2007

Natural River Restoration in Urban Ecology: The Bronx River

Samuel P. Loor

Natural River Restoration in Urban Ecology: The Bronx River

By: Samuel Paul Loor

Natural River Restoration in Urban Ecology: The Bronx River

Samuel Paul Loor

NSLU 4999-002 Bronx River Alliance, Fordham College at Lincoln Center, New York, New York

May 14, 2007

Abstract:

Environmental science is the systematic study of our environment and our proper place in it. A relatively new field, environmental science is highly interdisciplinary, integrating natural sciences, social sciences, and humanities in a broad, holistic study of the world around us. In contrast to more theoretical disciplines, environmental science is mission-oriented. That is, it seeks new, valid, contextual knowledge about the natural world and our impacts on it, but obtaining this information creates a responsibility to get involved in trying something about the problems we have created i.e. environmental science is an applied science. For this study the environment that will be observed will be that of the Bronx River with the help of the Bronx River Alliance. The Bronx River Alliance was created in 2001 by community groups and public agencies to serve as a coordinated voice for the river. Its mission is to work in harmonious partnership to protect, improve and restore the Bronx River corridor so that it can be a healthy ecological, recreational, educational and economic resource for the communities through which the river flows. This study will show the applied progress in the restoration and preservation of the Bronx River and the urban environment along it during the past five months as I intern with the Bronx River Alliance while keeping in mind the following objectives:

- Improvement of riparian buffers and aquatic habitat in the Bronx River Watershed
- Protection and enhancement of conditions for diadromous fish population in the Bronx River.
- Increase stewardship towards the river's renaissance.

Introduction:

"At one point in our history beaver pelts drove the economy of the former New Amsterdam, when New York City was a Dutch trading post full of trappers. The animal appears on the city seal, which in turn appears on the city flag, but the sighting of the animal has been quite rare. Records show the Dutch purchased 7,246 beaver pelts in 1626 and that by 1671 the renamed New York of British rule traded more than 80,000 pelts a year. By 1800, beavers were no longer seen east of the Mississippi River and they were nearly extinct by 1930. Today the species has recovered so much that it has returned to its traditional range" (Trotta, 1). Recently due to the cleaner water quality in the Bronx River more wild life is able to flourish along the river one being the almost extinct beaver. Other types of wildlife that are native to the river are: Bullfrog, Eastern chipmunk, Grasshopper, Green heron, Laughing gull, Mallard, Muskrat, Mute swan, Painted turtle, Red-tailed hawk, Sparrow, and Night-heron.

"During the era of Robert Moses, the 'master builder', the Bronx fell into a period of urban decay. The quality of life, particularly in the South Bronx decreased dramatically. Neighborhoods were fragmented by the construction of numerous highways. In particular, the construction of the Sheridan and Cross-Bronx Expressways further distanced the Bronx River communities from each other and from the River itself. In 1974, local residents became fed up with the dismal conditions of the Bronx River and formed Bronx River Restoration Project, Inc., with Ruth Anderberg as its first director. Bronx River Restoration succeeded in removing a plethora of debris, including refrigerators, tires, and even a wine press along the shoreline in the 180th Street/West Farms area. The pollution, vandalism, and exhaust fumes from vehicles passing by left the river and its surroundings were in dreadful shape. A once beautiful site was now an urban eyesore. In 2001, the Bronx River Alliance was created to build on the 27-year history of restoration work started by Bronx River Restoration Project, Inc. in 1974; strengthened in 1996 with the Bronx River keeper program developed in partnership with City of New York/Parks & Recreation and Con Edison; and fortified in 1997 with the formation of the Bronx River Working Group. The Bronx River Working Group, coordinated by Partnerships for Parks and Waterways & Trailways, expanded the effort to include over 60 community groups, government agencies, schools and businesses. The Bronx River Alliance is the next step in the effort to restore and protect the Bronx River in this urban environment" (Bronx River Alliance).

The Bronx River Alliance besides being an ecological restoration group they are also an environmental justice group. Environmental justice groups emerged from the environmental justice movement which was an extension of the civil rights movement. In the United States and around the world people of colored are subject to a disproportionately high level of environmental health risks in their neighborhoods and on their jobs. Minorities, who tend to be poorer and more disadvantaged than other residents, work in the dirties jobs where they are exposed to toxic chemicals and other hazards. More often than not they also live in urban ghettos, barrios, reservations, and rural poverty pockets that have shockingly high pollution levels and are increasingly the site of unpopular industrial

facilities, such as toxic waste dumps, land fills, smelters, refineries, and incinerators. For the purpose of this study the communities along the Bronx River, low-income and communities of color will also be looked at from the perspective of environmental justice. Environmental justice combines civil rights with environmental protection to demand a safe, healthy, life giving environmental for everyone.

Materials:

1, Waiters
1 box of Latex gloves
1 pair of Water proof gloves
2 pairs of Glove insulators
2 pairs of Water proof socks
1, Hack saw
1, Rakes
1, Shovels
1, Chain saw
1, Lapper
1, Pace meter
1, Sieve
7, Fine meshes
5, Column
6, metal containers
1, Pick
2, Goggles
10, Brown paper bags
25, Black plastic bags
1, Clippers
1, Hard Hat
1 pair all weather boats

1, Thermometer
1, Litmus paper kit
20, Test tubes
1, Bob Cat (small tractor)
1, Ford F150 Pick Up truck 4x4
1, Canoe with paddle
1, Rope (50 feet)
1 12 inch ruler
1 Yard stick
1, Raft with paddles
50, Wood Stakes (biodegradable)
15, Nettings (biodegradable rope)
1, Life vest
2, Radios
Sand
50, Sand bags (biodegradable)
Wooden chips (biodegradable)
1, First Aide Kit
1, Digital photo camera

Native plants from the Van Cortland Park nursery:
“ACRU”, “Acer rubrum L.”, “Red Maple”
“ARAR7”, “Aronia arbutifolia (L.) Pers.”, “Red Chokeberry”
“BENI”, “Betula nigra L.”, “River Birch”
“CEOC”, “Celtis occidentalis L.”, “Western Hackberry”
“FRPE”, “Fraxinus pennsylvanica Marsh.”, “Green Ash”
“LIBE3”, “Lindera benzoin (L.) Blume”, “Spicebush”
“NYSY”, “Nyssa sylvatica Marsh.”, “Blackgum”
“PLOC”, “Platanus occidentalis L.”, “American Sycamore”
“PRSE2”, “Prunus serotina Ehrh.”, “Black Cherry”
“QUAL”, “Quercus alba L.”, “White Oak”

"SANI", "Salix nigra Marsh.", "Black Willow"
"ULAM", "Ulmus americana L.", "American Elm"
"VIDE", "Viburnum dentatum L.", "Arrowood"

Methods:

1. Community input (work with partner organizations to educate and coordinate participation of volunteers and community groups in the restoration effort). Partner organizations: NYC Parks and Recreation Department, Green Apple, Greenway, Department of Environmental Protection, Sanitation Department, and the Environmental Protection Agency. Volunteers and Community: Bronx Initiative for Energy and the Environment, Fordham University, Manhattan College, CUNY Lehman College, Bronx Academy High School, Wild Cats restoration team, and Pablo Neruda.

2. Disturbance management (mechanical) and manual removal of exotic invasive species, household and industrial wastes from the sites)

3. Soil sampling and analysis for pH and identification of Volatile Organic Compounds (VOCs)
Standard protocols exist to provide a quantitative determination of many parameters of interest. Adequate measurements require moderate (i.e. temperature and pH), high (i.e. VOCs) level of effort, and depth (measurements done at top soil and bottom soil). Field methods, as well as location and frequency of sampling depend on the objectives of the sampling (Behar etal., 2000). For instance, sampling for heavy metal, IOCs, and VOCs could be administered but methods will vary depending on the kit. (Bronx River Ecological and Watershed Management Plan). **Note**: When testing for metals do not dry soil using a microwave or oven, because metals will expand and results will be inaccurate. Soil sampling and analysis was done in the area of the Concrete Plant and samples were sent to the laboratory for future testing.

4. Water sampling and analysis (of Dissolved Oxygen [DO] levels and pH)
Standard protocols exist to provide a quantitative determination of many parameters of interest. Adequate measurements require moderate (i.e. temperature and pH) or high (i.e. bacteria and nutrients) level of effort. Field methods, as well as location and frequency of sampling depend on the objectives of the sampling (Behar etal., 2000). (Bronx River Ecological and Watershed Management Plan). Water sampling was conducted once a week at Burke Bridge site.

5. Over a period of five months:

- Reintroduction of native species of herbaceous, shrubs, and trees
- Establishment of representative transects
- Monitoring for plant survivability and growth
- Restoring and maintaining the integrity of the river and its corridor
- Minimize soil erosion
- Maximized open green space
- Use recycle materials (biodegradable) to the extend possible
- Buffer sensitive natural areas

Results and Discussion:

Removed:

- More than 200 tires
- About 5 tons of household and industrial wastes
- One abandon car
- 3 dead trees
- Hundreds of invasive plant species

Planted:

- 150 native tress and shrubs
- More than 200 herbaceous plugs and 100 Lbs. of conservation seeds applied
- 25 volunteers participated in the projects for a total of 150 hours
- Green space maximized by 70% in the Concrete Plant site

Above:
Bronx River Alliance 10 member crew and volunteers working in the concrete plant triangle
Photo taken by: Bronx River Alliance.

Above:
Native plants being reintroduced to the Sound View site biodegradable netting is used as a sustainable planting method
Photo taken by: Bronx River Alliance.

Above:
A Fordham University volunteer (me) hard at work gathering biodegradable wooden chips that will be used to prevent soil erosion.

Above:
Three members form the Bronx River Conservation Crew collecting wooden chips at Charlie Prince site North of the Bronx River.

Above:
Crew member, Miguel, astonished at a leveled side walk and thorn down tress caused by the April 15, 2007 flood of the Bronx River.

Above:
Soil erosion at Fort Knox that was cause by the flood.

Above:
Flooding at Fort Knox caused by the March 1, 2007 Flood.

Above:
Removal of tires and household appliances from the Bronx River.

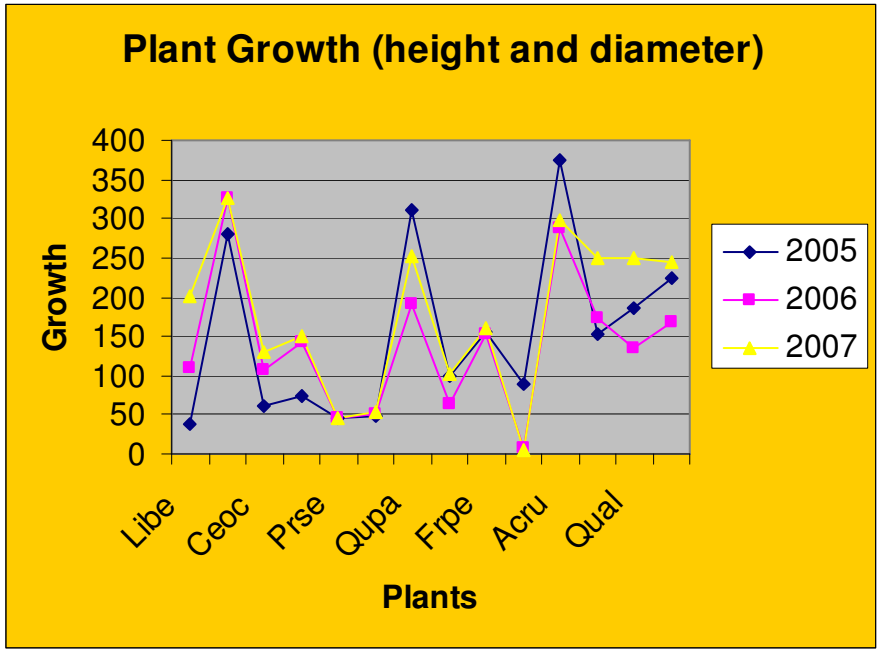
Above:
Ferro Magnetic Bacteria eating away a car rim. Iron bacteria are a type of bacteria that feed on small amounts of iron in the water. They are not a health threat, but are a nuisance because they form strands, masses, or thin films that create an aesthetic problem in the river.

Above:
The Bronx River Conservation Crew takes to the water to clear debris. "Following the heavy rainfall and subsequent flooding on March 1, 2007, the Bronx River Conservation Crew has been working hard to clear the river from floatable debris and massive blockages. The flooding filled up the river basin with woody debris and disturbed the ongoing banks stabilization/revetment in the northern portion of the Bronx River" (Bronx River Alliance). Photo taken by the Bronx River Alliance.

Above:
“At Drew Gardens, just south of Tremont Avenue, the Bronx River serves as a refuge for wildlife as it runs through an extremely urban area” (Bronx River Alliance). Photo taken by the Bronx River Alliance.

Above:
“On Saturday, May 5, with the sun high and the wind blowing gently off the banks of the river, the Bronx River Alliance and its partners celebrated the 8th Annual Amazing Bronx River Flotilla. With more than 200 participants, paddling in more than 70 canoes and kayaks.” (Bronx River Alliance) Photo taken by the Bronx River Alliance.

With the community support and continuous site management by the Bronx River Alliance Conservation Crew, 98.12% of the total native species planted survived.



Note: *Data received from Bronx River Alliance Archives.*

Figure 1: Plant Growth (height and diameter)

During 2005-2006, the growth rate at the site was -12.33%. However, in 2006-2007 it jumped to +23.36%.
The overall average plant growth for this site between 2005-2007 is +1.76%.
In the past five months (January –May 2007) some generation is occurring (Prinus serotina, Acer ruburn).

Soil Sampling:

- Monitor pH levels and identifying VOC's in soil to describe and characterize the types of soils found in the riparian area. However, riparian area soils can be highly variable, even within short distances. Therefore, soils should be sampled at intervals to determine soil type, texture, pH, presence of mottling, a clay layer, and other attributes.

Goal: To improve plant growth by understanding the area in which they are being planted in.

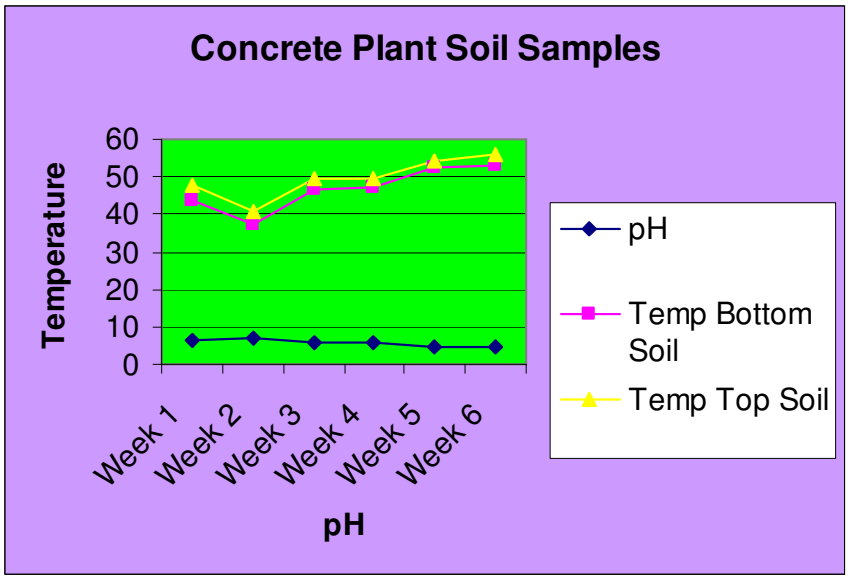
Volatile Organic Chemicals (VOCs): VOC's are man-made compounds that are released from water into the air. They present a health risk not only from drinking contaminated water, but also from inhaling VOCs that escape from the water as it is used during showering or other home uses. VOCs also are absorbed directly through the skin during bathing and showering. They are commonly used as solvents fuels, paints, or degreasers. Virtually all VOCs produce an odor in water, although it may not be obvious before the drinking water standard exceeds. Nearly all VOCs have primary drinking water standards, because they cause cancer or damage to the liver, kidney, nervous system, or circulatory system. Dozens of VOCs are regulated in public water supplies, but the most common are: Benzene, Carbon Tetrachloride, Tetrachloroethylene (PCE), Trichloroehtylene (TCE), Xylenes, Synthetic Organic Chemicals (SOCs), Arazine, and 2, 4- D. Several VOCs were identified by crew members and the Bronx River Alliance called the Department of Environmental Protection (DEP) oil and chemical spills division.

	Acid					Neutral			Alkali				
	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
Nitrogen, N													
Phosphorus, P													
Potassium, K													
Calcium, Ca													
Magnesium, Mg													
Sulfur, S													
Iron, Fe													
Manganese, Mn													
Boron, B													
Copper, Cu													
Zinc, Zn													
Molybdenum, Mo													

Table 1: gives a guide to the availability of several nutrients at various pH values. (Cunningham and Saigo).

Concrete Plant Soil Samples			
Weeks	**pH**	**Temperature- Top Soil (F)**	**Temperature Bottom Soil (F)**
Week 1	6.5	43.6	47.8
Week 2	6.7	37.3	40.5
Week 3	5.6	46.7	49.6
Week 4	5.7	47.4	49.3
Week 5	4.5	52.6	54.3
Week 6	4.7	53.1	55.7

Table 2: Concrete Plant Soil Samples



Note: *Data received from Bronx River Alliance Archives.*

Figure 2: Concrete Plant Soil Samples

Soil pH is an indication of the alkalinity or acidity of soil. It is based on the measurement of pH, which is based in turn on the activity of hydrogen ions (H+) in a water or salt solution. When in balance (pH 7) the soil is said to be neutral. The pH scale covers a continuum ranging from 0 (very acidic) to 14 (very alkaline or basic). It is however uncommon to find soils at either extreme of this range. Under many conditions soils tend to become more acid or alkaline over time if steps are not taken to maintain a balance. Species with that can grow in a pH of 4.5 -6.7 could be planted in designated areas of the concrete plant site. Those species include: Red Maple (6.1), Red Chokeberry (5.9), River Birch (5.8), Western Hackberry (5.5), Green Ash, Spicebush (5.7), Blackgum (6.6), American Sycamore (6.7), Black Cherry (6.4), White Oak (5.6), Black Willow (5.8), American Elm (6.1), and Arrowood (5.7).

Water Sampling:

- Maintain pH and DO levels IAW New York State Surface Water Quality Standards.

Goal: To improve water quality for public health and recreational benefits and to support sensitive life stages of aquatic organisms.

Significance and Standards: "Improvements in water quality are necessary both to increase access to the river and improve ecological health. Although several metrics can be used to evaluate water quality, dissolved oxygen (DO) and fecal coliform are two of greatest interest in the Bronx River. They are used by state and federal agencies to regulate water quality to protect human health and the environment [Table IV. 1]. The concentration of fecal coliform bacteria is an indicator of human and animal waste discharge into water and is used to establish permitted recreations uses of the river. Combined sewer over flows (CSOs) discharge a mix of sewage and storm water, both containing fecal coliform, when heavy rainfall overloads the sewage system. High levels of fecal bacteria are linked to pathogens that can cause illness in humans, so public health standards have been developed to determine whether the water is safe for swimming, fishing, and boating" (Bronx River Ecological and Watershed Management Plan).

"Since healthy aquatic flora and fauna requires a minimum level of DO, the rivers capacity to sustain life is limited when oxygen is scare. High fecal coliform counts are also linked to increase biochemical oxygen demand in the river and decrease DO levels. Biological indicators that are directly impacted by DO levels are also important" (Bronx River Ecological and Watershed Management Plan).

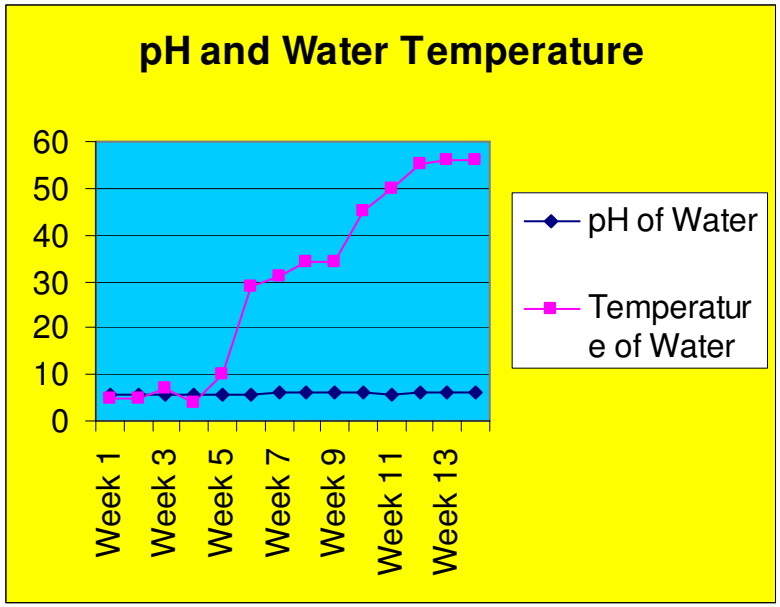
Water Quality Standards (Schmidt etal, 1981)	
Poor	-DO concentrations below the survival threshold for most aquatic organisms for more than one week in parts of the river. -Monthly geometric mean fecal coliform and monthly geometric mean total counts only suitable for secondary contact with water and fishing: Coliform counts adequate for fish propagation and survival.
Fair	-DO concentrations below levels required for growth by most aquatic organisms for more than one week. - Monthly geometric mean fecal coliform counts and monthly median total coliform counts suitable for primary and secondary contact with water and fishing: Coliform counts are adequate for fish propagation and survival.
Good	- DO concentrations above levels required for growth by most aquatic organisms year-round. - Monthly geometric mean fecal coliform counts and monthly median total coliform counts suitable for primary and secondary contact with water and fishing: Coliform counts are adequate for fish propagation and survival.
Very Good	-DO concentrations levels greater than 7 mg/L year-round. - Monthly medium total coliform counts suitable for commercial shelf fishing, primary and secondary contact with water, and fishing: Coliform counts are adequate for fish propagation and survival.

Note: Table IV.1: Water Quality Standards (Schmidt etal. 1981). (Bronx River Ecological and Watershed Management Plan).

Current Condition: **Fair**
"Monitoring indicates that the Bronx River currently experiences periods of low DO levels (hypoxia) that may have adverse effects on sensitive organisms and on juvenile life stages. The hypoxia conditions (below 4.8 mg/L DO) do not seem to persist for long periods and tend to be limited to impound meats and areas near CSOs. The primary sources of fecal coliform bacteria are CSOs after rain events; waste from wild life and domestic animals and illegal sewage discharges through storm sewer hook ups" (Bronx River Alliance).

pH and Water Temperature		
Weeks	**pH**	**Temperature (F)**
Week 1	5.8	5
Week 2	5.7	5
Week 3	5.6	7
Week 4	5.7	4
Week 5	5.6	10
Week 6	5.9	29
Week 7	6.2	31
Week 8	6.1	34
Week 9	6.2	34
Week 10	6.1	45
Week 11	5.9	50
Week 12	6	55
Week 13	6.1	56
Week 14	6.1	56

Table 3: pH and Water Temperature.



Note: *Data received from Bronx River Alliance Archives.*

Figure 3: pH and Water Temperature

Generally, reproduction is the most sensitive stage in fish life cycles. Eggs and fry of many species are killed when the pH drops to about 5.0. This level of acidification also can disrupt the food chain by killing aquatic plants, insects, and invertebrates on which fish depend for food. At pH levels below 5.0, adult fish die as well. Trout, salmon, blue fish, and other game fish are usually the most sensitive. Carp, gar, suckers, and other less desirable fish are more resistant. During the winter fish reproduction decreases as pH becomes more acidic.

Natural Buffers:

- Added Alkaline rocks (buffer acidic precipitation decreasing acidity)
- Maintained and added grass hedges (hedges reduced runoff in conventionally tilled soils)
- Wooden chips added to Fort Knox (decrease soil erosion and increase soil fertility)

Goal: To reduce the acidity levels of both water and soil in the Bronx River.

Above: Soil erosion at Fort Knox site after the April 15th 2007 flood.

Soil erosion and acidity were decreased due to the implementation of natural sensitive buffers. At the Fort Knox site, for instance, wooden chips were used as a natural buffer to decrease future erosion and increase the fertility of the soil by natural decomposition.

Justification for restoration:

Sections along the Bronx River such as, the Concrete Plant have been disturbed by human activities (dumping, encampment, desire lines, etc.) and overtaken by exotic invasive vegetation (Artemisia annua, Morus alba, Ampelopsis, brevipedunculata, Humulus japonicus, Ailanthus altissima and Phragmites australis).

Human activities and infection of invasion species cause:

- Perturbation of establishment and refuge sites for migrating birds

- Decrease of diversity
- Decrease of plant regeneration
- Limitations of natural mechanism for wildlife habitat improvement
- Limitations to free green space
- Limitations to the access of the river
- Decrease in the enjoyment of a pristine nature
- Minority communities along the river suffer disproportionately from pollution in river

Conclusion:

Over the past five months while interning at the Bronx River Alliance the quality of the river and its habitats along it have improved greatly due to the efforts of the conservation crew and volunteers like myself who have worked to preserve and maintain the natural integrity of the river. The progress in the Concrete Plant (70% open green space) is a testament to our hard work. The recent floods (in March and April) have caused destruction along the river banks and have clogged some portions of the river. The conservation crew spent many hours unclogging the river and revamping the banks of the river with bio logs, stakes, and netting. Due to the limited size and manpower of a 10 member crew restoration has been limited. If there were two crews the progress will increase sharply. Nevertheless, an increase in water quality levels and sustainability of wildlife along the river has improved as the spring season beings. The cause for the improvement has been the steps the alliance has taken to link, both ecologically and socially, the northern and southern parts of the river. Moreover, the Alliance has address environmental justice and community empowerment, through commitments to public participation, principles of sustainability, transparency and self-determination, the centerpiece of its mission and operating principles.

One particular about the river that struck me was that the river was a prime example of environmental prejudice and racism in our own back yard. Racial prejudice is a belief that someone is inferior merely because of their race. Racism is prejudice with power. Environmental racism is inequitable distribution of environmental hazards, land, resources, benefits, and burdens based on race. Evidence of environmental racism can be seen in the city's inability to post and enforce signs that will prohibit people from illegally dumping pollutants into the river. The low income and colored communities that live along the river have to live with pollutants a few feet from them which create a public health risk to them. In 1987 a study was done to examine whether there was a connection between race and the distribution of hazardous-waste sites in the United States. The study concluded that "race was the most

significant among all variables involved in hazardous sites" (McQuaid, 6). Discrimination has historically been a factor in many business and government decisions, including those governing land uses and the environment. The communities along the Bronx River have been subject to all kinds of environmental assaults and like other minority communities around the country they have a common aspiration: "Everyone has a right to a clean environment and a right to a job. Shutting these people out, that is not the American way" (McQuaid, 7).

Reference:

Bronx River Alliance, The. http://www.bronxriver.org/theRiver.cfm#1nat

Bronx River Ecological and Watershed Management Plan

Crimmens and Larson. City of New York Parks & Recreation, Natural Resources Group, Bronx River Ecological and Watershed Management Plan, Bronx River Alliance, Bronx New York, June 2006.

Cunningham and Saigo. "Environmental Science" A Global Concern 9th Ed., McGraw-Hill Companies Inc., 2007

Médozile, Macceau. Conservation Manager, Bronx River Alliance 2007

McQuaid, John. "Unwelcome neighbors: How the poor bear the burdens of America's pollution", The Times-Picayune, May 2002.

Trotta, Daniel. "Beaver returns to New York City after 200 years", Planet Ark, February 2007

USDA Plants. http://plants.nrcs.usda.gov/cgi_bin/gsat_download.cgi?gsatid=13

Special Thanks to:

Macceau Médozile, Conservation Manager

Teresa Crimmens, Environmental Coordinator

Michael Hunter, Canoe Program Coordinator

Michael Mendez, Conservation Crew Leader

Penny Matta, Assistant Conservation Crew Leader

Anibal Cerda, Conservation Crew Member

Elaine Feliciano, Conservation Crew Member

Miguel Rodriguez, Conservation Crew Member

Norma L. Rosa, Conservation Crew Member

Jason York, Conservation Crew Member

Frances Knickmeyer, Conservation Crew Intern

Mildred Torres, Conservation Crew Intern

Sandra Lobo-Jost, Director, Community Service Office Fordham University

Dr. John Davenport, Director, Environmental Studies Program FCLC

Dr. John van Buren, Director, Environmental Studies Program FCRH

Renaldo Alba, Assistant Director, CSTEP Program Fordham University