, per capita impact, obsolescence, access, usefulness), cost-benefits, and possible negative effects of the removal (e.g., spread of invasive species, transfer of toxic sediment; Tullos et al. 2016) (Fig. 8; Garcia de Leaniz and O'Hanley 2022). Additional factors may also need to be considered before barriers are removed, such as cultural heritage and historical value, as well as public attitudes about removals.

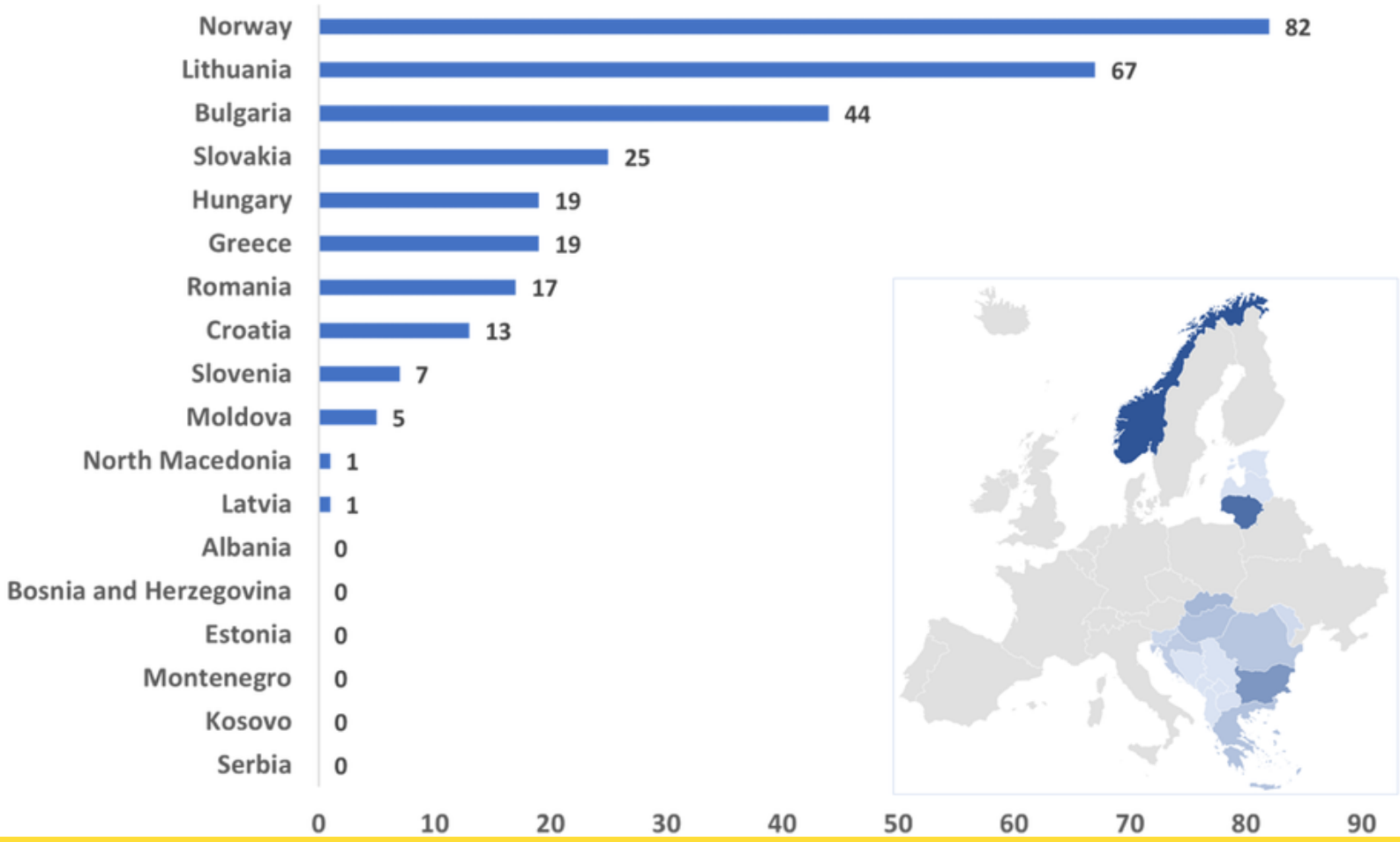


Figure 7. Number of new records in the countries that the DRE campaign was focused on, from mid-July till early-November 2022. Color gradient on the map refers to the number of new barrier records, where darker shades indicate larger numbers

Following these considerations, "low-hanging fruit" can be identified, meaning barriers that no longer serve any purpose and whose removal is cost-efficient, will result in a significant gain in longitudinal continuity, and won't cause any detrimental impacts on fluvial habitats. Many methods exist to predict the outcome of barrier removal and to prioritize such actions (Jumani et al. 2020; Garcia de Leaniz and O'Hanley 2022).

In the present report, a number of "low-hanging fruit" was identified for the sole purpose of showcasing the usefulness of the AMBER Barrier Tracker app and that it can be utilized **as a tool in prioritizing barrier removal or mitigation projects**. All these barriers are just indicative of the kind of structures that have been reported through the AMBER Barrier Tracker app and might have the potential to be prioritized for removal.

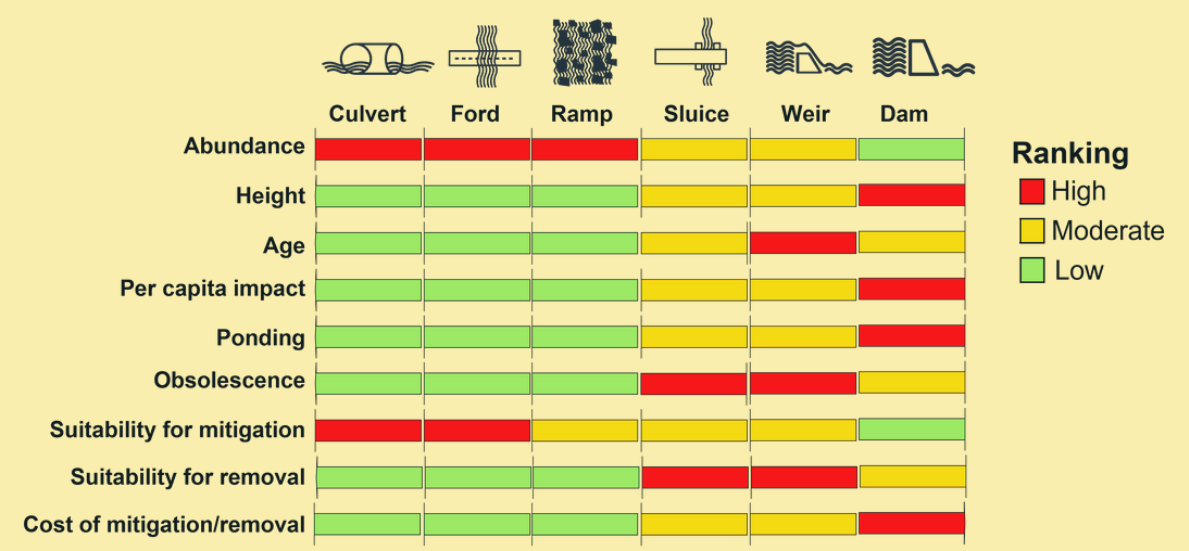


Figure 8. Features of different river barrier types (Garcia de Leaniz and O'Hanley 2022; presented with permission from the authors)

The latter assumption has been made based solely on the criteria used for the purposes of this report. **No information on ownership, legal status, usage or whether the stream (the barrier is situated) is an ephemeral water body is available through the AMBER Barrier Tracker app and thus was not taken into consideration. The barriers presented herein are classified in the following categories:**

1. **Barriers that are closest to a river mouth that runs into the sea, a lake or another river and that their removal would reconnect a substantial river stretch**
2. **Barriers that seem easy and/or cost-efficient to be removed, considering their type, location, access, flow conditions and obsolescence**
3. **Barriers right at the confluence of rivers or between lakes**
4. **Consecutive barriers that their removal could open several km**

Such barriers were initially identified in the AMBER Barrier Tracker map and database for several European countries. Then, Google maps and Google Earth Pro along with its Historical Imagery feature were used to access years of satellite imagery of these selected barriers to assess the presence of other barriers upstream or downstream and to measure the distance between features (e.g., between two barriers or between the river mouth and a barrier). Only cases where satellite images of good quality and clearness (i.e., river corridors were not covered by riparian vegetation) are available were assessed. However, even in such cases, low structures and structures below bridges may have remained undetected since they are not always visible through satellite images. Subsequently, the possibility the selected barriers had already been removed was excluded by searching into the DRE database.

For a complete overview of the barriers see Appendix 1 (p14-15).

TRACKED BARRIERS

IRELAND

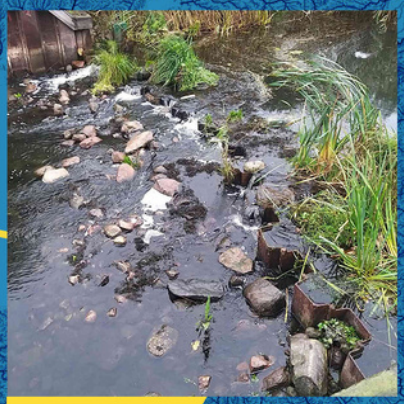
WALES

DENMARK

ITALY

FINLAND

ESTONIA



POLAND

GREECE

CONCLUSIONS

The current report aimed to demonstrate the kind of information recorded through the AMBER Barrier Tracker app and its value and a possible way to exploit it by identifying some barriers across Europe which might potentially be prioritized for removal. Most of the selected barriers are weirs (78%) as these have a high probability of being old and/or obsolete and can be removed in a cost-efficient way (Fig. 8; Garcia de Leaniz and O'Hanley 2022). Weirs are also quite abundant, and people can easily spot them and identify them as river barriers, in comparison with other types of barriers, like fords, ramps or culverts. In addition, weirs are more likely to be visible through Google Maps and Google Earth satellite images, which was the method used for the purposes of this report. Moreover, all the river barriers presented here are low head structures (≤2 m high). Such small structures are the most abundant river barriers across Europe, and their removal is easier and cheaper than the removal of larger structures, whose removal might face more opposition from local communities and stakeholders (Belletti et al. 2020).

This report also aimed to evaluate the performance of the app since its first launch. AMBER Barrier Tracker app is already popular, with more than 2800 registered users who have already recorded more than 10500 river barriers fragmenting rivers and streams in 40 European countries. The popularity of the app is growing constantly, but promotional efforts have been proven valuable. Specifically, the DRE campaign during the summer of 2022 significantly contributed to the registration of ~250 new users and the recording of ~600 new barriers in only a few months.

RECOMMENDATIONS

The AMBER Barrier Tracker app has proven useful for mapping river barriers and assessing the magnitude of longitudinal fragmentation in rivers and streams.

To take advantage of this data, DRE suggests:

- **the cross-check of the app database with national inventories of riverine barriers to improve their accuracy**
- **the utilization of the app database as a steppingstone in creating a national inventory of barriers for those countries that lack one**

However, for the app to be truly exploited in a meaningful way and to be utilized in making educated and well-informed river management decisions it is imperative to include additional information (e.g., ownership, legal status, usage) of each barrier. Such information could be provided by regional/national water authorities, and thus the managers of the app should try to reach out to them.

NEXT STEPS

Dam Removal Europe (DRE) aims to create the most accurate database of removed barriers and upcoming removals in Europe to evaluate the advancement in the implementation of European Union policies and to analyze the progress of this river restoration measure in each country. In that respect, an online survey is available on the DRE website that will enable the fast registration of barrier removals executed in 2022 and will ensure the accuracy of the submitted data. In parallel, DRE supports barrier mapping efforts through promoting relative tools, like the AMBER Barrier Tracker app. Thus, DRE will continue to evaluate all records provided through the app, will launch another promotional campaign in spring 2023 and will publish the next Barrier Tracker Report in the following year aiming to assist in the prioritization of upcoming barrier removal projects.

Barrier removal is a cost-efficient and highly effective river restoration tool and DRE's goal is to establish it as a common practice throughout Europe in the next few years. DRE will continue monitoring and reporting the trends in barrier removal and will keep providing guidance and assistance to river restoration practitioners, with the ultimate goal to mainstream barrier removal in all European countries. Additional information on unique barrier removal cases, upcoming projects, seminars, webinars, and relative news is provided on the DRE website, DRE social media accounts and by the DRE Newsletters (subscription available through the DRE website)

Ackowledgements

Dam Removal Europe coalition and World Fish Migration Foundation wish to express their gratitude to everyone who provided valuable information/data/photos on river barriers and to Swansea University, European Anglers Alliance, and everyone else that contributed to the promotion of the AMBER Barrier Tracker app.

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APPENDIX 1

1) Barriers that are closest to a river mouth that runs into the sea, a lake or another river and that their removal would reconnect a substantial river stretch

CYPRUS:
Type: culvert. Height: 1-2 m. Location: Koskinas River that runs into the Mediterranean Sea, western Cyprus, ~30 m from river mouth. Next barrier: culvert, ~420 m upstream

DENMARK:
Type: sluice. Location: Hoptrup Bæk River that runs into Diernæs Bugt Bay, south-eastern Denmark, ~160 m from river mouth. Next barrier: none till Slib Lake (~2.3 km upstream)

FINLAND:
Type: weir. Height: 0.5-1 m. Location: Tervajoki River that runs into Lake Lehesjärvi, south-central Finland, ~760 km from river mouth. Next barrier: >450 m upstream

GERMANY:
Type: sluice. Height: 1-2 m. Location: Haberniser Au River that runs into Flensborg Fjord, north-central Germany, ~78 m from river mouth. Next barrier: ~1.3 km upstream

GREECE:
Type: weir. Height: 1-2 m. Location: Alfeios River that runs into Gulf of Kyparissia, south-western Greece, ~4.7 km from river mouth. Next barrier: ~3 km upstream
Type: weir. Height: <0.5 m. Location: Melissourgos River that runs into Volvi Lake, northern Greece, ~3 km from river mouth. Next barrier: ~3.5 km upstream

ITALY:
Type: weir. Height: 1-2 m. Location: Piave River that runs into the Adriatic Sea, north-eastern Italy, ~40 km from river mouth. Next barrier: ramp, ~22 km upstream
Type: weir. Height: 1-2 m. Location: Tagliamento River that runs into the Adriatic Sea, north-eastern Italy, ~34 km from river mouth. Next barrier: ~61 km upstream

KOSOVO:
Type: weir. Height: 1-2 m. Location: Drenica River, a tributary of Sitnica River, central Kosovo, ~4.5 km from river mouth. Next barrier: ~1 km upstream

NORTHERN IRELAND:
Type: weir. Height: 0.5-1 m. Location: Roe River that runs into North Atlantic Ocean, ~12 km from river mouth. Next barrier: ~1.6 km upstream

POLAND:
Type: weir. Height: 0.5-1 m. Location: Potok Oliwski River that runs into the Gulf of Gdansk, north-central Poland, ~393 m from river mouth, right at the outlet of Jelitkowo Lake
Type: weir. Height: 0.5-1 m. Location: Putilovka River that runs into Jezioro Oświn Lake, north-eastern Poland, ~1 km from river mouth. Next barrier: ~330 m upstream

SLOVENIA:
Type: weir. Height: 1-2 m. Location: Mostnica River that runs into Sava Bohinjka River, right before the latter enters Bohinj Lake, north-western Slovenia, ~1.4 km from river mouth. Next barrier: ~780 m upstream

WALES:
Type: weir. Height: 0.5-1 m. Location: Artro River that runs into Cardigan Bay, north-western Wales,~2.9 km from river mouth. Next barrier: ~150 m upstream

2) Barriers that seem easy and/or cost-efficient to be removed, considering their type, location, access, flow conditions and obsolescence

ALBANIA:
Type: weir. Height: 1-2 m. Location: tributary of Osum River, central Albania
Type: weir. Height: 0.5-1 m. Location: south-eastern Albania

DENMARK:
Type: unclassified. Height: <0.5 m. Location: Thors Møllebæk River, east-central Denmark
Type: weir. Height: 0.5-1 m. Location: east-central Denmark

ESTONIA:
Type: ramp. Height: 0.5-1 m. Location: Nurtu jõgi River, central Estonia
Type: weir. Height: <0.5 m. Location: Munalaskme oja River, north-western Estonia
Type: ramp. Height: <0.5 m. Location: Munalaskme oja River, north-western Estonia

FINLAND:
Type: weir. Height: 0.5-1 m. Location: Mätäoja River, south-central Finland
Type: dam. Height: 0.5-1 m. Location: south-central Finland
Type: weir. Height: 0.5-1 m. Location: south-central Finland

IRELAND:
Type: weir. Height: <0.5 m. Location: tributary of Currane River, east-southern Ireland

ITALY:
Type: ramp. Height: <0.5 m. Location: north-western Italy
Type: weir. Height: <0.5 m. Location: north-western Italy
Type: weir. Height: 0.5-1 m. Location: north-western Italy

SWITZERLAND:
Type: weir. Height: 0.5-1 m. Location: tributary of Riale Seseglio River, south-central Switzerland

3) Barriers right at the confluence of rivers or between lakes

FINLAND:
Type: weir. Height: <0.5 m. Location: right at the Kelujoki River mouth, at the outlet of Kelujärvi Lake in north-central Finland
Type: weir. Height: 1-2 m. Location: only barrier between Ala-Rieveli Lake and Keskinen Lake in south-central Finland

IRELAND:
Type: weir. Location: Abhainn Bhoth Loiscthe River that runs into Galway Bay in west-central Ireland

SCOTLAND:
Type: weir. Height: 1-2 m. Location: right downstream the confluence of Loth Burn and Sletdale Burn in north-eastern Scotland

4) Consecutive barriers that their removal could open several km

ITALY:
Type: weirs. Height: 1-2 m. Location: Three weirs in a 930-m stretch of Canale Cormor that runs into the Marano Lagoon in north-eastern Italy. These are the first barriers from river mouth (~6 km). Their removal would open ~3.6 km upstream

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World Fish Migration Foundation is the coordinator of the Dam Removal Europe coalition, working together with other international NGOs to restore rivers in Europe that have high natural or cultural importance by removing obsolete barriers and ensure healthy free-flowing rivers.

Dutch Postcode Lottery & ForestPeace Foundation

World Fish Migration Foundation is proudly supported by the Dutch Postcode Lottery and ForestPeace Foundation to enable and scale up dam removal as a viable tool for river managers in Europe. Interested in becoming a donor too and help to restore free-flowing rivers in Europe? Send an email to:
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Resources and tools

For more information about Barrier Tracker app and the AMBER project:
https://portal.amber.international/

For more information about dam removal showcases, events, tools and resources, visit:
www.damremoval.eu

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