

# Technical Note 4



## WHAT IS RIVER RESTORATION?

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The mission of the Iberian Centre for River Restoration is to revert the trend of degradation that river ecosystems undergo at present.

CIREF is an independent, non-profit organization. It is constituted by a group of professionals linked to river restoration in the Iberian Peninsula, coming from universities, authorities, private consultancies and non governmental organizations. For more information, visit:

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Cover: Demolition of the Mendaraz dam (Urumea River). Diputación Foral de Gipuzkoa.

# WHAT IS RIVER RESTORATION?

## Table of contents:

<b>1. The big challenge of recovering natural systems</b>	<b>3</b>
<b>2. What is and what is not River Restoration?</b>	<b>4</b>
<b>3. Utopian restoration or realistic rehabilitation?</b>	<b>5</b>
<b>4. Principles and difficulties of River Restoration</b>	<b>6</b>
<b>5. Looking ahead</b>	<b>7</b>
<b>6. Glossary</b>	<b>11</b>
<b>7. More information</b>	<b>12</b>



# WHAT IS RIVER RESTORATION?

## 1. The big challenge of recovering natural systems

Environmental or ecological restoration is the most advanced of the management processes of a natural system, used as a final solution in the cases where deterioration occurred when preservation and prevention of the disturbance failed. Restoration is essentially a process based on recovery but also on correction and prevention. It is the last and most advanced step, but only viable and feasible in sustainable environmental management situations, while it is difficult or almost impossible in societies unable to refuse on an unstoppable consumption of resources. In these cases restoration is very urgent and necessary, but it is inapplicable due to the impossibility of eliminating or even reducing the pressures that caused the disturbance. In these economically “advanced” and environmentally unsustainable models it could be aspired to achieve some rehabilitation, some small improvements, or to protect small and unconnected sites. In general terms, some unusual restoration successes have been produced in small and relatively closed natural systems (endorheic wetlands, for instance), but no real restoration processes have been carried out in more extensive, open and complex systems.

It is precisely in these societies of consumerism and serious environmental decline where concerns and scientific and social initiatives of restoration have emerged, which unfortunately are forced to remain in theories or good intentions. From both, the conservationist and the environmental scientific approach the feeling of the beauty of nature and conservation responsibility has been developed. It is a duty to preserve and improve our environment to transfer it to future generations in good status (Convention for the Protection of the Natural and Cultural Heritage, approved by the General Assembly of UNESCO in 1972). We even have the moral obligation of recovering the environments damaged by a long history of insensible works on nature. Only very recently it has started to be appreciated that natural systems are active, dynamic, heterogeneous, complex, unstable, temporary, they fluctuate, they are irregular, unexpected, in continuous change, the aesthetic of the changeable and wild, rejecting taming and simplification defended by the society of consumerism and “well-being”.

This way, restoration has become a big challenge of our time, but it remains in an unrealizable chimera. A deep mentality change would be necessary in territorial and environmental thinking towards the reduction of the

*Channelling in  
Herrera de los  
Navarros (Zaragoza)*





*River dredging and vegetation “cleaning” cause very serious impacts that modify the hydrological and ecological functioning of the fluvial system. Arba River in Rivas (Zaragoza)*

consumerism and the sustainability. The society may not be ready for such a change, but it is interesting to confirm that in these “advanced” societies an important deposit of employment and market niche has emerged around “restoration”, together with a reason of prestige and location factor for “restored sites”. They are not usually authentic restoration cases, but actions of “make-up” that are included in urban and speculate processes. It is the marketing of the “restoration” word, used in excess, with absolute lack of property and without any environmental objective.

Against the challenge or utopia of the authentic restoration, recently new optimistic trends have shown up in the field of river restoration which give up returning to impossible natural status and stand for a restoration based on specific and feasible objectives, incomplete but responding to criteria of naturalness that contribute to benefit society. It is an interesting approach that, although it implies renouncing to ideals, opens many doors, even though it requires a careful design of the amelioration plans due to the risk of falling in pure marketing and forgetting the environmental objectives.

## 2. What is and what is not River Restoration?

To restore is to re-establish or recover a natural system through the elimination of the impacts that degrade it throughout a prolonged period of time, until the natural and self-sustaining functioning is achieved. A restored natural system would have recovered:

- Its natural processes and all interactions among its elements and with other systems,
- Its structure, that is, all its components and fluxes in their entire complexity and diversity,
- Its functions in the Earth system (transport, regulation, habitat, etc.),
- Its territory, that is, its own continuous space that should be occupied to develop all its processes and functions,
- Its natural dynamics throughout time,
- Its resilience against future impacts and its self-regulation and self-recovery capacity,
- And therefore, all the goods and services that provides to society.

In short, the process of restoration must attain **naturalness, functionality, dynamism, complexity, diversity and resistance for the natural system. The real restoration is, therefore, self-restoration.** The system needs to be able to self-recover only progressively, through a process, from the moment the impacts are removed.

Objectives of the restoration should not be a pretended “beauty”, neither leisure, nor stability, as it frequently is, neither simply obeying the current regulations. **Restoring is not stabilizing, planting, gardening, urbanizing, making-up or camouflaging.** For instance, strict landscape restoration is not real restoration, since it does not seek a natural objective as it focuses on the scenic quality of the natural system or of any of its elements, instead of focusing on its functionality or dynamism. Bioengineering or natural

engineering techniques, more and more used, should not be necessary associated to real restoration, since they are usually applied with aesthetic or stabilizing objectives.

### 3. Utopian restoration or realistic rehabilitation?

Therefore, **there is a real restoration and many possible partial improvements**, to which it is convenient not to call restoration, but rehabilitation, reestablishment, remediation, mitigation, naturalization, creation, conditioning, remodelling, etc. depending on their nature. It seems that against the real, but many times utopic, restoration the concept of rehabilitation is being consolidated as the group of feasible measures for improvement, when total recovery is not possible.

While restoration is a theoretical paradigm, pure, that responds exclusively to environmental objectives, rehabilitation is a practice that responds also to those objectives but with the limitations imposed by the human pressures and with the consensus of the society, being defined by the practitioners. Rehabilitation is, therefore, a management strategy against restoration, which is exclusively and strictly conservationist. Both are based on scientific background, but rehabilitation is basically technical. Restoration is passive, since the work is done by the natural system, once the impacts are removed, but rehabilitation is most of the times active, since it uses particular techniques and structures to accelerate the processes.

In short, **the real restoration is in practice extremely difficult because of two main reasons:**

- Because many human activities are not compatible with the natural systems and should be modified or moved, and this is socially and economically very complex. The real restoration would be a “revolution”. To restore, there are two main requirements that society should be willing to assume: eliminate or reduce to a minimum the sources of deterioration and reconsider the human activities that generated those sources. However, the intense urbanisation and speculation processes keep increasing a continuous environmental deterioration. While some spaces are being restored, many more will be deteriorated by human actions, domestication of the environment, urbanisation and deterioration of the ecological status. It seems likely that while society does not change its resource and territory consume habits restoration will be a useless task.

- Because in most restoration cases it is not possible to find reference natural status in the past. Human intervention has been extensive, complex and durable, and has disturbed natural systems directly, but also in many indirect ways very difficult to identify and quantify. It is not sufficient to return, for instance, to the preindustrial situation. It is impossible to know in which past moment a system found its best status. There are also some particular ecosystems that found their biodiversity and complexity high in the periods of greatest human intervention. And the reality is that it is impossible to reproduce a past situation since everything has evolved following a trajectory. Nature is in each moment product of conditions that would never be repeated. And in the process of recovery they will never be repeated exactly in the same trajectory that as the original succession. If the concept of trajectory is



*Demolition of the Mendaraz dam in Urumea River (Gipuzkoa). BIDUR transboundary cooperation project for the management of Urumea and Bidasoa Rivers. Gipuzkoa Council (IKT), Government of Navarra (GAVRN) and General Council of Atlantic Pyrenees.*

*Vallacuera embankment removal in Arga River (Navarra). LIFE-GERVE project, Ecosystemic management of rivers with European Mink. Government of Navarra-GAVRN.*



accepted, restoration is only applicable at a very short term and for local perturbations.

Facing these difficulties, a progressive change in the thinking of the restoration defenders is moving towards **more feasible positions clearly located in the grounds of rehabilitation**. At the same time, fundamental importance is being given to naturalness as environmental management key factor, considering other natural characters, regardless of their origin and trajectory, as a source of benefits for the society (do not mistake “natural” with “pristine” or “virgin”, which are now impossible). It is also assumed the role of human beings in natural systems and the need to include in the environmental recovery the cultural values together with the natural values. **This new perspective is fundamentally practical, in the sense that it is easier to be implemented, more “saleable” and socially acceptable. However, two problems are present: a) in many cases, interventions may be limited to a very superficial make-up, recovering very few natural values; b) it could favour that rehabilitation becomes a business or a political promotion tool.**

#### **4. Principles and difficulties of River Restoration**

According to what has been said, real river restoration should focus mainly on hydromorphological self-restoration and would need natural flows that include floods, mobile sediments, space (Fluvial Territory) to develop natural dynamics, removal of transverse and longitudinal obstacles and time for self-recovery. However, this real restoration is almost impossible, since rivers, streams, gullies and ravines

suffer numerous pressures and impacts in the entire catchment, most of them being of complex removal. If removal of all those impacts would be possible (dams, defences, channelling, etc.), river restoration would be fast and effective, since a few floods would be enough to recover the entire natural functioning of the system.

The main difficulties to restore rivers come from the enormous complexity of the fluvial systems, from the impossibility of restoring big impacts (reservoirs), and from the lack of precedents (at least in Iberian Peninsula and Mediterranean countries) that would serve as models, together with the enormous social inertias, administrative conflicts and absence of political and social will to restore the fluvial dynamics. It might be added also the temporary pressure under which many restoration actions are carried out, limited many times by political cycles. Since restoration is based on a relatively young scientific knowledge, practice goes faster than theory. Besides, river restoration needs the application of cross-disciplinary knowledge, which is many times difficult to achieve.

Contemporary society consumes high quantities of water and sediments (aggregate) and has occupied a great amount of the Fluvial Territories through intense processes of urbanism, speculation and big road infrastructures and services that continue deteriorating the fluvial systems. Besides, social demands have little to do with real restoration: security, stability, fluvial parks, river taming, urban models against nature (gravel and vegetation are usually synonymous of “dirty”), unnecessary ripraps, etc.

River restoration would lean on measures such as prohibition or rigorous limitation of dredging and

*“Cleaned” river and River Park in Bergasa (La Rioja)*



“cleaning”, demolition of dams to allow sediment transport, recovery of natural flows and revitalizing highs, removal of defences to allow bank erosion and mobilisation of sediments, recovery of the riverbed mobility space, to allow generation of new sediment surfaces that may (or not) be colonized by vegetation, to allow hydrogeomorphological dynamics to structure riverbanks as complex mosaics of biodiversity habitats that would host autochthonous species, etc. In short, it would seek to eliminate from the fluvial systems the pressures in order to recover its natural functions.

A basic determinant has to be taken into account: the scale of the intervention, to what stretches the project affects, what are the downstream effects. Ideally complete fluvial systems should be restored, but this is not always possible.

Against everything said so far we find the reality, a poor substitute that most of the times is marketed as

restoration: bank stabilisation, even in the cases where soft techniques as bioengineering are used, plantations, gardening and urbanisation of margins, rip rap and dredging “greening”, enlargement of the draining section, etc. Including interventions targeting an increase of the heterogeneity and biodiversity that created new complex and meandering rivers where natural rivers were much simpler. In short, a version of the river restoration is being constructed as a strategy for obtaining economic benefits, publicity and appearance, to which administrations dedicate increasing budgets with scarce control over the end use, since under the name of “restoration”, interventions contrary to environmental objectives are being financed.

## 5. Looking ahead

We should not beforehand renounce to river restoration because of the difficulties explained. It may be perfectly feasible and viable in stretches only affected



*“Environmental improvement” Chillar River in Nerja (Málaga)*



*Intervention in Sosa River in Monzón (Huesca). The low water riverbed was canalised by rip raps, but collapsed due to the incision caused by the straight canalisation.*



by local impacts. Therefore, restoration proposals and programmes should still be designed, even if many difficulties are foreseen, as they may be transformed in rehabilitations if circumstances occur. Having said that, in complex systems affected by many pressures and impacts rehabilitation based on specific objectives and carried out through specific actions is compulsory. It may be interesting to think in restoration and act in rehabilitation, to develop the theory and principles and, having them in mind, to implement the rehabilitation techniques, trying to reach as far as possible with the restoration ideals.

Restoration and rehabilitation should be more based on future objectives than in recovering past situations. If a reference model is necessary, it has to be looked for in another close natural fluvial system that remains in good status, better than looking in the past. It is essential to define clearly and precisely the objectives that would be achieved through the combination of what is aimed to recover in the fluvial system and what is functionally possible according to its trajectory and state. They should be based on natural values and in local characters. In some cases what society needs and what is economic feasibility may also be kept in mind, together with cultural aspects that should not be underestimated in an environmental improvement project.

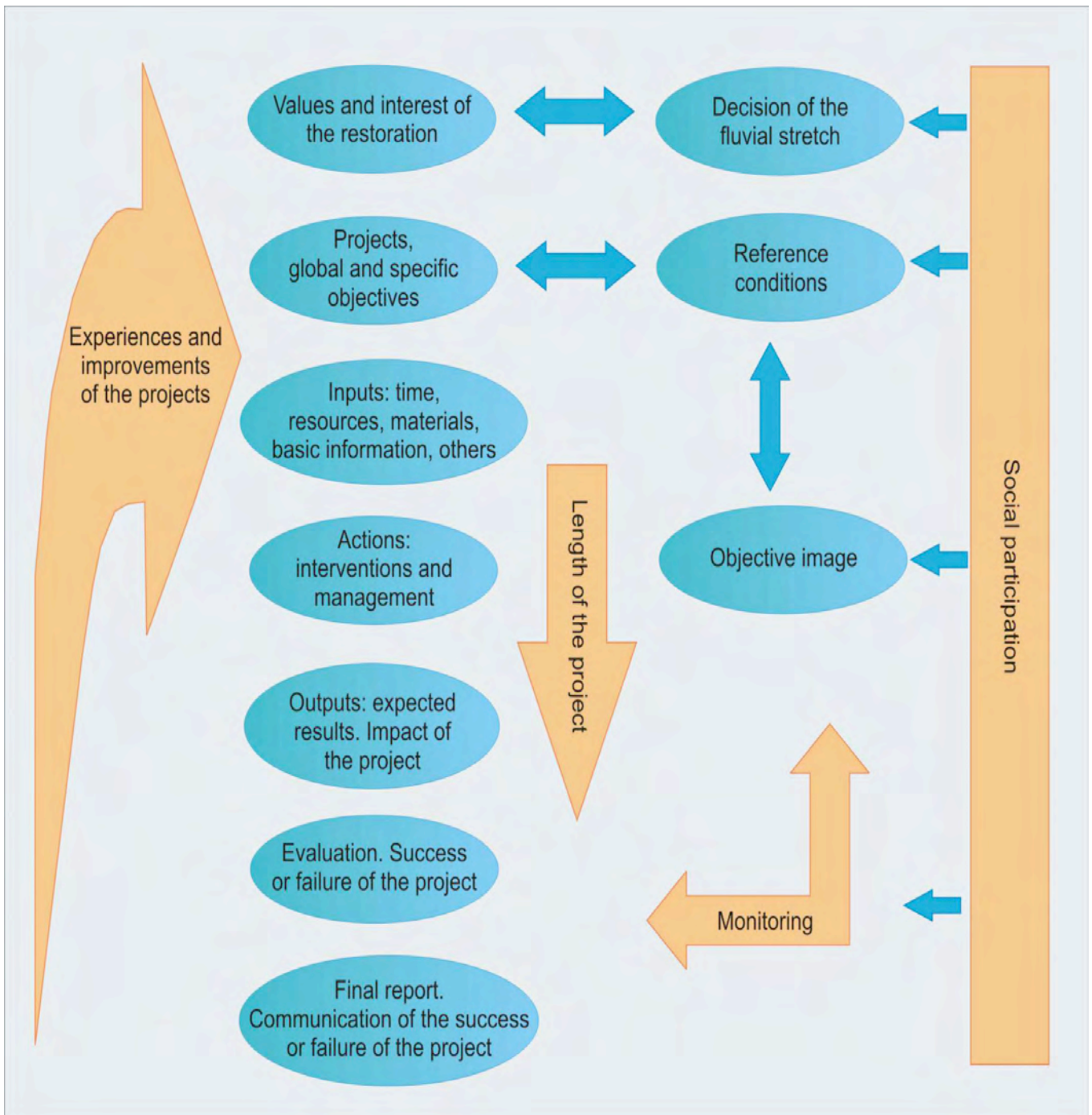
It is urgent to develop new regulations and establish public protection procedures of the restoration and rehabilitation. Some laws and European directives do not address restoration, but they establish valid foundations. Meanwhile,



*“Riverbank restoration” in Gállego River (Zaragoza)*

moratoriums for some impacting activities could be suggested, together with a tightening of the environmental impact evaluation procedures. Seemingly, it is needed to work on new figures of land and urban planning. In other words, it is necessary to integrate restoration in broader management plans.

As it has been mentioned, river restoration is a management process that should be applied when degradation has occurred. However, it should be insisted that in many cases degradation, which would prevent the latter restoration, may be avoided. Therefore, the main objective that should be applied to river management should be conservation of the fluvial system. Prevention is a cheap and useful tool, although many times forgotten. It should be addressed to increase environmental awareness



**The process of restoration or rehabilitation.** Based on Woodhill & Robins (1998). González del Tánago & García de Jalón (2007).

of experts and general public, together with the development of administrative measures whose application would ensure an appropriate protection of fluvial systems, which would result in a greatest respect towards our rivers.

In this sense, it is necessary to demand the compliance of the rare current protective

environmental regulations in front of the urban and territorial pressures, as it is stated in article 2 of the 42/2007 Spanish Law of the Natural Heritage and Biodiversity, that establishes as principle that “environmental protection shall prevail over territorial and urban planning”.

River restoration cannot be dependent on economic budgets set out for short periods of time. Both restoration and rehabilitation are processes that require long periods of time that need scientific monitoring and which conclusion can neither be foreseen nor certified. Interventions cannot be carried out just because they can be easily viewed or sold, since they would probably become a failure in terms of the environmental objectives achieved. The essential monitoring of the results to verify the achievement of the objectives may many times require the readjustment of the objectives and the means of the restoration or rehabilitation process, in the line of the adaptive management.

Good technical and scientific training is essential and as a big professional demand may be foreseen, it is necessary to consolidate educational programs on higher education. Society's environmental education addressed towards the natural functioning of fluvial systems and the benefits and objectives of the recovery processes is also basic. In this sense, it cannot be called restoration to what it is not. Society cannot be misled trying to sell interventions with a "green appearance".

Any activity that may potentially affect in a negative way the conservation of the natural heritage, should include active public participation. In river

restoration, this principle is even more relevant as fluvial systems have always been communication axis, source of resources and reason of conflict for its occupation and use. If restoration or rehabilitation of a stretch of river is expected, it has to be achieved that stakeholders that live or enjoy the territory participate. But, what participation and how?

First of all, to accept the objectives of the project, the promoter should make an intense effort in the early stages of its development to include as many interested parties as possible in order to make them feel that it is not going to be a simple technocratic document or an ecologist pointless gesture, no matter how good the intentions are. The final project should keep in mind the different feelings, cultures, traditions and positioning of the area where intervention would be carried out, since nobody owns the exclusivity of the fluvial heritage. All the time invested in this phase, that may be considerable, is a clear profit for the phases to come.

During the development of the interventions it is again necessary that people related to the fluvial space are actively involved. Many days of massive plantations or other well intentioned activities became a failure causing disaffection and disappointment. Therefore, yes to participation, but together with previous clear information and technical qualification, explaining



*Fluvial rehabilitation in an urban environment: Sant Boi de Llobregat (Barcelona). Developed by Aquanea for the Municipality of Sant Boi.*

how, where and when to assist in achieving the foreseen objectives and pointing that it is more important to recover spaces and processes than planting and that sometimes, a river with gravel bars or steep riverbanks with no vegetation may be more interesting than dense river forests. It is therefore required an expert supervision of the volunteer participation, avoiding excessive mandates. “Politically correct” picture of the public participation addressed to an advertising report, should be avoided and instead the environmentally effective results should be encouraged. But participation neither cannot end up here: restoration is a long term objective with feasible technical, social and economic costs, that would need that once the works have finished, active public participation insists on monitoring, conservation and maintenance of the objectives achieved.



## 6. Glossary

**Bioengineering.** Discipline specific of the engineering that studies the technical and biological properties of the plants and living fragments of autochthonous species and their use, as an isolated or combined way with other inert elements as stones, steel or wood, to be used as construction elements in environmental recovery works of riverbank stabilisation or erosion control.

**Fluvial Dynamics.** Group of complex active processes and geomorphological changes of the fluvial systems (migrations and river itinerary changes, eroded banks, sedimentary deposits, etc.) in either its spatial component (along the fluvial axis, transverse or vertical) or its temporal evolution.

**Dredging.** Excavation of the alluvial materials deposited in the riverbed, generally carried out to increase channel width and therefore its draining capacity. Dredging can sometimes be carried out with purely commercial purposes, prior authorization by the competent authority.

**Canalisation.** Literally, to canalise. Any intervention that takes a stretch of a river as objective of intervention usually with flood protection purposes (to impede or difficult flooding of territory).

**Adaptive management.** Continuous process of improvement of a management system as it is being implemented. Model of verification of hypothesis as “learning by doing” perspective. It is based on the adaptation to the natural processes, observed through monitoring and agreements with all stakeholders to vary the conditions and always seeking the sustainability.

**Impact.** Effect on a natural system of one or more human induced pressures.

**River cleaning.** Group of interventions carried out in a river to increase its draining capacity through the removal of obstacles: vegetation clear cutting, pruning or removal, dredging or other removals that do not include civil works.

**Pressure.** Any human activity that could modify a natural system producing an impact.

**Reference.** Condition that could be used as model to establish the objectives of a restoration or rehabilitation process. It May be found in real current or past examples or it can be a theoretical model.

**Resilience.** The ability or capacity of a system subject to a disturbance to maintain its functions. It has three main properties: the quantity of change the system can bear, the degree to which it can self-organise and the degree it can build its adaptation capacity.

**Fluvial system.** Integrated in water, solid and biogeochemical cycles, it is a complex hydrological, geomorphological and ecological mechanism of mobilisation of surface continental waters, accompanied by the materials that are transported, sediments and nutrients, with an enormous mass and energy transport capacity. They are open systems, tremendously dynamic in space and time and considerably complex.

**Fluvial Territory.** Land, area or landscape dominated by a fluvial system. River space, geomorphological and ecologically active, that includes the riverbed, riverside corridor and part of, or the entire, floodplain. It should be wide, continuous, subject to flooding and erosion, no defended and no urban space. See CIREF’s Technical Notes, nº 1.

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**Some interesting links related to River Restoration:**

Centro Ibérico de Restauración Fluvial: <http://www.cirefluvial.com>

European Centre for River Restoration: <http://www.ecrr.org>.

Fundación Nueva Cultura del Agua.: <http://www.unizar.es/fnca/index3.php?pag=11&id=1>.

Estrategia Nacional de Restauración de Ríos. MARM: [http://www.mma.es/portal/secciones/acm/aguas\\_continent\\_zonas\\_asoc/dominio\\_hidraulico/conserv\\_restaur/index.htm](http://www.mma.es/portal/secciones/acm/aguas_continent_zonas_asoc/dominio_hidraulico/conserv_restaur/index.htm)