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Challenges of River Restoration in Italy: significant experiences and trends

Paolo Negri, Pier Mario Chiarabaglio, Lorenzo Vietto, Emanuela Gravina, Andrea Nardini

ABSTRACT: Italian rivers belong to a wide variety of typologies, ranging from Alpine glacier-fed streams to ephemeral Mediterranean ones, from large rivers as the Po to spring-fed brooks and artificial canals, all flowing in very densely populated areas. The different geographic, morphological and climatic settings of the territory imply different challenges in terms not only of stream typologies but also of land-use, high urbanisation, high pollution and high pressure on water resources. On the other side, an extremely complex legal context and an evolving and still confused institutional and administrative setting definitely complicate the scenario. The Centro Italiano di Riqualificazione Fluviale (CIRF) is active in contributing to the debate in our Country regarding topics like the effectiveness and economic meaning of stream restoration as an alternative to flood control by means of near-to-natural solutions (e.g. focussing on the management of river vegetation); the perspectives available to manage conflicts amongst the several interest groups involved in river management and exploitation. Specific difficulties and challenges due to the highly variable climatic regime, highly urbanised and mountainous context is discussed, together with legal and administrative problems in relation to existing river management policy.

KEYWORDS: river restoration, river management, Italian River Restoration Centre, CIRF

1 River Restoration policy in Italy

A river restoration policy does not look only at water quality and minimum instream flow requirement ; and it involves scientific and technical knowledge, socio-economic interests as well as a legislative and administrative setting and financing means. Most important, river restoration policy tries to bring rivers closer to their natural state and first of all to stop their artificialization and deterioration. Such a broad-view policy is still lacking in Italy where apparently “watercourses” in good shape in a broad sense are not recognised yet as a clear advantage for men and a duty to the environment. The Italian contest makes rivere restoration opportunity quite difficult and complicated owing to a strong variety of climatic, hydrological, morphological conditions, a very dense and often “wild” urbanization together with an extremely complex and evolving legal and administrative setting and a weak financing system. This paper aims to give an overview of the Italian context regarding river restoration and its challenges.

2 Italy: extreme variety of conditions

2.1 Climate and morphological heterogeneity

Italy is very rich in terms of water although the distribution of the water resources is not widespread all over the country. The majority of this availability is in the north (65%),

15% in the centre part of Italy, 12% in the south and just 8% on the main islands (ANPA, 2001). This differences in terms of quantity reflects the variety of climate conditions of the Italian rivers. In Italy the climate is subdivided into different typologies which are difficult to classify because of the topography of the peninsula, where plains, mountains and coastal areas frequently alternate. The types are characterized by a variability in temperature, precipitation and humidity. For example the analysis of precipitation through the country (estimated during the period time from 1920-1950, elaboration from ANPA, 1999) have shown how the percentage of water quantity due to rainfall, is in the North 41%, in the Centre 26%, in the South 21%, in Sardegna 6%, in Sicilia 6%.

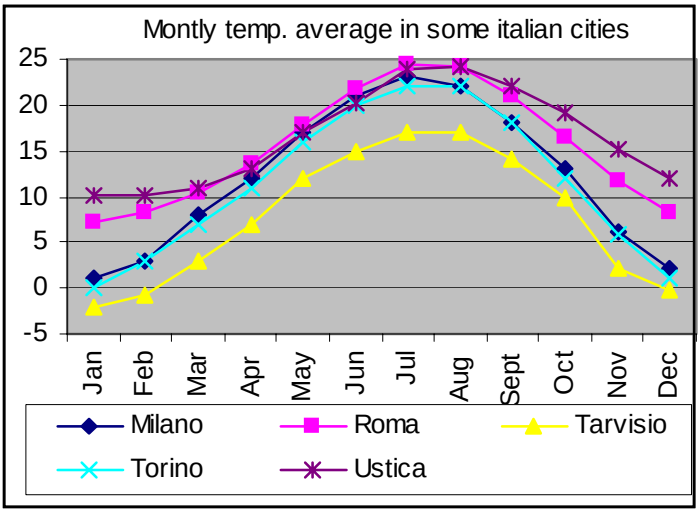

Figure 1 Montly temperature average in some Italian cities (in °C)

A realistic comparison of statistic climatic data dealing with the N-S axes, the geographic position and the altitude clearly show distinct differences in climate (source www.worldclimate.com). The heterogeneity of waters includes alpine glacier-fed streams, which generally blend scarce winter flows alternated with full summer flows due to melting snow; pre-alpine streams which have a secondary flow in autumn months as well; groundwater-spring fed rivers are also present in Northern Italy; while southern streams are extremely subject to the amount of precipitation with full flows during winter, and possibly scarce or totally dry state during summer. A wide variability is also present in geo-morphological aspects. Calabrian streams, in particular, have peculiar characteristics of total dryness, a very wide bed, a very high level of solid transport and sedimentation during the rainy season. We have some wide rivers such as the Po, which runs from West to East crossing the country, or the Adige, the Tevere, the Arno and the Adda; and a large number of quick-flow, high slope smaller streams in the Alps as well as a huge number of artificial canals (mostly in the north), some of which are so old that it is reasonable to consider them nowdays as natural streams. This diversity combines with different local conditions dealing with a very high level of dense urbanization and consequent anthropic impact. A frequent situation is either an intensive agricultural use along river courses, or a constellation of industrial settlements; or both.

3 The anthropic impact

The major issues of the Italian rivers can be categorized as follows: non-natural or insufficient water quantity, bad water quality, modified morphology. This paragraph underlines briefly the related major problems.

3.1 Water quantity

Italy can be considered one of the richest European Country as far as water availability is concerned. The water use, however, still suffers from lack of water availability, particularly during the summer. Agriculture is the most "water demanding" sector with an average of 46% of the total consumption (but ranging to much higher values in some areas), industry is 36% and household 18% (OCSE, 2002) . Efficiency in agricultural water use is one of the worst in Europe in terms of water used/productivity ratio. This is partly structural, as the higher temperatures of Southern European countries imply higher evapotranspiration rates but Italy holds the highest consumption with almost 1800 m^3/ha per year (European Commission). Moreover the consumed water is not metered (a fee is paid based on the irrigated area) which is an incentive to unsustainable use. The domestic consumption is also one of the highest in Europe with 200 litres per day (OCSE, 2002). The re-use of water especially in the industrial sector with the scope of reducing pollution is a practice not well diffused in Italy (ANPA, 2001). According to the Annual Report to the Parliament about the state of water service (CVRI, 2002), the water quantity loss in the distribution system is more then 40% and can run up to even 70% in some parts of central Italy. The sustainable use of the water resources is therefore an important issue which is underlined by the ministry of Environment that in the Environmental National Strategy for a Sustainable Development (CIPE, 2002) writes "It has to be considered priority to reduce water needs …, by promoting actions to save, reuse and recycle water resources". This Strategy states even detailed priorities like: use water in a more sustainable manner firstly trough a lower abstraction from the natural water cycle and by improving the infrastructures, in particular by renewing the distribution systems whose average age is 30 years (CVRI, 2002); and reducing the total consumption starting from the agricultural sector. At the moment is not clear how on a national scale the policy will be put in place and which legal, regulatory and financial instruments will be adopted. The issue of minimum instream flow requirement is particularly hot as the need for that is widely recognized and legal tools exist which require an action to satisfy it, but huge (economic) interests are at stake and no suitable political instrument to re-discuss the withdrawal concessions has been defined yet that is able to link sufficiently tightly the political dimension and the technical dimension.

3.2 Water quality

The first attempt to protect (not improve) the water quality was the law 319 of 1976 which lists pollution discharge limits for several substances. This approach was overtaken by the new law 152 of 1999 that defines good water quality as the capacity for water bodies to maintain the natural self-purification processes and a wide and well diversified community of plants and animals. Since 1999 there is a monitoring network that now is almost fully established which provides a clear picture of the water quality of the Italian rivers (although it is far from providing data useful to develop cause-effect relationships, i.e. river quality models, as discussed in Nardini and Soncini-Sessa, 2003)

. In the 2002 annual report on the environmental data published by APAT (the newly formed National Environmental Agency) the ecological state of the watercourses (ESWC) is summarized for 85% of the Italian rivers. The ESWC does not reach the good quality state in 56% of the monitoring sites. However the water quality trends in last decays indicate that there is a general improvement. This seems to be the effect of the construction of new water treatment plants especially for urban wastewater but at the moment the 27% of the household wastewater is still not treated (CVRI, 2002). The pressure of the agricultural sector is one of the most critical issues to be challenged (OCSE 2002). On a national scale the agricultural nitrogen excess (measured as nitrogen balance on the soil surface) has decreased from 44 kg per cultivable hectare in 1985-1987 to 31 kg in 1995-1997, still higher than the OCSE average (23 kg/hectare), but lower than the EU (58 kg/hectare). For an excessive use of fertilisers the Southern artificial basin used for water storage have serious eutrophycation problems.

3.3 Morphology

Levees, river canalization and diversions were traditionally adopted, and still are, as a means of protecting from floods urban areas as well as crops and cattle The mechanization of agriculture produced a strong alteration of the flatland landscape removing diversification factors such as riparian vegetation (Conte, 2002). Urbanization stole rivers large areas with an unbelievable determination, and linear infrastructures such as railways and particularly roads criss-cross the water network introducing uncountable points of stiffness. Sand and gravel extraction from river beds , together with damming in the early 1900, heavily degraded rivers, some of them locally down to 12 m (Surian and Rinaldi, 2003).

3.4 An example above all: the river PO

The Po river, in the North plain of Italy, is an emblematic case: more than half its total length has been enclosed within levees intended to protect towns and fields; river banks have been heavily modified and paved almost all along the river course; nearly 25% of the land along its banks has been denuded of natural vegetation.(National Geographic). Has all this improved safety? We do not have yet a definitive answer, but a dramatic acknowledgment about the reduction of the river Po floodplain surface happened in 2000. During that autumn flood, the river Po discharge was almost 13.000 m^3/sec and the public authorities in charge of flood protection (Civil Protection, Magistrate for the River Po, River Basin Authorities) realized that such a volume of water would not have been flowed trough some urban channel bottlenecks. It was decided to evacuate the population of a small village in order to free an area where to let expand the river flow by removing a stretch of the flood protection embankment.

4 The Italian water management framework

4.1 The legal framework

The legislation regarding water protection and management are fairly numerous but the three key laws are the following:

1 The law 183/1989 Norms for the organisational and functioning rearrangement of the land protection. The key elements are the River basin authorities responsible for planning of water resources and flood.

2 The law 36/1994 Regulation regarding water resources introduces the integrated water service (abstraction, distribution, treatment, discahrge) planned managed by the a new institution called Optimal Territorial Extend.
3 The legislative decree 152/1999 Regulation regarding water pollution. This law foresees a water body monitoting network including some biological parameters. The regulation includes a protection plan whose objective is to achive good waterbody quality status by 2016, similarly to the WFD concept.

The principles of this laws are genuinely correct and valid, but the implementation strategy and the instruments are often still inadequate.

4.2 The competences on water

There is lack of co-ordination and integration between this different levels which may operate with measures that can be conflicting. A central organisation or committee involving the different stakeholders which can co-ordinate all different institution would be an advantage. The Italian competencies on water are fragmented and this situation could be summarised partially in the following points:

- There is not a general institution which is responsible for water management protection and monitoring on national scale. Different Ministries have different competences
- There are 7 national river basin authorities, whose role is mainly assessing and planning water resources and water bodies management on catchment scale. There also other river basin authorities based on interregional or regional scale.
- The 20 Regions are responsible for implementing the measure planned by the river authorities but these don't happen often as the general interests of these two bodies are different
- The Provinces are responsible for water discharge permits and water abstractions
- The drainage authorities play an important role as they mange the artificial canals network and they provide water for irrigation (53% of Italy surface) (ANPA, 2001).
- The municipalities (or a consortium of them) are in charge of water treatment and drinkable water distribution.
- The national and regional environmental agencies (ANPA, ARPA) carry out the monitoring on all water bodies.

5 Open issues for problems and solutions

In this mosaic of competences, legislation and water quality-quantity-morphological problems, what can be the space for river restoration? In this paragraph some key questions are addressed and discussed showing different point of view.

5.1 Hydraulic safety: the only objective?

The key planning tool of the Italian Basin Authorities, the river basin plans for hydrogeological setting, aims at driving the territory towards "security", i.e. avoid damages for all events with statistical recurrence time under a given threshold (usually 200 years). This, however, does not necessarily coincides with "minimizing the risk" because the probability of harsher events is still not null, while the goods at stake will certainly increase owing to the claimed security (more houses, more infrastructures, ...). Climatic

change depicts, on top of that, a future of even heavier, torrential rains, i.e. increased probabilities of by-passing the security threshold. In fact, floods are strong but natural phenomena which contribute, along with volcanic eruptions and earthquakes , to the normal evolution of a territory. In such a context, wouldn't it be wiser to try to "learn how to live together with the flood risk" rather than aiming at eliminating it forever , while giving a false hope? Above all, confusion between causes and effects should be avoided: although causes can generally be ascribed to natural phenomena (particularly violent and prolonged rains can cause a crisis in a whole catchments basin) the recent floods confirmed that most damages are originated by human errors: buildings too close to river banks or on land subject to landslides, too little land left to rivers to host flooding volumes, scarce maintenance of hydraulic works, under-sized bridges. We know indeed that building higher and stronger embankments, far from preventing floods, simply "moves" them a little downstream. Nevertheless, public opinion, somehow reflected in administrative tools, still claims with certainty that the cause of problems is the lack of river-bed clearing, insufficient embankments or flood diversion works, too much vegetation in river beds or even in the catchments, or (on the contrary, but at the same time) the process of abandoning mountain areas and the associated old-dating land maintenance works (terracing, creeks regulation, forest clearings, ...). It is therefore important to improve the understanding of basic phenomena and avoid demagogy by stopping to give people the illusion that all such risks can be eliminated forever. The current technical know-how, still too dependant on a structural approach, is being harshly questioned especially after the latest flood events. In some cases the high level of urbanisation or the existence of high-value high-risk activities definitely require the use of structural defences. However, in many others where the risk is limited it is clearly better to invest in rehabilitating the territory: restored areas can increase the opportunity for the river to expand in case of high discharge, enhanced environmental value and offer recreational and economical opportunities. The key question is, however, how far should we go in restoring rivers, how much land should we give them back; in other words, where is the desired equilibrium between the two extremes A, "current river management practice", extremely costly for building defence works, and B, "more natural rivers", with reduced damages, increased security, reduced interventions, but heavier social changes and more problematic acceptability: "would you leave your home to host the river, please?".

5.2 The conflictual dimension

River restoration requires a planning process which touches settlements and productive activities such as crops, industries, gravel quarry, waste dumping, and so on. A restoration plan is inevitably going to impact sectorial interests of all the river stakeholders and may cause conflicts. One or more lobby fronts against the project may rise and consequently also fund-rising can be problematic. Conflicts can however be prevented, resolved or mitigated through a participatory, transparent, open and flexible decision process which involves since the beginning all the different stakeholders. This process should be developed around a "win-win" negotiation approach that tries not to impose decisions but to identify problems and opportunities looking for a wide consent. Although "participation" is definitely a very used word and the number of experiences is increasing also in Italy (some also in land-use planning, as for instance the Vara project undertaken by the Basin Authority of the river Magra: www.adbmagra.it), no clear position and tools exist at the policy level, and know-how and cultural background are still lacking.

5.3 The instream and riparian vegetation: remove or leave it?

The issue of instream and riparian vegetation in Italy often generates discussions: someone for instance (Schippa, 1995) considers vegetation a hindrance to water downflow, others demonstrate the good effects of vegetation on water and river ecosystem quality (Negri, 1997) and downflow as well as on the reduction of soil erosion thanks to tree roots even of poplars (Benini *et al*., 1986); a recent study regarding the effects of two exceptional floods occurred in North-West Italy in 1994 and in 2000 on land adjacent to the Po river (Chiarabaglio *et al*., 2003) demonstrated that forests prevent soil erosion better than crops. Even the laws are in contrast: at the beginning of the XX century the National Law n. 523/1904 forbade the establishment of plantations in areas subject to flooding because coppice management produces a very thick artificial forest ("boschina") which reduces water downflow during the floods. In 1928, the National Law n. 381 suspended the bond on condition that the plantations be Poplar or Willow managed as high forest (Ponticelli, 1988) and the recent National Law 152/99 says to preserve 10 m strip width along river banks to restore and protect the native riparian vegetation. This two different visions of the river vegetation (obstacle to remove or advantage to maintain), apparently very distant, reflect indeed diverging objectives: security from floods and landsliding on the one hand, and water quality, biodiversity and so on, on the other hands. But again the idea that carrying away water as fast as possible is the best policy to face flood risk is being highly questioned as, once more, the effect is too often just "moving the problem downstream". Hence, instream vegetation can be beneficial also for flood control. The challenge is to conciliate these diverging objectives, and visions. Possibly, acceptable basic criteria include:

- Creation of new vegetated areas for the river which do not affect the water flow.
- Selective instream vegetation cut to enhance the morpho-diversity of the river bed and to reduce the water velocity and the erosion capability.
- Selection of tree species which can grow very quickly providing wood for commercial use having a life cycle very short, the vegetation can be maintained "young".
- Use of vegetated buffer strips to reduce the diffuse pollution especially coming from cultivated areas.

6 The role of CIRF

In Italy there is not yet a comprehensive water policy which includes river restoration. There have been and there are some river restoration projects which have more the spirit of pilot studies rather then being constitutive part of an integrated river basin management plan. Cultural background, sensitivity, know-how and political will is still lacking or weak and contradictory. This weakness motivated the birth of the Italian Centre for River Restoration (CIRF), a no-profit, cultural association of river experts and professionals, belonging to the public or private sectors, who want to promote the river restoration discourse. CIRF's action focusses on awareness rising, education, capacity building, public debate (training courses, workshops, field trips, events, technical or cultural publications, opinion documents) and on the promotion and guidance of demonstrative-pilot projects of river restoration and management. The concept of river restoration adopted by CIRF comprises different aspects: from the physical dimension (water regime and water quality; geomorphology , by recovering a fair deposition-erosion process; forestry and vegetation; biology and ecology itself, etc); to the policy dimension of planning and manage-

ment (setting objectives: flood control , recreation, water supply, ecosystem health, ... integrated evaluation of projects, plans and policies; management of public participation and conflict resolution; innovative financing and administrative schemes; ...). The Italian word "Riqualificazione" chosed by CIRF is however closer to "Rehabilitation" than to "Restoration". This is because CIRF thinks that in Italy it would be counterproductive to push straightforward towards "going back to previous, natural conditions": the political interpretation would indeed be to confine such an effort only within specific protected areas. While restoring particularly environmentally valuable areas and watercourses is certainly welcome and has to be pursued, it would be a mistake to disregard all the others where something can anyway be done. There, one has possibly to choose a less binding trade-off between the pure environmental objective, and the crude, but definitely important, economic objective. The challenge is to ascertain and demonstrate that restoring rivers is rewarding even economically, because "working with nature" is indeed the best policy under all points of view.

7. Conclusions

The modification of natural processes by human activities is particularly clear looking at the riverine environment. The need for re-balancing this process is the goal for the feature and it is addressed also by the EC policy with the Water Framework Directive 2000/60. In Italy, where the river types, morphological conditions and climate is very diverse from North to South, this is a very hard challenge and requires a great effort by the public authorities. Some positive signals, such as the water quality network or the current water legislation, are noticeable but more other actions are needed (OCSE 2002). For instance, the current interpretation of the EC WFD 2000/60 is basically confined to the water quality issue, almost disregarding the geomorphological, vegetational and landscape issues. A more holistic approach (sharing knowledge from different disciplines) and a multi-objecive vision (i.e. improving water quality + flood defence + areas for human activities) can contribute to re-create better functioning rivers. CIRF promotes river restoration as one possible contribution for re-establish natural processes, but does not claim to hold all answers for each problem. Some questions are still open and CIRF is willing to participate in this debate bringing its vision and learning from others. Survival of CIRF is however a challenge itself as fund-rising to drive public authorities and politicians to think differently can hardly be supported by the same subjects.

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Authors:

Paolo Negri, Pier Mario Chiarabaglio, Lorenzo Vietto, Emanuela Gravina, Andrea Nardini, CIRF - Italian Centre for River Restoration, Via Garibaldi, 44/A, 30173 Mestre (Venezia), Italy, Tel/Fax +39 041 615640, info@cirf.org, www.cirf.org