

3rd European Conference on River Restoration **RIVER RESTORATION 2004**

Zagreb, Croatia, 17-21 May 2004

Restoration of floodplain woodlands with native Poplars (*Populus nigra* and *Populus alba*) in Italy: some case studies on the Po river

Lorenzo Vietto, Pier Mario Chiarabaglio

ABSTRACT: A few case studies demonstrate the fundamental role of Poplar for the rehabilitation of degraded sites: the restoration of a few floodplain areas was undertaken in consideration of their importance for biodiversity and for the downflow of water during floods. The main aim of these projects was to restore floodplain forests with environmental-friendly methods and selected poplar genotypes, shrubs and other broadleaves which had disappeared as a result of conversion of the areas to intensive agriculture. An additional aim was to re-establish a dynamic evolutionary process in the gene conservation of *P. nigra* and to create suitable ecological conditions for seedling establishment. The results obtained might be used in other similar situations by riparian ecosystem managers.

KEYWORDS: Poplar, floodplain, river restoration, Populus nigra, Populus alba

Introduction

The rehabilitation of degraded sites, the establishment of wood plantations in fluvial areas and their management using low-impact cultural techniques, the expansion of tree cultivation on agricultural land through cereal-surplus reduction policies have all become common goals for central and regional government agencies in response to a broadening of scope in the Common Agricultural Policy. This has greatly increased the importance of the genus *Populus* in a field that is different from traditional intensive cultivation. *Populus nigra* and *Populus alba* are two of the most representative and threatened forest tree species of old natural floodplain forests in the temperate zone in Europe. These species suffered considerably from urbanization and competition with human productive activities. Moreover *P. nigra* is considered to be on the verge of extinction in Europe so that many initiatives were undertaken to protect its germplasm and to implement conservation strategies (EUFORGEN, EUROPOP, EFP¹). If properly maintained, Black and White poplars, together with Willows, can be successfully used in establishing plantations in fluvial ecosystems and, generally, in damp areas, as they are typical pioneer species and can grow in poor soil and favour the natural evolution of forests.

In 2001 a Comprehensive Plan for the management of the Po river (652 km and 141 tributaries) was drawn up by the Institutional Committee (various watershed authorities of the Po river). Known as P.A.I. (the initials stand for the Italian words for 'Hydro Geological Settlement Plan'), this plan includes new forestry policies, the expansion of areas of spontaneous vegetation in the land abandoned by the river as a result of river dynamics and improved management of wetlands and wet meadows. For the first time a plan tackles the river as an organic unit, considering that what happens upstream has an impact further

down. The general objectives of the P.A.I. include "to guarantee the entire territory of the Po river basin an adequate level of security as regards hydraulic and hydro hydrogeologic damages by restoring hydrogeological and environmental balances, restoration of river banks and water systems, solutions for flood defence, stabilization and consolidation of land, restoration of fluvial areas for recreation purposes". The real point of the Plan is environmental restoration, meant as a number of operations capable of restoring environmental characteristics and the ecological functioning or performance of the ecosystem, which can be put into effect chiefly in State-owned river banks. Keeping in mind the geological and geomorphologic characteristics of the site, the geographical location, the climate and the past natural history it will be possible to put into effect a policy based on prevention, on restoration of flooded areas and on the reduction of the current high vulnerability of the territory. In recent years environmental land management has become more "river-friendly": some laws (i.e. "Legge Cutrera") set buffer strips along rivers liable to be occupied by the river following floods. In many cases it is important to identify areas suitable to be flooded without being damaged by floodwater introduced via spillways: these areas, called "casse di espansione", should not be abandoned, but used as open parklands for recreational or other activities compatible with occasional flooding. Several pilot trials to convert areas dedicated to conventional crops into floodplain forests and to recover areas previously damaged were carried out during the last years by the Istituto di Sperimentazione per la Pioppicoltura (ISP) together with local State-run organizations (Parco del Po e dell'Orba).

The Valenza case

The aim of this project was to improve the environmental value of densely populated flood areas in the plains of Valenza, along the Po river by establishing plantations in abandoned and degraded areas. Planting pioneer species, typical of floodplain environments, such as White Poplars, Black Poplars and Willows, is a way to rapidly create a natural forest. The final results of this project were closely tied to the utilisation of good quality nursery material, suitable to site conditions and, chiefly, of reliable origin (breeding identity).

The plan covered an area of about 43 hectares, mostly belonging to the Municipality of Valenza while a small part is State property. In compliance with the Hydro Geological Settlement Plan for the Po river basin this area is classified as Zone "A" (i.e. land where "normal flood" flows). It is subject to landscape restrictions according to Law 431/85 as it was included in the Park of the Po river where agriculture is subject to strict limitations. The soil is chiefly made up of gravely, sandy, silty and clayey sediments which are found in different deposits, and is subject to partial or total flooding during Spring and Autumn. As this area is very close to the old centre of the town, the inhabitants of Valenza frequently visit it for recreational activities even though it is an intensively agricultural area. The climatic conditions of the site can be classified as temperate/sub-humid; they are characterized by an average annual temperature of 12,4 °C and rainfall of 672 mm/year (141 mm during June to August, with periods of dry spells that cause plants to suffer from water stress). The vegetation is not natural and the site is fairly fertile. As a consequence of floods the area is heavily infested by exotic species such as Sycios angulatus and Humulus scandens. The potential vegetation of this site is represented by Oaks and Elm groves. The presence of spreading weeds found in clayey and sandy soils, as well as in uncultivated areas to be eventually cultivated, created problems during the preparation of



Figure 1.: The Valenza case: the restored area

the soil and, especially, during the first few years after the establishment of a new culture. It is always of utmost importance to control these weeds from the very start. Weed control between tree rows was effectively carried out by means of shredding. On the other hand this problem cannot be easily resolved at root collars, especially where there is intensive weed spreading (*Sycios*). A few weeks after sprouting, *Sycios* can wind itself around the young plants and completely strangle them. Plants should be controlled even in the years to come as this weed can also wind around adult plants, preventing the development of tree-tops and causing "suffocation". The repeated use of a shoulder land-clearing machine, especially when this operation is carried out by unskilled personnel, can cause damages to the cortical tissues of the root collar which can endanger the development of the plant. Under these circumstances it is advisable to resort to localized chemical weed control, using low impact products (glyphosate) and with specific equipment.

Owing to the delay in completing bureaucratic and administrative procedures for the financing of these activities, the establishment of plantations had to be carried out as quickly as possible in March-April 2003; this is not a suitable period for planting in North Italy because Poplar sets have already sprouted and this could have negative consequences on rooting. During the summer a particularly intense drought caused the death of about 50 % of the trees, which were replaced in 2004.

The Isola Santa Maria case

The objective of this project was to re-introduce tree and shrub species that had all but totally disappeared as a result of conversion to intensive agriculture of this area and, in particular, Black Poplar (*Populus nigra*) which is a symbol of fluvial environments and is in serious decline all over Europe. A dynamic-type conservation process is under way by establishing a genetic reserve. Moreover the project aimed at the phyto-filtration of an area subject to frequent erosive events separating it from intensive agricultural culti-



Figure 2.: Aerial view of Isola S. Maria. The red line indicates the area restored within the "A" Zone (yellow line).

vations by introducing a buffer strip between the "Doretta morta" and the River Po. The Isola of Santa Maria is situated on the orographic side of the Po River, where once the Dora Baltea River flowed into the Po River. Following both river management and natural events, the watercourses of the two rivers moved, and the island is now a peninsula. Like the Valenza case, this area is classified as "A" Zone. This area, which belongs to the Municipality, stretches out for about 100 hectares. The surface of the island suffered from continuous changes due to the river dynamics which caused erosion and sedimentation in many places. Historical and naturalistic records demonstrate the presence of Oak and Elm forests on this "island" together with spontaneous Poplar, Willow, Hazel and Ash trees. During the last century natural environments gave way to specialised Poplar cultivation. In the 90's, following the stipulation of rent contracts between the Municipality and farmers, the major part of this area was converted into arable land, mainly planted with maize. The surrounding areas were intensively cultivated with rice, which resulted in the pollution of the water table by nitrates and residual pesticide products. The ex branch of the river called "Doretta morta" is fed by spring water and gathers the major part of water drained from irrigation canals. Floods, that occurred in 1993, 1994 and 2000, had disruptive effects on agricultural land and owing to erosive phenomena deep gullies, holes and deposits of gravelly material were found. This site has a temperate/sub-humid climate, the annual average temperature is 12,7°C and rainfall is 827 mm/year (minimum rainfall during June to August). The soil is alluvial, loose, sandy and gravelly, having a neutral pH and is often subject to partial or total flooding during Autumn and Spring. The presence of infesting weeds, which are particularly active in meadows and uncultivated lands, created problems during the preparation of the soil, as well as over the first few years of cultivation. Erosive events caused by floods created favourable conditions for the diffusion of allochthonous and ecologically aggressive weeds such as *Helianthus tuberosus, Solidago gigantea* and *Sycios angulatus*. It is of utmost importance to control weeds during the first three years after establishment. Mulching alone does not guarantee good results. As land operations are too risky in riparian zone, weeds can be effectively controlled by shredding between each line of trees, followed by localized weed destruction and/or the use of land cleaning machines.

Bureaucratic financing procedures were not always completed in time and, in some cases, site preparation and planting had to be carried out in a limited space of time and, most of all, in a period which was not suitable for planting. In other cases nursery material was hard to find. This probably had negative effects on rooting, especially when the nursery material had not been grown in vases, and when, owing to the hurried purchase, it was of uncertain provenance. Resorting to non-specialised personnel for maintenance operations also endangered the survival of the plants. Floods took place almost towards the completion of establishment, which resulted in the need to coppice a few stands and caused a series of unexpected problems on the management of the damaged plantations.

The Garzaia di Valenza case

An other example of economical land use integrated with river restoration is the "Garzaia di Valenza" in the Po river Park, where a gravel quarry was authorized only following the presentation of a project for the reestablishment of a natural wetland system. The restoration plan aimed at converting arable land into a new wetland habitat by connecting and reactivating remnant meanders. The banks and the remaining areas were afforested with hygrophilous species or converted to barren land or meadows subject to periodical flooding. The area is located on the old course of the Po river, characterized by average to highly permeable alluvial soil. The water table is not far from the surface and is directly connected



Figure 3.: In the Po river Park near the town of Valenza a gravel quarry permitted to re-establish a typical wetland system.

with the Po river. The project consisted in the creation of a few lakes, lower than the water table and connected so as to restore a remnant meander. A great morphologic variability was designed for the wetlands, with winding bends, peninsulas and little islands with rather gentle slopes so as to create different habitats. The lakes reached a maximum depth of 4,5 metres from the average level of the water table. On the whole 430.000 cubic metres of sand and gravel were drawn. Along the banks the water level was lower to favour the natural growth of *Phragmites* spp. and *Carex* spp.. The meander looks very "natural": the first series of vegetation planted (Willows and Poplars) are naturally spreading, other species are scattered within the water (as *Potamogeton* spp., *Miriophyllum* spp., *Chara* spp.) and along the edge of lakes as *Carex* spp., *Phragmites australis*, *Typha latifolia*. The fish population has been introduced by the floods of the Po river; as for birds there are a lot of species living near the water, such as *Anas platyrrinchos*, *Fulica atras*, *Ardea purpurea* and *Casmerodius albus*.

Results

These cases demonstrate that it is possible to convert a flooded area into a riparian forest and that reforesting uncultivated areas is possible provided the natural process of re-colonisation is respected. By planting pioneer species, typical of floodplain environments such as White and Black Poplars and Willows, a permanent forest cover can be naturally re-established over a short period. However it is necessary to resort to forest material suitable to site conditions, of good quality and, above all, of guaranteed quality and genetic identity in order to succeed with rehabilitation. The success of reforestation operations can only be achieved by carrying out cultivation practices over the first three years after establishment, since plots planted and left to natural evolution are bound to fail owing to excessive competition with infesting weed species. In floodplain areas characterised by the presence of infesting weeds, the outcome of localised mulching is negative, whereas early localised weeding with molecules having a drying action and associated with an antigerminal product is very effective. Alternatively, weeding molecules having low environmental impact can be used, as long as the product is distributed locally and with suitable equipment. This operation is sustainable under an environmental and economical profile and could be repeated over the first few years completed by operations carried out by cutters, even though the number of plants damaged by the mechanical means is rather high. After coppicing the plots having a high percentage of plants damaged by floods, it was noted that the reaction of White Poplar was far quicker than that of Black Poplar as it produced a number of root-suckers even at a certain distance from the root collar. Plantations established with Black Poplars particularly need cleaning of the bole to be carried out manually within two months after sprouting. Plantations established with White Poplars also need cleaning of the bole and correction of treetops, to be carried out before the end of the second year. Delayed operations could cause damages and lack of plant stability.

Conclusion

River restoration affects and is often in contrast with many activities linked to possible land use, such as agriculture, industry, gravel quarrying, waste dumping and others. The needs and timing of agricultural practices, for instance, often clash with river restoration activities: the soil is ploughed in Autumn/Winter, when floods are more frequent (in the North of Italy) and during the cultural cycle phytosanitary treatments are carried out which may cause water pollution. Tree growing, on the other hand, can be carried out also on riparian sensitive land without interfering with the river dynamics provided some cultivation rules are respected that make it compatible with the preservation of the natural environment. Spontaneous Poplars (*P. nigra* and *P. alba*) can be used to obtain, in a relatively short time, a tree coverage which is able to eventually create favourable conditions for climax species. It is convenient to utilise genetically diverse materials and avoid monoclonal groups. To obtain the nursery material it is best to contact institutions that keep germplasm reserves and in this way utilization of material of uncertain origin can be avoided, as this type of material could jeopardize plantations or could be the cause of genetic pollution. In fact genetic pollution should be given due attention. In all cases artificial plantations are the fastest and most effective system to restore arboreal and shrubby species in areas to be covered with forests. The major problem arises from the fact that it is impossible to plan operations for the production of nursery material, especially as far as Poplars and Willows are concerned. Since project approval and funding take time experience demonstrated that to obtain the best results it is important to carry out bureaucratic procedures in good time so as to be able to establish plantations in the most favourable period (September – March) and with skilled personnel.

Reference

- 1. Chiarabaglio P. M., Cristaldi L., Facciotto G., Picco F., 2000 *Forest plantation to recover* gravel quarry in flooding area, Sherwood, 62, pp. 7-14.
- Vietto L., Facciotto G., Chiarabaglio P.M., Cristaldi L., 2003 Impiego di pioppi spontanei (Populus nigra e Populus alba) nella ricostituzione di ecosistemi forestali fluviali di pianura: il caso-studio di Isola Santa Maria. Atti Conferenza internazionale 'Alberi e Foreste di pianura', Milano 1-3 ottobre 2003
- Bergoglio M.T., Boffito G., Chiarabaglio P.M., Cristaldi L., Facciotto G., Vietto L., 2003 *Riqualificazione ambientale e valorizzazione turistica di Valle Po Valenza*. Atti Workshop 'La gestione sostenibile del territorio nei Parchi Fluviali', Casale Monferrato 7 ottobre 2003 (Poster).
- Chiarabaglio P.M., Cristaldi L., Facciotto G., Mallarino A., Vietto L., 2003 Recupero naturalistico della propriet^[] comunale dell'Isola di Santa Maria di Crescentino. Atti Workshop 'La gestione sostenibile del territorio nei Parchi Fluviali', Casale Monferrato 7 ottobre 2003 (Poster).
- Vietto, L.; Facciotto, G.; Zampighi, C.; Gasparini, C.; Cristaldi L., 2001 *The use of sponta*neous poplars (Populus nigra and Populus alba) in environmental restoration [Poster]. Presentato al Convegno IUFRO 'Nursery production and stand establishment of broadleaves to promote sustainable forest management'. Roma, 7-10 maggio 2001.

Authors:

- Lorenzo Vietto, Istituto di Sperimentazione per la Pioppicoltura, Str. Frassineto, 35 Casale Monferrato AL – Italy, vietto@populus.it
- Pier Mario Chiarabaglio, Istituto di Sperimentazione per la Pioppicoltura, Str. Frassineto,

¹ EUFORGEN: European Forest Genetic Resources Programme EUROPOP: EU project - Genetic Diversity in the River Populations of the European Black Poplar for Evaluation of Biodiversity, Conservation Strategies, Nature Development and Genetic Improvement EFP: WWF – European Freshwater Programme

^{35 -} Casale Monferrato AL - Italy, chiarabaglio@populus.it