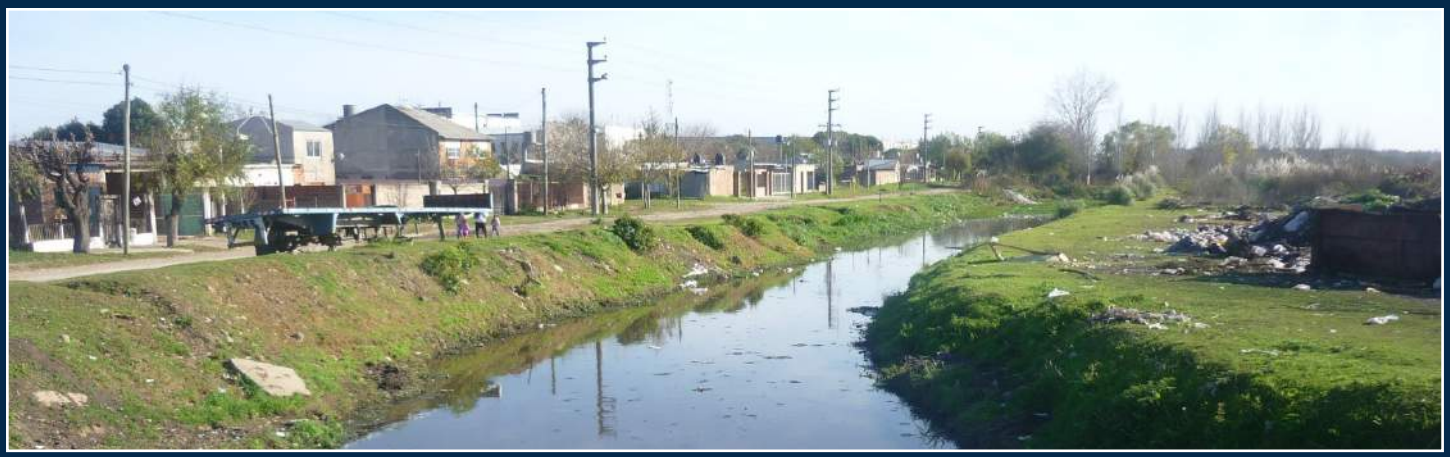
MATANZA-RIACHUELO RIVER BASIN

An ecological perspective on the recovery of its banks



Fotos by A. Faggi n. d.

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Content

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An Ecological Perspective on the Recovery of Its Banks

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Water Bodies

The riverbank forests perform important functions, such as the stabilization of banks, and the restraint of weather factors.
Foto A. Faggi n. d.

Water bodies, either lotic or lentic, suffer the impact of different activities developed in the city and its surroundings (Schumacher, 1998). This is why, in comparison to natural environment water bodies, urban water bodies have undergone significant transformations. Lentic bodies include lagoons, natural and artificial lakes, and rainwater reservoirs. Lotic bodies comprise rivers, streams, canals, and gutters (Gunkel, 1991). Water bodies and their banks provide multiple ecosystem services by means of ecologic, economic and social functions (DVWK, 1996). They are essential habitats for plants and animals, they help improve the weather, receive water from torrents, and embellish the urban environment with their recreational and aesthetic potential (Gilbert, 1989). A river is an ecosystem that functions as a biocorridor, and its functioning depends on multiple factors, especially on its structural characteristics, and on the disturbances that it may suffer. The quality of the water is the main indicator of its condition. In Central Europe, the impacts caused by effluent spills into water bodies have decreased, but in other countries, such as Argentina, the situation continues. In many cases, water bodies are overused as if they were part of the sewage system. This affects, either directly or indirectly the oxygen present in the water, and therefore, the toxic elements can accumulate in the living organisms. This situation limits the rational use of water bodies (Kausch, 1991).

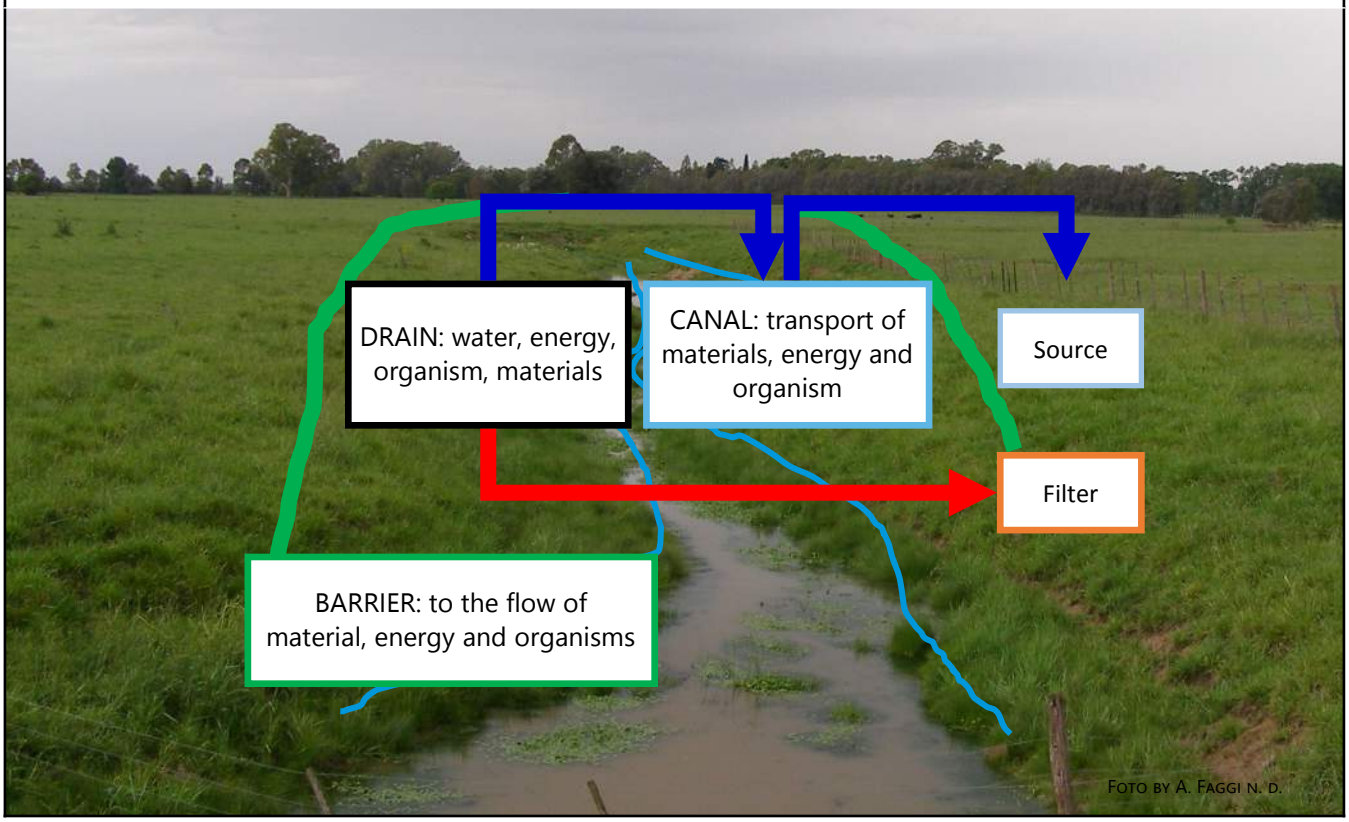
Function of the urban water bodies (Endlicher 2012, p. 87)

HYDROLOGY / HYDRAULICS	STRUCTURE OF THE WATER BODY	STATE OF THE WATER BODY
DYNAMICS AND SPEED OF THE CURRENT	WIDTH, LENGTH, PROFILE OF THE RIVER BED, TYPE OF BANK	QUALITY OF THE WATER

UTILIZATION	BIODIVERSITY
E. G.: FREE-TIME ACTIVITIES AND RECREATION	FREQUENCY AND SPECTRUM OF ALL BOTANICAL / ANIMAL SPECIES

Habitats: Special structures, which permit the life of fauna and flora

DVWK 2000



Ecosystem services include all all of the functions and processes that benefit society as regards economy or quality of life (Constanza et al. 1997; DeGroot et. at. 2002). In general, they are classified into four broad groups, including supply, regulation, support and cultural services. All of these groups are also present in urban areas (Breuste et al 20013).

Four broad groups of ecosystem services
(Breuste et al 2013)

From the first discussions about this topic in the nineties, and after the publication of the Millennium Ecosystems Assessment (2005), it has been clear that the human being depends on nature and the ecosystems, as well as on its functions and its variety of existing processes and fluxes. Most of these services do not usually have market or social value. Since they are used in an excessive way, nature and the ecosystems have been reduced up to the point in which they can no longer provide services, particularly in urban areas, where most of the global population lives. According to McDonald (2009), ecosystem services are provided within the landscape at different scales, such as, for example, the regulation of temperature by means the shades of trees planted in urban areas, the filtering of water and pollutants in the soil, or wood production. Among the regional or landscape scale services we can find recreation, weather regulation and biodiversity services, while on a global scale we find climate mitigation services by means of carbon sequestration, or services of genetic biodiversity conservation. In the city, both vegetation (urban green) and water resources (urban blue) are the components that provide the greatest part of the ecosystem services. For this reason, both components should be available in the proximity of dwellings. The urban gray grids, represented by the waterproof surfaces, are far from providing ecosystem services. As a matter of fact, they reduce them. (Breuste et al. 2013)

Services and indicators of quality of life related to the dimensions of sustainability

(Breuste, et al. 2013 according to Millennium Ecosystem Assessment, 2005 and Santos and Martins, 2007).

Sustainability dimension	Urban Ecosystem Service	Quality of life indicator
Ecology	• Air filtration • Climate regulation • Noise reduction • Rain water drainage • Water supply • Waste water treatment • Food production	• Health (clean air, protection against respiratory diseases, protection against heat and cold death) • Safety • Drinking water • Food
Social sphere	• Landscape • Recreation • Cultural values • Sense of identity	• Beauty of the environment • Recreation and stress reduction • Intellectual endowment • Communication • Place to live
Economy	• Provision of land for economic and commercial activities and housing	• Accessibility • Income

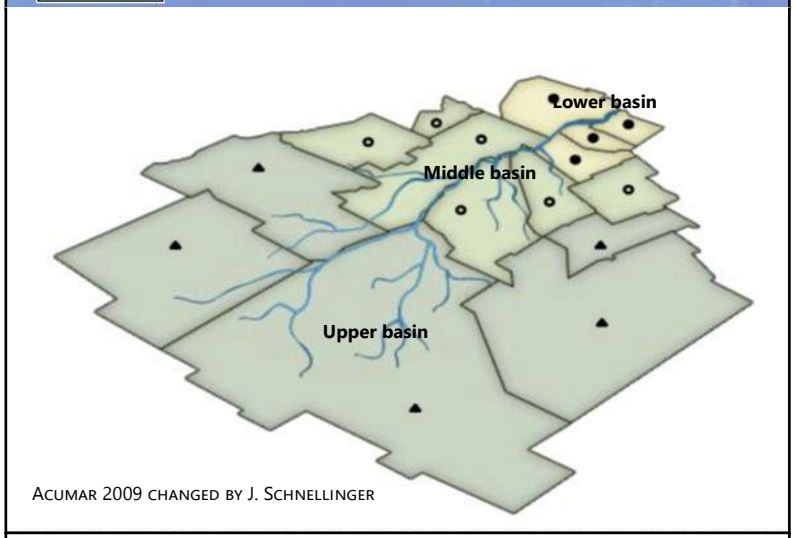
The River and Its Basin

Fotos by A. Faggi n. d.

Matanza-Riachuelo is the most polluted river in Argentina, and it has a long history of negative environmental impacts. The city of Buenos Aires was founded for the second time in 1580 on the banks of its estuary, which had an impact on the natural landscape and the quality of the water. Nowadays, it is on a slow but constant path towards recovery. The city government has implemented long-term recovering programs, while the civil society is still concerned about participation, citizen control, and the spreading of the basin's environmental issues.

Middle basin

Matanza-Riachuelo is a plain river of short length (8 km), low flow (8 m^3/s) and a not too steep slope (0,35%) that runs through the Pampa plain, a slightly wavy terrain formed by rivers. The river runs along Buenos Aires's south metropolitan area, and it flows into the Rio de la Plata. In the upper basin, it receives the waters of plenty of streams (232 courses), though only three of them (Rodríguez, Morales, and Cañuelas) are main streams. In this way, it makes up an irregular basin of. 204,768 ha with a maximum width of 40 km, which is home to 21% of the Argentine population. 22.14% of the basin is in the urban area and 54.55% in the rural area. The upper course of the river is shallow (0.3-0.5 m) and it flows without problems, although there are a few canals that guide the flow. Once in the lower plain, the riverbed loses its natural characteristics. The lower course of the riverbed has been channelled and rectified. It is called Riachuelo in the last 15 km before its estuary on Rio de la Plata, where it reaches its maximum depth (7 m). Moreover, train and road embankments arranged across the water courses affect the natural functioning of the basin. The least modified course is the one of the middle basin, and even though some streams have been cut, the river bed has deepened and soil has accumulated in the banks. Matanza-Riachuelo is the most polluted river in Argentina, and it has a long history of negative environmental impacts.



Project area

Lower basin

Foto by A. Faggi n. d.

Middle basin

Foto by A. Faggi n. d.

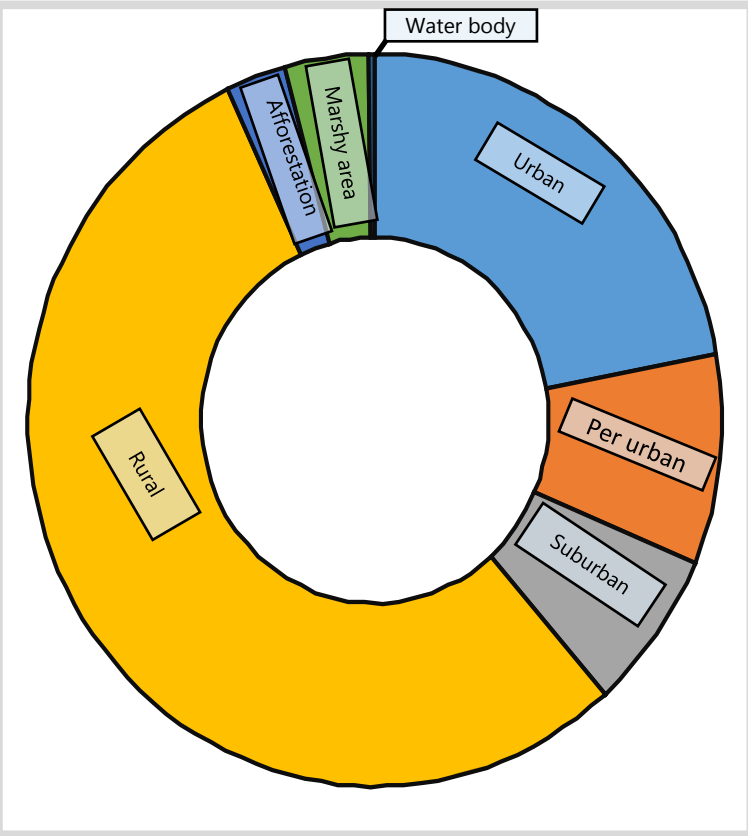
Upper basin

Foto by A. Faggi n. d.

Coverage and uses of soil at the basin Matanza-Riachuelo

Coveage/ uses of soil	Area (ha)	Area (%)
Urban	45,305	22.14
Per urban	18,901	9.24
Suburban	14,476	7.07
Rural	111,631	54.55
Afforestation	5,828	2.85
Marshy area	7,815	3.82
Water body	700	0.34
Total	204.656	100,00

Coverage and uses of soil at the basin Matanza-Riachuelo in %



Matanza-Riachuelo is the most polluted river in Argentina, and it has a long history of negative environmental impacts. The city of Buenos Aires was founded for the second time in 1580 on the banks of its estuary, which had an impact on the natural landscape and the quality of the water. The history of the pollution goes back to colonial times. This situation worsened in the 19th century due to the settling of slaughterhouses on the banks of the river. Throughout the 20th century, the pervasive pollution was caused by the agricultural and cattle industry in the upper basin of the river, as well as by industrial and domestic effluents that were dumped into lower and middle basins. The assessments carried out 1998 and 2001 revealed critical conditions regarding the content of dissolved oxygen and high rates of lead and chromium that were affecting life in the river. Several dumping grounds and cases of squatting its banks also played a part in the contamination of the river. This pressing environmental situation raised awareness among the civil society. The City Foundation organized several discussion forums between 2002 and 2003 in the three areas of the basin in order to summon multiple participants in search of mutually agreed solutions. These solutions were formally presented to the authorities. Although there have been many attempts to improve the environment, the situation only began to improve in 2006, when the Authority of Matanza Riacuelo Basin (ACUMAR) was created. Its functioning sped up in 2008 in response to a notification from the National Supreme Court of Justice, as a result of lawsuit filed by a group of neighbours of the lower basin in 2004. Although pollution hotspots still exist, generally speaking, the quality of water has begun to improve thanks to the reduction and control of illegal spills. Measures have been taken on the river banks to remove structures of abandoned ships, and to relocate people living in precarious conditions. Furthermore, a towpath was completed, the dumping grounds were eliminated, and a cleaning and reforestation plan was enforced in some areas. The river is on a slow but constant path towards its recovery. The city government has implemented long-term recovering programs, while the civil society is still concerned about participation, citizen control, and the spreading of the basin's environmental issue.

ACUMAR is organizing common public policies and coordination interinstitutional efforts between the National, Provincial and City Governments for the implementation of the Integral Plan of Environmental Sanitation. The goals are improving the life quality of the residents of the area, as well as recovering the environment in all of its elements (water, air, and soil) , and preventing possible future damage. (ACUMAR n. d.)

ACUMAR Foto by A. Faggi n. d.

Vegetation of the bank

Foto by B. Guida Johnson n. d.

The human impact of centuries of grazing, tree cutting and fire, followed by agricultural activities, and later on by the advance of urbanization, triggered several changes all along the basin that are reflected in the present composition of the vegetation. Nowadays, these effects can be recognized by the presence of indicator species, some of them are witnesses of the pristine vegetation, and some others of the man-made changes.

Lantana camara

Foto by A. Faggi n. d.

In the bank environment that extends along the basin, the pristine vegetation (native to the region) in the lower basin belongs to the river bank and scrub, which are similiar to the ones present today in the Buenos Aires delta. It includes *Erythrina crista-galli*, *Sapium haematospermum*, *Tessaria integrifolia*, *Salix humboldtiana*, *Phyllantus sellowianus*, together with a bush stratum with attractive flowers such as *Lantana camara*, *Hibiscus cisplatinus*, *Phyllantus sellowianus*, *Cephalanthus glabratus* and *Sesbania punicea*.

Sapium haematospermum

Foto by A. Faggi n. d.

Marshy species of grasses on the river bank Foto by A. Faggi 2007

In the marshy banks, we can find a wet meadow made up of palustre species such as the *Sagittaria montevidensis*, *Schoenoplectus californicus*, *Alternanthera philoxeroides*, *Echinodorus macrophyllus, Hydrocotyle ranunculoides* and *Hydrocotyle bonariensis*, *Polygonum punctatum* and *Pontederia cordata and P. rotundifolia*, *Senecio bonariensis*, together with different types of cyperaceae, grasses (*Paspalum distichum, Echinochloa helodes*) and a rush family among other species.

Erythrina crist-galli

Foto by A. Faggi n. d.

Floating plants Foto by A. Faggi n. d.

Floating plants (*Lemnacea*) grow over the water mirror, as well as water fences (*Azolla filiculodies, Salvinia biloba*), *Limnobium spongia* and *Pistia stratiotes*.

Alligator weed with white flowers

Foto by A. Faggi n. d.

These marshy plants (also called helophytes) are typical of bank environments. They put down roots in the bottom of the basin, and their stems surface and develop leaves, flowers and fruits in the aerial environment. When the water level goes down, they can survive for long periods under the ground. The play an essential role in the unity of the river as an ecosystem, since they protect the banks from the pounding of the water, and they are, at the same time, fauna habitats.

In those rivers crossing urban areas, there is another environmental service that becomes relevant: purification. In this way, marshy vegetation chains function as water filters that hold back organic matter, nutrients, particulate mater and pollutants. Many of them are absorbed into tissues, or by roots. In the root for environment there occur physical, chemical and biological processes caused by the interaction between plants, microorganisms, substrates and pollutants.

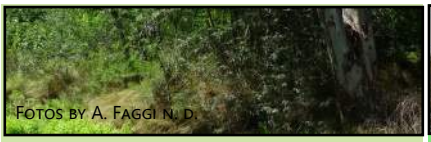
For this reasons, it is essential to guarantee the conservation of the riverbank vegetation and to avoid its reduction. In the middle and lower basins, the natural vegetation unfolds like a pasture of can needle grass (*Nassellla hyalina*) and prairie grass (*Bromus catharticus*) at the highest levels, and as a wet meadow in the shores that are similar to those in the lower basin.

Pasture of cann needle grass and prairie grass FOTO BY A. FAGGI N. D.

River basin	Impacts	Processes
Lower basin	Canalization, correction, impregnation, large slope of the embankment, weeding, cutting, reforestation	1. Reduction of the riverine vegetation. Impoverishment of the forest area and loss of species. 2. Afforestation with exotic trees. 3. Invasion of exotic bushes. 4. Reduction of native grass and bushes.
Middle and upper basin	Rural activities	1. Advance of exotic grass on the pasture. *(Festuca arundinacea, Arundo donax, Pichris echioides, Lactuca saligna).* 2. Spontaneous invasion of wood *(Acer negundo, Gleditsia triacanthos, Morus alba y nigra)*, used trees in cattle establishment for shade and firewood of easy dispersion for wind and/or birds. 3. Afforestation with eucalyptus.

Flora richness

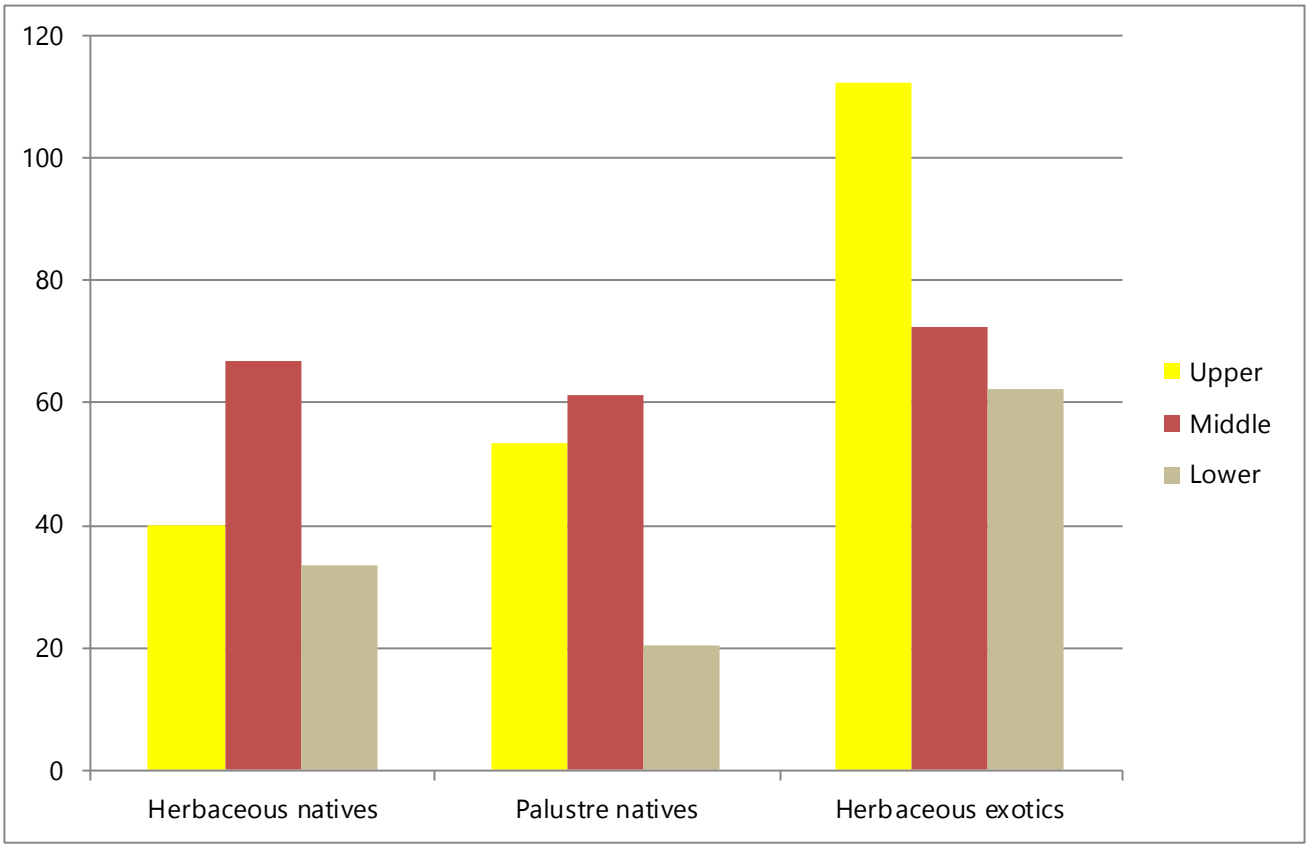
The results of the surveys of 54 sites allowed for the filing of 213 floral species: 174 herbaceous, 3 bushes, and 36 trees. Native species prevail among the herbaceous, while exotic species prevail among the trees. 39 palustre species, most of them native, and only one exotic species (Watercress: Rorippa nasturtium- aquaticum).

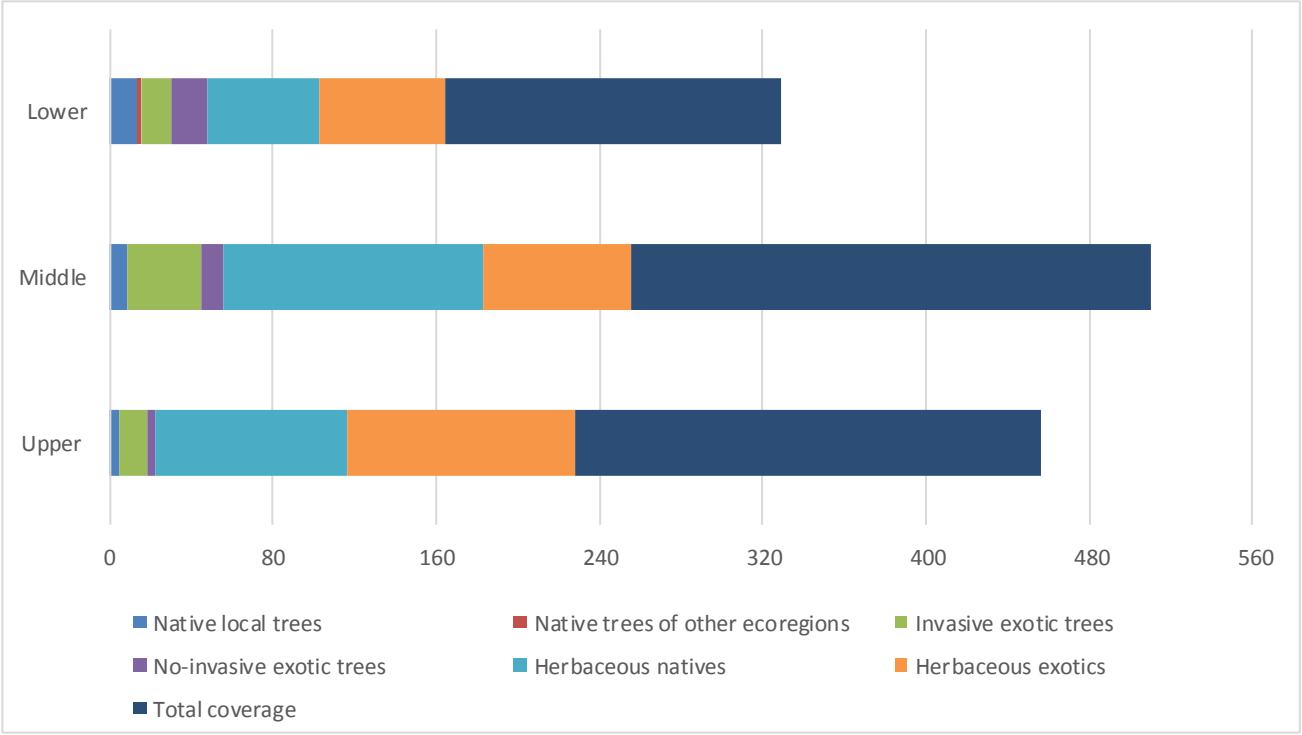
 Fotos by A. Faggi n. d.	 Fotos by A. Faggi n. d.	 Fotos by A. Faggi n. d.
GRASS	**BUSHES**	**TREES**
• 74 Natives	• 3 Natives	• 8 Natives from Buenos Aires
• 38 Native marsh plants		• 2 Natives of the country
• 61 Exotics		• 17 Exotics
• 1 Exotic marsh plants		• 9 Exotic invasives

Vegetative Cover

The main rates of total cover were registered in the middle basin, intermediate rates in the upper basin, and lower rates in the lower basin. The native herbs were more predominant in the middle basin, and less predominant in the lower. The exotic species, on the other hand, were more representative of the upper basin, indicating the influence of agriculture and pasture activities by means of species that are used as pastures, or that are considered weeds. The main tree cover in the middle basin is represented by invasions of woody species such as *Gleditsia triacanthos* and *Morus alba and nigra*.

		Upper basin	Middle basin	Lower basin
Natural vegetation		Pastureland and humid meadow	Pastureland and humid meadow	Forest, undergrowth and humid
Impacts		Rural activities	Rural activities Afforestation	Reduction, flooding destruction, afforestation
Coverage of plants indicated	Exotics	*Festuca arundinacea 30%* *Cynodon dactylon 18%* *Carthamus lanatus 13%*	*Festuca arundinacea 6,3%* *Humulus japonicus 12,3%* *Picris echioides 10%* *Acer negundo 7%* *Gleditsia triacanthos 20%* *Eucalipto sps*	*Cynodon dactylon 26%* *Sorghum halepense 10%* *Humulus japonicus 8%* *Populus sps 6%* *Morus alba and nigra* *Ricinus communis*
	Marshy	*Eleocharis bonariensis 12%* *Polygonum punctatum 5,5%* *Paspalum distichum 5%* *Hydrocotyle bonariensis 4%*	*Hydrocotyle ranunculoides 13%* *Althernanthera philoxeroides 10%*	*Sagittaria montevidensis 11%* *Erytrhrina crist-galli 4%* *Sapium haematospermum 4%*
	Natives	*Nassella hyalina 10%* *Bromus catharticus 6%* *Cortaderia selloana 4,5%*	*Nassella lyalina 10%* *Celtis tala 4%*	





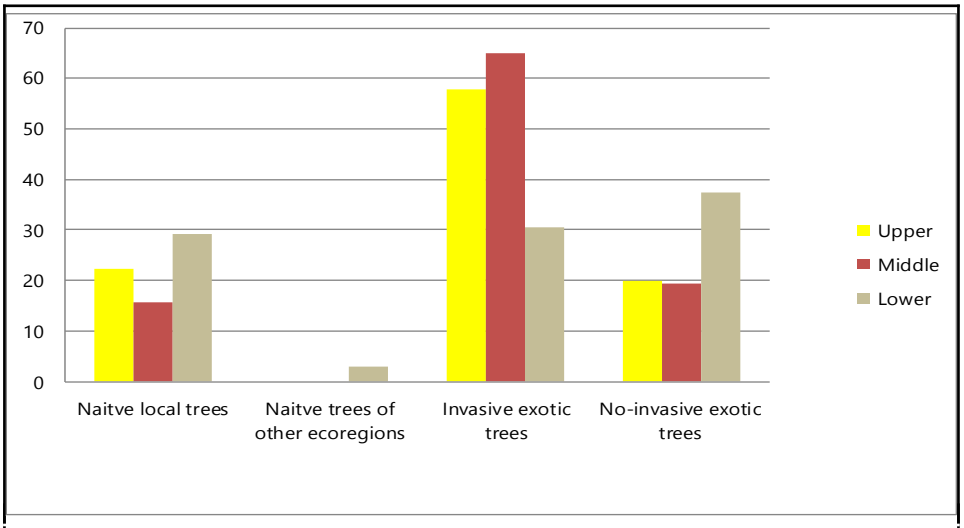
Average coverage as % of indicator plants

A. Faggi changed by V. Fischl 2015

You can find most of the forestland in the middle basin. There you can find invasion of *Acer negundo*, *Gleditsia triacanthos* and *Morus alba and nigra*.

Exotic tree invasion

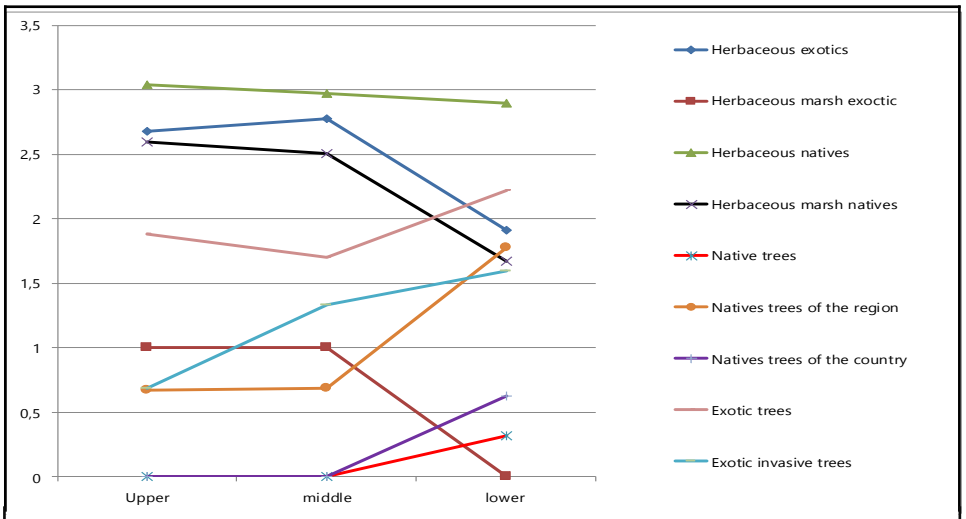
Originally, most part of the tree cover prevailed in the lower basin due to the development of a riverbank forest that was dependent on flooding, and that was part of the biocorridor of the Plata estuary. The feeling and reduction of the flooding caused by the steepening of the bank slopes was the main cause of the change in the flora. On the other hand, native species such as the willow, alder trees and „curupi" have been replaced by exotic species (poplar, ash) by means of forestation.



Forestland in the different sectors of the the basin
A. Faggi 2014

Floral Diversity

The rates of flower diversity are found in the lower basin, both for native trees and palustre species, where the human impact is higher. Most of the diversity can be observed in the herbaceous plants. In the native species, the diversity is greater in the upper basin and it reduces gradually towards the lower basin thanks to the change in the bed and bank structure, and also the weeding. The exotic species reach their highest level of diversity in the middle basin due to the influence of agricultural activities and the advance of urbanization. They are less prevalent in the lower area of the basin. The trees and bushes that are native to Buenos Aires, and that are witnesses to the currentlyreduced riverbank forest, have the highest level of diversity in the lower basin. The invasive exotic trees increase in number from the upper to the lower basin. The rest of the exotic species also increase in number towards the lower basin, but reach their lowest number in the middle one.



Floral diversity at the different sectors of the basin
A. Faggi 2014

Birds

Foto by A. Faggi n. d.

Birds are reliable indicators of the quality in the urban bank areas, since they are sensitive to environmental changes caused by urbanization. In the city of Buenos Aires, and its surrounding areas, there are more than 200 birds species, which represent about 20% of the Argentine birds. In the Matanza-Riachuelo Basin, they are good indicators of impacts and processes triggered by humans.

Sicalis flaveola
Foto by Larry Thompson 2007-2013

Paroaria capitata
Foto by Larry Thompson 2007-2013

Tyrannus savana
Foto by Larry Thompson 2007-2013

Machetornis rixosa
Foto by kathiana_cardona n. d.

In the cities, birds are used as indicators of environment quality, since they are an extremely diversified, globally widespread, numerous group with a marked sensitivity regarding changes in the use of the soil. Just by observing birds, the different species, their abundance, their behaviour habits, and their diets, we can gather useful information for urban planning and design, which will allow for the achievement of a more inhabitable, pleasant and appropriate environment for its population, guaranteeing the conservation of the bird fauna and the vegetative cover.

Matanza-Riachuelo Basin is a diverse area. The lower basin is located at the intersection of three different biogeographic regions: The Pampa region, characterized by plain meadows; the Espinal region, characterized by forests of low water requirements that are parallel to the Rio de la Plata and the ravines of Parana River; and the Paranaese rainforest, which is placed in the small islands of the riverbeds, and is characteristically humid. Although these native environments have virtually disappeared in the metropolitan area, the birds find shelter in the green spaces that remain in the area, such as the Riachuelo banks, the parks, and urban reserves such as Costanera Sur and Los Robles. Here in the river bank areas, we can find birds of different habitats, diets and behaviours.

The urban bird community in the riparian zones is made up of native and exotic species. The natives species are those that are native to the place, and the exotic species are those intentionally or accidentally introduced from other parts of the world.

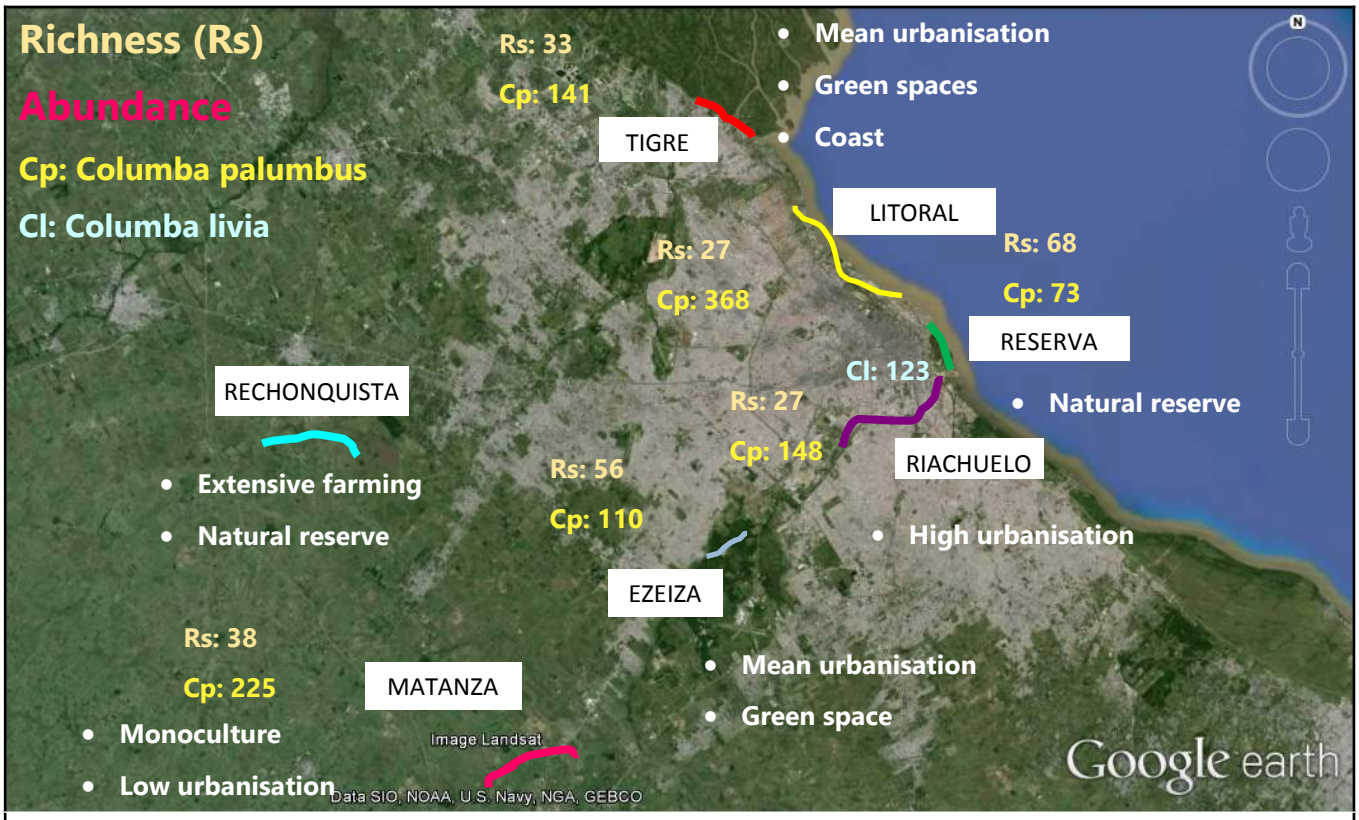
More than 90% of the birds that make up the community are native, but in many cases, in areas of high urbanization, only a few exotic species (such as pigeons and sparrows) can make up 85% of the birds. Some species are more common, and some others are rarer. The common species are more numerous and easier to observe. They are generally well-adapted to living among buildings, gardens and modified environments. This group represents a relatively low number of species (about 30). However, these species can appear in numerous groups of dozens, hundreds, and even thousand individuals. For instance, in the bank areas, the wood pigeon can represent 50% of the birds. The rare bird species, on the other hand, attract more interest for conservation. These native birds are the most vulnerable to environmental changes caused by urbanization. They have more exclusive habits, reduced number of individuals, and they prefer natural vegetation patched. They find shelter in different vegetated environments, vacant lots and urban reserves, but they can rarely be found in areas of high urbanization. In the communities, although there are fewer individuals, they still make up 70% of the species.

Birds can be classified into different groups depending on the environment in which they are found. In the banks of the metropolitan area, the groups are well represented, regardless of the degree of urbanization, by humid weather birds f humid weather that are attracted to water bodies, and generalist birds that benefit from the surrounding areas of the cities. However, other groups such as birds of pasture and forest zones disappear when the surface of constriction exceeds 60%.

bank areas function as biocorridors, allowing the flow of animals and plants, and they are a source of great biodiversity.

In the city of Buenos Aires, we can find more than 200 bird species, most of them dependent on natural landscape relicts.

When the vegetation cover increases, the prevailing exotic birds (pigeons and sparrows) decrease in number until the species disappears. Contrary to this, in banks filled by concrete and building waste, a high amount of noise, and other disturbances, only a few bird species can benefit. This causes the number of individuals to be excessively high, with a smaller diversity of communities, which reduces the environmental quality of the city.



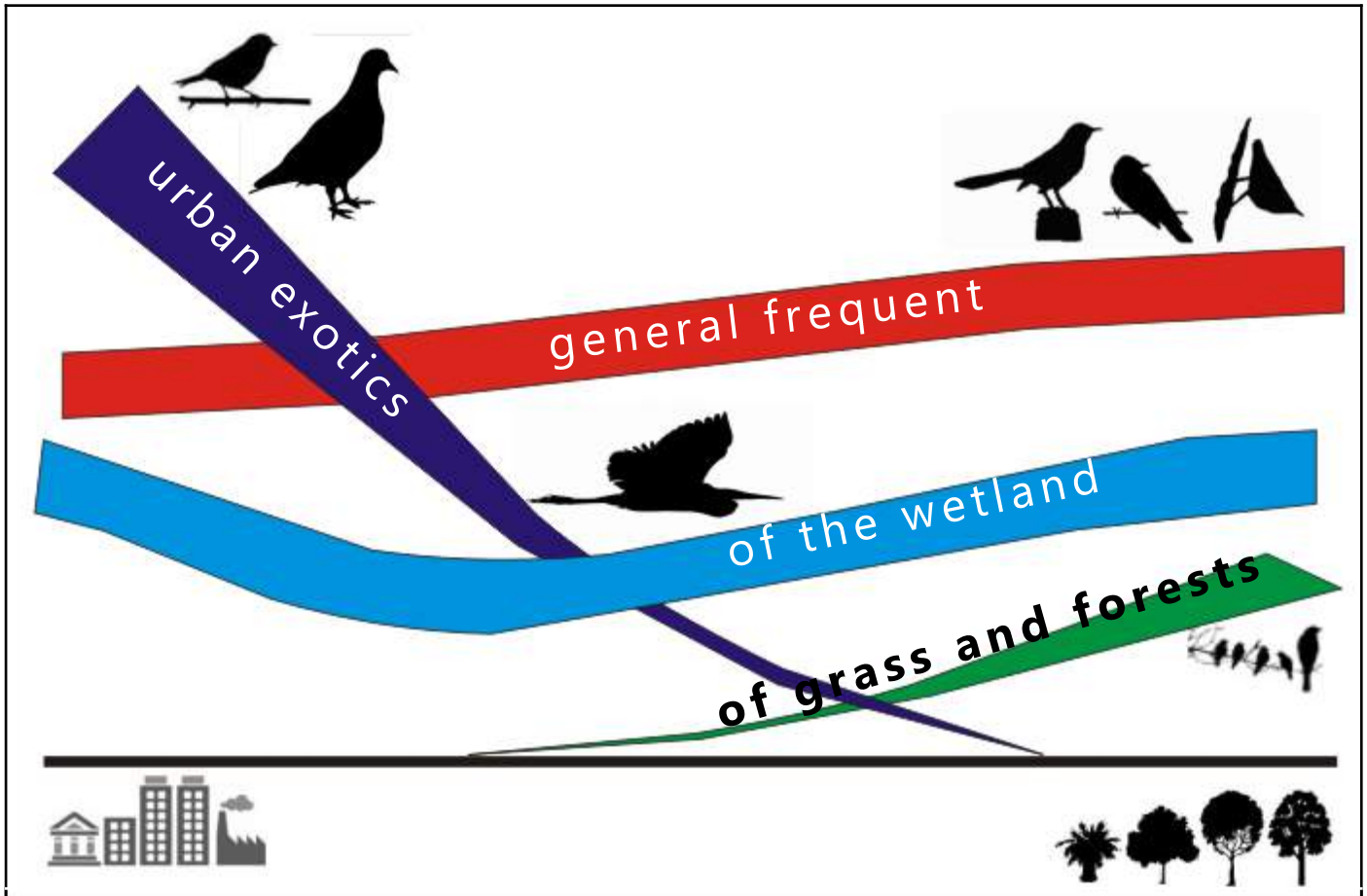
Total riches and abundance of *Columba plaumbus* and *Columba livia* inside the basin.

Total riches: Total number of the different species / abundance: number of individuals of the same species

P. V. Perepelizin 2014

The map shows the Matanza-Riachuelo Basin with different soil uses, and the name transects where the richness and abundance of birds were sampled. In order to carry out the assessment, we made a single morning or afternoon visit during the birds' spring/summer activity peak. Area of 50 m where observed for 5 minutes period. During this time, the totality of spotted or heard birds were recorded. Moreover, comparative data from Reconquista Basin and the littoral or Fio de la Plata´s estuary were included. In the upper basin, single crop farming, extensive cattle industry, low urbanization areas, and spontaneous vegetation areas predominate. However, although permeable areas with vegetation cover, bare soil or stubble prevail, birds respond differently depending on the use of the soil. When we count on reserve areas, water bodies, and meadows for extensive cattle production, the number rise up to 50, which is a considerably higher number than the ones for areas inside the urban matrix, but lower than the ones in Costanera Sur (a reserve area on the littoral that is home to important native vegetation). However, in some places in the upper basin but also in areas of single crop farming and low urbanization, the number drop to 38, which is just above the values obtained inside the city. What is more, they are environments in which the presence of the wood pigeon is of great importance, exceeding the 200 individuals per key point of observation. On the other hand, in parts of forests with a predominance of exotic species and pasture relicts dependent on the adjacent extensive cattle production in the middle basin, the caules of richness rise up to 56. This considerably high value in areas close to the metropolitan conglomerate signals the importance of the preservation of forests and pastures zones, principally as shelter for rare species in the surroundings of disturbed areas.

The lower basin, placed inside the urban matrix, has minimum richness values (27-33 species). The abundance of birds such as the wood pigeon in the surrounding areas of the urban centre - southwest and northeast - and the domestic pigeon in the centres with the highest urbanization rates reaches maximum values of abundance (between 100-368 individuals per key point).



Community of birds in areas of urban banks.

On the left side you can see a dense urbanisation, on the right side you can see nature and very large green areas.

The lines indicate the different types of birds in the future.

P. Perepelizin 2014

The structure of the constructed medium and of the vegetation has an influence on the presence of birds. The proportion of diverse green and natural areas with different stratum (trees, bushes, herbs, and grasses), and types of habitats (fountains, puddles, trees, standing dead trees, fallen branches, flowers and fruits, etc.) improves the shelter, diet, and nesting areas for rare species.

Generality frequents	
Eared dove	*Zenaida auriculata*
Picazuro pigeon	*Patagioenas picazuro*
rufous hornero	*Furnarius rufus*
great kiskadee	*Pitangus sulphuratus*
brown-chested martin	*Progne tapera*
rufous-collared sparrow	*Zonotrichia capensis*
red-bellied thrush	*Turdus rufiventris*
monk parakeet	*Myiopsitta monachus*
house wren	*Troglodytes aedon*
chimango caracara	*Milvago chimango*
glittering-bellied emerald	*Chlorostilbon lucidus*
southern crested caracara	*Caracara plancus*
grey-breasted martin	*Progne chalybea*
Picui dove	*Columbina picui*
chalk-	*Mimus saturninus*
cattle tyrant	*Machetornis rixosa*

At the paustres	
southern lapwing	*Vanellus chilensis*
hooded siskin	*Spinus magellanica*
saffron finch	*Sicalis flaveola*
fork-tailed flycatcher	*Tyrannus savana*
double-collared seedeater	*Sporophila caerulescens*
white-rumped swallow	*Tachycineta leucorrhoa*
campo flicker	*Colaptes campestris*
yellow grassfinch	*Sicalis luteola*
white-	*Mimus triurus*
American kestrel	*Falco sparverius*
guira (cuckoo)	*Guira guira*

Swarm of brown-hooded gulls Foto by P. Perepelizin n. d.

At wetlands	
Neotropic cormorant	*Phalacrocorax brasilianus*
great (white) egret	*Ardea alba*
white-faced ibis	*Plegadis chihi*
kelp gull	*Larus dominicanus*
snowy egret	*Egretta thula*
black-tailed stilt	*Himantopus melanurus*
yellow-winged marsh blackbird	*Agelasticus thilius*
(black-crowned) night heron	*Nycticorax nycticorax*
cocoi heron	*Ardea cocoi*
lesser yellowlegs	*Tringa flavipes*
crested screamer	*Chauna torquata*
white-faced whistling duck	*Dendrocygna viduata*
white-winged coot	*Fulica leucoptera*
brown-and-yellow marshbird	*Pseudoleistes virescens*
Chroicocephalus	*Chroicocephalus*
maculipennis	*maculipennis*
giant wood rail	*Aramides ypecaha*
yellow-billed teal	*Anas flavirostris*
Brazilian duck	*Amazonetta brasiliensis*
common moorhen	*Gallinula chloropus*
carrao	*Aramus guarauna*
red shoveler	*Anas platalea*
red-gartered coot	*Fulica armillata*
ringed kingfisher	*Megaceryle torquata*
white-tufted grebe	*Rollandia rolland*
yellow-billed pintail	*Anas georgica*
great grebe	*Podiceps major*
long-winged harrier	*Circus buffoni*
maguari stork	*Ciconia maguari*
red-fronted coot	*Fulica rufifrons*
ringed teal	*Callonetta leucophrys*
silver teal	*Anas versicolor*
snail kite	*Rostrhamus sociabilis*
Trudeau's tern	*Sterna trudeaui*
spectacled tyrant	*Hymenops perspicillatus*
striated heron	*Butorides striata*
wattled jacana	*Jacana jacana*

Urban exotices	
rock dove	*Columba livia*
house sparrow	*Passer domesticus*
common starling	*Sturnus vulgaris*
nanday conure	*Nandayus nenday*
white-eyed conure	*Aratinga leucophthalmus*
reddish-bellied parakeet	*Pyrrhura frontalis*

At the forest	
black and rufous warbling finch	*Poospiza nigrorufa*
checkered woodpecker	*Veniliornis mixtus*
creamy-bellied thrush	*Turdus amaurochalinus*
epaulet oriole	*Icterus cayanensis*
gilded sapphire	*Hylocharis chrysura*
golden-crowned warbler	*Basileuterus culicivorus*
grey monjita	*Xolmis cinereus*
grey-breasted saltator	*Saltator coerulescens*
green-barred woodpecker	*Colaptes melanochloros*
bay-winged hawk	*Parabuteo unicinctus*
masked gnatcatcher	*Polioptila dumicola*
masked yellowthroat	*Geothlypis aequinoctia-lis*
narrow-billed woodcreeper	*Lepidocolaptes angustiro-stris*
hepatic tanager	*Piranga flava*
roadside hawk	*Rupornis magnirostris*
sayaca tanager	*Thraupis sayaca*
small-billed elaenia	*Elaenia parvirostris*
solitary (black) cacique	*Cacicus solitarius*
spot-winged pigeon	*Patagioenas maculosa*
tropical kingbird	*Tyrannus melancholicus*
white-crested tyrannulet	*Serpophaga subcristata*
white-fronted dove	*Leptotila verreauxi*

Suggestion for the design and planning of urban areas of the bank

Rethinking cities are as a balance between construction and natural environments in order to use them as a tool to break up the artificial matrix. Increasing the proportion of green spaces incorporating a fraction of the native natural landscape.

- Make use of the bio corridors potential represented by the riparian zones as a source of bird diversity. Many of the species that are vulnerable to urban processes, and that have disappeared from cities, can be reincorporated when they leave a sector of a natural environment, such as cockspur coral tree, "aliso" or "saces cirollos" forests.

- Preserve, maintain, and increase the original natural landscape and native vegetation, making sure to count on different strata (trees, bushes and herbs) and heterogeneity of habitats. For example: incorporating or preserving humidity, leaving branches and dead trees to function as shelter and nests, floating plant, etc.

- Promote and familiarize the population with natural landscapes as a life habit. Promote educational and recreational activities. Inform people about its relevance, both as a place of biodiversity preservation, and as a place for providing environmental services.

- Discourage the feeding of pigeons and sparrows in order to avoid an excessive increase of their population.

Observation of birds in upper basin Foto by B. Guida Johnson n. d.

Bank Quality Index

FOTO BY B. GUIDA JOHNSON N. D.

A bank quality index is a tool that allows us to synthesize the information about the ecological state of riparian areas. This information also allows us to know the preservation conditions of the riverbanks by means of a diagnosis of the impact of human activities, and natural strengths and weaknesses of each riparian place to assess. In this way, we can contribute to the design and implementation of recovering actions in cases of severe deterioration, or strengthen and preserve the regenerative abilities of the natural ecosystem in cases with better environmental conditions.

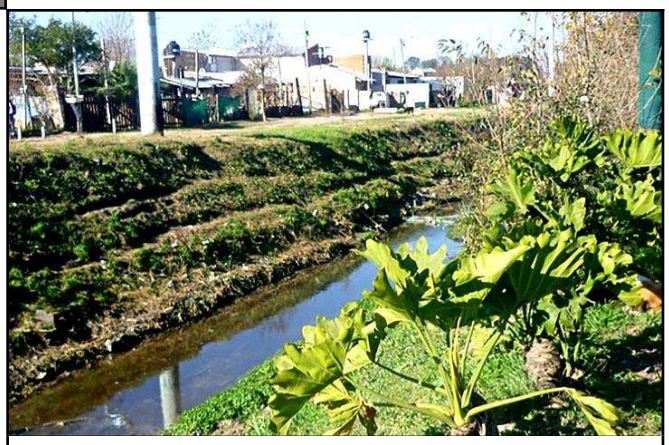
An index of bank quality is made up of a group of parameters that quantify different biological attributes of the banks, and whose assessment is carried out in relation to specific reference conditions. In this case, both ecological attributes related to the dynamic structure and functioning of the banks, and different types of direct and indirect impacts of human origin on the riparian corridor have been taken into account. Within the structure and functioning of the banks, the riparian space characteristics, as well as their connection with the river and its composition, and the structure and riparian vegetation cover have been taken into consideration. The riparian space is both lengthwise and widthwise a natural characteristic of the landscape's unity as constituted by the river. It signals the magnitude of the physical place where ecological processes and functions of the fluvial corridor that influence the area's heterogeneity take place.

The lateral connectivity between the riverbed and the bank is related to the flooding frequency, or hydrological connectivity from which the exchange of matter and energy between the bed and the floodplain is set up. The vegetation that thrives in the riparian space and its characteristics regarding compositions, structure and cover must be evaluated in relation to the reference conditions. This means they have to be assessed in relation to the native vegetation of areas with a lower level of degradation or potential vegetation corresponding to that section, to its hydrologic and geomorphic characteristics and the biogeographic region it is placed in.

Vegetation is important because it regulates matter and energy flows in aquatic and terrestrial ecosystems. It is one of the main sources of food, it provides shelter for organisms that inhabit fluvial beds, it helps stabilizing shore sediments and floodplain, it protects margins form erosion, and it provides vegetal material that boosts the creation of new habitats. As regards the effects of human activity on the banks, works and interventions on the riverbed and banks, dumping and the use of the adjacent soil of the bank have been taken into consideration. The condition of the shores is assessed as to regards its natural character in the same way that the man-made works and interventions in the riverbed and banks, which show the dynamic between the bed and the quality of the physical habitat. Dumping and the use of the adjacent soil in the banks are indicators of the type of activities carried out by the people in the surrounding areas of the rivers, and they allow us to estimate local potential disturbances on the canal and its floodplain that may arise from such activities.

Lower basin La Boca

Foto by E. Melignani n. d.



Middle basin

Foto by E. Melignani n. d.

Foto by E. Melignani n. d.

Physical characteristics of riparian area

Foto by E. Melignani n. d.

Impacts over the canal and/or the bank

Foto by E. Melignani n. d.

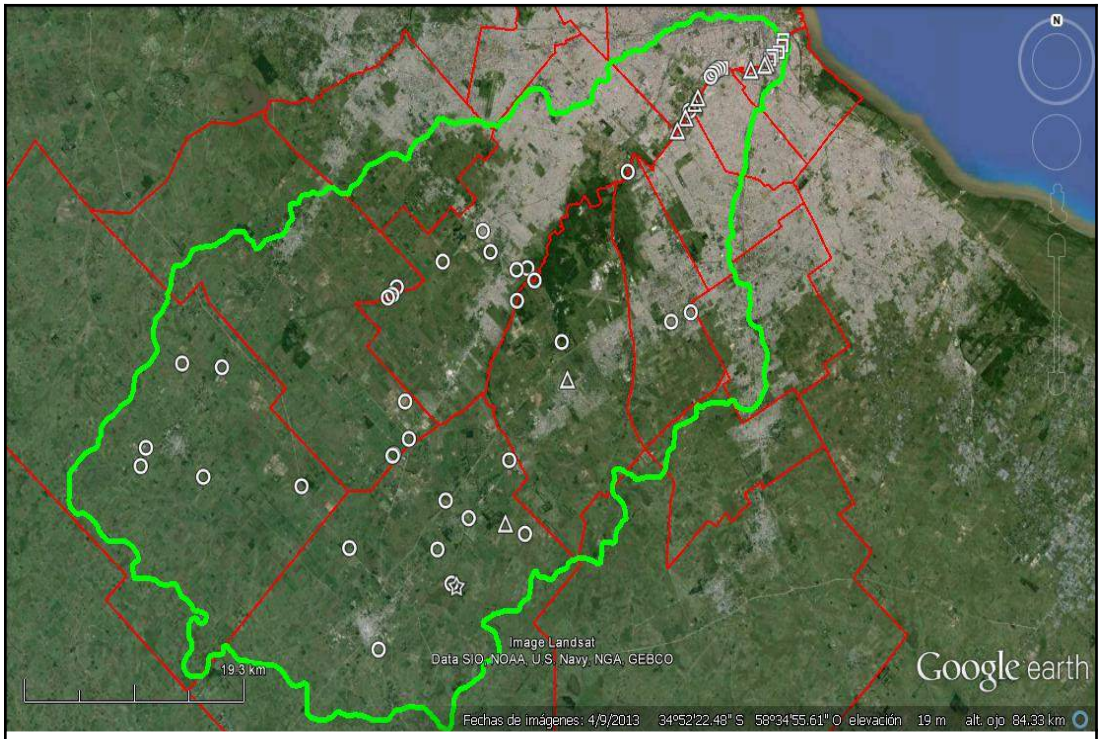
Use of the nearby ground

Foto by E. Melignani n. d.

Structure and body of the riparian vegetation

In Matanza-Riachuelo Basin, 56 different sites were analysed in which the bank quality index was used. To this end, an area of 100 m parallel to the riverbed an separated perpendicularly by 50 m was delimited for each margin. In each area, each one of the previously mentioned variables was evaluated and assigned a numerical value. This numerical value was later transformed into a category clue according to the judgment.

Finally, the category caules of every variable of a certain site were added up, both margins were averaged, and the result corresponded with the environmental evaluation of the analysed site.



Matanza-Riachuelo Basin (green line), which part they conform to (red line) and 53 analysed signs

E. Melignani 2014

Foto by E. Melignani

n. d.

Very good (87, 26-106, 00)

- Native vegetation is in good condition and consistent with its original country. Little or no presence of exotics.
- Riparian area is suitable. Very good connection between the river and adjacent eco-system. Rubbish is absent. Little sign of human impacts, permeable paths.
- Use of the ground associated with urbanisation and pre-urbanisation. Few or no influence of agriculture or livestock farming.

Foto by E. Melignani

n. d.

Good (68, 51-87, 25)

- Native vegetation well-preserved: Proportion of woody invasives is low, even though there are exotics. The floating and marshy plants are generally well-represented, but are sometimes tight.
- Canal and banks are good condition, but can be polluted by sewers and mud.
- Water quality more than less good, occasionally with organic residues, froth and rubbish. Few signs of human impacts.
- Use of the ground associated with urbanisation and pre-urbanisation. Little or no influence of agriculturre, but growing impacts from livestock breeding.

Foto by E. Melignani

Regular (49, 76-68, 50)

- Original vegetation is completely changed: Considerable woody invasives, few representative marshy plants, floating plants absent.
- Poor connection between the river and the adjacent ecosystem. Riverbed straighted and canalized.
- Bad water quality and smells unpleasant. No too much rubbish. Significant high human impacts on the streets and sealed surfaces.
- Ground use associated with dense urbanisation, affected settlement, energy-intensive industry and landfills.

Foto by E. Melignani

n. d.

Bad (31, 00-49, 75)

- Absence of vegetation
- Connection between the river and the adjacent ecosystem is low or is not-existent, because of the buildings which prevent high water. River-bed straighted and canalized with dredged material.
- Bad water quality and unpleasant smell due to the disposal, because of disposal of domestic and industrial waste without treatment.
- Poor connection between the river and the adjacent ecosystem. River-bed straighted and canalized. Little rubbish. High human impacts over the streets and sealed surfaces.
- Ground using associated with dense urbanisation, affected by settlement, energy-intensive industry and landfills.

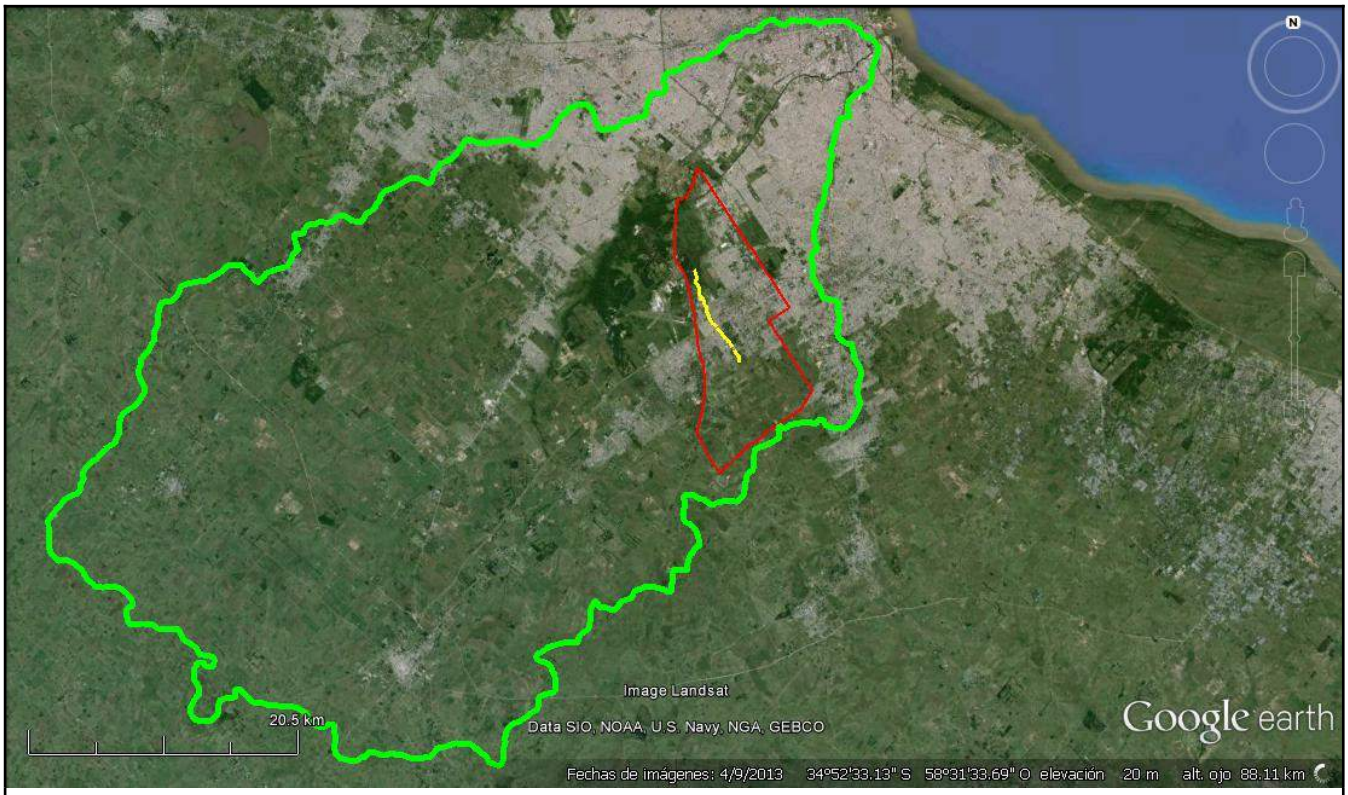
Three out of the 56 places analysed were found cut or dry. Thus, they were factored out of the evaluation. Out of the 53 evaluated sites evaluated, most of them were good (37 sites), only one was very good, nine were regular, and six were bad. The only very good site was found in the upper basin, although three other reference sites were also considered among the good results. Most of the good sites are places in the upper and middle basin, as well as three cut or dry sites.

Most of the good sites are situated in the upper and middle basin, as well as three cut or dry sites. Most of the regular sites and all of the bad sites were found in the lower area of the basin.

Environmental characteristics of each sector		
 Upper Basin Foto by B. Guida Johnson n. d.	 Middle basin Foto by B. Guida Johnson n. d.	 Lower basin Foto by B. Guida Johnson n. d.
Very good connectivity	Good connectivity	Tight riparian area. Without connectivity
Bank, canals and river course almost natural. Small mounds and imitation structures. Low river regulation and few dried up river courses.	Bank, canals and river course with few modifications. Mounds and imitation structures, erosion and some dried up river courses.	Banks impermeable to water, canalisation and river regulation.
Barely any waste	A lot of scattered waste and areas where waste has accumulated	Dredged material. Bad water quality. Smells unpleasant
Discharge of waste water: Feces and foam	Discharge of waste water: feces and foam	High discharge waste of water from households and industry
Peri-urban and rural	Peri-urban and rural, dense peri-urban	Dense urbanization with unpleasant odor
Livestock breeding and agriculture	Livestock breeding and intensive agriculture	
Low extractive industry	Extractive industry (brickyard and limestone quarry)	Heavy industry (tannery, refrigerated warehouse, chemical products)
Few woods; quite a lot of grasses, and many exotics		Forest area, different native plants; marsh plants

M. Diez and students of the higher institute of teacher and technical Training N°35

These case study refer to a part 3 km long part of the stream which flows through *Partido de Esteban Echeverría* in the middle basin. The case study goes into more detail and proposes possibilites to make it better.

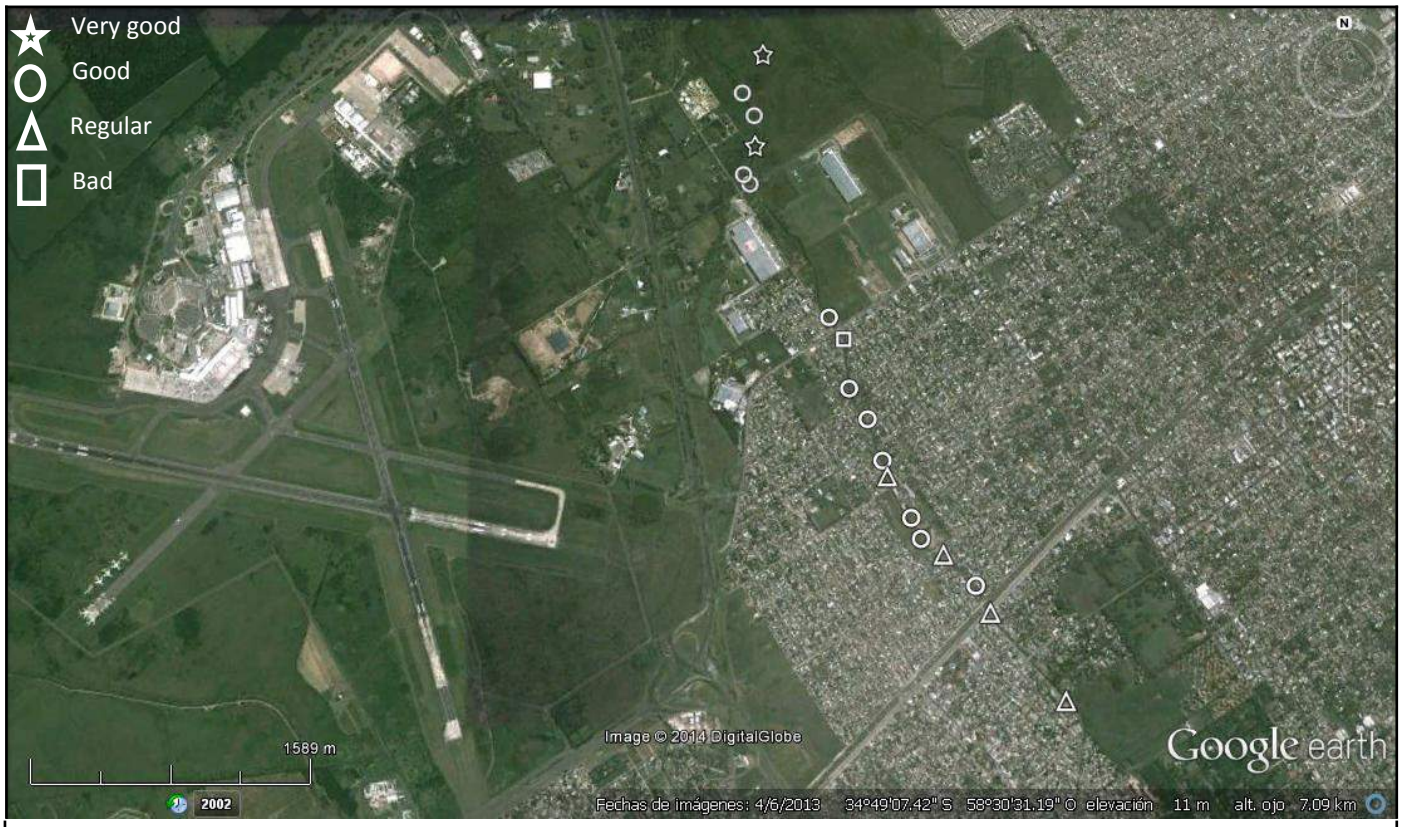


Matanza-Riacheulo basin (green line), Esteban Echverría (red line) and relevant part of 3 km long stream (yellow line)
E. Melignani 2014

For this reason, we worked together with students in the 3rd year of the Environmental Management and Health Technical Degree at the Higher Institute of Teacher and Technical Training N°35 „Profesor Vicente D'Abramo" in the town of Monte Grande, Ptd. Esteban Echeverría in 2013. There were two meetings with the students. In the first meeting, both the methodology of surveys and the use of the bank quality index were explained.

In the second meeting, the students commented on the results obtained , they discussed possible sites to rehabilitate, and preliminary rehabilitation proposals for such sites.

18 sites were surveyed, most of which turned out to be good. Two sites were found to be very good, four regular, and one bad.



18 survyed sites in Ptd. Estaban Echeverría

E. Melignani 2014

The good sites showed similar characteristics to similarly-surveyed zones in the middle basin. A small number of marshy plants were observed together with small amounts of garbage, bad water quality, and precarious settlements close to the body of water.

In the very good sites, on the other hand, the marshy plants were more abundant, the pressure of urbanization was peri-urban or rural, and no garbage or effluent dumping was observed. Thus, the water quality was good, no doubt influenced by the proximity of the preserved area of Laguna de Rocha.

Good area

Foto by E. Melignani n. d.

Very good area

Foto by E. Melignani n. d.

Regular area
Foto by E. Melignani n. d.

Very bad area
Foto by E. Melignani n. d.

The regular sites and the bad one were noticeable by their reduced riparian space, the absence of floating plants, the scarcity of marshy plants, the presence of garbage and effluent dumping, combined with bad water quality and precarious settlements. Particularly, there was scarce vegetation cover, and very few native herbs in the bad site

Case study team
Foto by n. a. n. d.

In the following figures, we can observe different situations found in the banks and the water body: the presence of garbage in the margins or in the water body, effluent dumping pipelines, and foam in the surface of the water

Waste in the water
Foto by E. Melignani n. d.

Car tyre in the water body
Foto by E. Melignani n. d.

Collected household waste nearby the basin
Foto by E. Melignani n. d.

Plastic waste in the water body
Foto by E. Melignani n. d.

Waste water pipeline which dumps the waste water directly into the water body
Foto by E. Melignani n. d.

Foam in the water body
Foto by E. Melignani n. d.

Rehabilitation Potential and Priority

Foto by Francisco Ferrer n. d.

Planning is an essential step in the achievement of success in any rehabilitation project. When the resources are not enough to rehabilitate all the sites at once, it is necessary to establish priorities, since selecting the one with higher potential guarantees the achievement of the goals and the maximization of the benefits. Rehabilitation implies bringing the system back to a condition prior to the disruption, without expecting to reach its original state. An analysis of the selection of rehabilitation priority sites was formally presented.

Middle basin
Foto by Christina Lafflitto n. d.

Middle basin
Foto by B. Guida Johnson n. d.

In the first place, river bank environments were evaluated in regard to their rehabilitation potential, taking into account the type of soil utilization in the surrounding areas. It was considered that the banks in an urban context had socio-environmental rehabilitation potential, while the banks in a rural context had ecological rehabilitation potential.

The goal of the *socio-environmental rehabilitation* is to create green urban areas that could be used with recreational, social participation, and environmental education purposes. In this way, the premise of this analysis was to give priority to banks whose rehabilitation represented more benefits for the local community. That is to say, it gives priority to those banks that are in the most deteriorated areas, or those with a higher necessity of green urban areas.

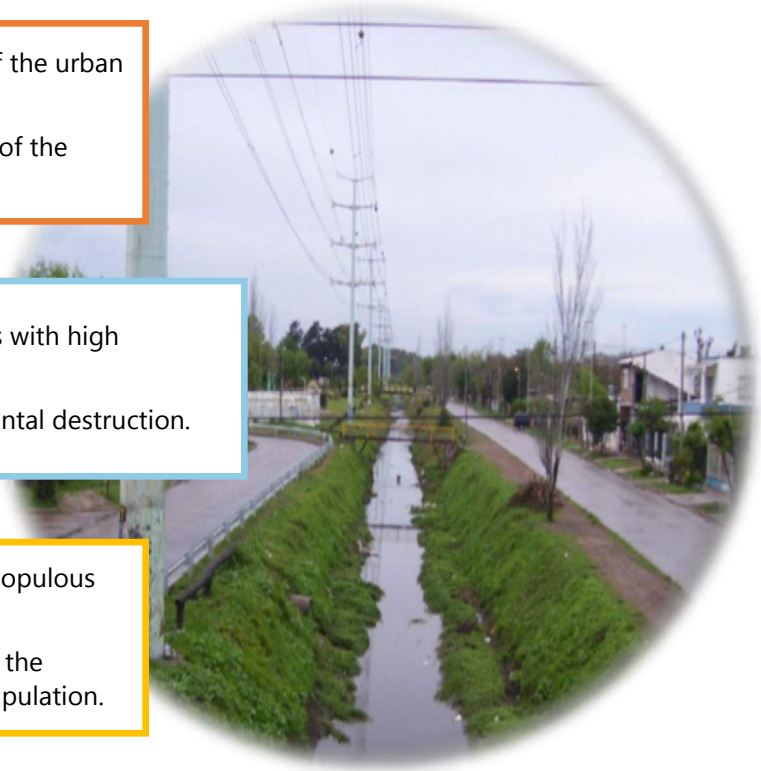
The goal of the *ecological rehabilitation* is to recover both ecological processes and functions, and ecosystem services through the enforcement of measures such as creating buffer zones, reconnecting banks and adjacent floodplains, reintroducing native species, or controlling invasive exotic species. In that sense, the premise was to give priority to banks that implied higher probabilities of success.

The first phase of the analysis made a distinction between these two types of banks. They were given priority later on through the assessment of two groups of criteria. At the same time, these groups were chosen according to the established premises.

Middle basin
Foto by B. Guida Johnson n. d.

Upper basin
Foto by B. Guida Johnson n. d.

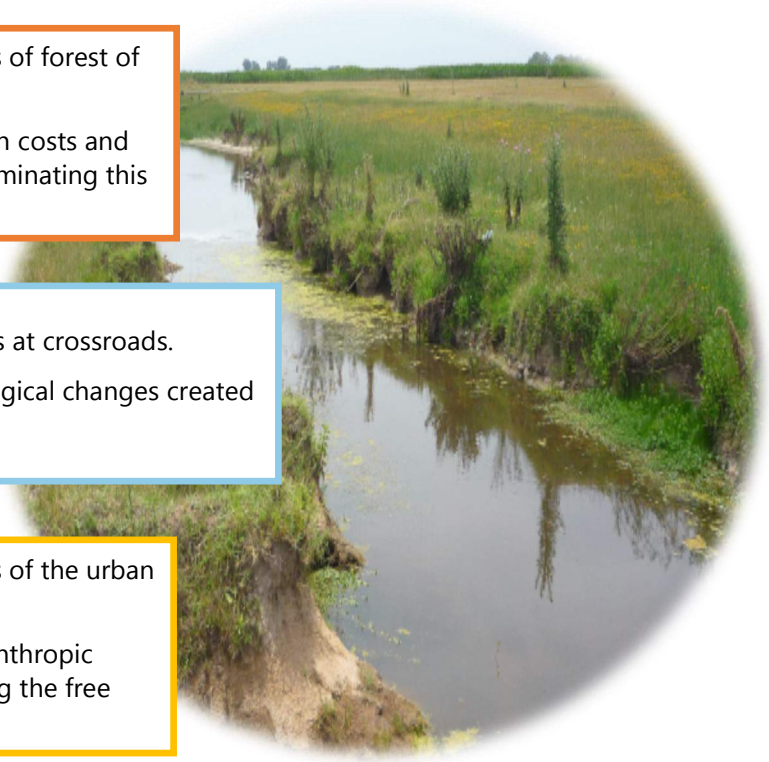
Recreational opportunities	Priority on remote banks of the urban green areas. Pay attention to the needs of the recreational area.
Environmental destruction	Priority on banks in regions with high proportion of sealed area. Pay attention to environmental destruction.
Population density	Priority on banks in most populous areas. Pay attention to areas with the highest benefit for local population.



Criteria for prioritizing the banks for social-environmental rehabilitation

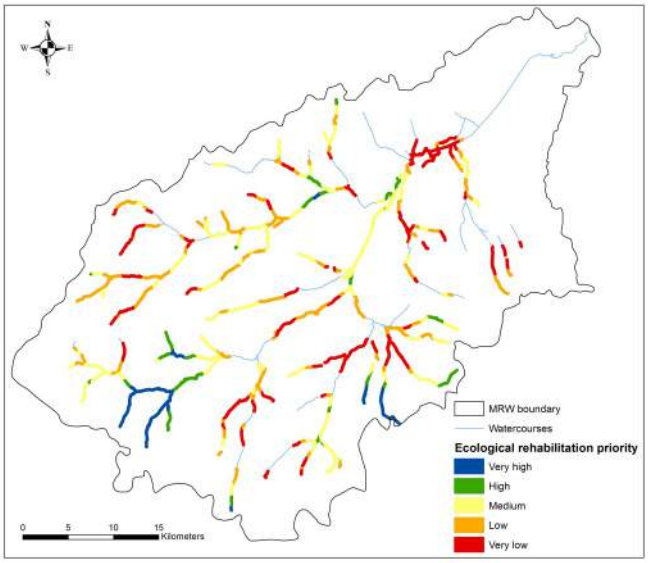
Foto by Christina Lafflitto n. d. by V. Fischl 2014

Resistance of the exotics	Priority on remote banks of forest of invasive species. Pay attention on the high costs and small possibility of exterminating this species.
Hydrological restoration	Priority on remote banks at crossroads. Pay attention to hydrological changes created by bridges.
Population density	Priority on remote banks of the urban area. Pay attention to direct anthropic effects triggered by using the free public area.

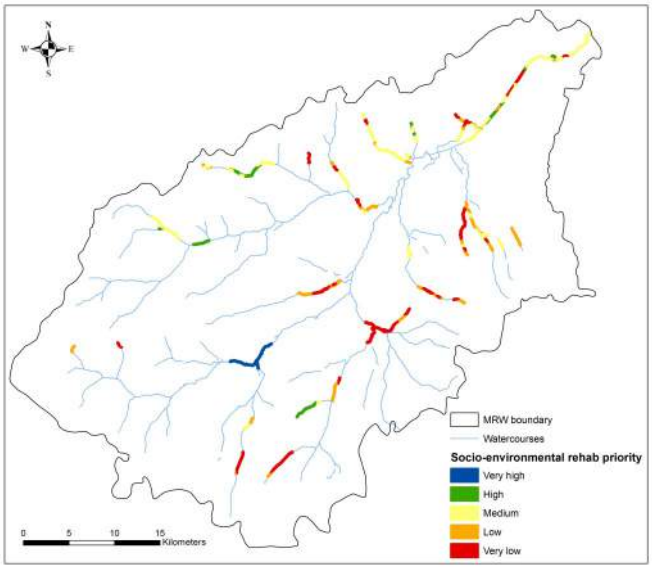


Criteria for prioritizing the banks for ecological rehabilitation

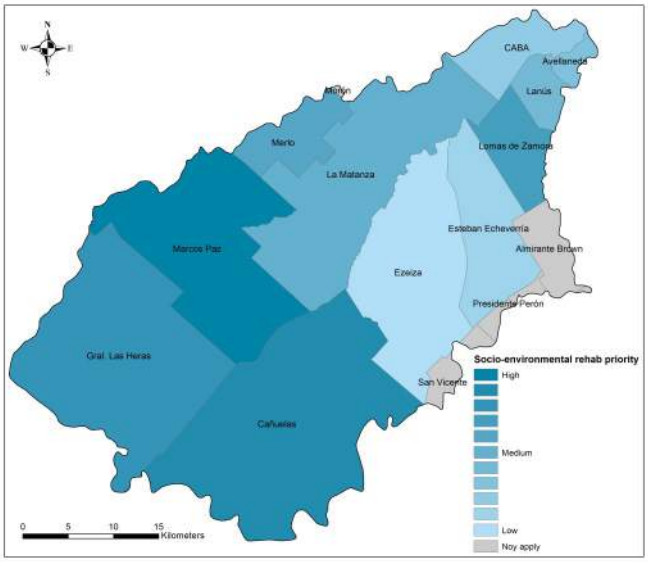
Foto by A. Faggi changed by V. Fischl 2014



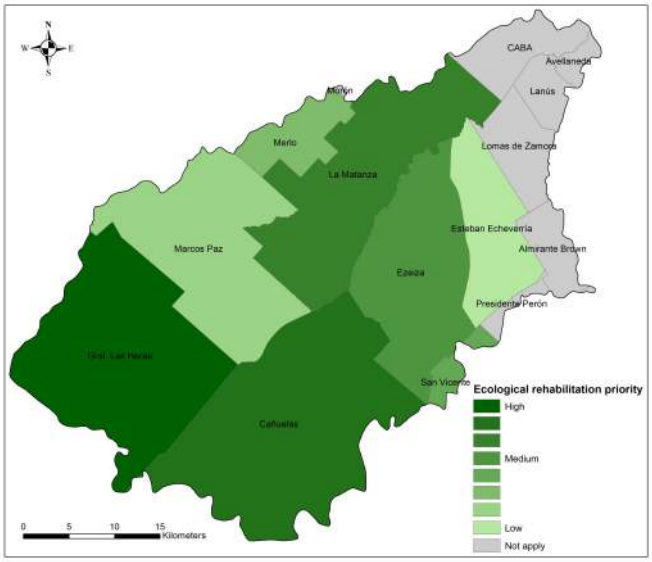
Prioritizing to the banks for social-environmental rehabilitation
B. Guida Johnson 2014



Prioritizing to the banks for ecological rehabilitation
B. Guida Johnson 2014



Prioritizing the different parts of the banks for social-environmental rehabilitation
B. Guida Johnson 2014



Prioritizing for ecological rehabilitation for the different parts
B. Guida Johnson 2014

The banks with extremely high social-environmental rehabilitation priority are only placed in the upper basin, while the banks with high priority are found all along the basin. The banks with extremely high ecological rehabilitation priority are mainly found in the upper basin, but they can also be found in the middle basin. The banks with high priority are evenly located in the upper and middle basins

ecological rehabilitation Up

ecological rehabilitation Upper

social-environmental rehabilitation Upper

social-environmental rehabilitation Up

Fotos by B. Guida Johnson n. d.

B. Guida Johnson | A. Voigt | A. Faggi | J. Schnellinger | J. Breuste

University of Lomas de Zamora-Univiersity Maimonides | University Lodron-Paris, Salzburg, Austria| MACN - CONICENT

The Riparian Space According to people's opinions

Foto by A. Faggi n. d.

The environmental deterioration of the river and its surroundings is reflected in the neighbours' perception of the water and landscape quality. The biggest differences are observed in the way in which the residents imagine the future, especially in the recreational potential of banks, and regarding the individual compromises to rehabilitate the water course in a collaborative way in the surroundings of their residences.

In the administration, and especially in rehabilitation programs for riparian spaces, the communities environmental perception is useful when it comes to identifying problems and discussing potentialities and synergies. There is worldwide evidence that people's opinions and attitudes towards the environmental quality of the river and its banks are closely related to the landscape, and they depend on the proximity of the water courses. 276 residents living all along the basin at up to 1 km from the bank were interviewed between 2012 and 2013. The survey explored their experiences and memories related to the river, the activities carried out, the aesthetic value, the perception of the water quality, garbage, hum impact, and risks. The participants were also asked about the change possibilities that they could envisage, and what would be the individual compromise in the search for the improvement of the environmental quality.

Ecualiptus trees in Ezeiza
Foto by A. Faggi n. d.

Residents who live on the banks	1) Upper 2) Middle 3) Lower	Are there any regional differences in perception?

Residents who live as far as	1) 100 m of the bank 2) 500 m 3) 1 km	Does proximity to the river influence opinions?

The opinions of the survey respondents reveal that most of them think that the riparian landscape is ugly (33%) or very ugly (49%) due to the water pollution and the garbage (80%). 63% of the respondents consider that the water quality to be bad, and 27% consider it very bad, based on the color and the perceived smell. For 90% of the survey respondents, the river does not provide recreational opportunities.

Reasons for dissatisfaction are accumulation of waste, bad smell, lack of care and attention to the area

Fotos by B. Guida Johnson n. d.

Different opinions in three areas of the basin

More than half of the survey respondents in the upper or middle basin expressed having negative experiences with the environment due to flooding or bad smell, while 57% of the survey respondents in the lower basin have no relationship with the river.

Insecurity was mentioned as an alarming characteristic in 48% of the cases in the lower basin, and in 28% of the cases in the middle basin.

Around 3/4 of the survey respondents of the upper and middle basin would be willing to collaborate with the city government in the cleaning, maintaining, and control of the riparian environment. The willingness is smaller in the lower basin (59%). Even though nowadays the riparian space is virtually out of use, the survey respondents agreed that it could be a place where their children could play (66% in the upper basin, 75% in the lower basin), and only 29% said that it could have recreational value in the middle basin.

Foto by A. Faggi n. d.

Foto by A. Faggi n. d.

Foto by A. Faggi n. d.

Negative experiences	Have no relationship with the river

Relationship of the respondents with the river

Differences depending on the closeness of the residents to the riparian border

The survey respondents living close to the bank border admit to having a negative relationship with the riverbed due to flooding risks and the prevailing environmental conditions. The residents that are live further from the basin do not have any type of relationship with the river or recreational area. The willingness to collaborate with cleaning, maintaining and control is higher in the survey respondents that live up to 500 m form the banks (84 % represented by those living less than 100 m away, and 76 % represented by those living between 100-500, and it goes down to 51 % for those living even further away. Female residents living up to 500 m from the banks were significantly more willing help than men. These gender differences disappear among the residents that live further away.

Foto by A. Faggi n. d.

S. Eisenreich University Lodron-Paris, Salzburg, Austria

The river as seen by kids and young people

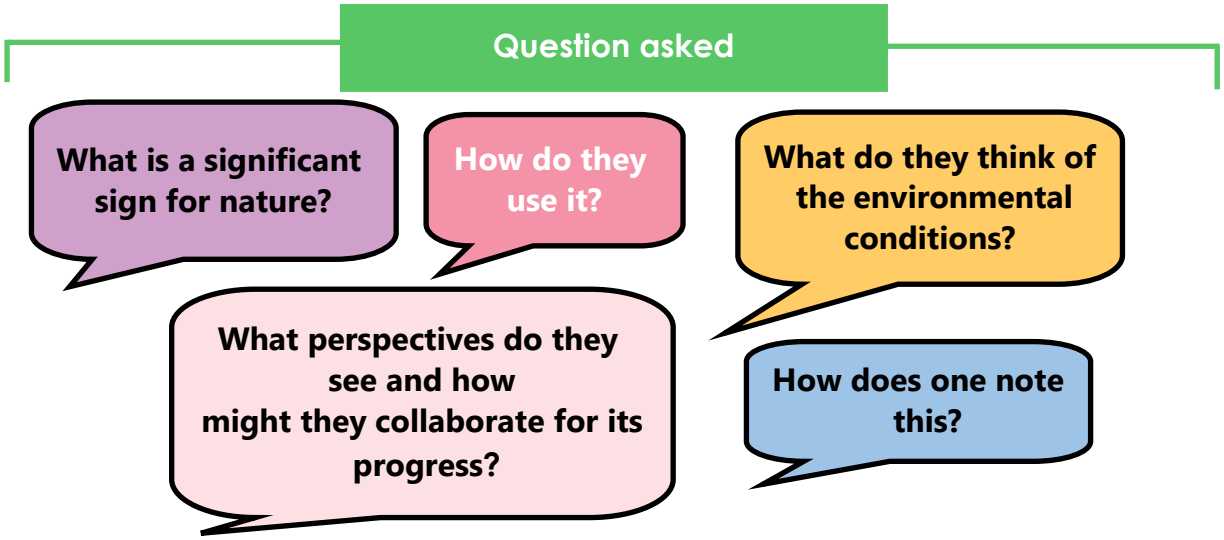
Foto by N. A. N. D.

More and more cities are addressing the necessity of planning a future that can guarantee life conditions with environmental quality, and correcting past mistakes. For this reason, keeping in mind the kids' and teenagers' knowledge of the environment is crucial, since they are the ones that will inhabit and manage the territory as responsible adults in the medium- and long-term. In workshops carried out in class in Matanza-Riachuelo Basin, children's and teenager's opinions, images and points of view about the river were assessed by means of written surveys and drawings.

Between February and May of 2013, 12 schools in the basin that where visited with the aim of interviewing kids and teenagers between the ages of 8 to 15 and their teachers. 69% of the students attended state schools, and 21% attended private schools, 54,4% of them were girls, and 45,6% were boys. The workshop started with the question of whether they all knew the image they had of the river, and how they imagined it in the future. Finally, kids were individually invited to answer an interview of five open questions about the importance of nature, the present conditions of the river and an their future expectations.

The 337 survey respondents answered that nature is very important and irreplaceable. They were aware of the alarming environmental conditions of the river; they envisaged possibilities of environmental quality improvement, independently from the area of the basin where they lived, and their socio-economic condition. This awareness coincided with their present images and future predictions.

Basin	Types	Population	Schools	N° of the interviewed kids
Upper	Rural, peri-urban	121,962	2	80
Middle	Urban, suburban	3,230,719	2	98
Lower	urban	4,861,631	8	199
Total		8,212,953	12	377



Results of the surbey

As regards the response to the question about what nature represent for them, 56.2% mentioned living elements like plants and animals, 36.3% non living elements like water and elements from the landscape, and 16.2% use more general terms such as environment and ecosystem services. Among the first group, vegetation was the most mentioned (72.2%), followed by animals (22.7%), the forest (4.4%), and men (3.5%).

Among the second group, the predominant elements were those referring to the landscape, such as water bodies, plains and mountains (69%), followed by sky and sun (17.7%), and weather conditions such as rain, wind, and storms (13%). Among the third group, 50.3 % mentioned the environment, 39.6% a healthy environment, and 8.4% a preserved environment.

The options were grouped according to a holistic or an anthropocentric view, the first one prevailing with 75 % of the words mentioned, which referred to biological and geographic concepts. Regarding the ecosystem services provided by nature, the most requested answers referring to the use of such services could be grouped into the cultural category, followed by the support category. The great majority of the students acknowledge the relevance of nature as regarding recreational uses (84,3 %).

It is noticeable that other categories such as supply categories (wood, fish, and water) and attenuation categories (improvement of the weather, erosion and flood control) were not mentioned in the surveys. It appears that these concepts, which are quite frequent in the environmental sciences and in present issues, have not been fully developed at school.

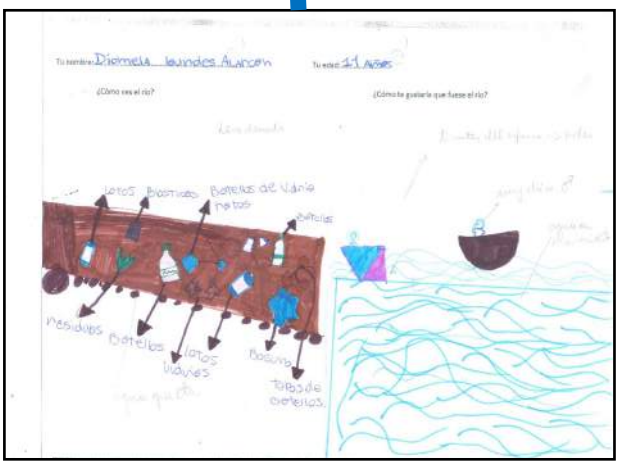
Cultural	Support
recreational 84.3 % aesthetic 4.4 % spiritual 3.8 % education 1.3 %	6.3 %

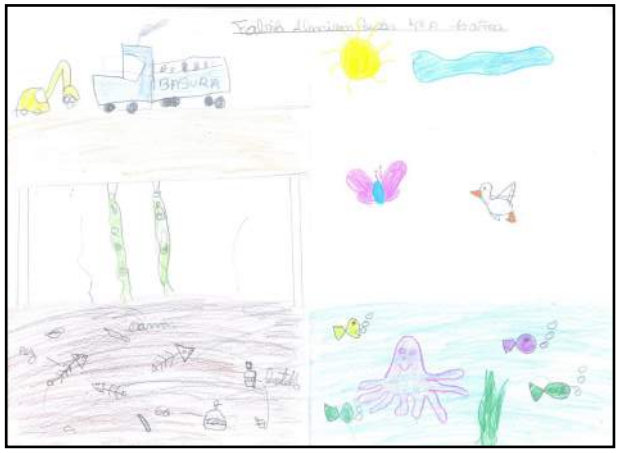
Evaluation of the question with regard to nature and ecosystem services

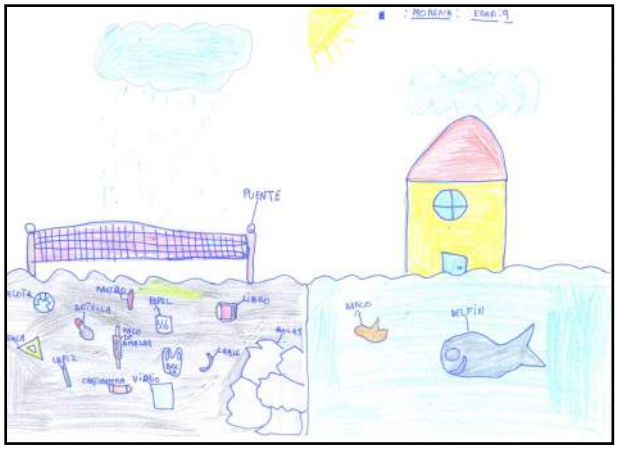
Visons for the future	Actual image
clean water animals restless fish happy faces parks plants clean places	dark-coloured water garbage factories fish with crossed eyes sad faces skulls

The objects represented in the drawings illustrate the current situation (how it is) and the future expectations (how the river should be)


Valentina León 13 años


Tu nombre: Diomela Leandes Alancon
Tu edad: 11 años
¿Cómo es el río?
¿Cómo te gustaría que fuese el río?
Botellas de Vidrio
Botellas
Bolsas de botellas


BASURA


PUENTE
PAPEL
LIBRO
VIDRIO
BALSA
DELFIN

Corporeal experience, creative experience and representations

Foto by V. Fischl 2014

"In the productive domain, the kid focuses on the task that he or she hast to perform. The kid tries to bring life into a visual form that could, in some ways, satisfy the intuition, feelings, images or ideas that she or her has, or that he or she has discovered in the same action or creation. But (...) the realization of these intuitions, feelings, images or ideas require that a material become a media, a vehicle that can transport them or shape them" (Eisner, 1995).

In this section, the previously-mentioned drawings produced by kids and teenagers are analysed according to indicators that confront real images with desired images.

The trigger which was prompt put forward the creation of a drawing that contrasted on one side the representations of the real, concrete and everyday experience of every kid with the polluted area of Matanza-Riachuelo Basin where he or she lives, and, on the other side, the representations that each of them has regarding favourable conditions. It is important to keep in mind that the type of answers to work proposals with set guidelines in terms of contrast (reality/expectative, how it is/how it should be) almost inevitably provoke a reciprocal influence between both parts of the representation, resulting in both being mutually conditioning at the moment of the realization. We could add to the development of the specific task the experience the kid has gone through, together with his or her corporeal schema, and identify it as unfavourable in direct contact with the environment. Thus, it is possible to think that we are in the face of a double experience. It is a corporeal experience on one hand, and a creative experience on the other. Now, in this case, the creative experience functions as a vehicle for what the kid had previously been through, and registered through his or her body and senses, and that had to be recovered and reproduced through drawing. In the same way, the kid acknowledges the representation that her or she has of that space in a state in which the presence and intervention of men is not injurious. Indicators such as the use of colour, the intensity of the lines, the definition of the silhouettes, the chosen shapes, its position in the scale, and the delimitation of space allow us to make an approximation, and give signification to the previously mentioned double experience and to the kids' representations of an environment free of man-made damage. The study distinguishes three areas of Matanza-Riachuelo Basin. Following this schema, the previously mentioned indicators will be analysed in different productions carried out in towns of the upper, middle and lower basin.

Image 1, corresponding to a drawing by 11 year old in the locality of Avellaneda, it shows three salient elements. In the first place, the use of colour is virtually reduced to the representation of a toxic liquid or pollutant stain coming out of a pipeline. The intensity of black, in contrast with the background and the rest of the figures, is not only the inevitable entry to the drawing, but it is also possible to identify it with the main cause of the damage of the river. In the right side of the drawing, all of the figures lack colour or filling. There is no contrast. Secondly, in the left side of the drawing, the margins of the river are defined by a winding dark river. Meanwhile, in the right sector of the drawing, where all the figures have a similar type of line and are placed in differentiated spaces with predominately straight lines, we can perceive a certain "order". Finally, the child has represented activities that people could perform if the river was pollution free. In his or her collective imagination, the development of recreational activities penetrate into the natural space.

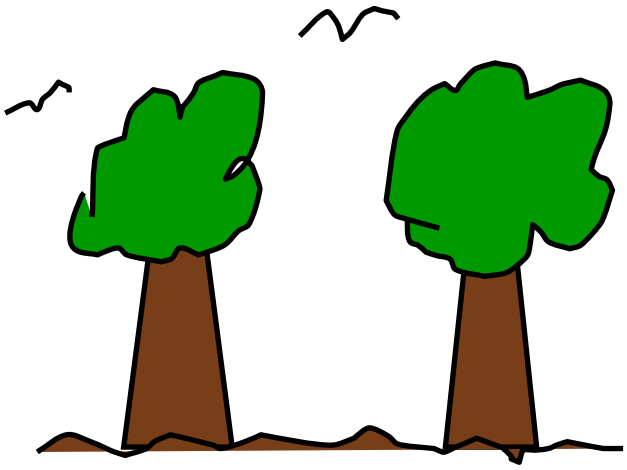
Image 1—Lower basin

Image 2, the figure of a bridge organizes the space of the representation in both parts of the drawing. The element is repeated with variations such as the use of colour. Just as in image 1, the intensity of colour functions as an entrance to the drawing. On the left side, which was used once again for the representation of the surroundings of the river in real conditions, the bridge is black, as well as the plastic bags and the represented pollutant elements. It is interesting to stop and analyse the corporeal and physical experience that the kid has had to experience when circulating through that space. The kid has chosen to represent a construction intervening in modifying the natural river area. The kid repeated the choice when it came to incorporating the idea of a pollution free river in the right side of the sheet, this time without colour. Both representations are opposed, and show marked differences as regards intensity of colour and lines. In the right side of the sheet the only coloured elements are the vegetation and the water. The bridge has been left colourless, and it is relegated to a second plane in comparison to the plants, the tree, and the flowers, which were given more relevance. Could we infer that the intensity and depression of colour and line refer to a concrete, probably hostile or uncomfortable environmental experience?

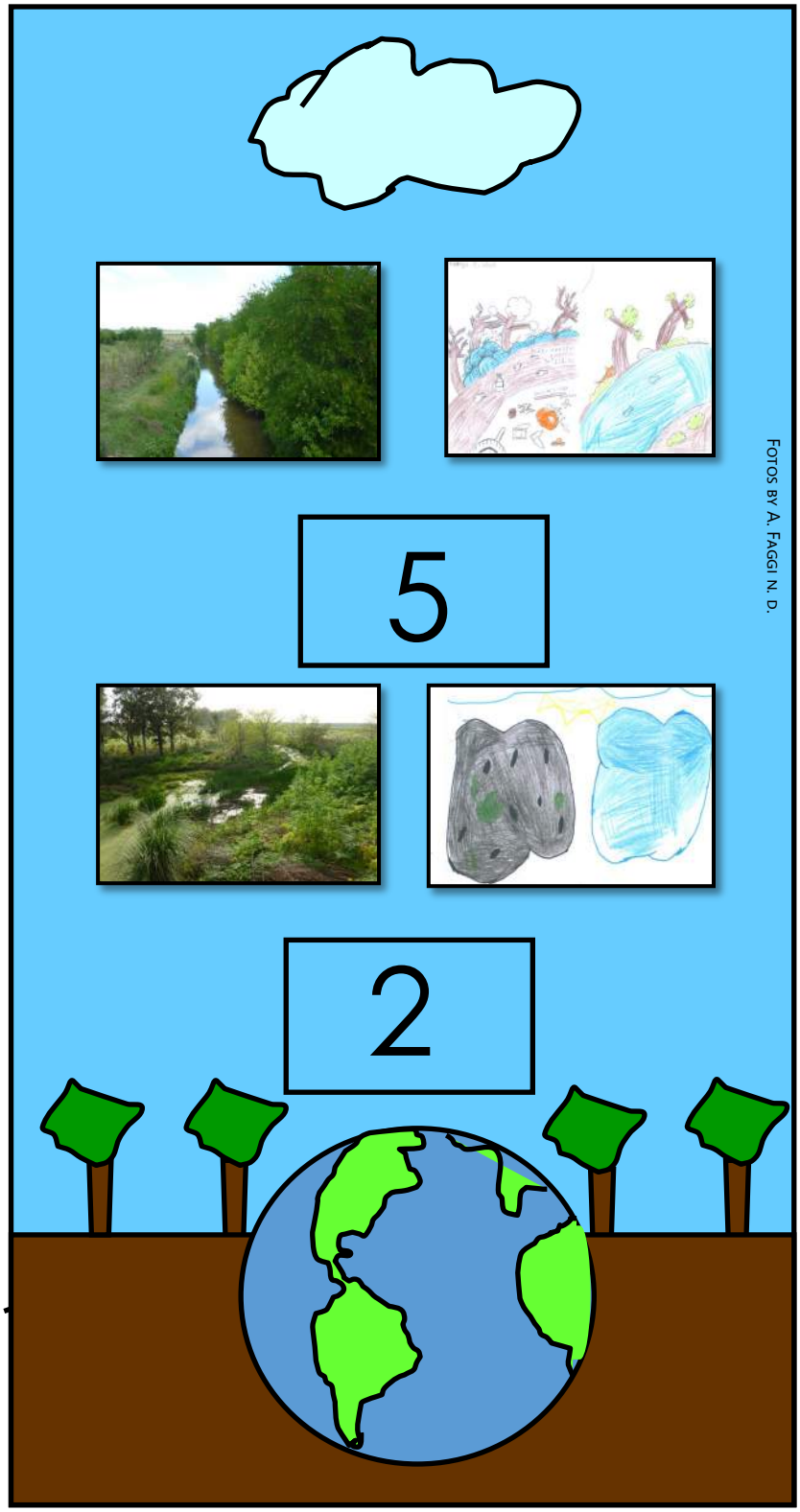
Imagen 2 - Middle basin

Image 3, the salient element is now the scale of figures. The waste bags and the garbage dumped in the river are out of scale. Their size, in comparison to the trees represented in both sides of the drawing, is highly noticeable, and they occupy a large part of the picture. On the other hand, the trees on the left have been delineated in grey (some of them without leaves), but the absence of the grey contour in the trees on the right could pose the following question: Is it possible to interpret the grey contour as a man-made limit to the natural environment, which is absent in the kids representation of that same space in different conditions? Once again, colour is an expressive element that distinguishes the two representations. Although the intensity of the lines is similar both in the right and the left part of the drawing, in the left part the colour is lot more intense, which reinforces the possibility of answering to the question in image 2.

Image - Upper basin



Finally, resuming what was mentioned before, it is important not to lose sight of the articulation that the different authors of the images have made up between their personal experiences, their intuition, and the ideas that they have about environment. The creative moment simplifies and facilitates the person's interpretative process, which, by means of this proposal, has analysed the way in which human take over the environment, damage it, ignore it, cherish it, observe it, exploit it, circulate through it, remain in it, and even organize it. In every way, humans are always present.



Fotos by A. Faggi N. D.

J. Breuste University
A. Faggi

Londron-Paris, Salzburg, Austria
CONICET—University de Flores

Ecological Restoration

Foto n. a. n. d.

The envirionmental consciousness set up in the 70s warned about the necessity of developing strategies to reduce the human impacts that are deteriorating the urban quality of life and the ecosystem services of surrounding peri-urban, rural, and natural areas. Towards the 80s, he reaction to the degradation process of the environment, together with the necessity of fixing damages that put the degradaton of ecosystems in the forefront, nurtured a branch of applied ecology called ecological resotration, whose goal is to help recovering deteriorated or destroyed ecosystems.

This discipline applies ecological knowledge, and develops techniques and models of action. It seeks to catalyse natural processes that could contribute to the recovering of the ecosystems in order to mitigate different instances of environmental deterioration, for example, the reduction of biodiversity, the presence of biological invasions and/or loss of environment services.

Throughout these last four decades, ecological restoration has changed paradigms. It has distanced itself from the concepts that it defended in the beginning, such as bringing ecosystems back to their initial or historical condition with the aim of restoring the conditions previous to the impact. These concepts were inspired on the basis of original reference ecosystems (role models).

At a later stage, and in the face of the complexity of reaching this goal, the branch adopted a more realistic approach. It is now based on concepts of succession and ecological resilience, more than in agricultural or silvicutural practices. Such change showed that restoration is not a synonym for forestation and/or gardening, since it attempts to achieve an ecosystem that can acquire functionality, and that can sustain itself throughout time. To achieve this, the ecosystem cannot be regarded as something isolated from its landscape, or form its historical, social, and economical context.

It is important to highlight that the restored areas have low possibilities of achieving the environmental quality of the properly protected areas. As a technique, it is a temporary solution for deterioration, and it always requires the investment of resources and time. At the same time, in order to achieve success in restoration projects, the community must become involved, and people's perception or relationship with nature, how they understand or involve themselves with impacts and its effects on the environment must also be taken into account. It is also important to appreciate people's position towards the different necessary alternatives to achieve restoration, both to improve the production of goods and services and to restore habitats for ethical reasons. Undoubtedly, restoration projects are compromises with nature that each society must collectively set up as a medium-and long-term investment to yield collective results, and thus preserve intergenerational ecosystem services.

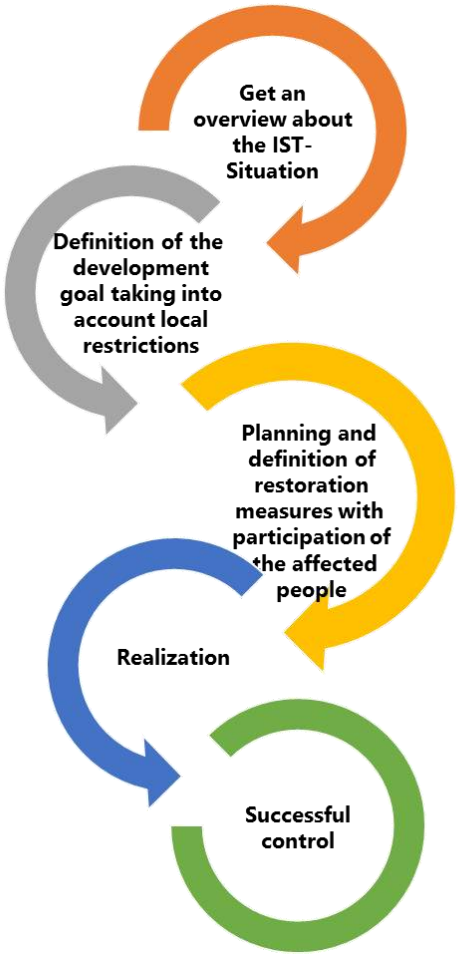
In the projects of ecological restoration, one of the most frequently addressed ecological services is to improve the environmental quality of rivers and their basins to guarantee water quality and health for the population of the area. The riparian areas are multidimensional, and thus, complex. They are flora and fauna habitats and source of resources, but they are also drains that receive the contribution of different sectors of the basin. They function as filters and barriers for the materials, energy and organisms carried along by the water. At the moment of restoring or rehabilitating an area, it is essential to understand these intricate mechanisms.

More than analysing the observable symptoms, we must fully understand the previously mentioned factors in order to tackle the causes of the deterioration.

In some cases, the restoration of rivers can lead to the recovering of the characteristics of the riverbed, which might have been altered by canalization, rectification, excavations, loss of connectivity with other effluents by avoiding abiotic filters, etc. In the urban environment, when rivers are regulated, the course is canalized and rectified, its banks are cemented in order to reduce flooding risks, the floodplains (anural sites of water retention) lose their ecological functions and the aquifer deepens, destroying the wetland habitat. In other cases, attempts are made to ensure the reduction or eradication of house or industrial effluents that disrupt food chains, and affect fishes and other animals and vegetation. Since the river is a tract that crosses a certain territory, its restoration would have to take into account the space, the historical use of the area and the biotic and abiotic changes that took place at the regional level.

In many cases, the restored elements are the biotic components. This is done by means of identifying ecological filters hampering the setting and survival of the desirable species, and thus minimizing those that are undesirable. In order to achieve this, it is necessary to understand the structure and functioning of the community, which species or functional groups are necessary for the community stability, or why some species cannot settle. (DVWK 2000)

In the urban environment, it is normal to find cases in which the ecosystem functions of the water bodies are ignored or have even deteriorated.



Steps to realize a restoration project
MINISTRY OF ENVOIRNMENT HESSEN CHANGED BY V. FISCHL

Ecological restoration of rivers, streams and basins from urban flooding: international experiences

In the cities, the rivers and streams constitute, together with their river banks areas, the last natural landscape elements. Contrary to parks and gardens, they are home to relatively pristine flora and fauna that benefit from the bio corridor that they make up, as long as the quality of the habitat is guaranteed. At the same time, these spaces are valued as recreational sites, and as places for reuniting with nature, especially in water bodies that have remained unaltered. This condition allows them to develop a great potential in tandem with the development of their surrounding green environment. For this reason, in order to be able to use these spaces they should be cautiously managed by means of measures that guarantee, first of all, the quality of the water. Frequently, rivers and streams that used to be culverted are returned to their natural state. In many cases, the previously constructed banks are naturalized, ensuring the population's free access to it. Generally, this process is always carried out together with ecological restoration measures directed toward recovering the quality.

River Salzach in Salzburg, Austria - canal with good water quality and recovery functions.
FOTO BY J. BREUSTE 2003

With the implementation of restoration measures, the result pursued is to regenerate a water body that contains the greatest amount of natural environmental characteristics possible, rather than going back to the conditions prior to the human disruptions. In this way the attempt is directed towards generating new habitats for plants and animals in the shores and banks which can be also accessible for recreation and nature contemplation. Restoration measures must engage their constituents members as soon as possible in order to gain their support and guarantee their success. It is important to take into account that the inhabitants have been losing their relationship with nature, which is the reason why they will have to overcome the controversies that may spring from the lack of awareness, or by the fact that environments that are not under control are perceived (as it is usually the case) as unkempt or dangerous. In order to build a new relationship between human and the river, this mistrust must be overcome. At a global level, there are several successful restoration projects that include different ecosystem services that enhance the quality of life of the citizens. Some of them show the great potential in urban courses of water as significant elements for the sustainable design of the urban landscape (DVWK 2000).

Newly-created recreational waters near the Traun-Donau-Auen nature reserve in Linz
Foto by J. Breuste 2011

Ecological restoration of Isar river in the city of Munich, Germany (2000-2011)

The Isar River and its bank environment made up of islands, gravel bars, meadows, flood forests and parks constitute an attractive zone for recovery in Munich, in the South of Germany, and its surroundings, especially for the 200,000 people that live in the nearby. In this area, people can go cycling, go for walk, run, get a tan, have barbeques, play and even practice winter sports. The Isar is an example of a river that was negatively affected by human activity for more than 150 years. The effects of canalization and rectification caused it to lose its natural character. In the 80s, the people raised their voices and demanded a more natural river with higher recreational quality. The goal was to restore the riparian space in some of the sections in order to free the river from its cement banks in the urban area. In order to naturalize it, a large-scale ecological restoration project was devised on the basis of solid technical proposals. The project was financed by the state, and a campaign was launched to spread the issue into the community.

The restoration project was formally presented in 1988, although it had been planned since 1995 with the involvement of the community, associations and political committees. During the eleven years of the project, the riverbed was enlarged, and the dams were repaired, creating flat partially terraced shores that could be circulated on foot. The project, unique in Europe, created gravel accumulation areas and natural formations on the shores, which provide recreation opportunities and interesting views of the river. The widening of the riverbed has also reduced the impact of flooding. The flat shores, grave bars and islands, and the ramps of great stone forests with rather shallow pools provide the river with a natural appearance in its urban sector. The enjoyment of nature and spare time was boosted by the improvement of the habitat diversity of characteristic flora and fauna of the area. The implementation of the project, which was finished in June 2011, allowed for the creation of a 4.97-mile natural bank environment in the urban sector. The supply of quality water sustains the natural habitat for the appropriate development of the flora and fauna. Like every other restoration project seeking to create an ecosystem that regenerates itself with time, this project expects that, in the future, the riverbed will continue with its normal development.

Three goals were pursued in this project:

- Improving protection against flooding
- Developing space and nature in the proximity of the fluvial landscape
- Improving recreational functions for the fluvial urban landscape

The cost of the project reached 35 million EUR, which was financed by the state (55%) and the –city of Munich (45%) (Munich water management 2011).

The Munich Water Authority was awarded a prize in 2007 issued by the *German Association for Water, Wastewater and Waste* as a recognition for its exemplary activities of conservation, their nature-oriented design, and the development of water bodies in urban zones.

Part of the restored Isar, Munich Germany

Foto by A. Voigt 2013

Environmental restoration and sanitation in the city basins of Belo Horizonte, Brazil - restoration project of the Beleares stream (2003-2009)

The proposal for the restoration of the Beleares stream was part of the SWITCH project (Managing Water for the City of the Future) coordinated by UNESCO, which gathers 32 networked institutions led by the Government of Belo Horizonte (PBH) and Federal University of Minas Gerais (UFMG). One of the interventions guided by PBH was the Drenurbs Programme, whose goal was to restore and clean up municipal hydrographic basins from an environmental perspective. This action was specially directed to those streams with higher possibilities for feasible improvement (Brown 2000, Wasd et al. 1998), since many of the water bodies were virtually impossible to restore to their original condition.

In the 1. section (v. i.) of the stream was deverted because of the construction of a side street. The new riverbed was covered with rocks, which provided the bed and bars with more stability, rugosity, and permeability. The bars were planted with grass, bushes, and young trees. A sewage system was also constructed.

In the 2. section (v. i.), the river's course was kept in its original position, but it was covered by a rock structure. The left bank was covered with a weed barrier and bushes. A sewage system and some streets were also constructed.

In the 3. sector (v. i.), we can find the Baleares park, where the stream and its floodplain were kept in their natural conditions, only restoring the riparian vegetation.

In the 4. sector (v. i.) is an underground tributary stream of Baleares that was not rehabilitated.

In the 5. sector. (v. i.) is placed in the upper part of the stream outside the park, and it is closed to the public. Riparian vegetation was restored in this area, guaranteeing the permeability of the substrate.

The control of the water quality before and after the restoration made evident the improvement triggered by the intervention, both in physical and chemical parameters of the water. In 2008, after the first restoration, 179 people were interviewed to collect opinions. This survey revealed the value and level of acceptability of the project. However, the opinions gave more importance to the sanitary aspect than to the recovering of the course (Macedo and Magalhães Jr 2010).

Five parts of the Beleares stream restoration project - Belo Horizonte, Brazil

Macedo and Magalhães Jr 2010

Suggestions of improvement

In the following figures we suggest rehabilitation measures for the bank area with different degrees of human influence.

The rivers in these examples, when crossing different territories under different courses (natural, residential, industrial coverage etc.), differ in the bed characteristics and the impacts they receive.

Rectified riverbed and elimination of riverside vegetation

The ecological conditions of the river deteriorate if the vegetation riparian is removed by the urban development and modifications in the banks.

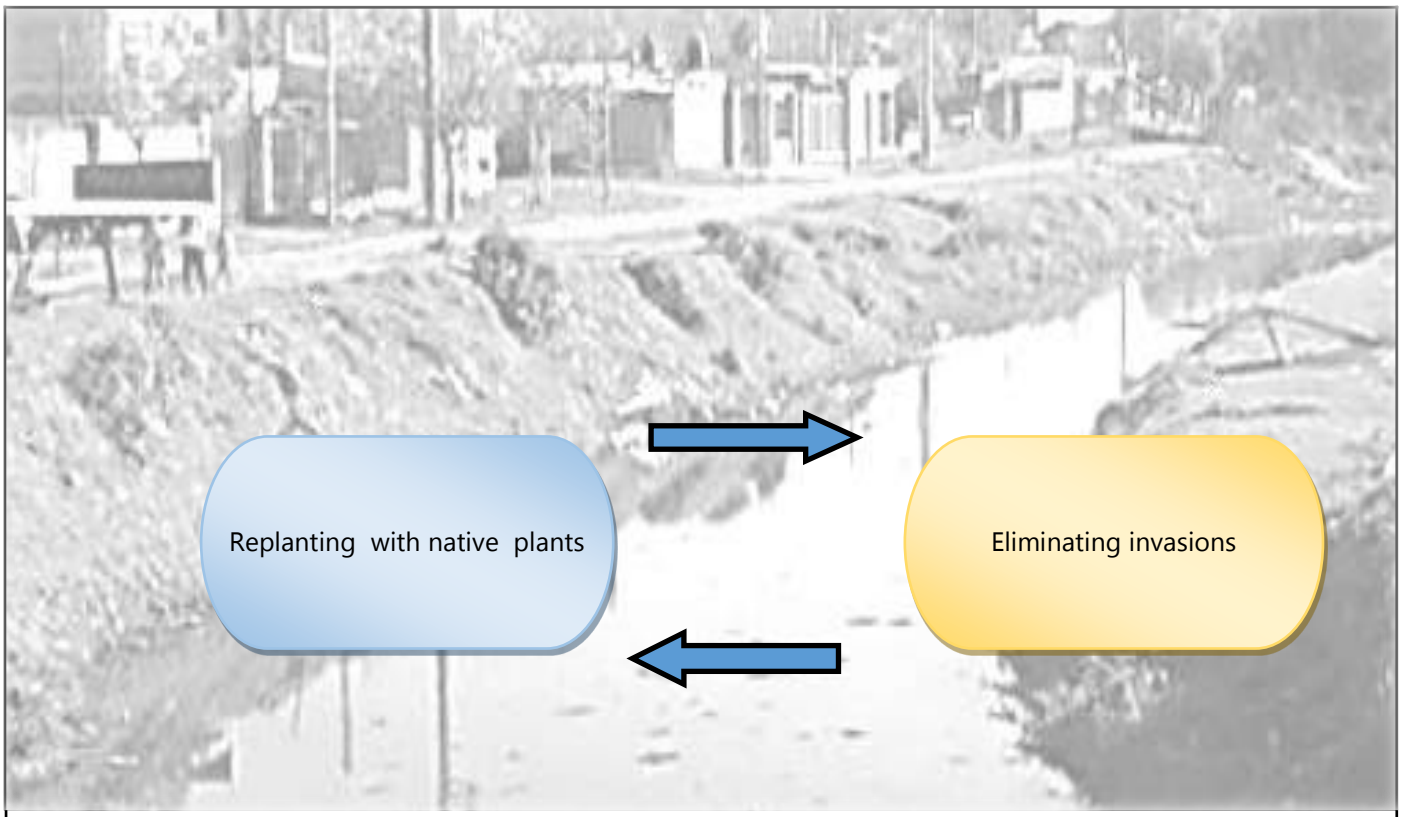
Foto by A. Faggi n. d.

It is inadvisable to cut the excessive vegetation in the region, since it does not allow the development of the marshy plants, which along the rims control the erosion caused by the water course offer habitat for flora and fauna, and they oxygenate the water and diminish its contamination from accumulated heavy metals.

Foto by A. Faggi n. d.

The presence of animals in the water courses and banks must be avoided. Otherwise, they can produce physical disturbances and bacterial contamination.

Foto by A. Faggi n. d.



Improvement suggestions

Foto by A. Faggi n. d.

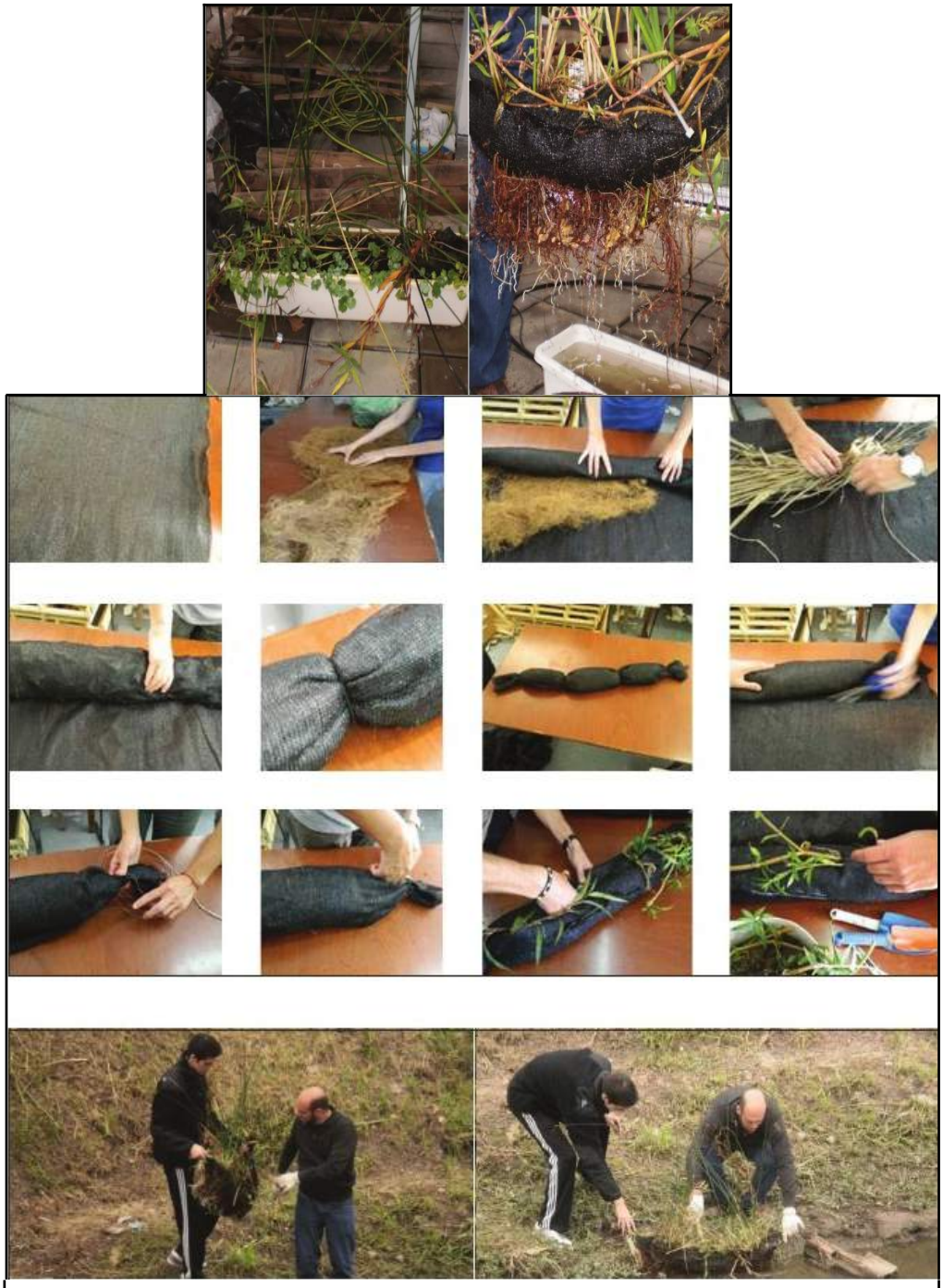
Vegetation stripe by the bank

Filter sediments and other contamination which reduce pressure that changes the water course.

Stabilize the borders with vegetation and reduce erosion by runoff. There are habitats for wildlife and save the food chain. The provide attractive scenery and opportunities for recovery. They should have a width of approximately of 30 m.

Foto by A. Faggi n. d.

In order to accelerate the growing vegetation in the banks, it is a good option to use bio rolls, which are cylindrical structures of 15 cm in diameter and varying lengths. They can be made with a jute or polypropylene net filed with soil, compost or live parts of plants (seed, rhizomes, or whole plants) mixed with rests of other dead vegetation (fiber, branches) to provide more volume. They are useful for fighting back the erosion of water, protection shores, and allowing for fast growth of the new vegetation. This construction is simple, fast and inexpensive. They can be made in the sample place where they are going to be used, or previously in a workshop. A simple cut in the net and the introduction of the chosen species in the roll, or the collection of propagule will speed the growing of the new vegetation. Bio rolls can be use on hillsides and slopes by holding them with stakes. The recommended plants are the ones that grow roots more easily. In the riverbeds, the California Bulrush (Shoenoplectus califonicus) can be used, in addition to other marshy plants (Hydrocotyle bonariensis, H. ranunculoides, Polygonum punctatum, Polygonum stelligerum, Polymnia connata, Alternanthera philoxeroides, Eichornia azurea, Typha latiollia).



Construction of "Bio Rolls"
Foto by A. Faggi n. d.


Invasion of Spanish Cane
(Arundo donax)
Control: court and elimination of rhizome
Foto by A. Faggi n. d.


Invasion of Honey Locust
(Gleditsia triacanthos)
Control: Killing invading trees
Foto by A. Faggi n. d.

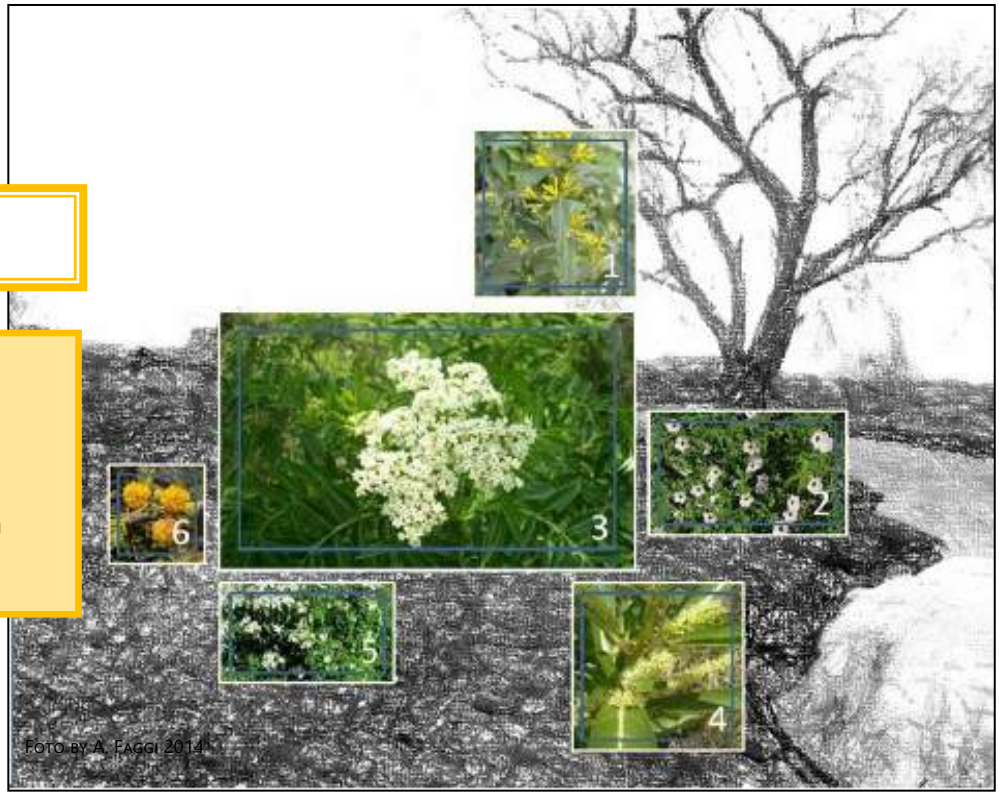
Planting

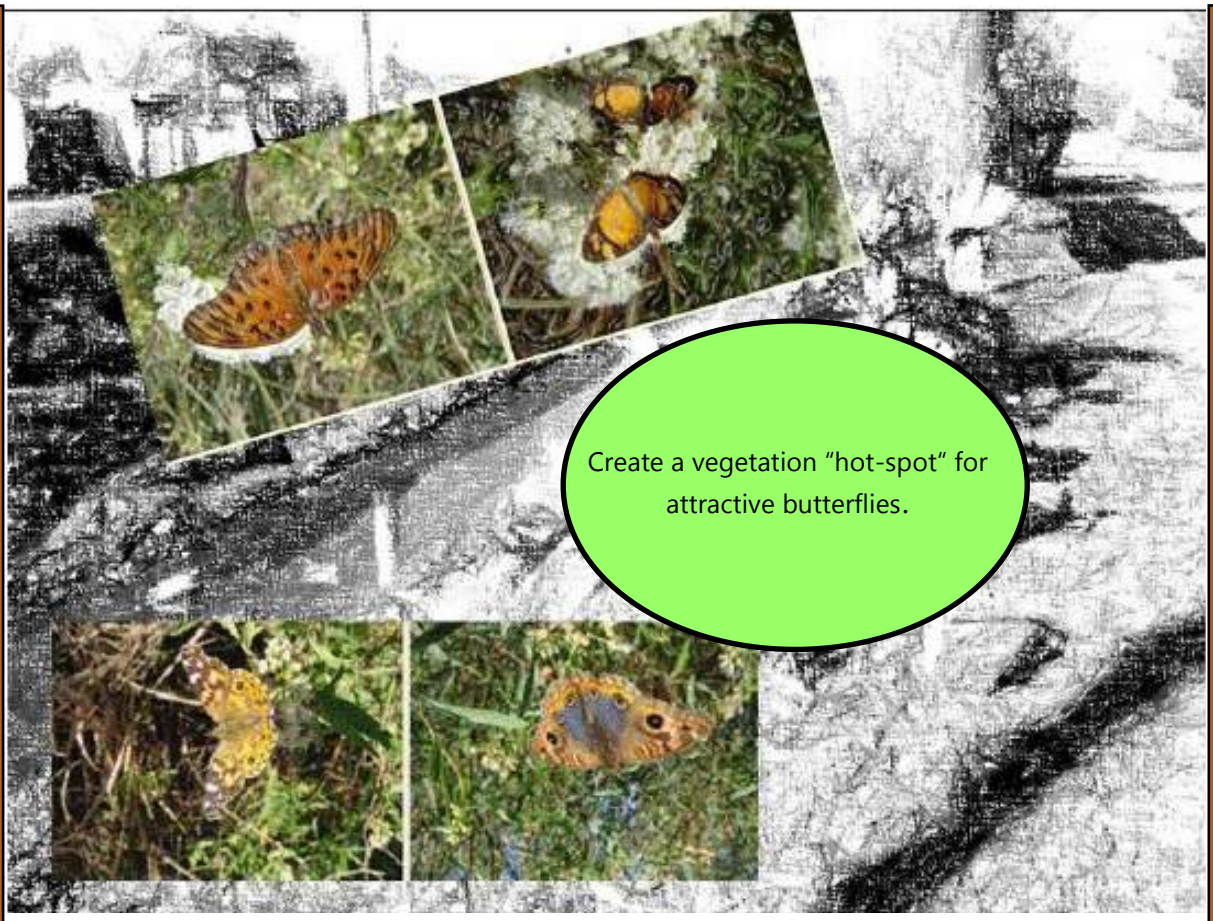
(1) Aloysia gratissima
(2) Acacia bonariensis
(3) Senna corymbosa
(4) Caesalpinia gilliesii
(5) Abutilon grandifolium

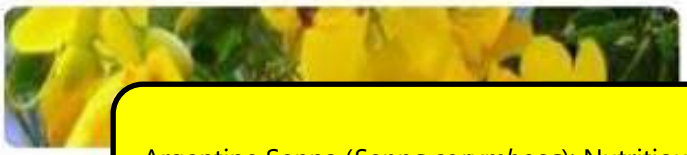
Planting with native plants to increasing the variety of the local fauna.

Planting

(1) Cestrum parqui
(2) Pavonia hastata
(3) Sambucus australis
(4) Phytolacca tetramera
(5) Eupatorium inulae folium
(6) Acacia caven







Argentine Senna (*Senna corymbosa*): Nutritious plant for caterpillar of the butterfly *Eurema deva*

Asclepia mellodora and *Oxypetalum Solenoides* are nutritous for the caterpillar of the butterfly *Danaus erippus*.

Offering food for the fauna

Fotos by A. Faggi 2014

Proposed socio-environmental rehabilitation

Fotos by B. Guida Johnson canged by G. Roccaforte and C. Kowalewicz 2014

Proposed ecological rehabilitation

Fotos by B. Gcanged by G. Roccaforte and C. Kowalewicz 2014

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What was mentioned in the previous page account for the environmental present state of a metropolitan water course whose environmental services have been deteriorated by human activity. However, its habitat of great biodiversity enriches the waters and banks.

Human perception, particularly young peoples perception reveals a present situation that, despite being discouraging, still expresses a deep wish for a change.

The technique provides tools that can guide rehabilitation actions. Their implementation could produce a gradual recovering of the previously described environmental services.

The ideal scenario for action, is without any doubt, the local level. As regards this, municipal policies and programs are necessary to improve the quality of life of the citizens, to guarantee a pollution free environment, and to preserve the natural heritage. In order to achieve this, it is necessary to involve the community, who, according to what previously exposed, is willing to collaborate,. Resuming our initial words:

„MATANZA-RIACHUELO RIVER IS ON A SLOW BUT CONSTANT PATH TOWARDS RECOVERY."

Walking through this path implies understanding and valuing the bank ecosystem and its complex interactions, respecting the norms, and usin the common sense. It is simply collective will, as it has been exemplified with experiences of other countries that would lead in the medium term to the recovery of the bank areas.

Fotos by A. Faggi canged by V. Fischl