Deliverable 11: Report of the results of the first year

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Abstract

In this deliverable we present the first results on biological data in the TRivers project under action B2. At this stage, we prioritized in analysing first those results from macroinvertebrate samples corresponding to reference streams, with the objective of reducing variability by a priori classifying temporary rivers into different flow regimes and by analysing community changes at different aquatic states. In the case of fish communities, we prioritized in analysing those data also from reference streams (both perennial and temporary) and also those streams that became temporary due to water abstraction (human-induced temporary streams.

1. Introduction

In this deliverable we present the first results on biological data in the TRivers project. At this stage, we prioritized analysing first those results from **macroinvertebrate** samples corresponding to reference (least-disturbed) streams. The problem of setting reference conditions for temporary rivers has been present at the national (Sánchez-Montoya et al., 2009) and at the EU level in the context of the intercalibration (IC) exercise of the Water Framework Directive (WFD) (Feio et al., 2014; Reyjol et al., 2014) and has been mainly attributed to the high variability of biotic communities in these streams and rivers. According to Gallart et al. (2012) and Prat et al. (2014), if temporary rivers are sampled when all habitats are still connected (Eurheic or Oligorheic aquatic states), current standard methods developed for perennial streams can be applied. Thus, variability could be reduced by classifying temporary rivers (TRs) into different flow regimes and by analysing community characteristics accordingly. These flow regimes are the following: Perennial (P), Intermittent-pools (I-P), Intermittent-dry (I-D) and Ephemeral (E) (see Gallart et al., 2012 for details). However, communities from those streams and rivers with the longest dry period (i.e. I-D and E) may not be able to develop rich communities as least disturbed perennial or near-perennial streams (i.e. I-P). In this context, we hypothesized that some problems may arise in ID streams due to their longer dry periods, since macroinvertebrate communities would be poorer in taxonomic richness and those taxa adapted to flow cessation score low values in many biological assessment indices due to their tolerance to a wide range of environmental conditions.

In the case of **fish** communities, due to the few of information on reference temporary rivers in Spain and the increasing impacts on water abstraction present and predicted in the Mediterranean area (Forzieri et al., 2014), we prioritized in analysing those data from **fish** samples corresponding to reference streams as done for macroinvertebrates (both perennial and temporary) but we also included those streams that became temporary due to water abstraction (human-induced temporary streams). The aim was to determine the effect of the hydrological regime and the different aquatic states in the biological quality using fish as bioindicators, and demonstrate the importance of isolated pools as a refuge during summer. We hypothesized the following: (a) Perennial streams do not have significant variation in abundance and composition of fish communities whereas for temporary rivers density peaks are expected during the arheic aquatic state (i.e. isolated pools) during summer; (b) Natural perennial streams may have a better biological quality than temporary streams when using current methods, with less temporal variation than temporary ones, in which biological quality may be determined by the aquatic state. (b) Hydrologically impacted perennial streams (i.e. human-induced temporary streams) may have a lower water quality than non-impacted ones, both perennial and temporary mainly during the arheic aquatic state (i.e. isolated pools).

In general, we aimed at testing whether current methods can be applied to TRs according to the different hydrological regimes and the influence of the aquatic state of each stream at the moment of sampling for different biological quality elements used in the WFD as bioindicators (i.e. macroinvertebrates, fish, diatoms and macrophytes).

2. Methods

2.1 Selection of sampling sites

Once the stream reaches for the testing and implementation of the TREHS software were selected (see Deliverable 8 "Report on the extension of TRs in the studied basins and the water bodies candidates as pilot sites") a second step in the project involved the selection of sampling sites to assess the ecological status. According to the project description, the selection of the water bodies to be sampled considered the following aspects:

Aspect to be considered	**How we did it**
Represent the diversity of typologies and data availability present in the Mediterranean area	Include intercalibration river types defined in the Mediterranean group (Med-GIG)
River types classification made by TREHS: Permanent Intermittent with pools Intermittent Dry Episodic	Apply the Spanish IPH classification. Apply the TREHS classification. Look for inconsistencies.
Additional characteristics of the water body (e.g. karstic area or not).	Include ecotypes in IPH and used by WA (e.g. *ecotipo 10 Ríos mediterráneos con influencia kárstica*), which are in line with river types for Med-GIG.
Reference stations will be set up using the TREHS. Reference conditions module and these should be defined for each river type.	Take data from WA from which we may obtain the natural flow regime and use it as a pool data for setting reference conditions.

Complementary characteristics to be considered were the following:

- Level of protection. Water bodies located in Natura 2000 were selected in order to establish synergies between the WFD and Habitats Directive and maximize management efforts.
- Conservation value. Water bodies within catchment know to contain threatened species could be included in order to propose effective programme of measures and integrate conservation priorities (Figure 1). This can be related with the previous criteria on Natura 2000.
- Type of pressure (for impacted rivers). This was used to capture different pressures not only in TR's but also to include in our study those perennial ones becoming temporary due to water abstraction (Figure 2).

The result was the selection of a total of 25 sites including different hydrological regimes, ranging from perennial to ephemeral and integrating all the other above- mentioned aspects. Nevertheless, as mentioned in the introduction, in this deliverable we show the first results obtained at the time of writing this deliverable. For macroinvertebrates we show results for 12 **reference streams**, 5 being perennial and 7 temporary. Within the temporary ones, 2 are intermittent-pool (IP) streams, and 3 intermittent-dry (ID). Regarding **fish communities**, we show data from 9 water bodies with different hydrological regimes (perennial, naturally temporary, and human-induced temporary streams) sampled in spring, summer and autumn 2015. Three out of 9 water bodies correspond to perennial streams with no significant human impacts, and 6 are streams with a temporary flow regime. Within the temporary ones, 2 are naturally intermittent-pool (IP) streams, 2 naturally intermittent-dry (ID) streams, and 2 correspond to human-induced temporary streams as a result of hydrological alterations (Figure 3).

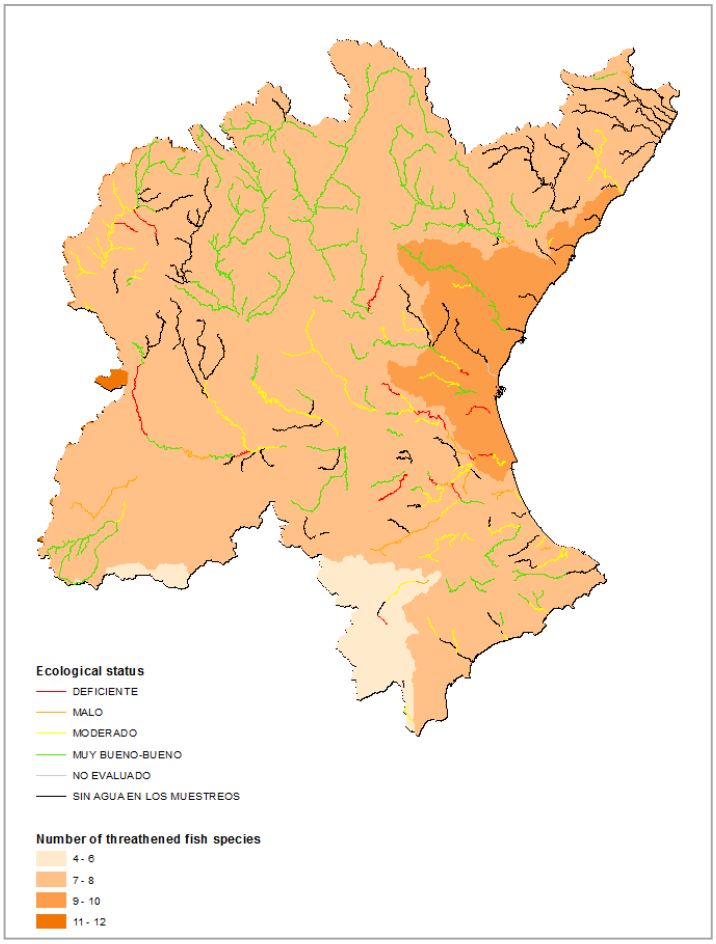


Figure 1. Number of threatened fish species (according to The Red List Categories of IUCN) in the Júcar River Basin and the ecological status of water bodies.

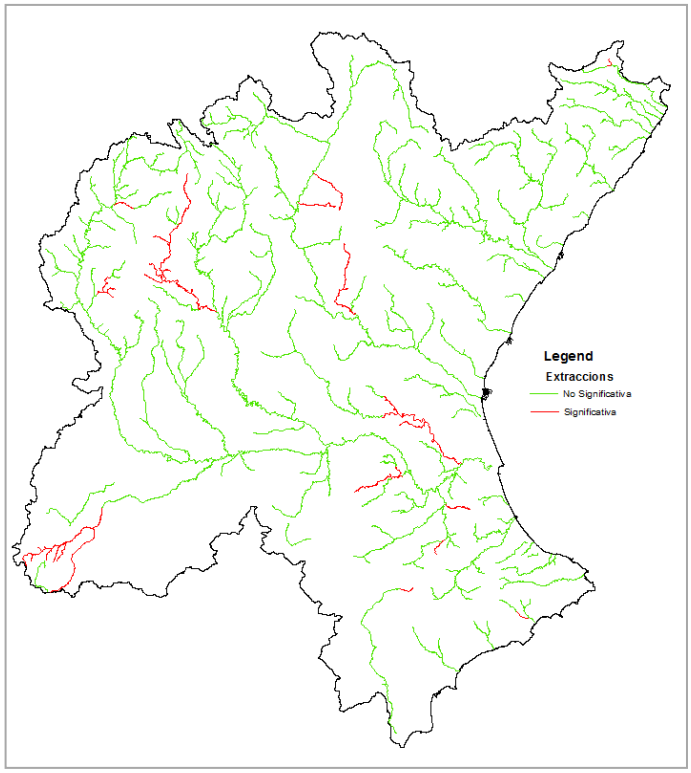


Figure 2. Water bodies in relation to water abstraction in the CHJ.

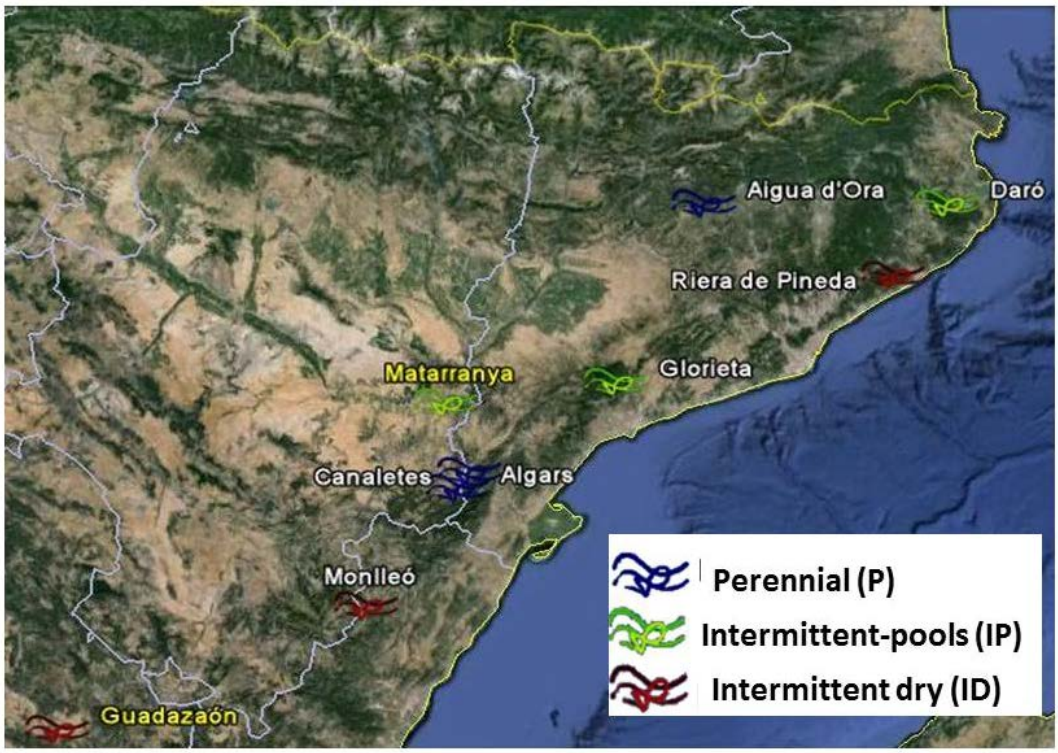


Figure 3. Map with the location of the 9 water bodies, indicating their observed flow regime. In yellow, human-induced temporary rivers.

2.2 Field work and sample processing

Sampling **protocols** used corresponded to the official ones used by the Spanish government. Different biological quality elements (BQE) used in the WFD were sampled, including fish when possible, and macroinvertebrates, and algae. In the field, water temperature, conductivity, dissolved oxygen and pH were taken *in situ*. Water samples for the analysis of nutrients and total organic carbon were filtered in the field for suspension solids analysis and taken to the laboratory to be analysed. Hydromorphological quality assessment was performed using standardized protocols such as QBR index (riparian quality index) that was recently adapted for TR's. In addition, the habitat quality index (IHF) was also calculated in order to record meso- and microhabitat changes in relation to the aquatic states.

For each BQE, the links to the sampling and index calculation standardized protocols are listed below:

- Spanish macroinvertebrate sampling and laboratory protocols
- Protocol for the calculation of the Iberian invertebrate unimetric index IBMWP
- Official river typologies and associated thresholds for quality class boundaries based on macroinvertebrates and diatoms
- Spanish diatom sampling an laboratory protocols
- Protocol for the calculation of the IPS diatoms' index
- Spanish sampling an laboratory protocols for macrophytes
- Protocol for the calculation of the IBMR index for macrophytes
- Spanish fish sampling protocol
- Protocol for the calculation of the IBICAT2b and other indices for fish

For macroinvertebrates, the Iberian Iberian Biological Monitoring Working Party index (IBMWP) was calculated (Alba-Tercedor et al., 2004). Fish-based biological indexes were calculated in relation to the catchment where the water body was located (IBICAT2b i IBIJÚCAR) and a common index for Mediterranean rivers (IBIMED, or alternatively named IBICAT2010). L'IBICAT2b was designed for rivers and streams in the Catalan Internal Basins and is validated also in Ebro Basin (Sostoa et al., 2003, 2010) and was used to assess the biological quality of the water bodies in the Daró,

Matarranya, Glorieta, Algars, Aigua d'Ora and Canaletes Rivers. L'IBIJÚCAR was developed for the Júcar river Basin (Aparicio et al. 2011) and was used to determine the biological quality of the Guadazaón River. Finally, IBIMED was also developed for Catalan rivers with the name of IBICAT2010 (Sostoa et al., 2010) and was posteriorly adapted to all the Spanish river Basins with the name of IBIMED. Biological quality thresholds for each index can be found in Table 1.

Table 1. Thresholds for assigning biological quality using the applied indexes: IBICAT2b, IBIMED i IBIJÚCAR. For IBIMED, values vary for different typologies (T1: coastal streams, T2: mountain streams; T4: lowland Mediterranean streams.

ÍNDEX	Very Good	Good	Moderate	Bad	Very Bad
IBICAT2b	≥4,5	3,5 - 4,5	2,5 – 3,5	1,5 – 2,5	<1,5
IBIJÚCAR	>80	>60 - 80	>40 - 60	20 - 40	<20
IBIMED-EQR T1	>0,966	>0,817	>0,567	>0,231	≤0,231
IBIMED-EQR T2	>0,966	>0,849	>0,732	>0,616	≤0,616
IBIMED-EQR T4	>0,971	>0,851	>0,576	>0,299	≤0,299

In order to capture the different aquatic states in the selected water bodies, field sampling was conducted every six weeks for macroinvertebrates and algae, with a total of 5 sampling campaigns in 2015 and every 12 weeks for fish, with a total of 3 samplings in 2015. Nevertheless, in this first report we only present data on macroinvertebrates, fish and environmental variables taken *in situ* due to time limitation in data processing at the time of writing this deliverable.

3. Results of the first year

3.1 Aquatic states

The different hydrological conditions and aquatic states were assessed at each sampling campaign. We observed that many TRs with abundant flowing water in spring (Eurheic state) progressively dried out, passing through a stage with a succession of pools connected by a tiny river flow (Oligorheic state), disconnected pools (Arheic state) and, finally, until they were completely dry (Hyporheic state) . As shown in the maps (Figure 3), this included natural temporary streams, but also permanent ones affected by water abstraction. Other streams did not dry out and kept disconnected pools all along the summer, and reconnected with the first rains in September.

Some streams that in natural conditions would be temporary (intermittent, seasonal or ephemeral) suffered from "perennialization" mainly due to the effluents from the sewage treatment plants. That is, water flowing continuously where it's not supposed to. These changes alter the natural temporary water regime of the river, and, in most cases, contribute to the impoverishment of biological communities due to pollution.

Ephemeral streams did not have water at any time during our visits and therefore they presented a Hyporheic state during all the sampling period. Flow in these systems is only originated during heavy rains of autumn or spring and therefore it is characterized by pulses, which did not occur during our samplings. None of our streams was sampled under a hyperrheic state. In contrast, permanent streams with no significant hydrological impacts, only the Eurheic and Oligorheic states were observed.

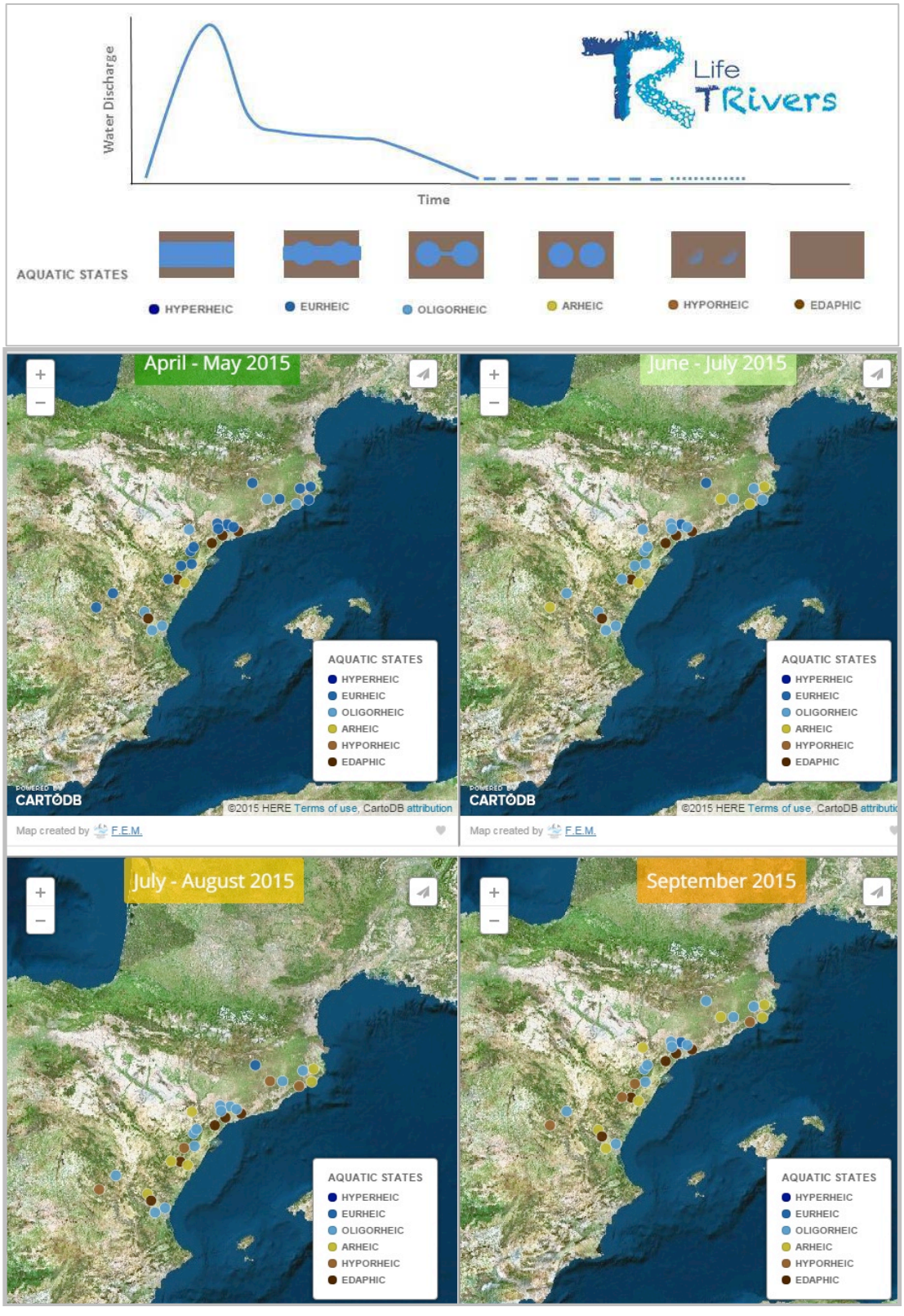


Figure 3. Results on the aquatic states of the first year in all sampling sites. Interactive map available at http://lifetrivers.eu/en/10-english/98-from-flowing-to-dry-conditions-first-results-on-the-aquatic-states

3.2 Macroinvertebrates

Macroinvertebrate results showed that, compared to P streams, both IP and ID streams presented lower values for the IBMWP index (Figure 4), with the lowest values for IDs streams. When analysing the effect of the aquatic state within the different hydrological regimes, we observed that values for I-P reference temporary streams can be compared to P reference streams when habitats are still connected (Eurheic aquatic state) (Figure 5). Therefore, in IP streams current methods can be applied if samples are taken when flow is still present. In these streams, the information on the frequency of different aquatic states (e.g. flowing, isolated pools, dry) occurring throughout the year obtained with the TREHS software facilitates decisions on the application of existing standard methods in this typology of temporary rivers. For ID temporary streams, variability was very high during the Eurheic state and mean values were similar to those in the Arheic state. This complicates the use of current methods in these streams and suggests that a site-based approach could be used. For instance, in some ID streams (e.g. close distance to perennial sources, see Figure 6) if sampled during Eurheic and oligorheic states (connected flow) current methods can be applied. However, other streams show highly variable values, even showing higher values during the arheic state in autumn (Figure 7). In this case, current methods cannot be applied. Finally, the reference values established by the Spanish transposition of the WFD for each typology may underestimate or overestimate the biological quality class. For instance, some ID streams classified as Mediterranean coastal streams under the official Spanish classification, even if they present lower IBMWP values during the arheic state, the reference value is very low and biological quality is always very good (Figure 8). In this case, managers need to be careful in determining if the use of this low reference value is able to distinguish between a reference and an impacted ID temporary site.

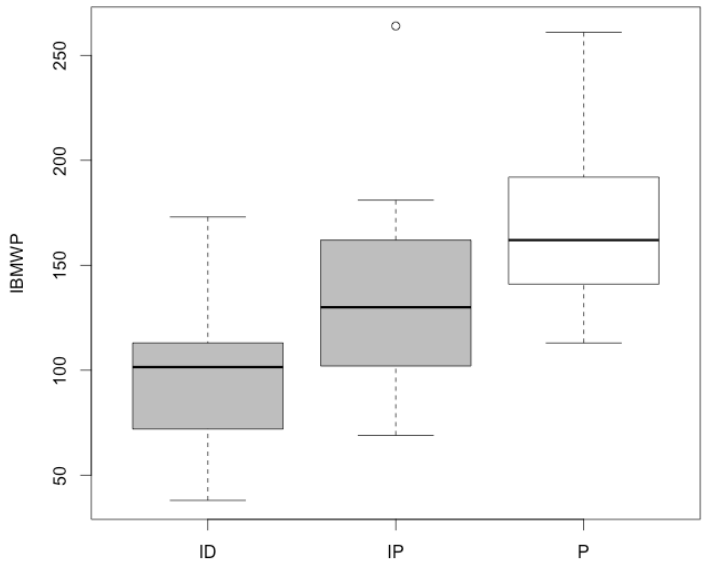


Figure 4. Values for the IBMWP index obtained for the different aquatic regimes. P: perennial; IP: intermittent-pools; ID: intermittent-dry. Temporary rivers are coloured in grey.

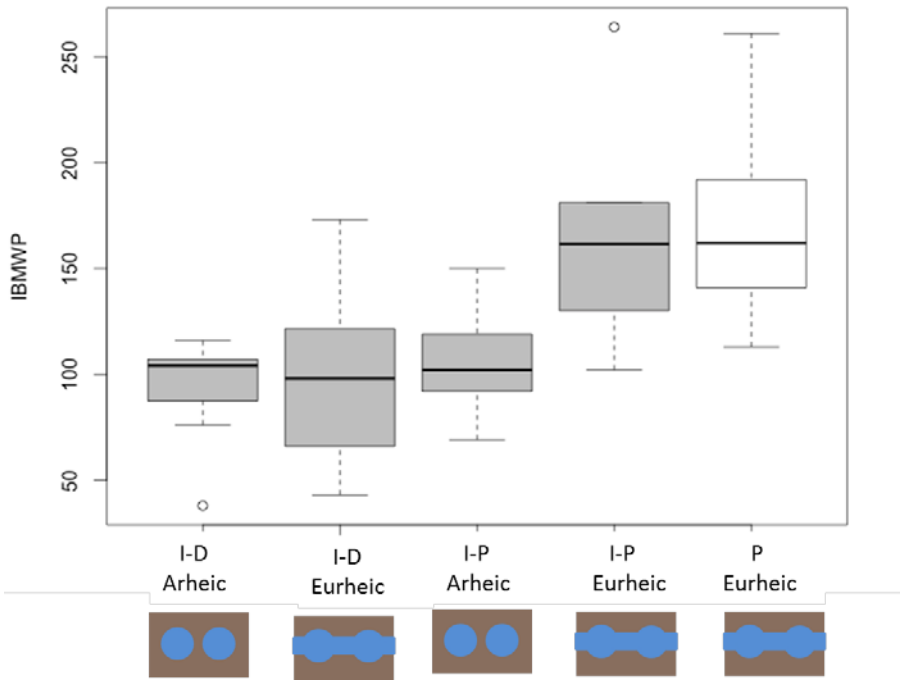


Figure 5. Values for the IBMWP index obtained for the different aquatic regimes and aquatic states (Eurheic, when habitats are connected, and Arheic when only isolated pools are present). P: perennial; IP: intermittent-pools; ID: intermittent-dry. Temporary rivers are coloured in grey.

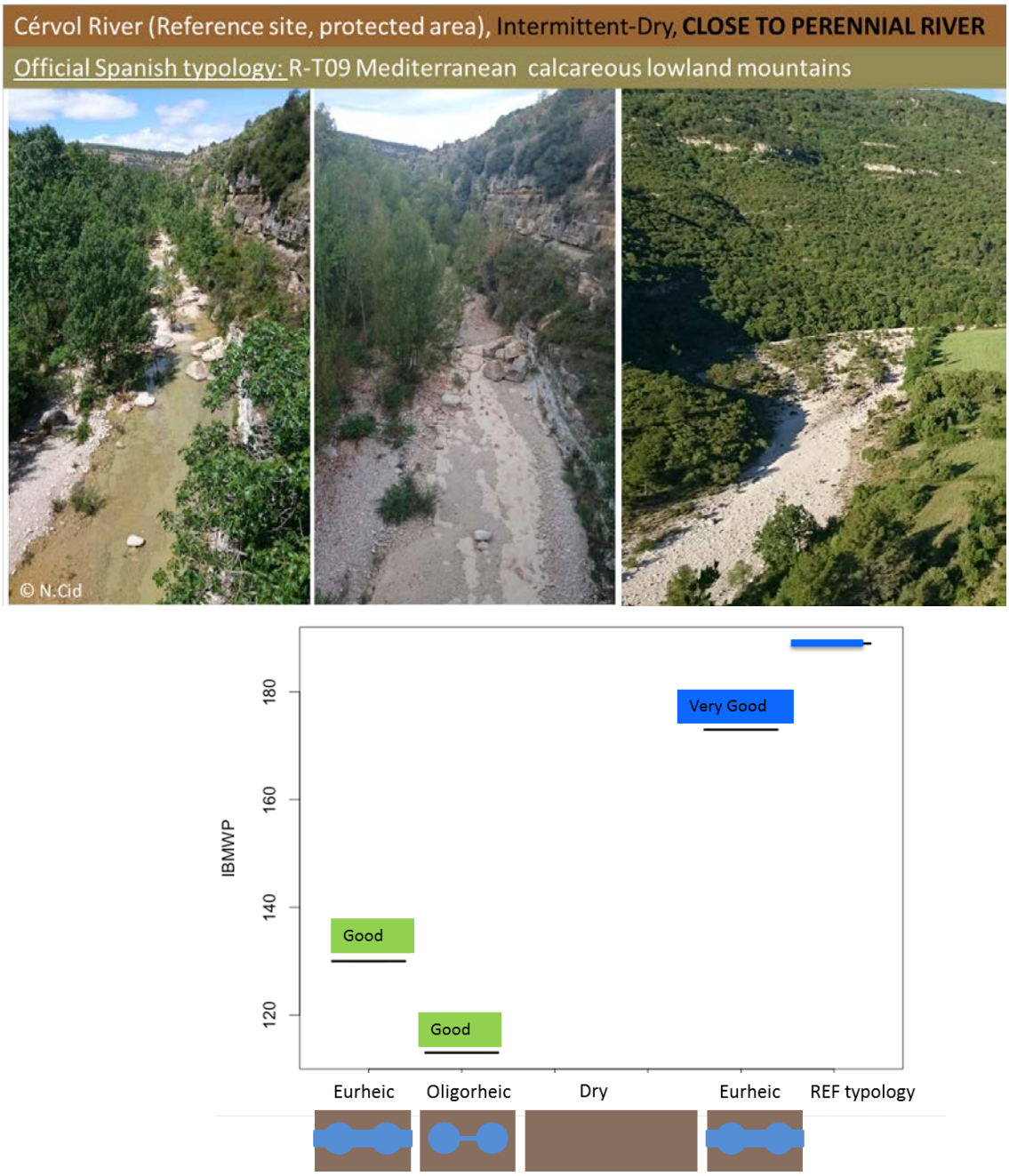


Figure 6. Values for the IBMWP in the Cérvol River. Note that when using current methods a different reference value is attributed for each official Spanish typology. In this case, the reference value for Mediterranean calcareous lowland streams is 189. Picture: Núria Cid.

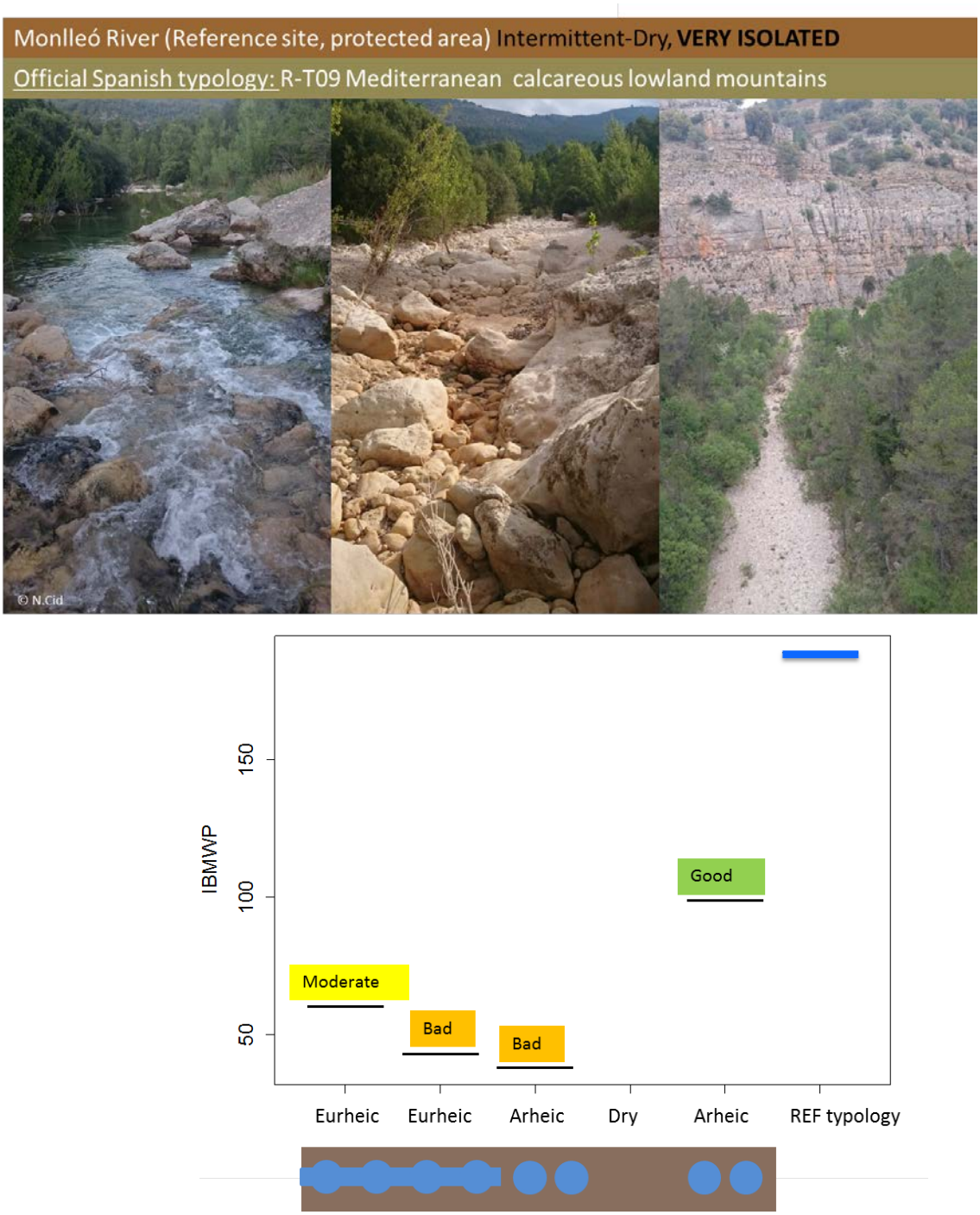


Figure 7. Values for the IBMWP in the Monlleó River. Note that when using current methods a different reference value is attributed for each official Spanish typology. In this case, the reference value for Mediterranean calcareous lowland streams is 189. Picture: Núria Cid.



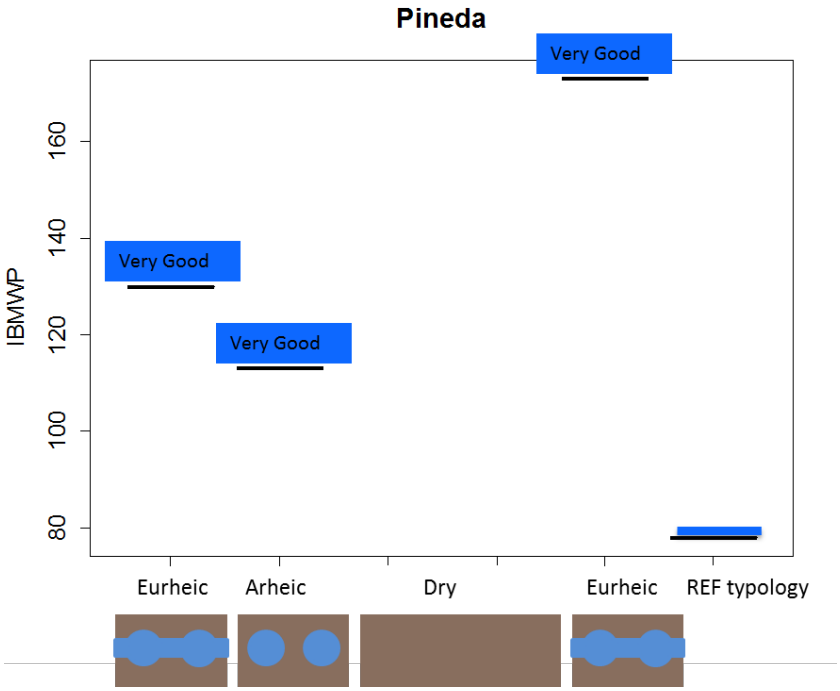


Figure 8. Values for the IBMWP in the Pineda stream. Note that when using current methods a different reference value is attributed for each official Spanish typology. In this case, the reference value for Mediterranean coastal streams is 78. Picture: Núria Cid.

3.3 Fish

Results showed that, when comparing total mean fish densities in relation to hydrological regime and the aquatic states, we observed that in perennial (P) rivers with no impacts, values were maintained from spring to summer and slightly decreased in autumn (Figure 10). However, these differences were not significant and the variability was attributed to oscillation of some species. For instance, in the Canaletes River, *B.haasi* was always the most abundant species, while *P.miegii* i *S.pyrenaicus* presented a higher variability. In intermittent-pools (I-P) streams, densities were much higher during the arheic aquatic state (isolated pools) in summer, and were lower than in autumn under the Eurheic aquatic state when flow was resumed. The increase in densities during the arheic State in I-P rivers, both natural and human-induced, is mainly due to the habitat reduction that occurs gradually as drought severity increases, leaving the fish finally retained in isolated ponds and increasing sampling efficiency. The drop in the densities observed in the autumn can be explained by two reasons. On the one hand, after floods and reconnection of habitats (back to the eurheic state), fish are highly dispersed along the river. On the other hand, the deteriorated conditions in the pools during the dry period or the fact that they can completely dry out may lead to high fish mortality and therefore less fish core populations to recolonize when flow resumes. High densities of organisms in the same isolated pools increase competition for resources and limit fish survival (Lake, 2011). This could be the case of the Daró River, in which oxygen concentration reached very low levels during summer in the arheic state (Table 2). In I-D streams, only one species *Achondrostoma arcasii* was present at very low densities in the hydrologically impacted river (Guadazaón River) during spring. Other ID streams sampled were fishless during flow conditions (Eurheic state).

Regarding biological quality, in non-impacted perennial streams values were maintained for each sampling season, with the exception of one site (Canaletes River) when using IBIMED (Table 3). In contrast, biological quality in IP rivers was considerably affected by the the aquatic state. For instance, when using IBICAT2b, Daró River presented a good biological quality in spring and summer and moderate in autumn. In those naturally I-D rivers, no index was applied since sampled reaches were fishless during flow conditions and no pools were detected during dry season. For those hydrologically impacted sites, the worst case was for the Guadazaón River, where biological quality was very bad during flow conditions (Eurheic state) and the river was completely dry with no pools for the next 8 months. In this hydrologically impacted river, no stable fish populations were present, as observed on other studies (Benejam et al., 2010). In the Matarraña River (Figure 11), where isolated pools were maintained during summer, biological quality differed for the different sampling seasons and associated aquatic state, presenting the lowest quality during the arheic state. During this phase, and potentially related with high water temperatures (Table 2) invasive fish species such as *Gambussia holbrooki* were captured and a high number of native fish were injured or presented parasites (Figure 12) In general, biological quality was considerably different when using IBICAT2b o IBIMED, whereas similar results were obtained when IBIJÚCAR and IBIMED.

The results show how the temporary flow regime can affect fish communities mainly regarding fish densities, with very high values during the arheic aquatic state (summer dry period with isolated pools). This highlights the ecological value of these pools in Mediterranean rivers since they act as a refuge for fish during the dry season. It is also important to note that not only the presence of isolated pools is important but the habitat conditions therein (Lake, 2011). Thus, the maintenance of isolated pools and of the quality of these pools is crucial for the survivorship of fish communities inhabiting TR's, both naturally TR's and perennial ones affected by water abstraction (human-induced TR's). Sampling fish communities would give us key information on the state of those communities that cannot escape when the river is dry (e.g. flying adults of macroinvertebrates can escape to other perennial streams).

When using traditional methods for assessing the biological quality using fish in temporary rivers there is a need to consider the hydrological regime and the hydrological status of the river (i.e. using the TREHS software). In a naturally temporary river (in which the hydrological status is good since no significant hydrological alterations are present) is crucial to be aware of the best sampling period. For instance, if we sample an I-P river under the arheic state, biological quality may be different depending on the time elapsed from flow disconnection. If flow cessation persists and conditions in disconnected pools deteriorate, fish communities can be strongly affected. Arrived to this point, it may also be possible that biological quality is lower in autumn since communities still did not recover from summer dry period. Nevertheless,

naturally temporary rivers can reach a good biological quality during Eurheic or Oligorheic aquatic states in spring comparable to P streams. Those human-induced temporary rivers (in which the hydrological status is bad since significant hydrological alterations are present) presented a lower biological quality than naturally IP temporary rivers and non-impacted perennial rivers. Therefore, WFD environmental objectives of achieving a good ecological status will not be attained without the implementation of environmental flows, which, in the context of TRIVERS means achieving a good hydrological status. For example, water discharge in the Matarraña for 2008 only represented 10% of the natural flow regime. An increase up to25-40% was proposed by water agencies to maintain baseflow. Unfortunately, due to lack of adequate management or implementation, the results from this study and others (Sostoa et al., 2005; Quirós and Vinyoles, 2016) indicate that the current flow is not enough to maintain a good condition of the fish community.

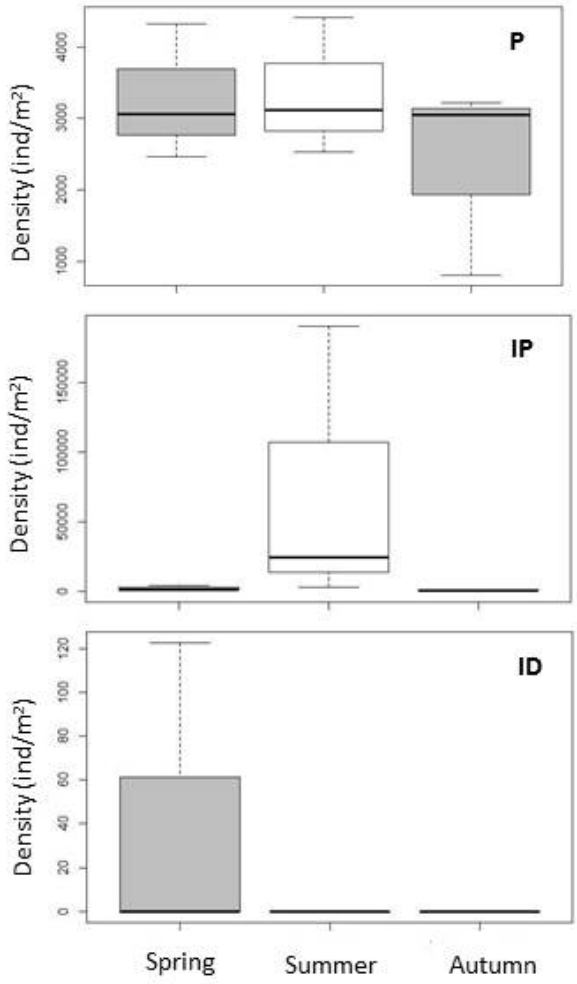


Figure 10. Total fish density (ind/m^2) for the studied perennial (P), intermittent-pools (IP) and intermittent –dry (ID) streams in different sampling times. In P, the aquatic state was always Eurheic or Oligorheic (flow). In IP, spring and autumn presented an Eurheic or Oligorheic state with connected flow whereas summer only isoloated pools were present. In ID, flow was only present in spring and the rivers were completely dry from summer to autumn.



Figure 11. Different moments of the Matarraña River, a human-induced temporary river from the Ebro Basin. During summer (arheic state) fish are accumulated in isolated pools and densities significantly increase. Pictures: Núria Cid.

Table 2. Water Physicocemistry variables for the rivers in whihc fish we present fish results.

Date of sampling	Aquatic State	Discharge (l/s)	Conductivity (us/cm)	O_2 (%)	O_2 (mg/l)	pH	Tª (ºC)
DARÓ. Naturally temporary (IB)							
7/5/15	Eurheic	3,94	581	98,1	9,55	6,56	16,5
21/7/15	Arheic	0	635	29	2,36	7,63	26,2
25/11/15	Eurheic	6,2	251,1	90,7	10,92	7,56	7,5
GLORIETA. Naturally temporary (IB)							
8/5/15	Eurheic	43	581	98,1	9,55	6,5	16,5
22/7/15	Arheic	1,4	806	42,6	3,68	7,41	21,5
24/11/15	Eurheic	nd	556	94,9	11,31	8,09	7,8
AIGUA D'ORA. Non-impacted P							
30/5/15	Eurheic	320	382,1	80,1	8,08	8,07	15
9/9/15	Oligorheic	417	342,8	84	8,64	8,31	14
26/11/15	Eurheic	280,7	293,8	93,14	11,98	8,4	4,7
MATARRANYA. Hydrologically impacted P= human induced IB							
13/5/15	Oligorheic	344	830	128,2	11,2	8,16	22,7
17/9/15	Arheic	0	1437	114,2	9,3	8,01	25,5
3/12/15	Eurheic	269,2	595	103,6	11,93	8,47	9
ALGARS. Non-impacted P							
13/5/15	Eurheic	38	492,3	102,8	9,53	7,91	18,9
3/8/15	Oligorheic	19,9	598	96,6	7,79	7,87	25,5
4/12/15	Eurheic	25,31	374	89,1	10,29	8,16	8,5
CANALETES. Non-impacted P							
14/5/15	Eurheic	31,5	420,7	102,9	10,27	8,27	15,8
3/8/15	Oligorheic	16,4	457,3	83,1	7,58	7,81	19,9
4/12/15	Oligorheic	12,6	313,9	95,9	11,55	8,51	7,3
GUADAZAÓN. Hydrologically impacted P= human induced ID							
18/5/15	Eurheic	15	498,4	98,5	9,8	8,1	15,5
29/7/15	Hiporheic	dry	dry	dry	dry	dry	dry
13/12/15	Hiporheic	dry	dry	dry	dry	dry	dry
MONLLEÓ. Naturally temporary (ID)							
19/5/15	Eurheic	395	329,5	102,6	10,81	8,12	13
15/9/15	Arheic	dry	dry	dry	dry	dry	dry
13/12/15	Oligorheic	0	302,7	33,5	4,02	7,54	7,2
RIERA DE PINEDA. Naturally temporary (ID)							
29/4/15	Oligorheic	23	554	91,9	9,49	6,66	13,8
30/7/15	Hiporheic	dry	dry	dry	dry	dry	dry
20/11/15	Oligorheic	1,57	613	26,8	2,95	8,05	12

Table 3. Biological quality based on IBICAT2b, l'IBIMED and 'IBIJÚCAR, for each studied water body and in each aquatic state. Empty cells represent those cases where the index was not applicable for the Basin. CIC: Conques Internes de Catalunya; CHE: Confederación Hidrogràfica de l'Ebre; CHJ: Confederació Hidrogràfica del Júcar.

River name	Hydrological regime	Impacts	Date of sampling	Aquatic state	IBICAT2b	IBIMED-EQR	IBIJÚCAR
Daró CIC	**Natural:** IP **Observed**: IP	None	7/5/15	Eurheic	3,88	0,601	---
			21/7/15	Arheic	3,88	0,789	---
			25/11/15	Eurheic	3,25	0,424	---
Glorieta CIC	**Natural:** IP **Observed** : IP	None	8/5/15	Eurheic	4,6	0,933	---
			22/7/15	Arheic	4,6	0,911	---
			24/11/15	Eurheic	3,8	0,852	---
Aigua d'Ora CIC	**Natural**: P **Observed** : P	None	30/5/15	Eurheic	3	0,966	---
			9/9/15	Oligorheic	3	0,931	---
			26/11/15	Eurheic	3	0,966	---
Matarranya CHE	**Natural**: P **Observed** : IP	Water abstraction	13/5/15	Oligorheic	4,38	0,688	---
			17/9/15	Arheic	3,13	0,844	---
			3/12/15	Eurheic	4,75	0,784	---
Algars CHE	**Natural**: P **Observed** : P	None	13/5/15	Eurheic	5	0,894	---
			3/8/15	Oligorheic	5	0,896	---
			4/12/15	Eurheic	5	0,895	---
Canaletes CHE	**Natural**:P **Observed** : P	None	14/5/15	Eurheic	4	0,831	---
			3/8/15	Oligorheic	4	0,825	---
			4/12/15	Eurheic	4,25	0,852	---
Guadazaón CHX	**Natural**:P **Observed** : ID	Water abstraction	18/5/15	Eurheic	---	0,052	8,6
			29/7/15	Hiporheic	---	Dry	Dry
			13/12/15	Hiporheic	---	Dry	Dry
Monlleó CHX	**Natural**: ID **Observed** : ID	None	19/5/15	Eurheic	---	Fishless	Fishless
			E. 30/7/15	Hiporheic	---	Dry	Dry
			T.13/12/15	Eurheic	---	Fishless	Fishless
Riera de Pineda CIC	**Natural**: ID **Observed** : ID	None	P. 29/4/15	Eurheic	Fishless	Fishless	---
			E. 3/8/15	Hiporheic	Dry	Dry	---
			T.20/11/15	Eurheic	Fishless	Fishless	---



Figure 12. Native fish with parasites in the Matarraña River during summer (arheic state). Picture: Núria Cid.

5. References

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