KNOWLEDGE CONVERSION FOR ENHANCING MANAGEMENT OF EUROPEAN RIPARIAN ECOSYSTEM AND SERVICES

COST ACTION **CONVERGES**

DELIVERABLE 1.1.: GUIDANCE TO IMPLEMENT THE PROTOCOL FOR THE STATUS/PRESSURES ASSESSMENT

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CONTENT:

ANNEXE I

RIPARIAN VEGETATION AS AN INDICATOR OF HYDROMORPHOLOGICAL STATUS: VEGETATION RESPONSES TO PRESSURES AND IMPACTS

1 INTRODUCTION

Inland aquatic ecosystems have been recognised as some of the most threated by human pressures in the world (Saunders et al. 2002). This fact is especially relevant in Europe, where the degradation of its rivers is widespread and nearly all river basins are heavily affected by human activities (Tockner et al. 2009). Recently, Schinegger et al. (2012) conducted a high-resolution data analysis of human pressures at the European scale and they found that more than 79% of the sites analysed (for a total of 9330 sampling sites in 14 European countries) were impacted. However, the same authors also pointed out that little is known about the prevalence, spatial patterns, interactions with natural environment and co-occurrence of pressures.

The identification of significant anthropogenic pressures is an important part of river basin planning and particularly for implementing the EU Water Framework Directive (WFD) (2000/60/EC). All Member States are obliged not only to estimate these pressures within their river basin districts (in a consistent and comparable way), but also to assess the consequent potential impacts on the ecological status of water bodies and, based on this, the susceptibility of the water bodies, i.e., if the impacts potentially lead to a risk of non-compliance with the environmental quality objectives set for the water bodies.

Following the **DPSIR framework**, promoted by the European Environmental Agency (Nixon 2003), the **driving forces** are human activities (e.g. agriculture, urbanisation, industry, tourism…) generating a combination of **pressures** (e.g. water abstraction, physical alterations, pollution discharges, climate change…), which alter the **state** of the abiotic components of the ecosystem (e.g. physico-chemistry, hydro-morphology…). These alterations **impact** biological communities and thus ecological status, eventually resulting in a **response** at the water policies level (e.g. water use restrictions, wastewater treatment…) (Friberg 2010, Wasson et al. 2010).

In the general approach of the WFD, pressures are defined as alterations of the water regime (water abstraction, water flow regulation), uses which lead to morphological alterations of the water bodies, and pollution (from point and diffuse sources); and impacts are those modifications of the quality elements resulting from one or a number of pressures, which potentially leads to a failing of the environmental objectives set under Article 4 of the WFD (Borchardt and Richter 2003). Nevertheless, different authors have categorized pressures in different ways and have evaluated their impacts on organism groups according to specific ranges of pressure severity, for example see Hering et al. (2006); or Schinegger et al. (2012), who categorized pressures into four groups: hydrology, morphology, water quality and connectivity.

Different biological communities can show different responses to a certain pressure depending on the nature of the disturbances, the spatial scale considered and the specific indicator or metric used as response variable (Bruno et al. 2014a). For example, the effect of certain anthropogenic pressures on vegetation could vary depending upon the function and features of the type of vegetation considered (Bunn and Arthington 2002, González et al. 2018).

Here, pressures have been categorized into several groups: hydrological pressures, morphological pressures, pollution, land uses and others (multiple pressures). The specific impact of these pressures on riparian vegetation is explained, as well as the main responses of vegetation features and the scale and metrics that should tackle the pressure and impact assessment.

2 HYDROLOGICAL PRESSURES

Hydrological pressures cover impoundments and other infrastructures that affect natural water and sediment fluxes. Some examples of hydrological pressures are reduction of the natural flow velocity, hydropeaking,

water abstraction (water flow alteration/minim flow), reservoir flushing, seasonal hydrograph modification (because of water storage for irrigation, hydropower, etc.). Artificial alterations in hydrological features are considered one of the major stressing impacts in many river types (Hooke 2006) that cause modification and impoverishment of aquatic biota (Schinegger et al. 2012), both upstream and downstream of the infrastructure causing the alteration (Nilsson et al. 2005).

Riparian vegetation consists of a group of species highly dependent on fluvial processes, but particularly they depend on the hydrologic regime of rivers and associated geomorphic adjustments to complete their life cycles (Karrenberg et al. 2002). When fluvial processes are affected by human pressures, different types of vegetation and different stages of their life cycles can be compromised (González et al. 2018). Not only riparian and floodplain woodlands can be disfavoured by river regulation and human pressures, but also non-woody wetlands (Weisberg et al. 2013).

Recruitment of new individuals is a disturbance-dependence process (Scott et al. 1996, Cooper et al. 2003) and therefore is episodic (Mahoney and Rood 1998). Mature riparian woodlands in good ecological status are composed of a shifting steady state mosaic of patches that established in different years (Johnson et al. 1976, Stanford et al. 2005). Different types of human pressures produce a simplification and homogenization in hydrogeomorphic processes (Shafroth et al. 2002) that involve a decrease (or even suppression) in the creation of safe-sites, suitable for the regeneration of new individuals, at spatial and temporal scales enough to maintain the shifting steady state mosaic. The bare areas that remain expose after the reduction in flooding disturbance, are colonized by pioneer vegetation in a first phase, and then these species are progressively replaced by early successional species and finally by late successional species, properly terrestrial or even invasive ones. This encroachment, species replacement and eventual "terrestrialization" of the riparian corridors (Stella et al. 2011) is a direct consequence of the floodplain disconnection and general reduction in the hydrogeomorphic dynamism (Garófano-Gómez et al. 2013, Garófano-Gómez et al. 2017). Many studies have verified the sharp decline in regeneration after floodplain disconnection, while established populations age and are replaced by less disturbance-dependent species (Merritt and Cooper 2000, González et al. 2010, Martínez-Fernández et al. 2017).

In some other cases of hydrological alteration, the annual flow magnitude is not heavily modified but the seasonal hydrograph. Regeneration will not take place if floods able to do geomorphic work (creating moist and bare surfaces), are not timed with seed release (Karrenberg et al. 2002, Wilcox and Shafroth 2013). Dispersal season and high (Spring) flows must be coupled.

The sediment regime has also been highly altered by human pressures (Wohl et al. 2015), and as well as the flow regime, it is also very important to create bare surfaces and maintain the shifting steady state mosaic. Reservoirs trap sediments, reducing the sediment load and modifying the type of sediments downstream of these infrastructures (Scott et al. 1997, Johnson 1998). The sediment deficit affects the potential of large flows to induce geomorphic dynamism; consequently, sediment releases should be a necessary component of environmental flows (Wohl et al. 2015).

Not only sediment texture is important, but also sediment moisture (Kranjcec et al. 1998, Cooper et al. 1999). Both are interconnected, as flow regulation promotes coarser textures that generate an increase in cohesiveness (bank hardening effect) and complementary a decrease in the soil water-holding capacity (González et al. 2010). Other factors that affect moisture in the riparian and floodplain zones are related to the rate of recession following floods, the base flows and the water table conditions (Mahoney and Rood 1998). All of them are determinant of both, the regeneration and survival of young seedlings and saplings (Guilloy-Froget et al. 2002, Guilloy et al. 2011), as well as of the maintenance of mature riparian ecosystems (Scott et al. 1999).

3 MORPHOLOGICAL PRESSURES

Morphological pressures refer to the alterations of the morphological condition of the streambed and banks as a consequence of the installation of artificial structures and barriers (e.g. dams, weirs, lateral protections…) causing breaks in longitudinal, transversal, vertical (and temporal) connectivity (Borchardt and Richter 2003, Wasson et al. 2010). Some examples of morphological pressures are channelization, alterations of the natural morphological channel plan form, alterations of the cross-section, alterations of instream habitat conditions, presence of artificial embankments and rip-rap of different levels that limit channel migration and dykes for flood protection (Van Looy et al. 2003, Dufour et al. 2007, Schinegger et al. 2012).

The reduction in the hydromorphological connectivity is one of the main causes of habitat degradation and loss in river channels and their floodplains for many riparian species, including other biota groups, like fish (Hughes and Rood 2003, Aarts et al. 2004). In this sense, habitat loss and reduced hydrological connectivity have been defined as the more frequent impacts nowadays in European rivers (Schinegger et al. 2012).

Reduction in channel widening and migration reduces the presence of safe sites for regeneration of riparian species (González et al. 2018). Artificial barriers that affect the natural movement of water and sediments in a river system may reduce the necessary genetic exchange between riparian species and also between the species of other organism groups, like fish or aquatic macroinvertebrates, along longitudinal and transversal gradients (Stromberg 1993). Reduction in both types of connectivity may affect the natural balance between riparian species in an ecosystem, as some species are more prone to vegetative reproduction than others.

Other human activities like mining (gravel extraction) alters channel topography, destroy habitats and regeneration sites for riparian species. However, if habitats remain hydrologically connected to the river and are regularly flooded, their restoration can be relatively easy and successful (González et al. 2017).

4 POLLUTION

Apart from alteration of river morphology and of water and sediment regimes, other ecological impacts in running waters result from various pressures acting simultaneously, like point sources discharges and diffuse pollution that can alter both water and soils (Borchardt and Richter 2003, Wasson et al. 2010). Although water quality has improved markedly in European rivers in the last decades (Aarts et al. 2004), this pressure is still present. It can be generated by non-treated stormwater, public sewage treatment plants, industries, croplands, livestock, etc. The chemical pollution generated covers acidification, artificial eutrophication or nutrient enrichment (P, N, C), heavy metals and organic pollution.

Water pollution is a key pressure in river ecosystems and impacts aquatic biota (Schinegger et al. 2012). Periphytic diatoms, macrophytes, benthic macroinvertebrates and fish are more responsive to nutrient enrichment (eutrophication) and organic pollution gradients than riparian vegetation (Hering et al. 2006). Riparian vegetation features like species composition can be affected by chemical water quality (Salinas et al. 2000), but in turn, riparian vegetation also protects streams from nonpoint source pollutants and improves the quality of degraded streams water (Dosskey et al. 2010).

Most riparian species are pioneer species adapted to poor soil conditions (Karrenberg et al. 2002). However, the nutrient levels in the substrate can affect significantly seedlings survival and growth in riparian systems (Adair and Binkley 2002). In this sense, sediment releases from dams have shown to be an important input of nutrients in the system triggering recruitment (Asaeda et al. 2015).

Sediment properties other than moisture and texture can also influence seedling establishment, such as salinity, that can increase as a result of human activities (Jolly et al. 1993). In rivers with an altered hydrology, lack of annual flooding can result in high soil salinity values that are stressful to riparian species, reduce germination rates (Shafroth et al. 1995) and compromise seedling survival (Bhattacharjee et al. 2008).

5 LAND USE PRESSURES

Land use covers industrial and urban areas, agriculture, irrigated croplands, fishery and forestry. Land use is one of the larger pressures on riverscapes (Allan 2004), and particularly on riparian vegetation (Bruno et al. 2014a), because many types of uses like urbanisation or agriculture occupy the riparian and floodplain areas, producing a complementary morphological pressure with the modification of the bank profiles and a pollution pressure with the input of sediments, nutrients and pollutants. For example, agricultural land uses near riparian forests are often associated with increased soil salinity due to irrigation (Jolly et al. 1993).

Wasson et al. (2010) pointed out that artificial land uses like urbanisation and industry represent the pressure with the most negative impact on aquatic biota, over those generated by agriculture, which can be more variable. But in all these cases, riparian forests can have an important protective or buffer effect mitigating the impacts from both agricultural and urban land uses at the basin and riparian corridor scales (Moore and Palmer 2005). Furthermore, the direct influence of riparian forest on invertebrate community structure is widely recognised (Naiman et al. 2005). However, riparian vegetation is not often evaluated in terms of ecological

status. Riparian vegetation should have a relevance by itself and not only as a complement factor to other organism groups or status indices.

Livestock, in addition to wild animals, such as ungulates, can also produce an impact on riparian vegetation, for instance, affecting health plant condition and damage (Beschta and Ripple 2016).

6 MULTIPLE PRESSURES

Almost 90% of lowland European rivers are affected by a combination of multiple pressures. Many river sites are affected by hydromorphological pressures or a combination of water quality and hydromorphological pressures. However, there is still a lack of knowledge about the prevalence, spatial patterns, interactions with natural environment, co-occurrence of pressures and the ecological status of rivers at large scales (Allan 2004, Schinegger et al. 2012).

Hydrological alteration and land use changes (like agricultural intensification) can be considered the main human pressures modifying aquatic and riparian communities (Ward 1998). However, the natural constraints in certain ecosystems can make them more sensitive in combination with the nature of the human pressure, leading to different regional responses (Allan 2004). Specifically, this is the case in Mediterranean areas, where human pressures can interact or even exacerbate the pressures along with the proper natural stressors of these river ecosystems, like water salinity, water scarcity or temporality (Stella et al. 2013, Bruno et al. 2014a, Bruno et al. 2014b).

Natural stressors comprise wildfire, windthrow, insect outbreaks, snow loading, ice accumulation, snow avalanching, landslides, and debris flows, floods, bank erosion and avulsions, the last three unique to riparian zones. Furthermore, disturbance regimes vary with catchment scale and stream size (Johnson et al. 2000). Riparian zones exhibit a mosaic of patches at the landscape scale that reflect different local habitat conditions, disturbance histories and recovery trajectories (Naiman et al. 2010), which influence the resilience or the system to new disturbances. Apart from the specific disturbance agents, it is necessary to consider also their spatial extent, frequency, intensity and pattern of disturbance. Their characteristics may vary geographically as a function of climate, topography, vegetation, soil moisture and their interactions (Moore and Richardson 2012).

Multiple pressures act simultaneously in most cases, therefore, managers require to define a hierarchy amongst these to identify priority actions, particularly because pressures are predicted to intensify in the future because of an increase in extreme flow events and the growing water demand for agriculture and energy (European Commission 2009).

7 PRESSURE AND IMPACT ASSESSMENT DEPENDING ON THE SCALE AND METRICS

Human pressures can have a negative influence on aquatic and riparian communities regardless of the scale considered, as pointed out by some authors (Gregory et al. 1991, Allan 2004). However, others consider that the assessment of the impacts on a water body requires a defined area, i.e., the collected data and information have to be referred and aggregated to particular scales (Borchardt and Richter 2003).

The hydrological pressures are often evaluated at reach level or even microhabitat, while land use is evaluated at basin level (Hering et al. 2006). According to Wasson et al. (2010), the impact of a given land use can be different at the basin level compared to the riparian corridor (landscape) level, and the regional variability of these pressure-impact relationships has seldom been analysed at a large geographical scale.

Streams and their riparian and floodplain areas are subject to a wide variety of natural and anthropogenic disturbances across a range of spatial and temporal scales (Moore and Richardson 2012). Therefore, their response to impacts depends upon the nature of the pressures and the spatial scale considered (Richards et al. 1996, Ferreira and Aguiar 2006). Different studies, such as those developed by Salinas and Casas (2007), Aguiar et al. (2009) and Bruno et al. (Bruno et al. 2014a) have stated that human pressures acting at basin scale seem to play a major role in riparian vegetation. Aguiar et al. (2009) indicated the scale dependency of multi-metric plant-based indices, an important consideration in the development of typological-adapted systems for meeting WFD criteria or for other assessment and monitoring purposes.

Apart from the scale considered, the assessment of biological communities' responses can be different depending on the indicator or metric used (Bruno et al. 2014a). A "metric" is considered a measurable part or process of a biological system that changes in value across a human-disturbance gradient (Karr and Chu 1999).

The indicators of the ecological condition, such as the QBR (Munné et al. 1998, Munné et al. 2003) and the RQI (González del Tánago et al. 2006, González del Tánago and García de Jalón 2011) are more appropriate to assess river health (Karr 1999) and respond more clearly than biodiversity indices (such as species richness) to human pressures (Bruno et al. 2014a). Furthermore, they can be more integrative, as they consider different ecosystem components (e.g. composition, structure, functioning, diversity), what give them a more holistic nature, and they have been identified as sensitive to different types of disturbances including land use change and stream modification (Garófano-Gómez et al. 2011, Belmar et al. 2013). Despite many ecological studies regarding the influence of human pressures on biological communities continue using richness as a response variable (Birk et al. 2012), species themselves are not considered a good indicator of human pressures because the indicator taxa for different types of stressors differ geographically depending on the ecological amplitude of the species and species optima in each ecoregion (Aguiar et al. 2009). It is also relevant to consider the sampling season constraints and the inter-annual variability of plant structure and composition.

Apart from the indicators of the ecological condition, different structural and functional components of the riparian ecosystem can be used separately in bioassessments of ecological quality of Mediterranean-type streams (Aguiar et al. 2009), However, depending on the spatial scale of approach some components can be better than others.

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SHORT QUESTIONNAIRE ON RIPARIAN VEGETATION ASSESSMENT IN EUROPE

To answer the questions, please maintain the right answer for your case and remove all the indicated options not valid for you

I. **PERSONAL DATA**	
Name	
Country of work	
Affiliation	
Email	
What is you involvement in the study of Riparian vegetation?	Research: Public Universities / Scientific Centers / Consulting Public administration: Conservation / River Management / Water resources Other (please, specify)
	If Research, do you collaborate with river managers? YES / NO
	If Public administration, do you collaborate with research centers? YES / NO

Are you aware **o**f people (researchers, public administration, private company) working on riparian vegetation assessment at national/regional scale, within the context of the Water Framework Directive? **YES / NO**

If you answered YES. Can you please provide the contacts:

1. Name……Institution……..
Contact email……..
Another information…….

2. Name……Institution……..
Contact email……..
Another information…….

II. MANAGEMENT OF RIPARIAN ZONES

1. Are you aware of any legal definition of riparian zone in your country (e.g., fixed width, some flooding return period, other …)? Could you indicate the criteria and the source where it is described?

2. Is the riparian zone in your country : **PUBLIC / PRIVATE / BOTH or OTHER, according to specific features**

If **PUBLIC**, are you aware of the maintenance works done by the public administration, and their main purpose? Please, indicate approximately the frequency of these works

If **PRIVATE**, are you aware of the mandatory rules (e.g. restrictions of use) for the owners to maintain the riparian zones in proper conditions?

If **BOTH, or OTHE**R, please could you describe the specific features to differentiate public vs. private domain or other?

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3. Are you aware if in your country do exist specific management plans or legislations directly addressed to the riparian zones? **YES / NO**

If **YES**, can you provide any information on them, and where this information applies?

Protection / Conservation of habitat (e.g. Natura 2000)

Protection / Conservation of buffer functions in agricultural land

Flood control measures

Specific constraints in urban areas

Others:

III. INFORMATION ON RIPARIAN VEGETATION CHARACTERIZATION AND ASSESSMENT IN YOUR COUNTRY

4. Are you aware of available data sets on riparian vegetation in your country?
YES / NO

If YES, can you provide relevant information about the existing data sets?

SCALE: National / Regional / Local / Other

DATA SOURCE: Air photographs / Field work / Both / Others

VEGETATION TYPE: Woody species (Trees, shrubs) / Herbaceous / Macrophytes

CONTENT: Vegetation structure / Presence of species / Abundance of species / Age of plants

ADDITIONAL INFORMATION: Habitat information Flow regime conditions Channel conditions

ECOLOGICAL STATUS; assessment of degradation / conservation status

OTHER ISSUES:

5. Are you aware of how riparian vegetation is characterized and assessed, as a component of hydromorphological conditions according to the Water Framework Directive? YES / NO

If YES, Can you provide information on the protocol or method, including their scientific reference, grey literature, field protocol, etc.?

Protocol name ……
Reference where it is described ……..
Data acquisition: Air photographs / Field work / Both / Others

6. **What type of RIPARIAN VEGETATION indicators are described in the referred protocol used in your country?**
Please, indicate the way of their measuring, if qualitative by classes, or quantitative by measured numbers. Select "No considered" if the indicator is not included in the protocol:

	Qualitative appraisal	Quantitative appraisal	Not considered

Longitudinal continuity (Fragmentation)			
Vegetation structure: spatial arrangement (isolated trees, patches …)			
Vegetation coverage:			
Species composition: Select "qualitative for Presence of species, "quantitative" for Abundance of species			
Lateral connectivity:			
Age classes:			
Pioneer recruitment:			
Dead wood: presence, abundance, others			
Other attributes:			

7. Does the protocol include assessment of the riparian vegetation status? YES / NO

Please, describe the additional information you consider relevant in the protocol, and duplicate this section as many times as official protocols you know from your country

IV. RIVER TYPOLOGIES AND REFERENCE CONDITIONS TO DEFINE ECOLOGICAL STATUS

8. Are you aware of river typologies in your country to establish reference conditions and thresholds of ecological status? YES / NO

If YES, could you include the reference, web page or other information where they are described?

9. Are you aware of the existence of reference conditions of riparian vegetation status according to river typologies in your country?
YES / NO

If **YES**, please, can you indicate the scientific reference, grey literature, official administrative documents, etc where the official assessment is described?.

V. PRESSURES AND IMPACTS OF RIPARIAN VEGETATION. ADDITIONAL INFORMATION

10. Are you aware of any report or research from your country informing the main pressures and impacts of rivers at national /regional scale? YES / NO

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If YES, could you give the reference, page web or source of information?

- From your point of view, could you Rank the following human activities from 1 (most important) to 7 (less important) affecting riparian vegetation?

Agriculture / Urbanization / Mining / Navigation / Recreation / Grazing / Others

- Could you rank the following impacts on riparian vegetation in the same way:

Land Cover changes / Water pollution / Flow regulation by dams and reservoirs / Groundwater depletion /

Channelization / Invasive species / Others

- From your point of view, and in general terms, riparian zones and their vegetation are in your country during the last decades:

Improving their status / Degrading their status / No significant changes

- Could you briefly state your answer?

11. Please, could you add any relevant information, or references dealing with riparian vegetation characterization and status assessment from your country?

Please send the filled questionnaire to marta.gtanago@upm.es before 31 May 2019 if possible

THANK YOU VERY MUCH FOR YOUR CONTRIBUTION!

ANEX II. Table 2.- Synthesis of the answers to the questionnaires.

	COUNTRY (Name of reporter)			FRA (S. Dufour)	PRT (P. Rodríguez)	PRT (F. Aguiar)	PRT (T. Ferreira)
Riparian zone: LEGAL DEFINITION				Absolute value: 5 m	10 -30 (non navigable –navigable rivers)	10 -30 (non navigable – navigable rivers)	10-30-50 m, according to river width and navigation
Riparian OWNERSHIP				Mixed: Public if floatable and navigation possible/private for others	Mixed: Public if urban, private if land limiting rivers is private, public rest of cases.	Mixed: Public if urban, private if land limiting rivers is private, public rest of cases.	Mixed: Public if urban, private if land limiting rivers is private, public rest of cases.
Riparian MANAGEMENT PLANS	**Conservation/Biodiversity (E.g., Natura 2000)**			YES???	YES	YES	YES
	Protection / Conservation of buffer functions in agricultural land			YES	NO	NO	YES
	Flood control			-	YES	YES	YES
	Specific constraints in urban areas			-	NO	YES	YES
	Other (specify)				-River Basin Manag. Plans. - Restoration after fires		
Riparian Vegetation (RV) DATA SOURCE	**RV inventories**	**National scale**		YES	YES	YES	-
		Regional /Local scale		-	-	-	-
	RV indirect monitoring (included in HYMO monitoring within the WFD implementation)			YES	YES	YES	YES
	Data acquisition	**FW: field work AP: air photos**		Both	FW	Both	-
Riparian Vegetation CHARACTERIZATION	**Phytosociological / Autoecological approach**	**Species composition**	**Presence**	Native vs. non native	NO	YES	YES
			Abundance	NO	NO		YES
		Habitat features	**Flow conditions**	-	YES	YES	-
			Channel conditions	YES	YES	YES	NO
	Spatial features	**Longitudinal continuity**		Semiquantitative	Semiquantitative	Qualitative	Qualitative/Quantitative
		Vegetation cover		Quantitative	Semiquantitative	NO	Qualitative/Quantitative
		Size / Shape vegetation patches		Semiquantitative	Semiquantitative	Qualitative	Qualitative/Quantitative
		Other structural features		NO	Lateral Connectivity	Lateral Connectivity	Lateral Connectivity
	Functional approach	**Age diversity**		NO	NO	NO	NO
		Pioneer recruitment		NO	NO	NO	YES
		Functional traits		NO	NO	NO	NO
		Dead Wood		YES	Qualitative classes	Qualitative	Qualitative

		Other	-		Trees rooted in riverbed	
		(continuation)	**FRA (S. Dufour)**	**PRT (P. Rodríguez)**	**PRT (F. Aguiar)**	**PRT (T. Ferreira)**
Riparian Vegetation Assessment	**Name of protocol /index**		SYRAH; CARHYCE	QBR, RHS and Riparian Vegetation Index	Macrophyte protocol	RHS
	Related to WFD HYMO assessment		YES	YES	YES	YES
	Referred to river typologies		YES	YES	YES	YES
	Referred to reference conditions		YES	YES	NO	YES
	Existence of RV reference types		NO	YES	NO	YES
Riparian Vegetation PRESSURES AND IMPACTS (Rank of human activities from 1, most important, to 7, less important)		**Agriculture**	1	1	1	1
		Urbanization	4	5	2	2
		Mining	7	4	6	4
		Navigation	5	7	-	6
		Recreation	6	6	-	3
		Grazing	3	3	5	5
		Others	2 Maintenance	2 River Manag.	3 Forestry	7
Riparian Vegetation PRESSURES AND IMPACTS (Rank of impacts from 1, most important, to 7, less important)		**Land cover changes**	1	1	1	1
		Water pollution	7	5	6	4
		Flow regulation by dams and reservoirs	5	2	3	2
		Groundwater depletion	3	4	4	3
		Channelization	2	2	6	5
		Invasive species	6	3	2	6
		Others	4 Plantation		5 Fire	7
Riparian zones and their vegetation are in your country during the last decades:			Improving their status	Degrading their status	Degrading their status	No significant changes
Reason			Large part of network is less pressured due to agricultural changes	Intensification of agriculture, increase effort in hydroelectric engineering, increase in the number and incidence of invasive species	Agricultural activities, forest plantations, urbanization, flow regulation and interruption of longitudinal connectivity.	On a local level, many changes and a greater awareness, but globally, riparian zones are ecotones with constant pressure from human activities and water scarcity

	COUNTRY (Name of reporter)			ESP (I. Biurrum)	GRC (E. Papastergiadou)	DEU (S. Lorenz)	CZE (J. Jakubinski)
Riparian zone: LEGAL DEFINITION				-	-	Fixed width (not said)	-
Riparian OWNERSHIP				PUBLIC	PUBLIC	PUBLIC	PUBLIC
Riparian MANAGEMENT PLANS	Conservation/Biodiversity (E.g., Natura 2000)			YES	YES	YES	YES
	Protection / Conservation of buffer functions in agricultural land				YES		-
	Flood control			-	-	YES	YES*
	Specific constraints in urban areas						
	Other (specify)			-	-	-	-
Riparian Vegetation (RV) DATA SOURCE	RV inventories	National scale		YES (SIVIM)	YES	-	NO* (starting now)
		Regional /Local scale		YES (BIOVEG)		-	NO
	RV indirect monitoring (included in HYMO monitoring within the WFD implementation)			YES	-	-	NO
	Data acquisition	FW: field work AP: air photos		FW	FW	-	FW
Riparian Vegetation CHARACTERIZATION	Phytosociological / Autoecological approach	Species composition	Presence	YES	YES	YES	YES
			Abundance	YES	-	NO	-
		Habitat features	Flow conditions	-		-	-
			Channel conditions	NO	-	-	-
	Spatial features	Longitudinal continuity		-	Qualitative	Quantitative	Qualitative
		Vegetation cover		-	Qualitative	Quantitative	Qualitative
		Size / Shape vegetation patches		-	Qualitative	Qualitative	Qualitative
		Other structural features		-	-	-	-
	Functional approach	Age diversity		-	-	NO	Qualitative
		Pioneer recruitment		-	-	NO	Qualitative
		Functional traits		-	-	NO	-

		Dead Wood			Qualitative	-
		Other	-	-	NO	Water regime characteristics
		(continuation)	**ESP (I. Biurrum)**	**GRC (E. Papastergiadou)**	**DEU (S. Lorenz)**	**CZE (J. Jakubinski)**
Riparian Vegetation Assessment	**Name of protocol /index**		-	MEDGIG	Gewässerstrukturgütekartierung	No official prot. (Evaluation of current state of bank vegetation)
	Related to WFD HYMO assessment		-	YES	YES	NO
	Referred to river typologies		-	YES	YES	NO
	Referred to reference conditions		-	YES	YES	NO
	Existence of RV reference types		-	YES	NO	NO
Riparian Vegetation PRESSURES AND IMPACTS (Rank of human activities from 1, most important, to 7, less important)		**Agriculture**		1	2	1
		Urbanization		3	1	2
		Mining		-	5	3
		Navigation		-	3	4
		Recreation		4	4	5
		Grazing		2	6	6
		Others		-		7
Riparian Vegetation PRESSURES AND IMPACTS (Rank of impacts from 1, most important, to 7, less important)		**Land cover changes**		1	2	1
		Water pollution		4	3	2
		Flow regulation by dams and reservoirs		2	4	3
		Groundwater depletion		5	5	4
		Channelization		3	1	5
		Invasive species		6	6	6
		Others		-		7
Riparian zones and their vegetation are in your country during the last decades:			Degrading their status	Degrading their status	Degrading their status	Improving their status
Reason			water depletion, flow regulation, eutrophication, channelization, spread of invasive species…		consistent conflicts on land use (agriculture, urbanization, nature conservation, recreation) riparian zones are threatened by diffuse inputs or area shrinkage.	More restoration actions, but actions are mostly aimed primarily at restoring the watercourse itself or

					creating natural flood protection measures

	COUNTRY (Name of reporter)			SVK (A. Kidová)	SVK (M. Slezák & M. Šibíková)	BIH (R. Nurković)	SVN (G. Urbanič)
Riparian zone: LEGAL DEFINITION				Absolute value: 20 m	Not defined	NOT SAID	1st order stream 40 m, 2nd order stream 5 m
Riparian OWNERSHIP				PUBLIC	MIXED	MIXED	MIXED
Riparian MANAGEMENT PLANS	**Conservation/Biodiversity (E.g., Natura 2000)**			YES	-	YES	YES
	Protection / Conservation of buffer functions in agricultural land			NO	-	YES	-
	Flood control			YES	-		YES
	Specific constraints in urban areas			NO	-		-
	Other (specify)				-	-	Management plans according to WFD
Riparian Vegetation (RV) DATA SOURCE	**RV inventories**	**National scale**		YES	YES	YES	YES
		Regional /Local scale		-	-	YES	-
	RV indirect monitoring (included in HYMO monitoring within the WFD implementation)			YES	-	-	-
	Data acquisition	**FW: field work AP: air photos**		FW	FW	-	Both
Riparian Vegetation CHARACTERIZATION	**Phytosociological / Autoecological approach**	**Species composition**	**Presence**	-	YES	YES	NO
			Abundance	-	YES	YES	NO
		Habitat features	**Flow conditions**	-	-	YES	NO
			Channel conditions	-	-	YES	YES
	Spatial features	**Longitudinal continuity**		Qualitative	-	-	
		Vegetation cover		-	-	-	Qualitative
		Size / Shape vegetation patches		Qualitative	-	-	Qualitative
		Other structural features		-	-	-	NO
	Functional approach	**Age diversity**		-	-	-	NO
		Pioneer recruitment		-	-	-	Invasive species
		Functional traits		-	-		-
		Dead Wood					YES

		Other	erosion destruction, permanent grassland, planting, artificial construction, cultivated arable land	-	-	Invasive species
		(continuation)	**SVK (A. Kidová)**	**SVK (M. Slezák & M. Šibíková)**	**BIH (R. Nurković)**	**SVN (G. Urbanič)**
Riparian Vegetation Assessment	**Name of protocol /index**		Hydromorphological monitoring for ecological status assessment (GES, GEP)	-	NOT SAID THE NAME	SIHM method
	Related to WFD HYMO assessment		YES	NO	YES	YES
	Referred to river typologies		YES	YES	-	YES
	Referred to reference conditions		YES	NO	YES	YES
	Existence of RV reference types		YES	NO	NO	YES
Riparian Vegetation PRESSURES AND IMPACTS (Rank of human activities from 1, most important, to 7, less important)		**Agriculture**	1	3	RELEVANT	1
		Urbanization	2	2	RELEVANT	2
		Mining	3	1		5
		Navigation	5	4	RELEVANT	6
		Recreation	4	5		4
		Grazing	6	6		3
		Others	7	7		7
Riparian Vegetation PRESSURES AND IMPACTS (Rank of impacts from 1, most important, to 7, less important)		**Land cover changes**	1	2		1
		Water pollution	4	4	RELEVANT	4
		Flow regulation by dams and reservoirs	3	1		3
		Groundwater depletion	6	6		6
		Channelization	2	5	RELEVANT	2
		Invasive species	5	3		5
		Others	7	0		7
Riparian zones and their vegetation are in your country during the last decades:			Improving their status	Degrading their status	Degrading their status	Degrading their status
Reason			Due to actual trend of the river channels incision, the riparian zone is less affected by flood			Especially increased pressures from the agriculture, river

	discharges, i.e. increased riparian zone area.			damming and urbanization.

	COUNTRY (Name of reporter)			LTU (L. Baležentienė)	HUN (T. Kiss)	ITA (N. La Porta)
Riparian zone: LEGAL DEFINITION				No exist	2 year flood return period in free floodplains; In confined FP: area between embanked levees	Not said (Rinaldi et al 2011)
Riparian OWNERSHIP				Mixed. All people have the right to access water bodies. Land owners have a duty not to impede them to do so.	Mixed. Different rules according to ownerships: public, towns, forestry companies…	Both. Maintenance works mainly done by public administration. Removal of wood and vegetation for safety
Riparian MANAGEMENT PLANS	**Conservation/Biodiversity (E.g., Natura 2000)**			-	YES	YES
	Protection / Conservation of buffer functions in agricultural land			YES	YES	YES
	Flood control			YES (some restrictions)	YES	YES
	Specific constraints in urban areas				YES	YES
	Other (specify)			-		
Riparian Vegetation (RV) DATA SOURCE	**RV inventories**	**National scale**		-	-	-
		Regional /Local scale		YES	YES	-
	RV indirect monitoring (included in HYMO monitoring within the WFD implementation)			-	-	-
	Data acquisition	**FW: field work AP: air photos**		FW	FW	Both
Riparian Vegetation CHARACTERIZATION	**Phytosociological / Autoecological approach**	**Species composition**	**Presence**	YES	YES	YES
			Abundance	NO	-	YES
		Habitat features	**Flow conditions**	-	-	-
			Channel conditions	-	-	-
	Spatial features	**Longitudinal continuity**				Qualitative/Quantitative
		Vegetation cover		-	Qualitative/Quantitative	Quantitative
		Size / Shape vegetation patches		Qualitative	Qualitative/Quantitative	Qualitative
		Other structural features		-	-	-
	Functional approach	**Age diversity**		-	-	-
		Pioneer recruitment		-	-	QUANTITATIVE/ QUALITATIVE
		Functional traits		-	-	-

		Dead Wood		NO	QUANTITATIVE
		Other	Invasive herbaceous species	Floodplain width	
		(continuation)	**LTU (L. Baležentienė)**	**HUN (T. Kiss)**	**ITA (N. La Porta)**
Riparian Vegetation Assessment	**Name of protocol /index**		The total plant species composition and cover (%)	IMMI EQR	NAME IS NOT PROVIDED
	Related to WFD HYMO assessment		NO	YES	YES
	Referred to river typologies		YES	YES	YES
	Referred to reference conditions		YES	YES (1860-70)	YES
	Existence of RV reference types		YES	NO	YES
Riparian Vegetation PRESSURES AND IMPACTS (Rank of human activities from 1, most important, to 7, less important)		**Agriculture**	-	1	1
		Urbanization	-	5	2
		Mining	-	7	4
		Navigation	-	6	6
		Recreation	-	5	5
		Grazing	-	0 Positive	3
		Others	-	Forestry (1)	
Riparian Vegetation PRESSURES AND IMPACTS (Rank of impacts from 1, most important, to 7, less important)		**Land cover changes**	-	1	2
		Water pollution	-	4	5
		Flow regulation by dams and reservoirs	-	6	6
		Groundwater depletion	-	3	3
		Channelization	-	5	1
		Invasive species	-	2	4
		Others	-	-	-
Riparian zones and their vegetation are in your country during the last decades:			-	Degrading their status	Degrading their status
Reason				Intensive forest plantations since 80's, problems with invasive species, incision problems	The above human activities are increasing. Also invasive species.

	COUNTRY (Name of reporter)			ITA (A. Andreoli)	SRB (J. Milovanović)
Riparian zone: LEGAL DEFINITION				-	Areas unprotected from floods: 10 m; Areas protected from floods: 50
Riparian OWNERSHIP				PUBLIC	PUBLIC
Riparian MANAGEMENT PLANS	Conservation/Biodiversity (E.g., Natura 2000)			-	YES
	Protection / Conservation of buffer functions in agricultural land			-	-
	Flood control			-	-
	Specific constraints in urban areas			-	-
	Other (specify)			-	Special laws relating with national parks and monuments
Riparian Vegetation (RV) DATA SOURCE	RV inventories	National scale		-	-
		Regional /Local scale		YES	YES
	RV indirect monitoring (included in HYMO monitoring within the WFD implementation)			-	-
	Data acquisition	FW: field work AP: air photos		Both	FW
Riparian Vegetation CHARACTERIZATION	Phytosociological / Autoecological approach	Species composition	Presence	-	YES
			Abundance	-	NO
		Habitat features	Flow conditions	-	YES
			Channel conditions	-	YES
	Spatial features	Longitudinal continuity		Quantitative	Qualitative
		Vegetation cover		-	Quantitative
		Size / Shape vegetation patches		-	NO

		Other structural features	Lateral connectivity	Lateral connectivity
	Functional approach	**Age diversity**	-	QUANTITATIVE/QUALITATIVE
		Pioneer recruitment	-	NO
		Functional traits	-	NO
		Dead Wood	QUANTITATIVE	QUALITATIVE
		Other		
		(continuation)	**ITA (A. Andreoli)**	**SRB (J. Milovanović)**
Riparian Vegetation Assessment	**Name of protocol /index**		IDRAIM/SUM/MQI	Stream Visual Assessment Protocol 2 (SVAP 2) and Proper Functioning Condition (PFC)
	Related to WFD HYMO assessment		YES	YES
	Referred to river typologies		NO	YES
	Referred to reference conditions		NO	YES
	Existence of RV reference types		NO	NO
Riparian Vegetation PRESSURES AND IMPACTS (Rank of human activities from 1, most important, to 7, less important)		**Agriculture**	2	3
		Urbanization	4	1
		Mining	3	2
		Navigation	-	4
		Recreation	-	5
		Grazing	-	6
		Others	1.River cleaning	
Riparian Vegetation PRESSURES AND IMPACTS (Rank of impacts from 1, most important, to 7, less important)		**Land cover changes**	3	4
		Water pollution	5	3
		Flow regulation by dams and reservoirs	2	2
		Groundwater depletion	6	6
		Channelization	1	1
		Invasive species	4	5
		Others	-	0
Riparian zones and their vegetation are in your country during the last decades:			Improving their status	Degrading their status
Reason			Conscience about the importance of riparian vegetation is slowly growing,	Dam construction, drought, erosion

	together with river restoration actions promoted by WFD	