

LAYMAN'S REPORT

Deliverable 33: TRivers. A life+ programme on Temporary Rivers

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Implementing the Water Framework Directive in temporary rivers: tools for the assessment of their ecological status
LIFE13 ENV/ES/000341



The project partners were formed by two research institutions – Universitat de Barcelona (UB) and Consejo Superior de Investigaciones Científicas (CSIC) – and two river basin authorities from the Mediterranean region – Agència Catalana de l'Aigua (ACA) and Confederación Hidrográfica del Júcar (CHJ)

Project partners:

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Deliverable 33: TRivers. A life+ programme on Temporary Rivers (Layman's report)

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The different hydrological conditions of a temporary river from flowing (eurheic state) to the complete absence of surface and subsurface water (hyporheic state).

1. Temporary Rivers and the project LIFE+ TRivers

Temporary rivers are waterways that stop flowing on a regular basis or even completely dry up. Many streams in the Mediterranean Basin naturally dry up in the summer and are refilled after autumn storms, but they may remain dry for several years due to the variability in flow intensity from year to year.

Temporary rivers are ecologically unique, they support key ecosystem functions and processes and are extremely important in terms of biodiversity. At the same time they suffer from a wide range of human-induced impacts, including alterations in the natural flow regime, modifications to riverbanks and channels, excess nutrients and invasive species. Climate change predictions indicate that the Mediterranean region will face severe streamflow deficits, increasing the vulnerability of temporary rivers and causing permanent ones to become temporary.

Although temporary rivers are very common in many regions of the world, there has been a general failure to understand, protect and manage this type of freshwater ecosystem. In Europe, the implementation of the Water Framework Directive has been unable to provide a solution to determine the ecological status of temporary waters. One of the main reasons for this is that assessment tools using biological indicators have been developed primarily for perennial streams and, therefore, are inadequate for rivers with complex hydrological regimes such as temporary rivers.

The LIFE Trivers project provided European river basin authorities and relevant stakeholders with an operationally tested software tool (**TREHS, Temporary Rivers' Ecological and Hydrological Status**) which is designed to adequately implement the Water Framework Directive in this type of water bodies. Based on a predictive model of the evolution of a river's characteristics over time, the tool is expected to help managers select appropriate sampling dates and use the correct methods to determine ecological status. The results will contribute significantly to improving the management of temporary rivers and to increasing their recognition in society and in policies related to water and biodiversity.
Specifically, the **objectives** of the project were the following:

- To develop a management tool for assessing the Hydrological and Ecological Status of temporary water bodies.
- To determine the ecological status and the role played by the flow regime of a set of 25 water bodies selected together with the River Basin Authorities.
- To identify the main pressures and impacts in temporary rivers and conduct a participation process to obtain a programme of measures.
- To produce an application for Smart phones and Tablets for engaging citizens in the public participation and in the diagnosis of temporary rivers.
- Raise awareness on the importance of temporary rivers.

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2. The TREHS Software: Temporary Rivers Ecological and Hydrological Status









In Europe, implementation of the EU Water Framework Directive (WFD) has not yet provided a solution for establishing the ecological status of temporary rivers because the river typology is still unclear to water managers and remains a matter of controversy for some researchers.

TREHS (Temporary Rivers Ecological and Hydrological Status) is a software programme to help river basin managers implement the WFD in temporary rivers. The fundamental assumption underlying TREHS is that the hydrological features of temporary rivers relevant for aquatic life are not flow rates (hydrographs) but rather the temporal patterns of occurrence of aquatic mesohabitats. This includes the occurrence of pools of stagnant water, which are not identified in hydrographs.

TREHS employs alternative methods for river regime monitoring as well as different metrics and classifications to characterise river regimes, facilitating selection of sampling dates and enabling comparison with the natural regime in order to assess the degree of hydrologic impairment (hydrological status).

The main instrument used in TREHS is the monitoring station in a water body, as defined by the WFD. Several different stations can be created in the same water body in order to measure diverse stream regimes, and this is especially recommended for temporary rivers due to their spatial regime variability.

TREHS is intended to help managers monitor and understand temporary river regimes, select appropriate sampling dates and use suitable methods to determine hydrological and ecological status. Both results will contribute significantly to improving the management of temporary rivers, raise social awareness of their importance and increase their inclusion in policies related to water and biodiversity.

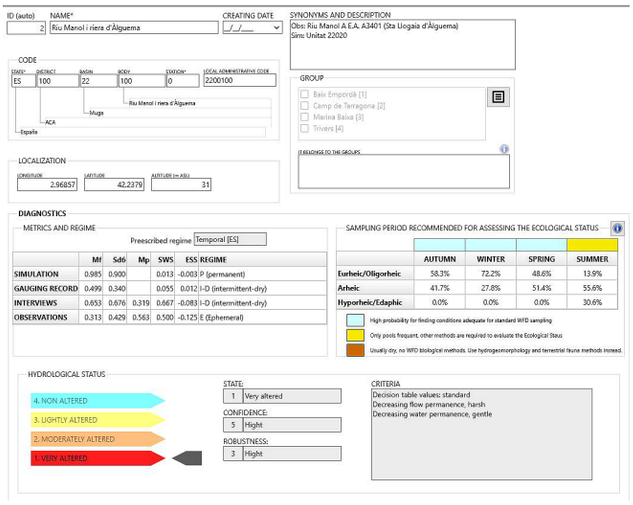
Hydrological regime and status

To characterise the **hydrological regime** and assess the **hydrological status** (i.e. degree of hydrological alteration) of rivers, TREHS allows the use of several information sources. The present regime may be determined using historical data on river flows, interviews with residents or observations obtained from in situ inspections or from aerial or terrestrial photographs. The reference (or natural) regime can be obtained from flow simulations obtained with any rainfall-runoff model, historical flow data obtained before the hydrological alteration, or any other source. For each station, TREHS determines six metrics for each entered data source, classifies and plots the corresponding regimes and analyses the differences between the present and reference regimes to assess the degree of hydrologic alteration or hydrological status (i.e. if the hydrological regime is natural or has been modified by human action).

Hydrological status

The degree of hydrologic alteration is shown in four severity levels, together with the confidence level (i.e. significance of the differences in relation to their standard deviations) and robustness (i.e. number of types of information used) of the assessment. The criteria used to assess status are also shown in order to help managers define the remedial measures to be taken. A free space is provided for users to add known pressures and other comments.

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Screenshot of the hydrological status summary



The Matarraña River in Nonaspe has an altered hydrological status. In this case, flow intermittence is a result of water uses.





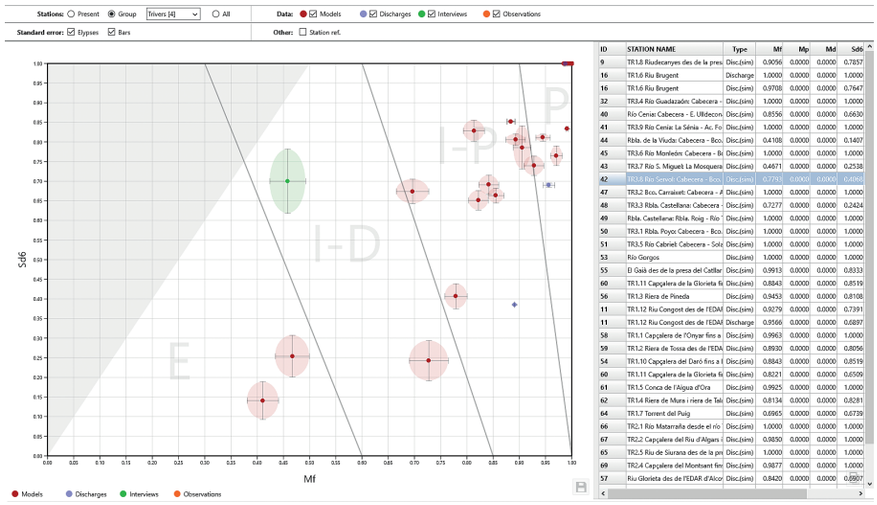
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Metrics and graphs obtained with TREHS

The Temporary Regime Plot (TRP)

The TRP was designed to compare the two main metrics on the flow occurrence obtained for different rivers: flow permanence (*Mf*) and seasonal predictability (*Sd6*). The four sectors represent the temporary aquatic regime types: Perennial (P), Intermittent-pools (I-P), Intermittent-dry (I-P) and Ephemeral (E).

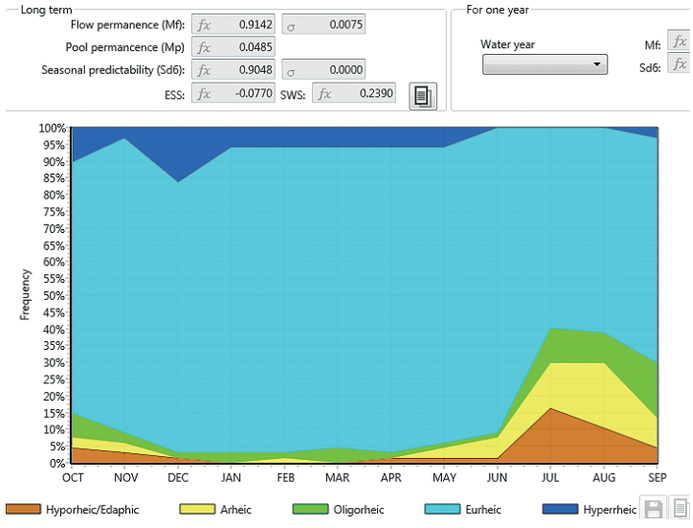
Screenshot of the TRP plot



Aquatic States Frequency Graph (ASFG)

The ASFG summarises the relative frequency of the wetter aquatic states throughout the year, using a monthly scale when employing flow records or simulations, or a seasonal scale when showing the three aquatic phases obtained from interviews or observations. The purpose of this graph is to show the relative frequency of the different states or phases throughout the year and the degree of seasonality of the regime, at a glance. It also provides an initial indication of the best station sampling dates. However, it does not provide a quantitative assessment of a river regime for comparison between rivers or reaches.

Screenshot of the Aquatic States Frequency Graph window by month. The lower colour bands indicate the occurrence of aquatic states in the water year selected.



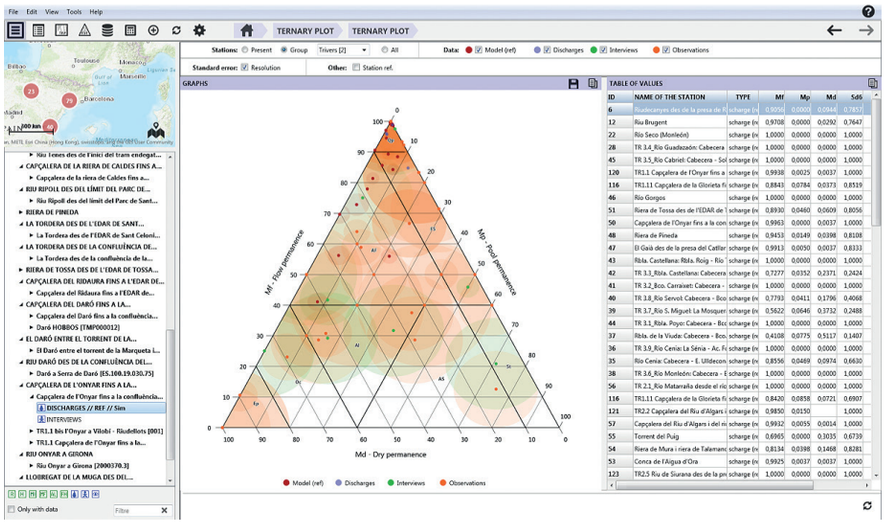
The Flow-Pools-Dry (FPD) triangular plot and classification

The FPD plot shows the permanence of the three aquatic phases in a single plot. As these phases are complementary, the plot takes the form of a triangle. Each of the three axes forms one of the altitudes of the triangle, but the corresponding scales are shown at the sides for ease of reading. The vertical axis (on the left) represents flow permanence (Mf), with the percentage of Mf increasing from the base of the triangle to the top. The axis on the right represents pool permanence (Mp), increasing from the left side to the bottom right vertex. Finally, the axis at the bottom represents dry channel permanence (Md).

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Ecological status

The Water Framework Directive (WFD, European Commission, 2000) requires assessment of the ecological status of a river by means of groups of aquatic organisms, namely biological quality elements (e.g. macroinvertebrates, algae, and fish). In addition, it establishes that ecological status assessment must also include information on the hydromorphological alterations that support these biological elements. Consequently, ecological status in TREHS includes both hydromorphological and biological quality. In order to determine hydromorphological quality, indices can be entered in TREHS, such as the riparian quality index (QBR) and the fluvial habitat index (IHF). Biological quality can also be determined using macroinvertebrate, fish, diatom and macrophyte indices.



Screenshot of the triangular FPD plot showing the complementary frequencies of the three main aquatic phases in %: flow (Mf), isolated pools (Mp) and dry stream bed (Md). Mf frequencies increase from the bottom to the top, Mp frequencies increase from the Mf axis to the right vertex and Md frequencies increase from the Mp axis to the left vertex.



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3. RiuNet:

an app for assessing the hydrological status and ecological quality of a river

Download on the App Store

ANDROID APP ON Google play

A simplified version of TREHS was developed with the aim to involve citizens in the evaluation of the hydrological and ecological status. Using a simplified and interactive approach, this app allows for the aquatic phase surveillance of the river, the classification of the hydrological regime of a river, the assessment of hydrological status, and the evaluation of its hydromorphological and biological quality.

The innovative part of the app is the incorporation of hydrological features such as the aquatic phase at the time of sampling, the hydrological regime and the hydrological status.
The aquatic phase is a simplified description of the water conditions observed at the time of sampling. This will determine whether a biological assessment of the river can be carried out using RiuNet.



Screenshot of the RiuNet video.

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Flowing water



The water in the river is flowing and aquatic habitats are connected.



Disconnected pools



The water in the river is not flowing, and is present only in disconnected pools.

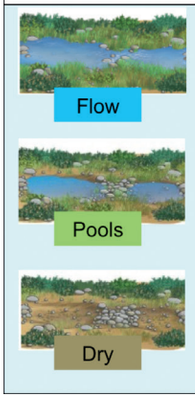


Dry riverbed



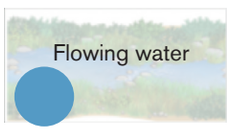
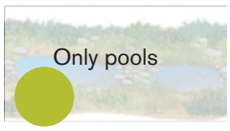
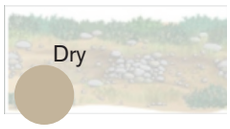
There is no surface water in the river, or it is present only in small amounts (because of recent rains, for example).

The hydrological regime influences riverine biological communities, meaning that the methodologies used by RiuNet to evaluate river ecological status will vary depending on this. RiuNet provides options for selecting the aquatic phases (flow, pools or dry) for each season of the year (spring, summer, autumn, and winter).

Spring	Summer	Autumn	Winter
			

To determine hydrological status, RiuNet asks for information on human activities (infrastructure and water uses), signs of hydrological alterations, and personal impressions on the temporal changes on the hydrological regime. The findings will indicate whether river hydrology is the result of natural elements or human action.

HOW HAS THE RIVER FLOW CHANGED IN THE RECENT YEARS?

BEFORE	NOW		POINTS
		The river flow has not changed significantly, so the options selected are the same	5
		River flow has changed but the difference is small (e.g. where there was mostly *pools* before, now there is constantly *flowing water*)	3
		River flow has changed completely (e.g. where there was *flowing water* previously, now the river is mostly *dry*	0

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RiuNet steps to follow

BEFORE YOU START

01

safety measures

RiuNet equipment

sampling tutorial

Install the APP

www.riunet.net
RiuNet "The Manual"

IN THE RIVER

02

information about the river

localization GPS

Aquatic phase

Hydrological regime

Type of river

If there is water in the river, and if it is flowing or not

When and how often the water is flowing in the river

The location (altitude) and size (small or large) of the river

TESTS

Hydrological status

Set of observations of the human activities affecting the river (infrastructures and water uses)

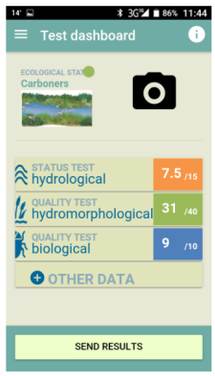
Hydromorphological quality

Set of questions about the riparian vegetation and the surroundings

Biological quality

Identification of invertebrates living in the river, our water quality bioindicators

03



AFTER RESULTS VALIDATION...

your map of the quality of rivers will be thriving!

For the assessment of hydromorphological quality, RiuNet takes into account alterations along the banks of the river due to human activity. As most impacts stem from livestock or the presence of infrastructure (for example, roads, dams, urban areas, etc.), the app looks for evidence of such activities (e.g. livestock, river bank erosion, or infrastructures). Finally, the RiuNet APP uses aquatic macroinvertebrates as bioindicators to assess the biological quality.

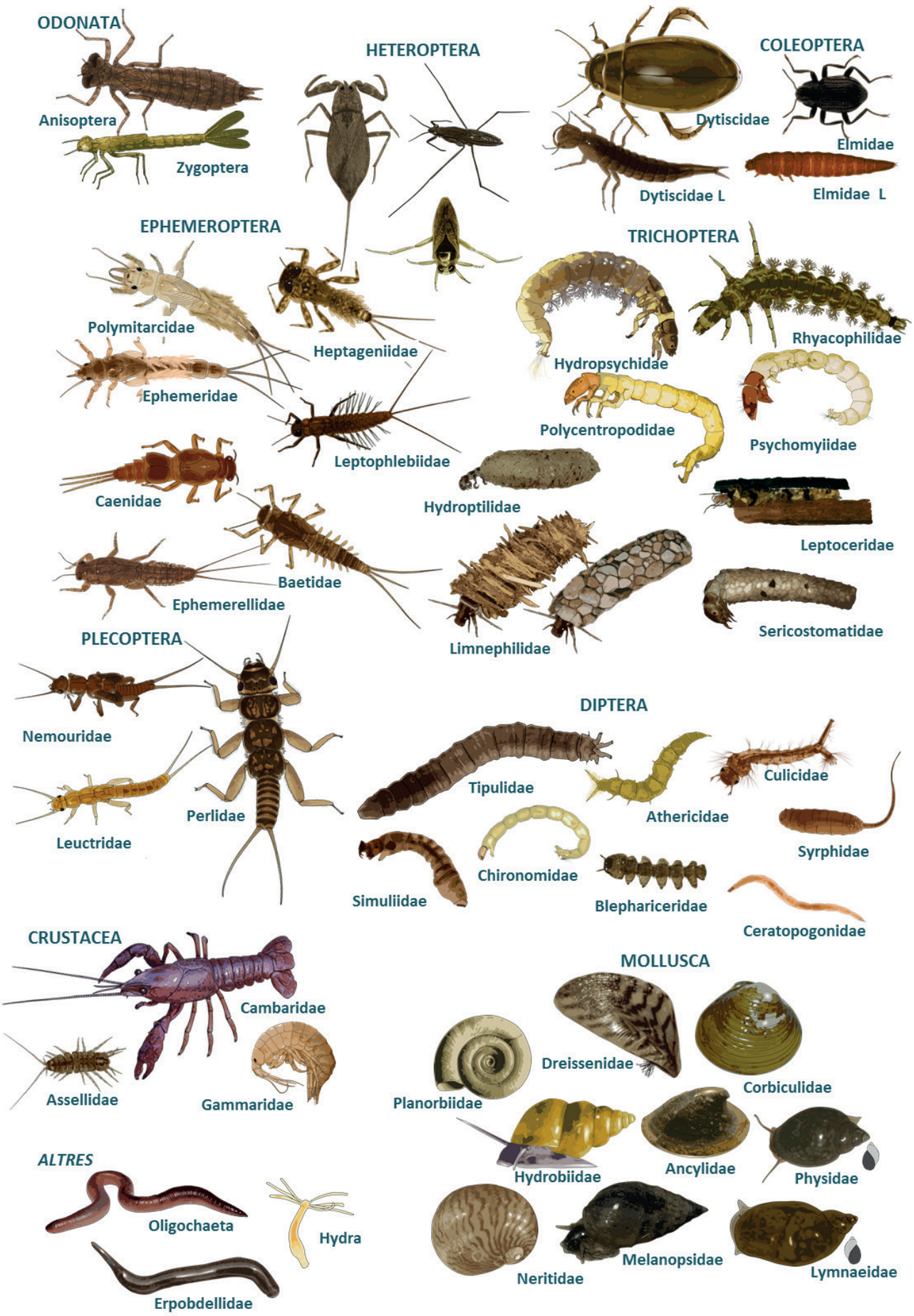
With the combination of new technologies and the phenomenon of citizen science, RiuNet is a pioneer tool to draw attention to the degradation of our rivers and promote scientific engagement and data contribution of the citizens, and improve the level of understanding of river ecosystems with poor social recognition such as temporary rivers.







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Aquatic macroinvertebrate families that are used to assess the biological quality in RiuNet.

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4. Hydrological and ecological monitoring and assessment in pilot sites





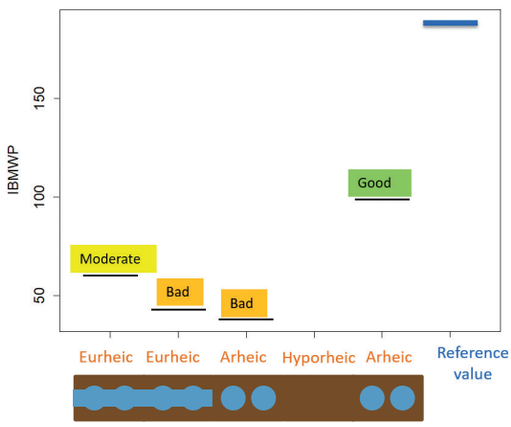


The project monitored 25 pilot sites to assess the effects of flow on biological communities and determine if current methods developed for perennial rivers could be applied. The sampling took place during spring, summer and autumn 2015 across a gradient of flow intermittence and human impacts. The TREHS was used to classify each site as perennial or temporary and to obtain information on the flow regime and the hydrological status. In addition, the hydrological conditions during the study period were obtained from temperature data loggers installed at each site. Results showed that the response to anthropogenic impacts of most of the biomonitoring metrics analysed were different when the river was temporary, suggesting that current methods need to be adapted if applied to temporary rivers.



Monlleó River: Reference site, protected area. Alternate-fluent < 60% flow permanence

Current official Spanish typology: R-T09 Mediterranean calcareous lowland mountains





Example of the Monlleó River, in which traditional biomonitoring metrics do not work.

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5. A new classification of river ecotypes for temporary rivers

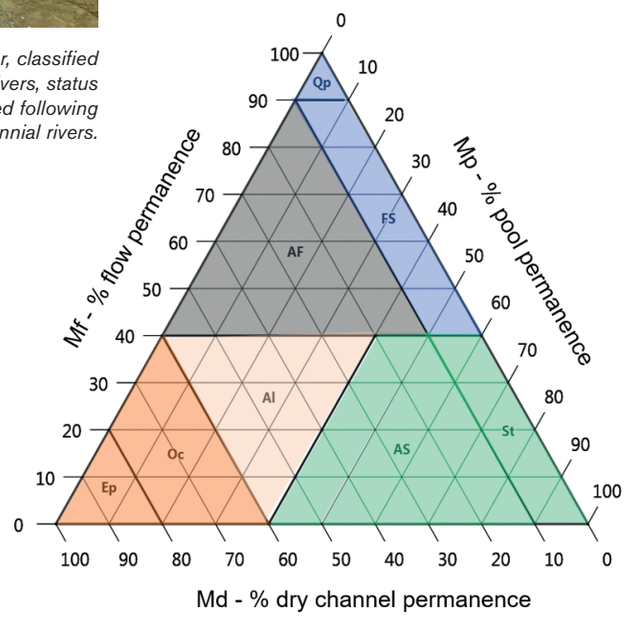


The lower part of the Cérvol River, classified as Occasional (Oc). In these rivers, status assessments will be determined by hydromorphological quality.



The headwaters of the Glorieta River, classified as Quasi-perennial (Qp). In these rivers, status assessments will be determined following protocols for perennial rivers.

The experience of the implementation of the Water Framework Directive (WFD) so far showed that it was necessary to develop a common methodology for the assessment of temporary rivers within the EU. At the end of the project, TRivers developed a methodological approach to establish a status assessment methodology following the WFD and according to the characteristics of the temporary rivers. Based on different types of information and using the TREHS software, this approach analyses the hydrological status and performs a regime classification. If the natural flow regime of a river is perennial but the hydrological status shows that the river regime was altered, the ecological status should be assessed according to methods developed for perennial rivers. If the natural regime is temporary, then the level of flow intermittence is taken into account and TREHS classifies the water body into several three new ecotypes: R- T33, R-T34 and R-T35. Depending on the ecotype, different biomonitoring protocols will be implemented.

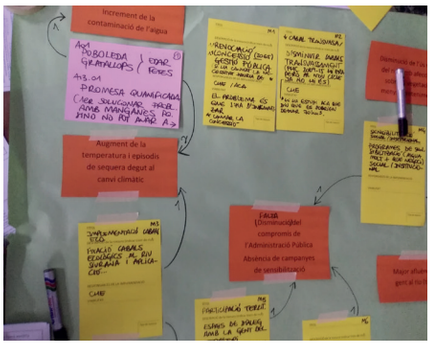


New designation of ecotypes for the adequate assessment of temporary rivers in Spain.

- Quasi-perennial (Qp) and Fluent-Stagnant (FS) rivers. They maintain the ecotype for perennial rivers.
- R-T33. Alternate –Fluent (AF) temporary rivers.
- R- T34. Stagnant temporary rivers. This includes Alternate-stagnant (AS) and stagnant (St).
- R-T35. Occasional (Oc) or episodic (Ep) temporary rivers.
- Alternate (Al) temporary rivers. This type will be included into R- T33, R-T 34 or R-T35 according to expert criteria.

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6. The participation process and the programme of measures



Activities during the participation process: relation between measures and ecosystem services

In addition to the evaluation of ecological status, public participation is also an essential part of the European Water Framework Directive. It contributes to gathering information from the general public and stakeholders on the **management measures** necessary to achieve the objective of good ecological status of water bodies.

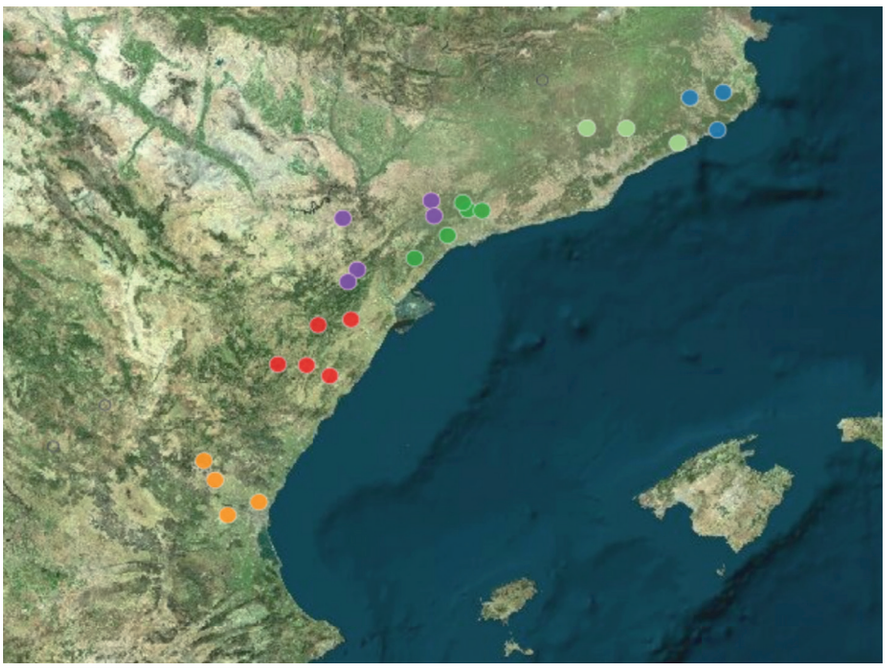
The TRivers participatory process was conducted between June 2017 and May 2018, within **six geographical areas**:

A1) Girona (blue spots)
A2) Barcelona (light green spots)
A3) East Tarragona (dark green)
A4) West Tarragona and East Zaragoza (purple spots)
A5) South Tarragona and Castelló (red spots)
A6) Valencia (orange spots).

Within each area, workshops were held in the most central village, in order to facilitate the participation of stakeholders from the whole region. In total, two workshops were organized: one on the diagnosis on temporary rivers, with visits to river sites for testing RiuNet App, and a second one dedicated to measures. In addition, an online survey was developed as a complement to the participatory process, as some stakeholders that could not attend the meetings were interested in being involved. Feedback from public authorities involved in the project was ontained at the end of the participatory process, arguing the measures that will be included in the planning.



Participation meeting in La Sénia.



Location of the different areas of the participatory process

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The programme of measures

Measures proposed by participants in each area

Management and awareness	
A1	Promote public involvement. Educational programme of Daró river for schools and general public; dissemination of the aquifers status. Developing studies of the river erosion.
A2	No measures were discussed. RiuNet workshop.
A3	Improve effectiveness of management; aids/grants for land management; regulation of the access to temporary rivers; apply penalties to inappropriate parking; developing educational and dissemination programmes. Establish clear guidelines for riverbed conservation. Activate participatory water forums;
A4	Social and institutional awareness campaigns; improve public participation; Promote public management of water.
A5	Public awareness campaigns.
A6	Control and protocols/guidelines for aggregates extraction. Qualitative characterization of rivers. Give more competences (management) to municipalities; Increase institutional coordination; develop social awareness campaigns.

Hydrological issues	
A1	Revision and control of water extractions. Implement saving practices.
A2	No measures were discussed. RiuNet workshop.
A3	Having the Plan for Fluvial Areas. Improve river continuity.
A4	Reduce the quantity of water flow of the river transfer. Implement ecological flows. Revision/suspension of water concessions.
A5	Revision and control of water concessions and extractions. Accomplishment of environmental flows.
A6	Improve the management of rain water. Restoration of riverside vegetation.

Quality issues	
A1	Change the agricultural model. Increase the fees for inappropriate agriculture; Control of dumping/ releases (fertilizers, livestock farms); remove invasive species.
A2	No measures were discussed. RiuNet workshop.
A3	Promote local sanitation; improve the purification system in housing areas; control and reduction of non-native species. Modernization of collectors in Valls municipality. Achieve an integral management of the whole basin.
A4	Not identified.
A5	Control of dumping (individuals, municipalities, etc.); control of invasive species.
A6	Improve purification. More efficient management of invasive species. Impulse of organic farming.

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Measures selected by participants in the online survey (% participants)









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7. Stakeholder meetings

During the project course, five meetings (including the final conference) were organized.

- 1st stakeholder meeting (Valencia, January 2015). This first meeting was hosted by the Júcar River Basin (CHJ). The actions and expected outputs of the TRivers project were presented, introducing the challenge of assessing the ecological status of temporary rivers both from the scientific and stakeholder's perspective. A field visit to the temporary rivers of the Júcar River Basin was organized by CHJ. 22 participants.

- 2nd stakeholder meeting (Murcia, January 2016). The Segura River Basin (CHS) authorities hosted the meeting at their Central Office. The training of the TREHS software was the core activity of this meeting. Preliminary results of the project regarding ecological status measured in temporary rivers with different hydrological regimes and during different aquatic states were presented and discussed. A field visit to the temporary rivers of the Segura River Basin was organized. 25 participants.

- 3rd stakeholder meeting (Zaragoza, January 2017). This meeting was dedicated to the detection of hydrological impacts and hydrological status assessment using TREHS. The main objective was to solve any doubts and gain experience with the software, and collect suggestions to improve it. A field trip was organized visiting different stretches of the Aguas Vivas River in order to observe and discuss very different hydrological impacts. 21 participants.



Field visit at the Cérvol River during the first meeting.

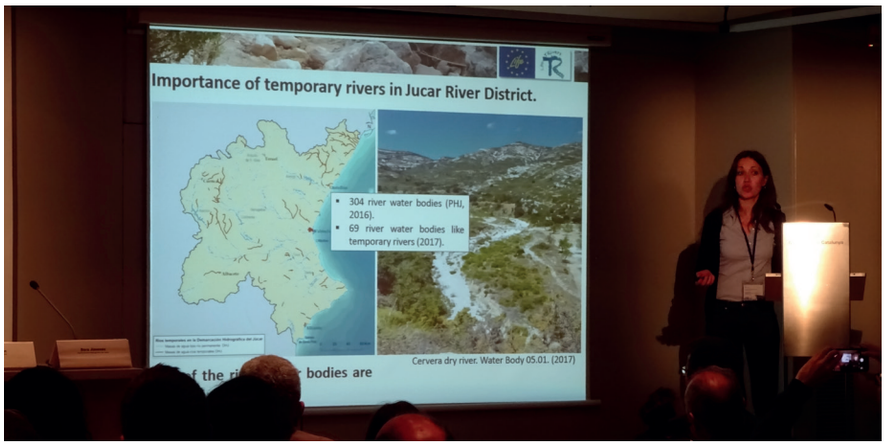


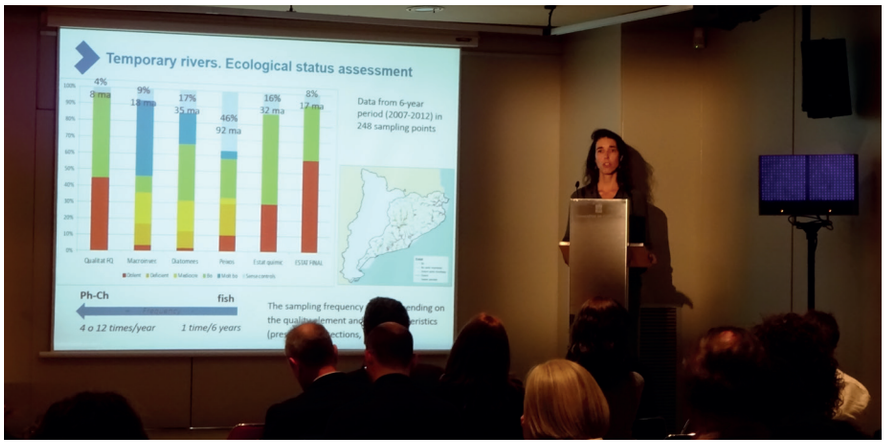
Pictures taken during the fourth meeting.



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Images taken during the final conference of TRivers.







- 4th stakeholder meeting (Barcelona, January 2018). This meeting aimed at showing the importance of public participation processes in water management, and governance, with special attention to temporary rivers and streams. During the meeting, different perspectives within the TRivers project that involve the participation of citizens were presented and discussed, including the use of interviews for the classification of stream regime and their application by stakeholders, as well as citizen science with the new hydrological components of the RiuNet app for smartphones and tablets. 23 participants.

- Final conference (Barcelona, May 2018). The LIFE+ project TRivers organised the final meeting on 3-4 May 2018, held in Palau Robert. The main target of this meeting was to offer the LIFE+ TRivers project outcomes to water managers, scientists and general stakeholders regarding water management in temporary rivers and its ecological status assessment. In this TRivers final meeting, several experts from other countries were invited to explain their experiences on the management of temporary rivers according to the Water Framework Directive. During the second day (May 4th), a training course on the TREHS software was held at the Catalan Water Agency headquarters, with 71 participants.

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8. Dissemination

- VIDEOS

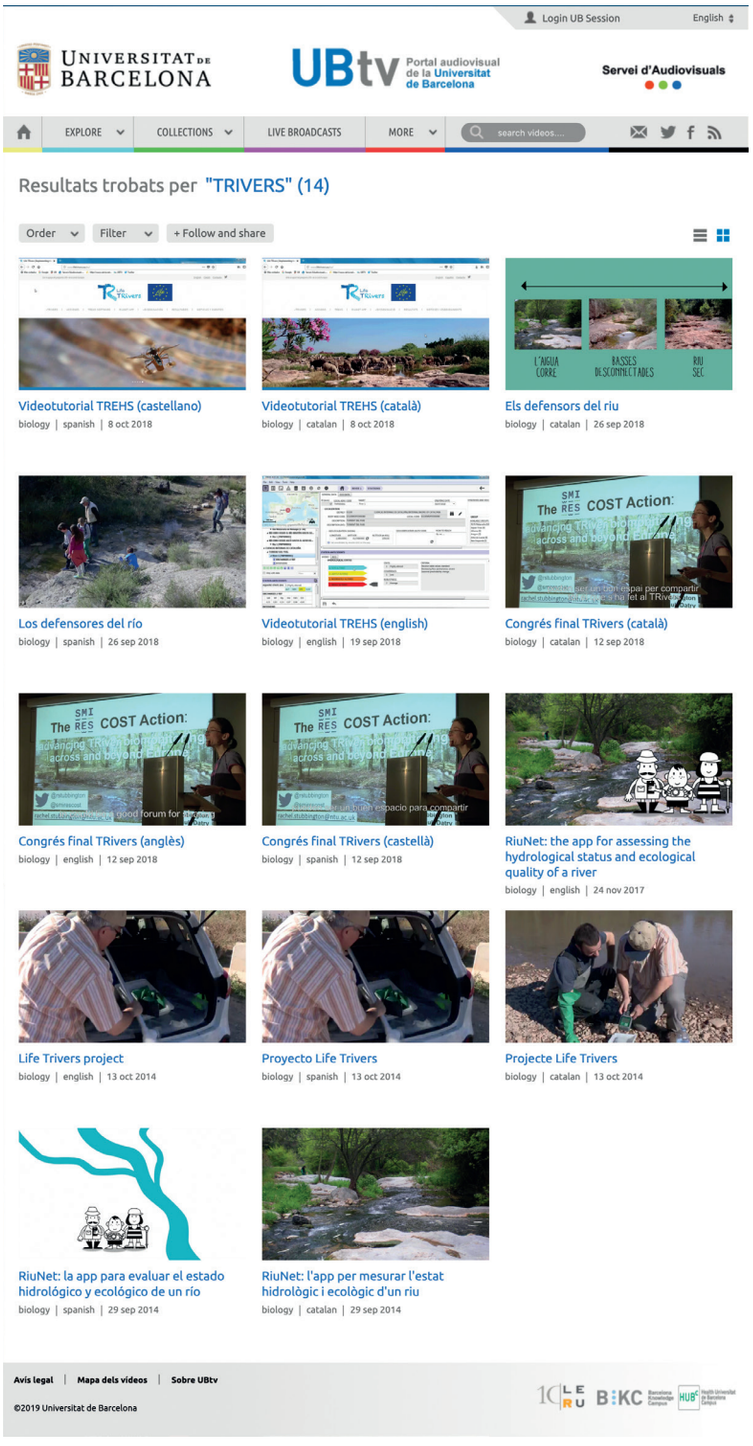
TRivers and temporary Rivers
English
http://www.ub.edu/ubtv/video/life-trivers-project
Spanish
http://www.ub.edu/ubtv/video/proyecto-life-trivers
Catalan
http://www.ub.edu/ubtv/video/projecte-life-trivers

RiuNet app
English
https://youtu.be/S3A77W9nfxk
Spanish
https://youtu.be/VR0N5LglV84
Catalan
https://youtu.be/W_OcVrFlaJk

Tutorial of the TREHS software
English
http://www.ub.edu/ubtv/video/videotutorial-trehs-english
Spanish
http://www.ub.edu/ubtv/video/videotutorial-trehs-catala
Catalan
http://www.ub.edu/ubtv/video/videotutorial-trehs-castellano

RiuNet app for educational purposes.
This was only done in Spanish and Catalan and entitled “Els defensors del riu” and “Los defensores del río”.
Spanish
http://www.ub.edu/ubtv/video/los-defensores-del-rio
Catalan
http://www.ub.edu/ubtv/video/els-defensors-del-riu

Final conference of TRivers
English
http://www.ub.edu/ubtv/video/congres-final-trivers-angles
Spanish
http://www.ub.edu/ubtv/video/congres-final-trivers-castella
Catalan
http://www.ub.edu/ubtv/video/congres-final-trivers-catala



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- LEAFLETS AND INFORMATION BOARDS

2000 leaflets printed and distributed, available in English, Spanish and Catalan

25 information boards

1000 postcards printed



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- 25 YEARS OF THE LIFE PROGRAMME

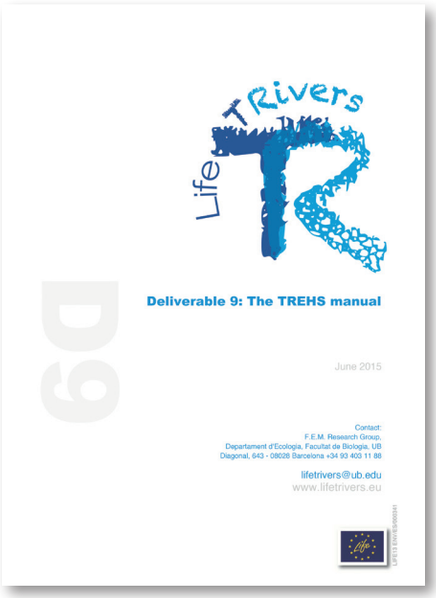


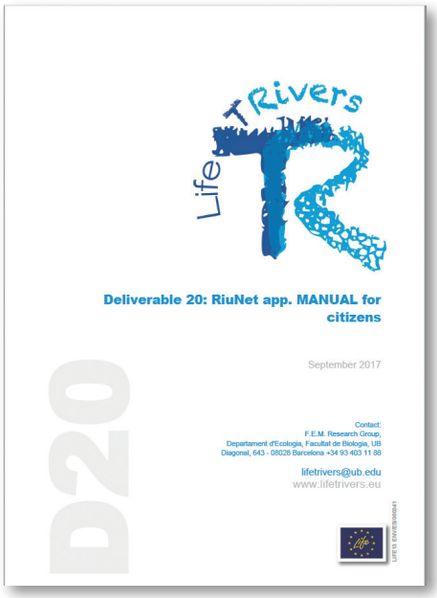


Picture taken during the activities celebrating the 25 years of the LIFE programme at the Open Day of the University of Barcelona.

- TECHNICAL REPORTS

2 manuals available in English, Spanish and Catalan.

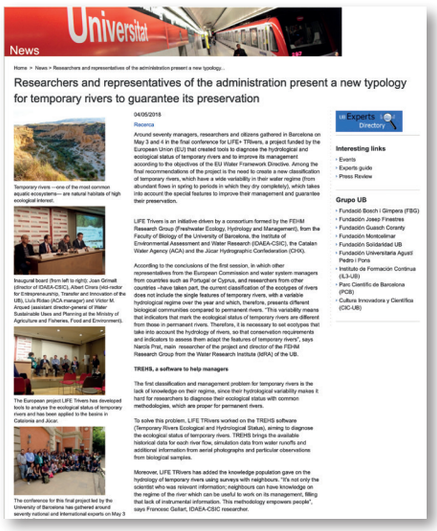




- MEDIA

8 press releases

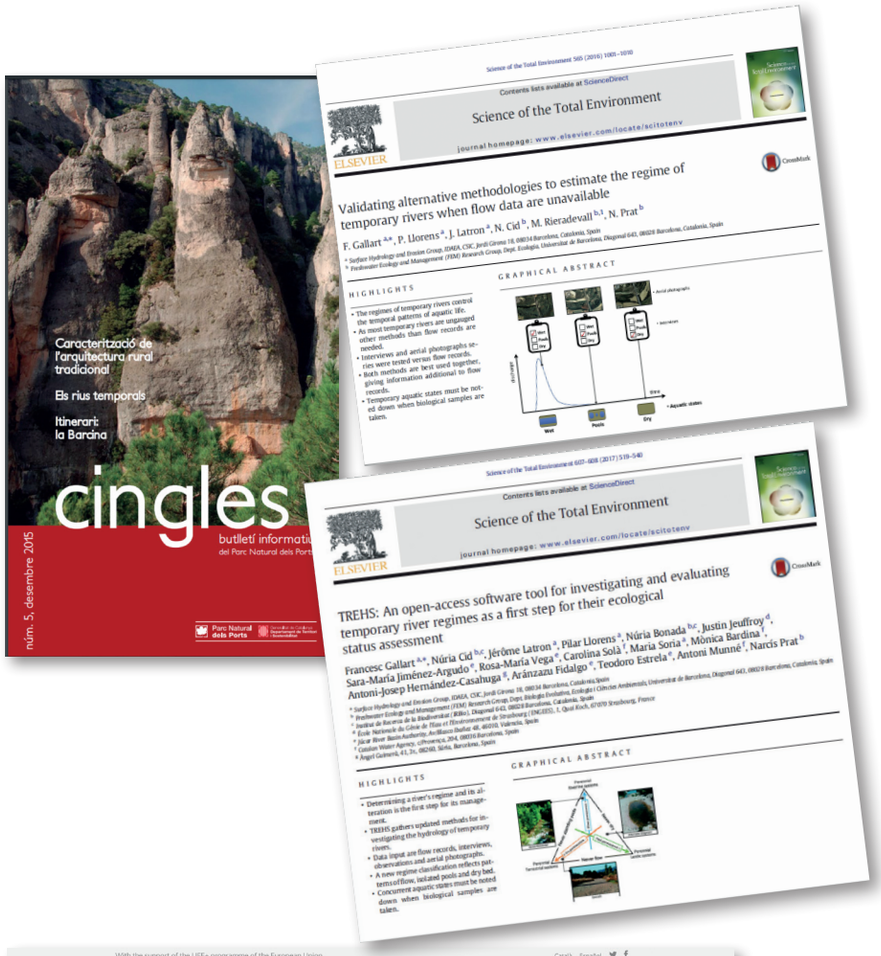




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- PUBLICATIONS

3 dissemination articles
2 articles in scientific journals



- WEBSITE AND SOCIAL NETWORKS

214.202 visits to the website
376 downloads of the TREHS software
518 downloads of the TREHS manual
586 followers on Twitter



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LAYMAN'S
REPORT

Deliverable 33:
TRivers. A life+ programme on Temporary Rivers

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