ECOTECHNOLOGIES FOR RESTORATIONING THE LOTIC ECOSYSTEMS

I. ECOTECHNIC METHODS FOR THE ECOLOGICAL RECONSTRUCTION OF WATERCOURSES

Method 1.**I**

Rivers within cities are generally contaminated being under hydromorphological pressure and isolated from other ecosystems. These rivers have to be restored ecologically by environmental restoration of some of their sectors. Generally, these riverbeds are made of concrete or gravel, therefore any lateral or longitudinal connectivity of these rivers is blocked destroying almost any ecosystem function. Ecological recovery or restoration means natural regeneration, environmental rehabilitation, reconstruction, remediation and construction.

Treated or untreated sources of pollution are generally located at the first bottom-up half of the height of concrete or stone wall channels within cities. Unfortunately, because they are not referred as aquatic ecosystems anymore, a first step in protecting these water masses is the construction of some platform beds. These platform beds are built over the first half of the channels walls height or are fixed into the channel walls, on the concrete pillars or are fixed into channels walls and concrete and pillars, too.

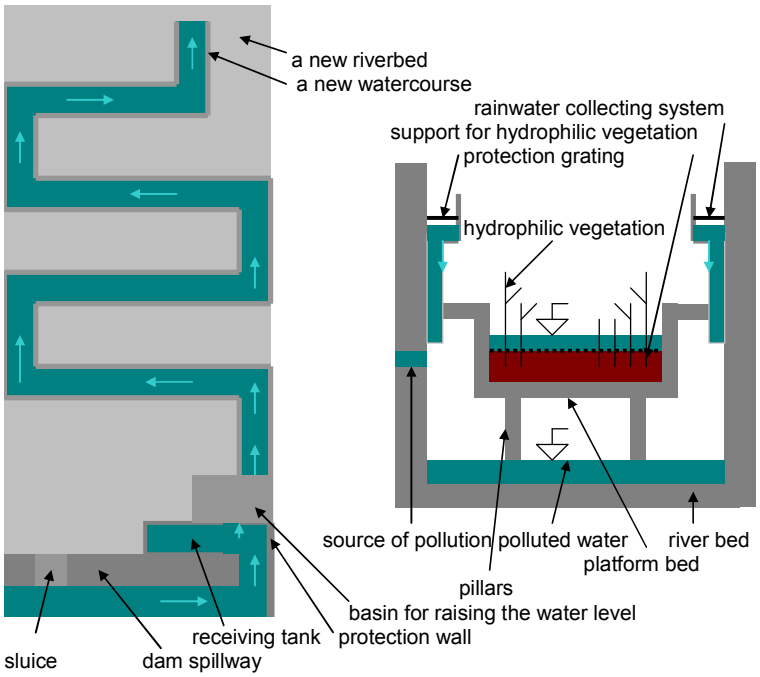

Fig.1.1.**I** The features of platform riverbed - indicative scheme

If water from the river is wanted to reach the riverbed platform it must first be directed to a settling tank and furthermore, another tank must be built in so that the water level in the tank to be higher than the water level of the bed platform.

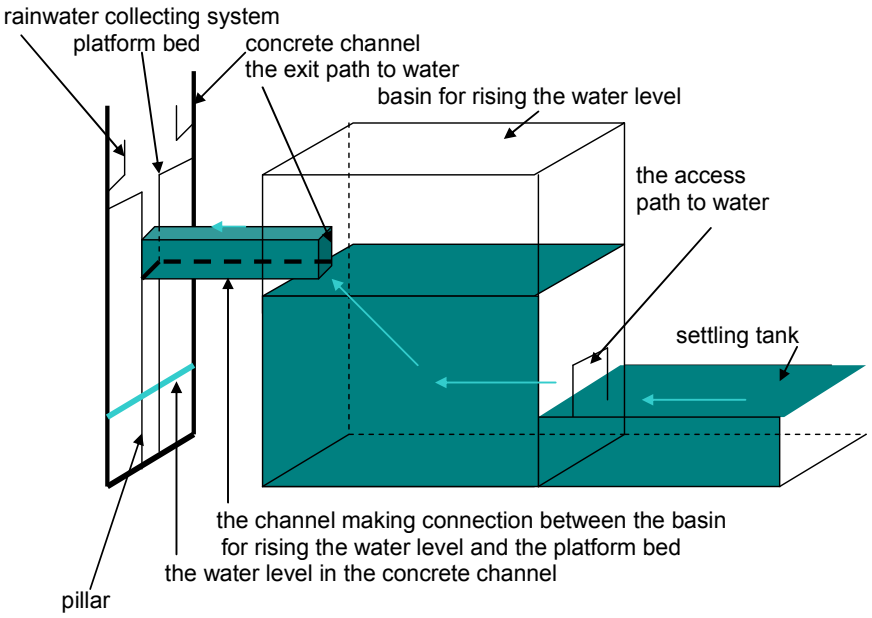

Fig.1.2.**I** Water basin systems for supplying the new platform - indicative scheme

Dam spillway will be equipped with a sluice provided with a rotating opening on the right side of the basin used for raising the water level. In case of strong flood, water will be discharged over the dam spillway entering directly into the old concrete channel.

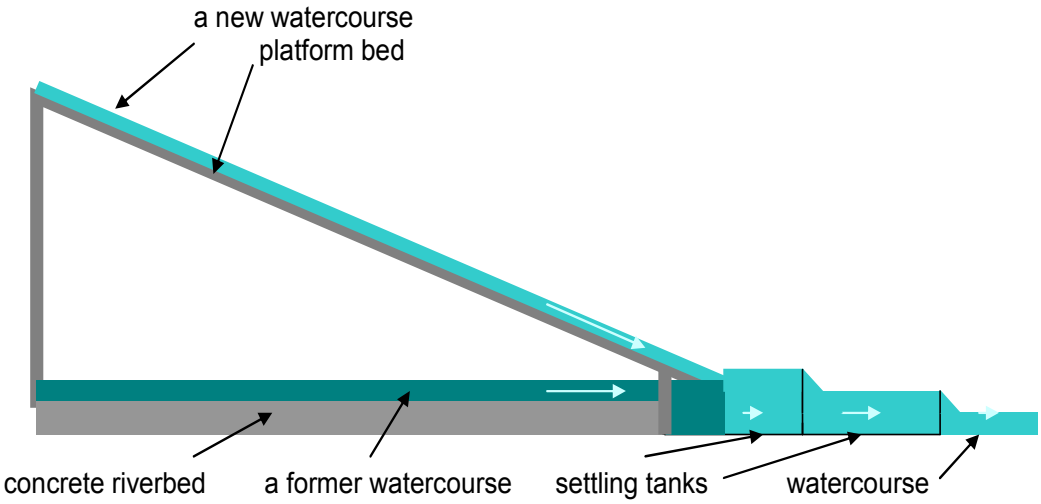

Fig. 1.3.**I** Area of confluence - indicative schedule

This basin used for raising the water level is useful for the migration of fish and other aquatic creatures from side to side, upstream and downstream, on the river's bed platform. There are many aquatic species of lotic system in the center of cities that are disappearing because the obstacles created by man. This river bed platform provides a much safer habitat than the concrete river bed because it no longer receives the anthropogenic polluting components (sewage, petroleum spillage, plastic bottles, etc.) directly into the body of water. River bed may be partially or completely covered by a metal grid, but also it may be provided with no grid. Platform bed separates polluted water coming from the town from river waters while providing an olfactory and auditory protection but also an agreeable and environmental design of the watercourse. Some of the water resulting from precipitation is captured by some concrete channels fixed into the concrete banks. These concrete channels (fig.1.1.**I**) are about the maximum height of the banks, being directly linked to polluted water taken from municipal sources and, therefore, they improve water quality by dispersion and dilution phenomenon. Likewise, these channels can capture the pollutants accidentally discharged in the river bed vicinity of watercourse. At the confluence between the river bed platform and the old concrete one, two settling tanks are built. (fig.1.3.**I**). For all methods presented, before the confluence, the river bed platform takes the shape of the inclined plane in order that fish and other aquatic creatures can climb it the upstream.

Method 2.**I**

There are other ways to protect the water stream against the anthropogenic pollution of cities, namely to build a semicircular type dome shaped riverbed. The water supply of the new riverbed is the same as the one presented in the method of riverbed platform. The water will flow on these riverbed platform extremities into the area formed by the riverbed extremities and concrete walls of concrete channel.

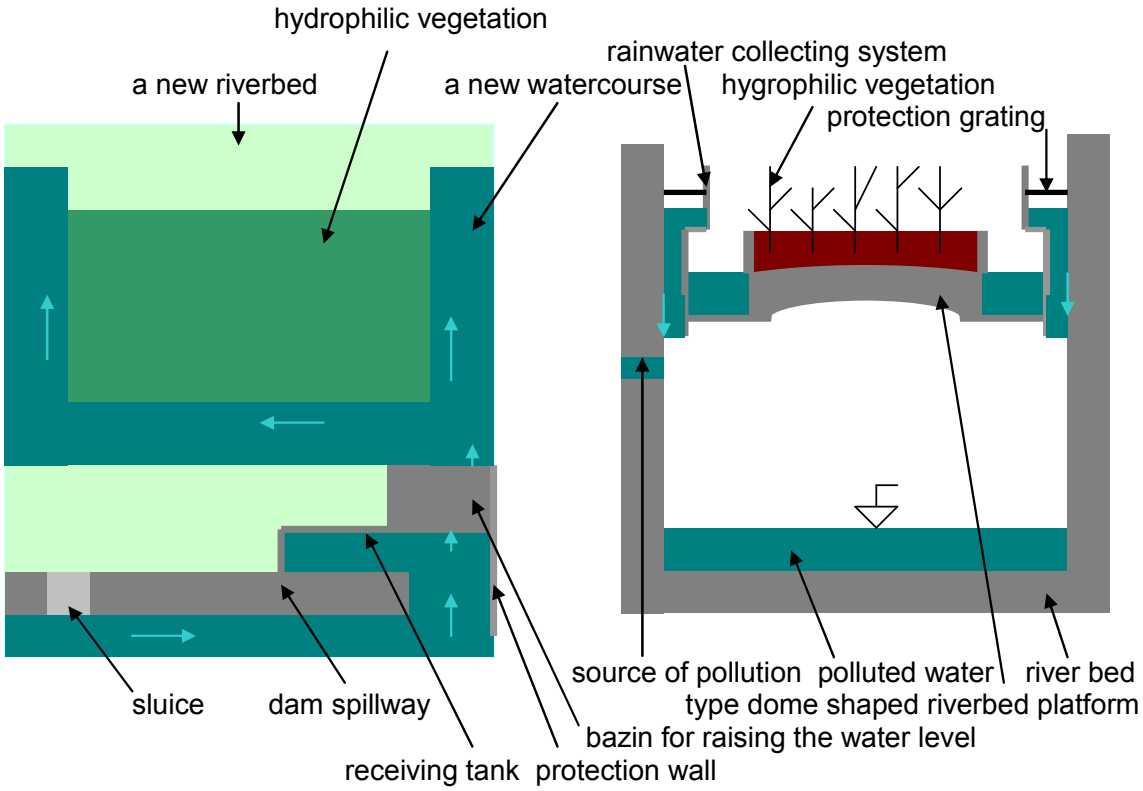

Fig.2.1.**I** Type dome shaped riverbed features - indicative schedule

The dome shall have ventilation systems and access to the old riverbed of the concrete channel. The dome should be covered with a grass surface to be supported by two concrete thresholds that are actually the inside banks of the two flow systems. Before the confluence with the water inside the concrete channel, the two watercourses on the dome shaped riverbed descend slowly the inclined plane in two settling tanks sequentially built (fig.1.3.I).

Inclined plane is used in upstream and downstream movement of aquatic living creatures.

Method 3.**I**

Building a prismatic rectangular shaped riverbed provided with side ventilation systems (fig.3.1.I).

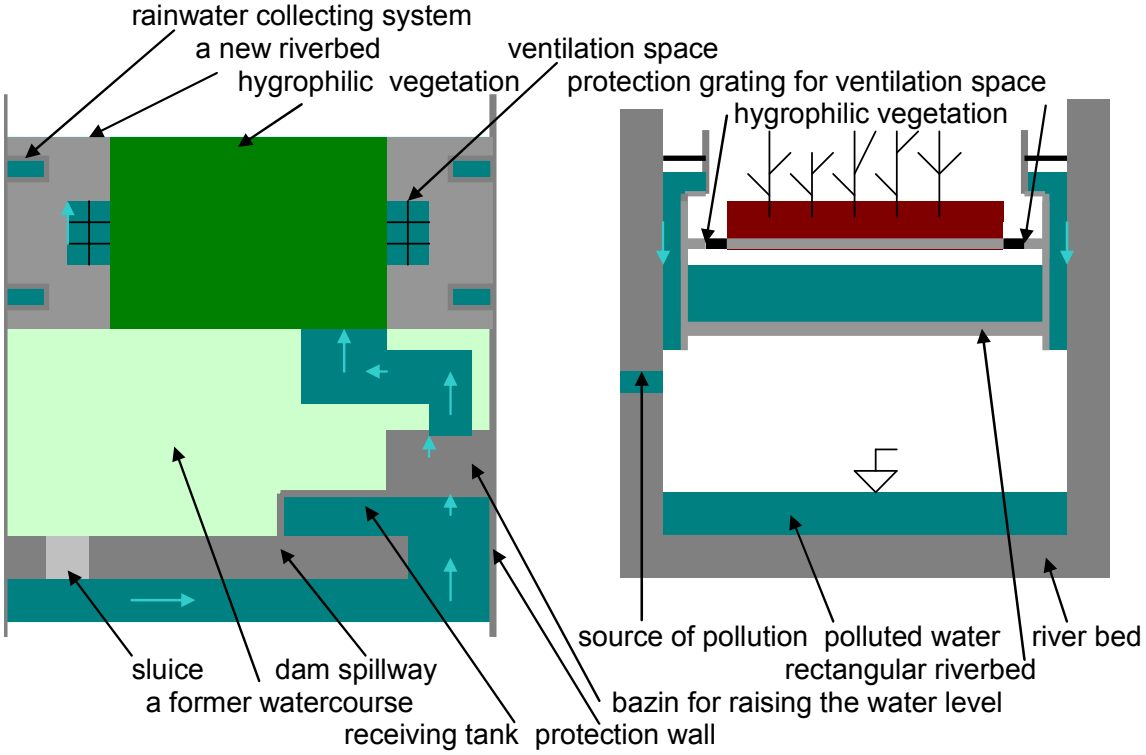

Fig 3.1.**I** Rectangular riverbed features - indicative scheme

The water supply system of the new riverbed is the same as the one in the riverbed platform method. Ventilation into the concrete channel can be done at the first sector of the channel, where the basin for raising the water level and the settling tank are positioned and through the rainwater collection system equipped with protection grids. The rectangular riverbed platform can be cover with a lawn area or even with woody and hydrophilic vegetation.

II. RESTORING THE WATERCOURSES CONNECTIVITY

Method 1.**II**

Watercourses are a changing in terms of quantity and quality but also in terms of hydromorphological aspects. Direct changes in the habitat due to activities made inside the river or the slope or indirect changes due to activities that modify the morphodynamic equilibrium will have repercussions on all aquatic environments and, therefore, the

fundamental ecological processes may be affected. Building dams across the watercourse and hence the lakes along the rivers led to changes in flow regimes downstream of the dam, leading to a drastic modification of aquatic and terrestrial ecosystems in the vicinity of lakes and to loss of other ecosystems downstream of the dam. These hydrotechnical activities have severely affected the functionality of the local ecobiomic systems which means that the specialists in ecotechnics must take action on ecological restoration of river flows, namely to restore the continuity of lateral and longitudinal water courses.
Method 1.II shows how fish cross upstream to downstream and vice versa by a funicular type transportation systems (fig.1.1.**II**).

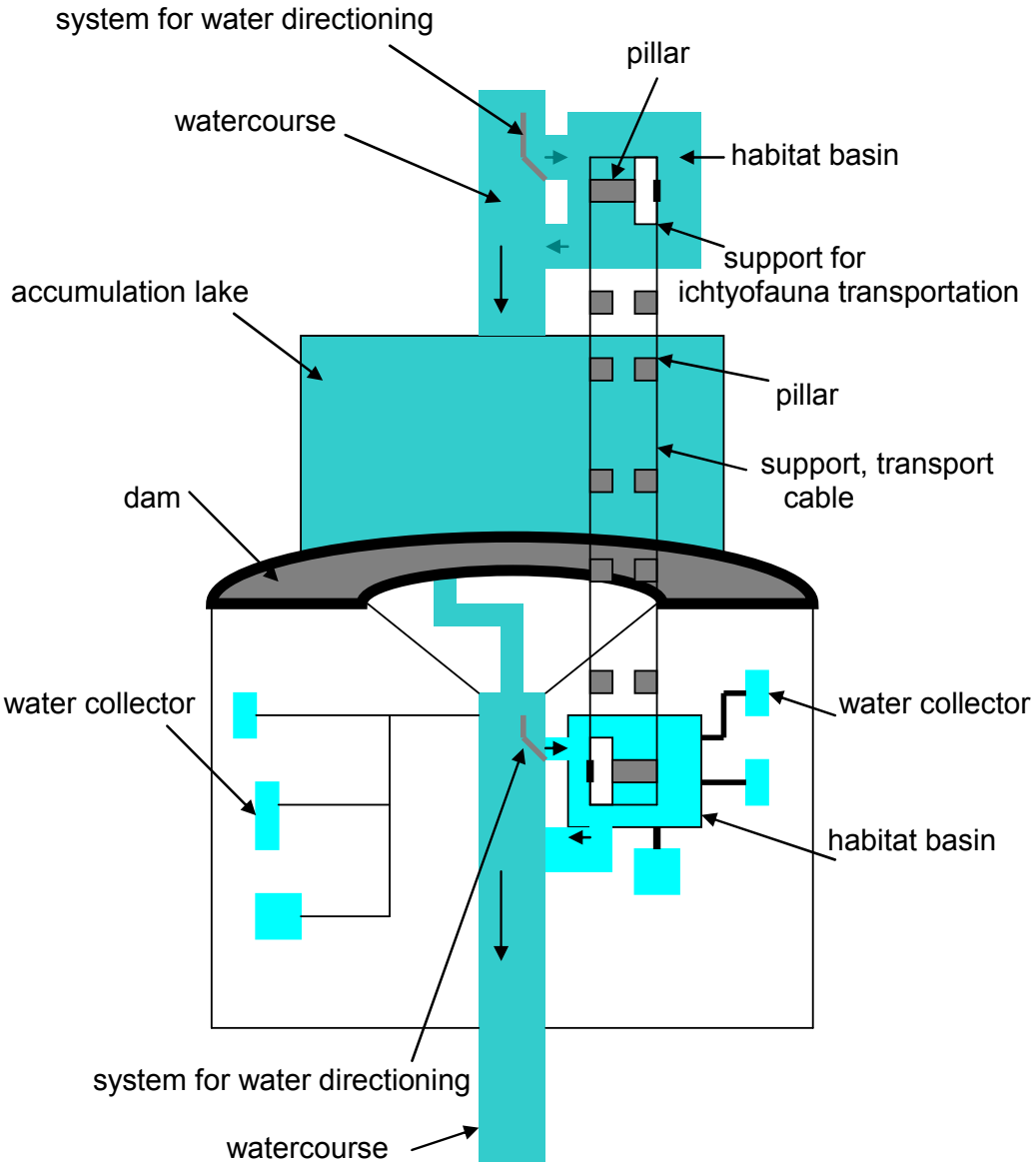

Fig.1.1.**II** Features of funicular type transportation systems – indicative scheme

A basin habitat where not only the migrating fish can get or even grow will built downstream of the dam, the area where the watercourse is regenerated. Environmental flow for fish and other aquatic species (vertebrates and invertebrates) can be recovered if necessary by capturing water from slopes. This method is effective when basin habitat is at a distance up to 200m downstream of the dam. Another basin habitat will be built about 200m before the accumulation lake on the side of the river (fig.1.1.**II**).
The tank for ichthyofauna transportation shall be made of durable plastic and covered with a protective grill. Depending on the number of fish gathered in the tank, those in charge of dam maintenance must set going the ichthyo-funicular system from time to time in order to carry various migratory fish both upstream and downstream. This method can be applied to any dam; financial investments are averages and may offer a chance to maintain the functionality of the lotic ecosystem that was strongly modified by dam's construction.

Method 2.**II**

Another way to maintain the connectivity side of the watercourse is building a basin habitat close to the river. From this basin habitat starts a plastic flexible and transparent pipeline resistant to various natural and anthropogenic pressures. This pipeline that passes through the area specially built inside the dam is shaped inside by sectors for fish climbing and goes through some basin habitat that serves as both dissipater and rest areas for fish that must reach the first basin habitat upstream of the dam (Fig.2.1.**II**).

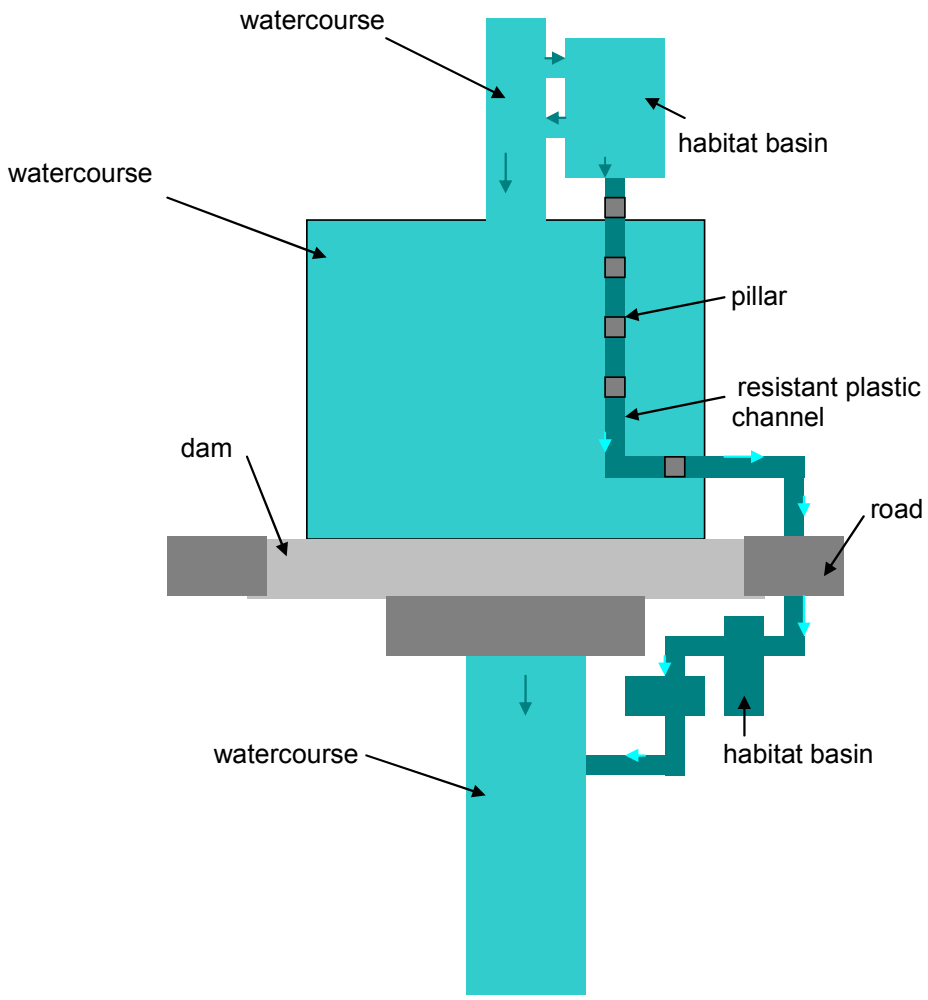

Fig.2.1.**II** Transport tube system features - indicative scheme

Method 3.**III**

If inside the dam structure a structural space cannot be arranged in order to let a durable plastic transparent and flexible pipeline pass through the dam as in method 2.II, then we can develop method 3.II. This method presents the development of a pipeline as the method 2.II does except that, it goes towards the dam extremity before to reach it. The pipeline will pass through this extremity and on the road by one of the slopes of the accumulation lake.

Method 4.**II**

Dams of up to 10 m heights can be adapted or designed to be able to maintain the longitudinal connectivity of watercourses. Thus, dams having flow systems within them can be designed. Windows inside the dam will be related to the upstream but also downstream by systems for directioning the river water.

Facilitation of migratory movements of fish upstream and downstream of the dam is given by the interior platforms of the accumulation lake that are connected to the interior windows of dams with heights of up to ten meters.

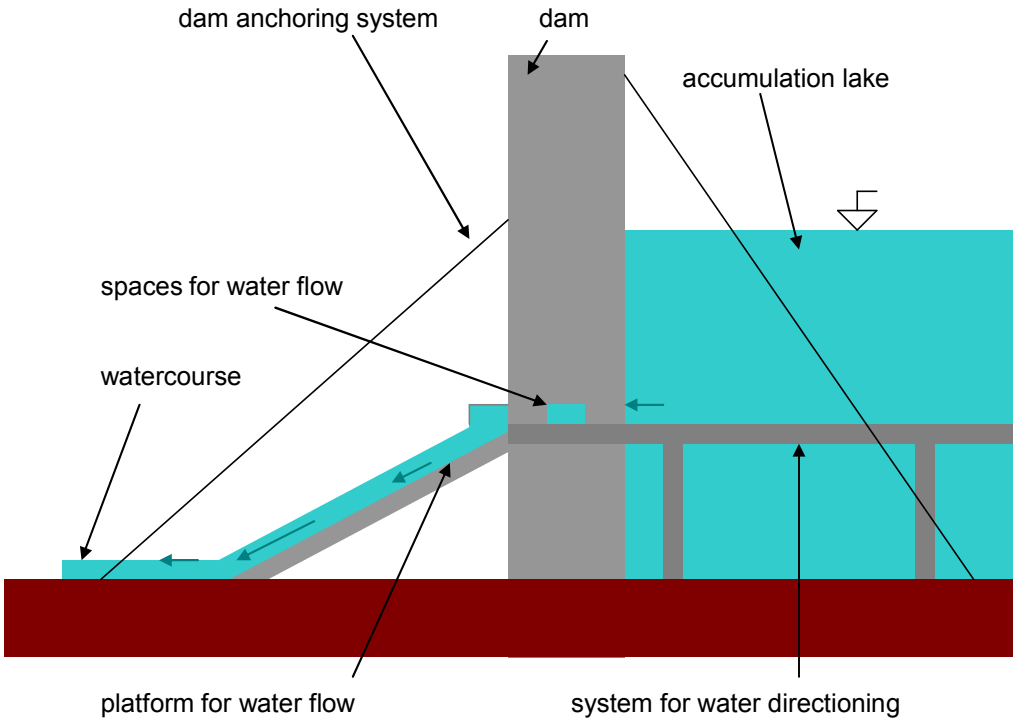

Fig.4.1.**II** Features of spaces or windows within dams that maintain connectivity to water courses - indicative scheme

Water coming from the windows inside the dam is spilled on the inclined plane (fig.4.1.**II**) or through helical systems of channels connected by basins habitat. Spaces or windows for ichthyofauna's circulation are of prismatic rectangular shape and do not affect the structure of the dam (fig. 4.2.**II**).

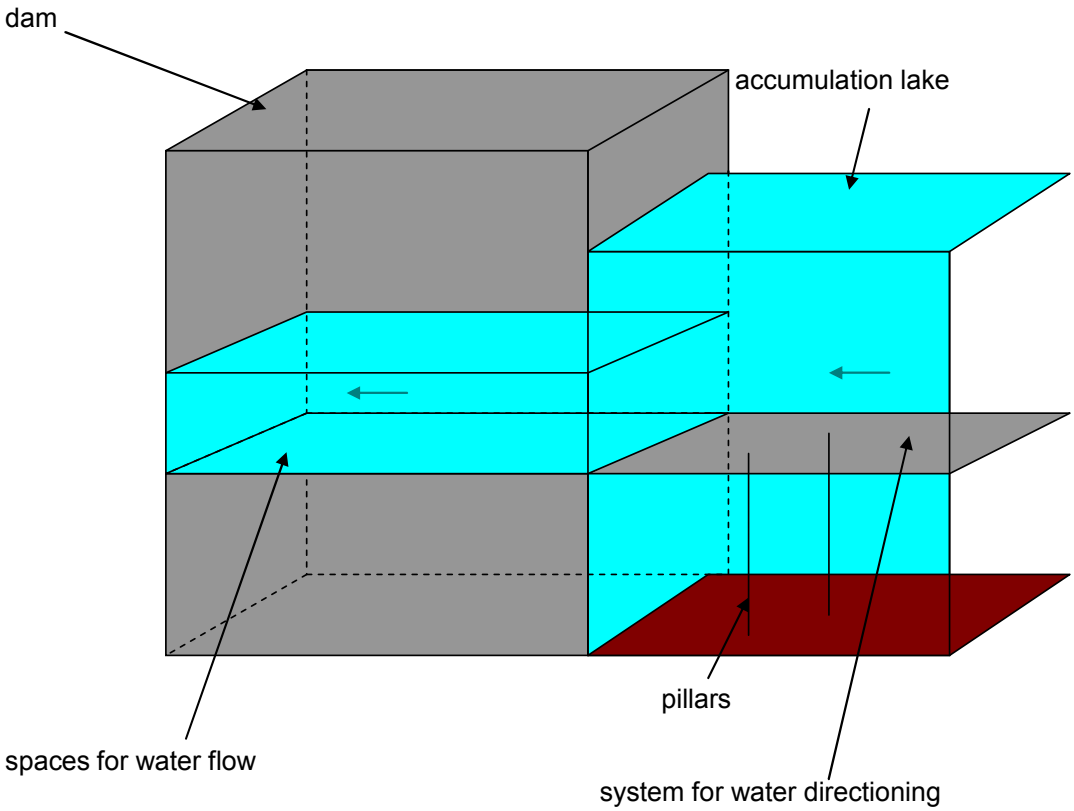

Fig. 4.2.**II** Prismatic spaces for water flow - indicative scheme

Method 5.**II**

For dams less than 15 feet height a method by which the watercourse can be ecotechnically recovered may be found in order to maintain the watercourse continuity crossed by hydrotechnical constructions. Accumulation lakes must be partially covered with a platform that can support the riverbed to be ecotechnically built (fig.5.1.**II**).

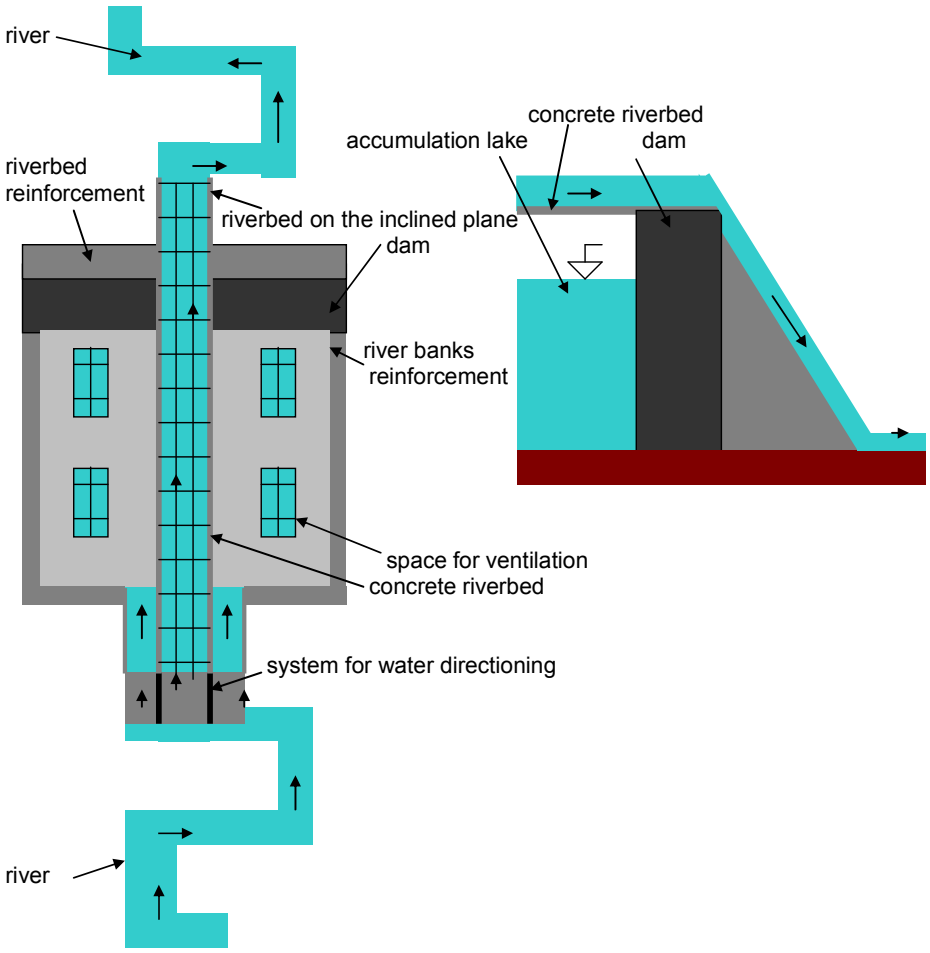

Fig.5.1.**II** Features of concrete riverbed and accumulation lake - indicative scheme

Spaces or windows for ventilation must be built within the platform if the lake is completely covered. Downstream of the dam, the new riverbed shall be an inclined plane where migrating fish will migrate upstream and downstream of the dam. The dam is built according to all standards (flood discharge systems, turbines, decolmation systems, etc.). Construction of the new components does not affect the dam features. Part of the river flow will climb the platform while the rest will flow through two parallel pipelines reaching the accumulation lake. The pipelines are provided with metal grating. In case of

flood, the new riverbed can take in a rate of approximately three times higher than the multiannual average flow which was designed, and the two parallel pipelines can also take in a rate of approximately several times higher than the multiannual average for which they were designed. These ecotechnical arrangements are more efficient in case of floods due dissipative and water transport systems. The old riverbed is arranged on a small sector in front of the two parallel channels and the new riverbed. A concrete sector will make the connection between the two channels, new and old riverbed. Flow which is used for fish migration inside the concrete riverbed can be partially re-established by capturing water from the slopes so that the water and power used are not diminished. At an appropriate height the riverbed must be covered on its entire length with hard plastic grating so that fish do not reach the concrete covering the lake or into the accumulation lake. Water must be managed properly from an environmental perspective.

Method 6.**II**

The method of basins drilled on the slopes avoids the destruction of longitudinal connectivity of watercourse avoiding destruction of lotic ecosystem area (fig. 6.1.II).

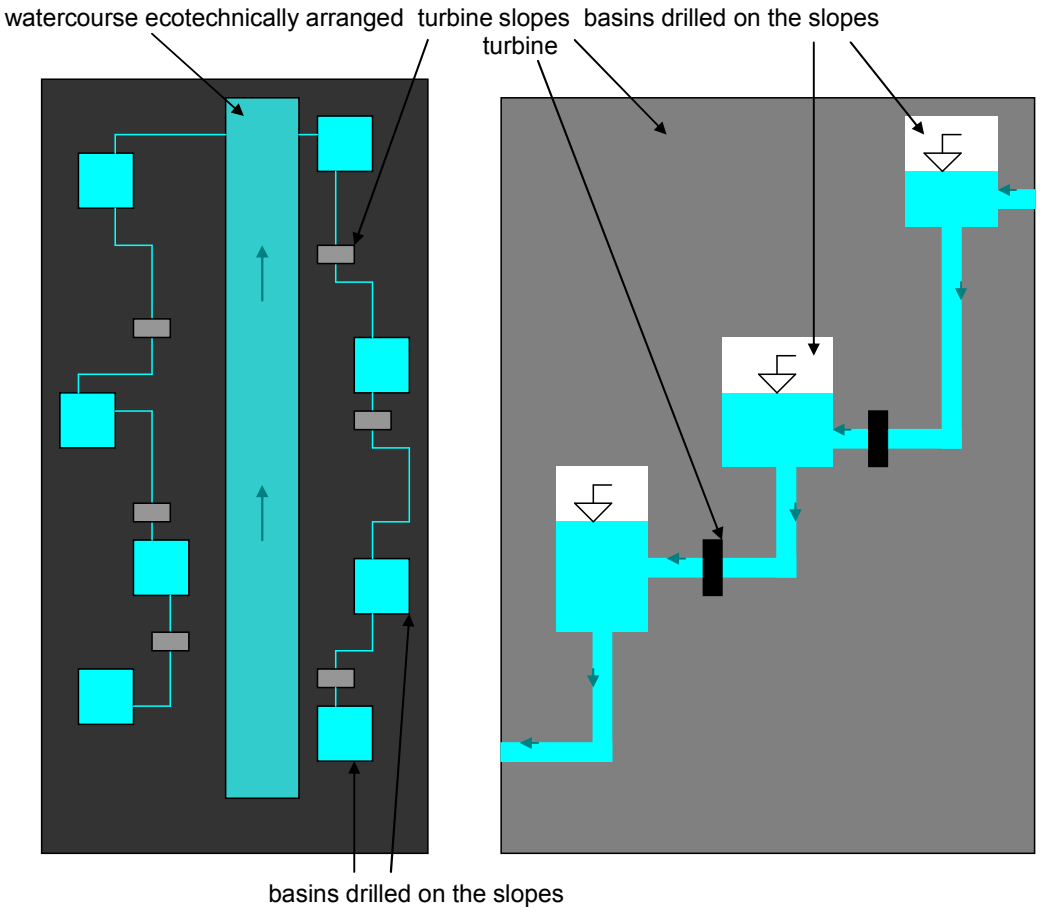

Fig. 6.1.**II** Features of successive basins - indicative scheme

Basins drilled on slopes are linked by pipelines that are connected to turbines which help achieve power. These basins provide water supply and can be used as power generators, too. These ecotechnical methods of longitudinal connectivity storage of watercourses play an important role for providing new ecosystems or improving the old ones. New ideas regarding the construction of new dams or the development of old ones or how to give up dams are discussed. Their functions are taken over by other hydrotechnical structures such as basins built along the slopes. All these hydrotechnical construction are developed in order to reintegrate various river waters into the functional ecobiomic local system. Barring any connectivity (laterally and longitudinally) of watercourse means to stop or reduce the three main functions of the ecosystem: energy, transport and self-regulation which, in the end, will lead to local ecosystems' destruction. The watercourses will be taken into account only if both the local community and those who design and complete these construction projects have a performance in environmental education (fig.6.2.**II**).

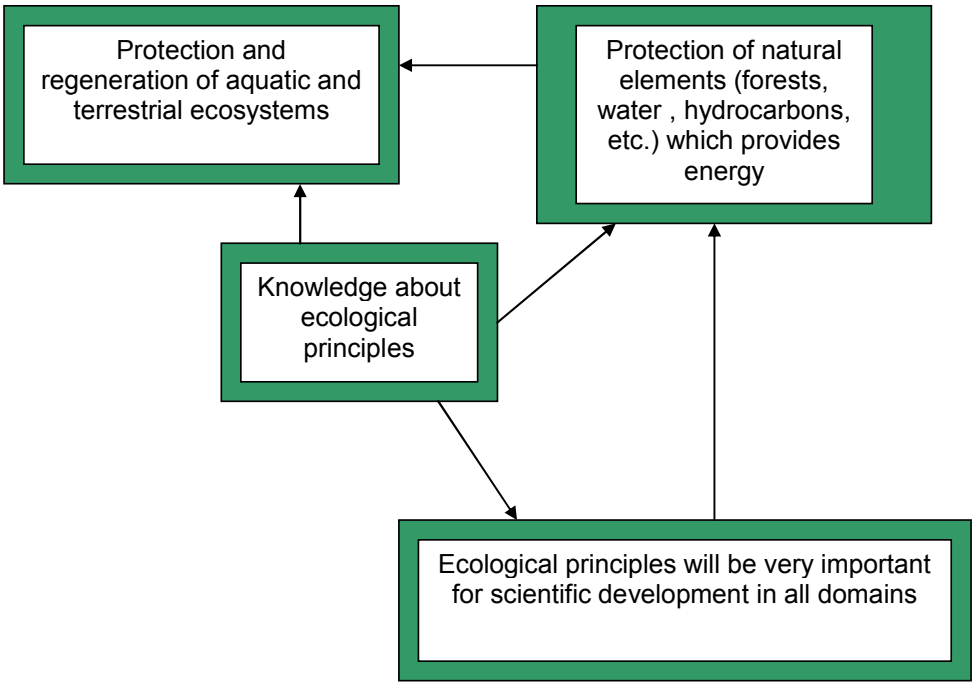

Fig.6.2.**II** The necessity of ecological principles

All hydrotechnical buildings to be built must be designed so that they fit perfectly into the local ecosystems biotopes and do not affect the ecosystem operation.

ISBN: 978-973-0-07561-8